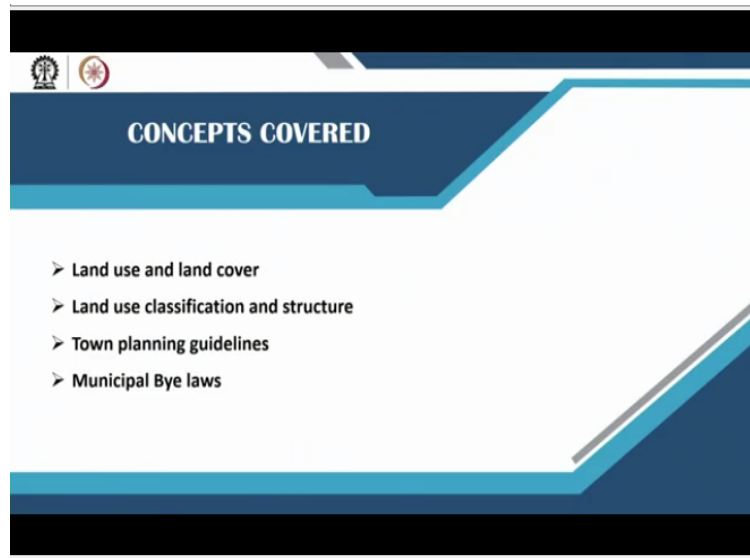


Urban Landuse and Transportation Planning
Prof. Debapratim Pandit
Department of Architecture and Regional Planning
Indian Institute of Technology-Kharagpur

Lecture-03
Urban Landuse Planning

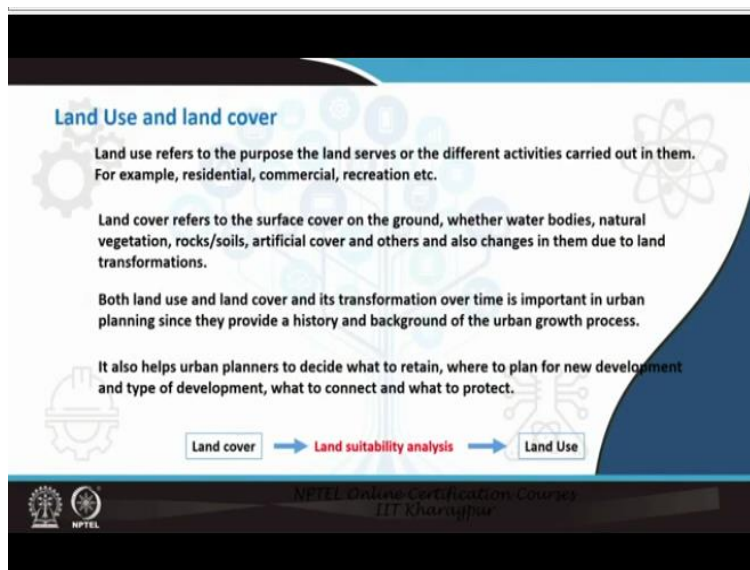
Welcome to lecture 3. This lecture will be on urban land use planning.

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The key concepts covered in this lecture are land use and land cover, land use classification and structure, town planning guidelines and municipal bye laws. Town planning guidelines and municipal bylaws are included to discuss on how these influence integrated land use transportation planning.

(Refer Slide Time: 00:54)



Land use and Land cover

Land use refers to the purpose the land serves or the different activities carried out in them. For example, residential, commercial, recreation etc., whereas, land cover refers to the surface cover on the ground such as water bodies, natural vegetation, rocks, or artificial cover (i.e built-up area or built-up urban area) and also changes in these over a period of time. Hence, we not only consider the quantum of land use or land cover of an urban area, but also try to understand the transformation that land use and land cover has gone through over a period of time and this helps us to understand how the city has grown and to plan for its future. This also helps urban planners to decide what to retain, where to plan for new development, the amount development that should be planned in a region and what to connect and what to protect. For example, if certain areas are disjointed, then those are to be connected or if certain areas are sensitive considering its land cover (i.e. forest land cover depleting over a period of time) it has to be protected. Similarly, based on existing land use structure and land cover one can decide what should be a suitable area for new industrial or residential development.

Hence, first we look at land cover which is a broad classification of the different features that are available on the land surfaces (eg. whether it is built-up area or forest area), followed by classification of the built-up area using land use classification.

Once we have land cover data, we use land suitability analysis. Land suitability analysis helps us to decide what sort of land use is suitable for a particular area based on present land cover. For example, if an area is having a lot of productive agriculture, it is not advisable to allocate residential or other land use in that area, rather we will try to provide the residential land use in another suitable area if space permits.

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Land Use and Land cover

Development Plan requires both Land cover and Land use maps which can be prepared using Remote Sensing (RS) data & Geographic Information System (GIS).

- Base map preparation process
- Preparation of existing land use plan
- Proposed land use plan

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Development plans require both land use and land cover maps for preparation of final land use and other maps for the urban area. Remote sensing data and geographical information (GIS) system data are used to prepare these maps. The first step while preparing a development plan is to prepare a base map. We use land use maps and land cover maps from previous years to prepare the base map. Once the base map is prepared, we prepare an existing land use plan where we show the percentages of land use for each category of land-uses based on both ground truth and remote sensing data. Finally based on the existing land use and the way we are going to develop the urban area we will propose the land use plan for the future.

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Data

Bhuvan Land use sheets
(land use/land cover data, administrative boundaries, infrastructure, water bodies, watershed boundaries, soil resources, wasteland, groundwater prospect)

National Urban Information System (NUIS)
(Thematic data: urban land use/cover, physiography, geomorphology, geological structures, lithology, soils, drainage, surface water bodies, road, rail, canal, transportation nodes etc.
Attribute data: administrative boundaries, forest boundary, settlement names and boundaries, non-spatial data etc.)

Indian Space Research Organization (ISRO) satellite imagery data

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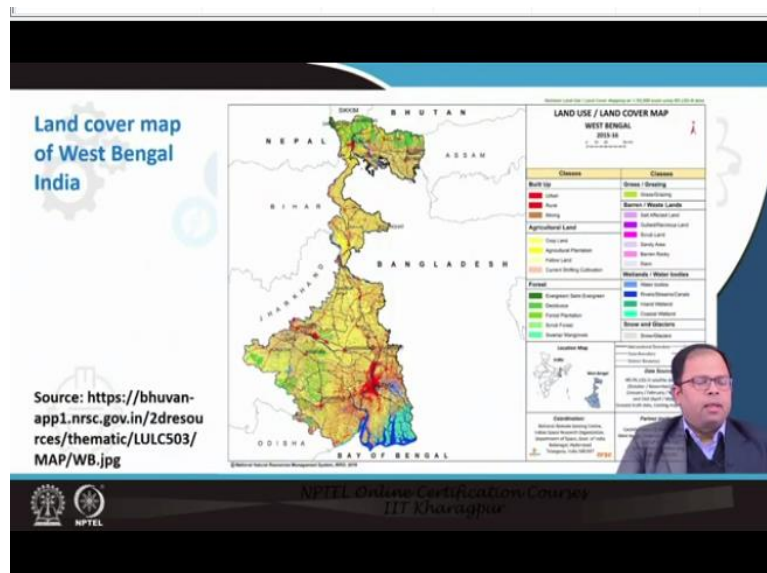
Land use and Land cover data

Lot of free data are available. For example, Bhuvan land use sheets are available from Government of India. Bhuvan data contains land use data, land cover data, administrative boundaries data, infrastructure data, water bodies, watershed boundaries, soil resources etc. This is the most recent data set that is available with us.

Another source is the National Urban Information System(NUIS) database which contains map data as well as a database i.e., both thematic data and attribute data. Thematic data contains land cover maps (with scale), physiography maps, geomorphology maps, geological structure maps, lithology maps, soil maps, drainage maps etc. Attribute data contains administrative boundaries, forest boundaries, settlement names etc. For specialized studies, like study on green cover depletion over a period of time can use satellite imagery data from ISRO (Indians space research organisation).

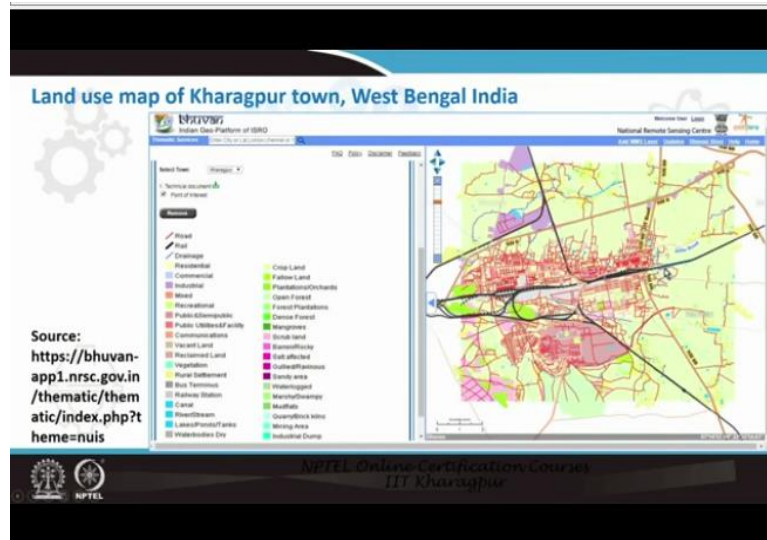
We can use these databases for the preparation of land use and land cover maps for a particular urban area and also for preparing development plans.

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This is an example of a land cover map for the state of West Bengal. This map shows urban and rural built-up area, mining area, agricultural land including cropland, agricultural plantations, fallow land, land for current shifting cultivation, different kinds of forests, grasslands, barren lands and wetlands. This land cover map of West Bengal was obtained from Bhuvan data sheets.

(Refer Slide Time: 07:20)



This shows the land-use map for Kharagpur town in West Bengal, India. Built-up area includes roads, rails, drainages, residential areas, commercial areas, industrial areas, mixed use areas etc. (Refer Slide Time: 07:54)

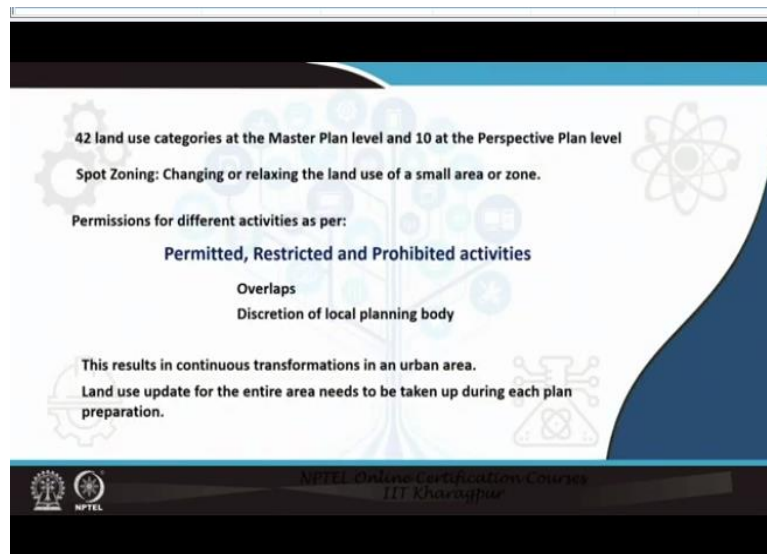
Use Category	Use Zone	Use Category	Use Zone
Residential	Primary Residential Zone	Recreational	Playgrounds/ Stadium/ Sports Complex
	Unplanned / Informal Residential Zone		Parks & Gardens – Public open spaces
Commercial	Retail Shopping Zone	Transportation and Communication	Multi-open space
	General Business and Commercial District/ Centres		Roads/ BRTS
	Wholesale, Godowns, Warehousing/ Regulated Markets	Railways/ MRTS	
	Service Sector	Airport	
Industry	Regulated/ Informal/ Weekly Markets (TCPO Study on Zoning Regulations)	Seaports and Dockyards	
	Service and Light Industry	Bus Depots/ Truck Terminals and freight Complexes	
	Extensive and Heavy Industry	Transmission and Communication	
Public and Semi - Public	Special Industrial Zone - Hazardous, Noxious and Chemical	Primary Activity	Agriculture
	Govt./ Semi Govt./ Public Offices		Forest/ Horticulture
	Govt. Land (use undetermined)		Poultry and Dairy Farming
	Police Headquarter/ Station, Police Line	Rural Settlements	
	Educational and Research	Brick Kiln and Extractive Areas	
	Medical and Health	Others (fishing, pottery etc.)	
Mixed Use	Social Cultural and Religious (Cremation and Burial Grounds)	Protective and Undevelopable Use Zone	Water Bodies
	Utilities and Services		Special Recreation Zone / Protective Areas such as sanctuaries/ reserve forests and Eco-sensitive zone
	Mixed Industrial use Zone	Undevelopable Use Zone	
	Mixed Residential Zone	Old Built-up (Core) Area	
Mixed Commercial Zone	Heritage and Conservation Areas	Special Area	Scenic Value Areas
	Government Restricted Area (such as Defense)		Other Uses/ Spot Zone*

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Land use classification

The town planning guidelines have specified 10 broad land use categories such as residential land use, commercial land use, industrial land use etc. and around 40 subcategories of land uses. For example, within residential land use there are primary residential zones and unplanned or informal residential zones. Within commercial land use, there are retail shopping zone, general business zone, commercial district centres, wholesale go-downs, warehousing, regulated markets etc. Similarly in industrial land use there are service and light industry, extensive and heavy industry etc. The built-up area in an urban locality is divided into these land use categories and this division is needed to segregate the different activities.

However, mixed land uses could also be present, such as mixed industrial use zones, mixed residential zones, mixed commercial zones. **(Refer Slide Time: 09:20)**



While preparing perspective plans, only the 10 broad land use categories are considered. However, during the preparation of master plans or development plans, considering the future purpose and growth of the city, land for each of the 42 land-use categories mentioned earlier have to be reserved.

Once a land use plan is prepared it is not absolute. Based on certain requirements that arise over time, the authorities, (e.g our government bodies) can allow certain changes in the land use which could be taken care of by ‘spot zoning’. That is, we can either change or relax certain land use sub-categories within a broader land use category which was already been finalized in a development plan. Such changes can be only considered for small areas after careful consideration. However, changing land use for large areas is neither required or neither suitable for a particular development plan.

Within a land use category, certain activities are permitted, certain activities are restricted, (i.e we can allow those activities with certain variation or change in scale) and certain activities are prohibited. For example, in an area which is designated as a residential land use, we can have some amount of commercial areas where local shopping can take place. Similarly, we can allow certain amount of home-based offices to operate from certain residential areas. These are permitted categories. In restricted categories we can allow certain type of schools and institutions but they should be small in size. Certain types of industries are allowed (i.e if it is small and not polluting) as well. Usually a case-by-case check is done

to allow an industry to be set up in a particular area. But there are certain activities which are prohibited. For example, we cannot have an oil refinery in a residential zone.

However, there is no absolute rule to say that an activity is not permitted or would not be allowed in a particular land-use category. It is up to the discretion of the local planning body to decide what activities should be permitted in a particular area which has been designated with a particular land use.

Once the development plan is prepared, it acts as a guideline and has to be adhered to, to the best possible extent. However, there are cases where certain changes have to be accommodated. Urban areas continuously goes through these transformations and when the next development plan is prepared the land-use is updated to include these changes.

(Refer Slide Time: 13:23)

Census of India 2011
Urban Settlements Minimum population(5000)
 75% of the male main working population (non-agricultural JOBS)
 Population density (more than 400 persons per sq. km)

Sl.No.	Classification/ Nomenclature	Population Range	Local Authority (As per 74 th CAA)
1	Small Town I	5,000- 20,000	Municipal Council/ Nagar Panchayat
2	Small Town II	20,000- 50,000	Municipal Council/ Nagar Panchayat
3	Medium Town I	50,000- 1 lakh	Municipal Council
4	Medium Town II	1 lakh to 5 lakhs	Municipal Council
5	Large City	5 lakhs to 10 lakhs	Municipal Corporation
6	Metropolitan City I	10 lakhs to 50 lakhs	Municipal Corporation
7	Metropolitan City II	50 lakhs to 1 crore	Municipal Corporation
8	Megapolis	More than 1 crore	Municipal Corporation

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Urban Land use Classification

Use Category	Use Zone
Residential	Primary Residential Zone Unplanned / Informal Residential Zone
Commercial	Retail Shopping Zone General Business and Commercial District/ Centres Wholesale, Godowns, Warehousing/ Regulated Markets Service Sector Regulated/ Informal/ Weekly Markets (TCPO Study on Zoning Regulations)
Industry	Service and Light Industry Extensive and Heavy Industry Special Industrial Zone - Hazardous, Noxious and Chemical
Public and Semi- Public	Govt./ Semi Govt./ Public Offices Govt. Land (Use undetermined) Police Headquarter/ Station, Police Line Educational and Research Medical and Health Social Cultural and Religious (Cremation and Burial Grounds) Utilities and Services
Mixed Use	Mixed Industrial use Zone Mixed Residential Zone Mixed Commercial Zone

Use Category	Use Zone
Recreational	Playgrounds/ Stadium/ Sports Complex Parks & Gardens – Public open spaces Multi-open space
Transportation and Communication	Roads/ BRTS Railways/ MRTS Airport Seaports and Dockyards Bus Depots/ Truck Terminals and freight Complexes Transmission and Communication
Primary Activity	Agriculture Forest& Horticulture Poultry and Dairy Farming Rural Settlements Brick Kiln and Extractive Areas Others (Fishing, pottery etc.)
Protective and Undevelopable Use Zone	Water Bodies Special Recreation Zone / Protective Areas Reserve forests and Eco-sensitive zone Undevelopable Use Zone
Special Area	Old Built-up (Core) Area Heritage and Conservation Areas Scenic Value Areas Government Restricted Area (Use Other Uses/ Spot Zone*

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Different land use categories also require transportation to connect them. For example, residential and industrial land uses are connected by transportation and thus land use distribution and classification determines the land use and transport integration that is suitable and possible for an urban area.

Urban settlements and land use structure

The size of urban settlements also determines the land use that is likely to be present or suitable for an urban area. The allowable land use, their percentage breakup and even the predominant land use of an urban area while depending on the size of the town, also depends on the current context or the historical context of the town. Towns having a historical central core and conserved areas which are either archaeological sites or preserved monuments or buildings has a different flavour and has to be planned in a different way. However, in general, the size of town plays a role in how the plans should be developed or how the land-use categories need to be designated for that particular town.

Urban settlements as defined by Census of India are areas where the minimum population size is 5000, 75% of the population are not engaged in agriculture and practices non-agricultural work and with a population density of more than 400 persons per square kilometre. Census of India has also defined different categories of urban settlements depending on size. For example : ‘Small town 1’ starting from 5,000 to 20,000 population range and these are managed by a municipal council, ‘Medium town 1’ which has population of 50,000 to 1 lakh or ‘Medium town 2’ which has 1 lakh to 5 lakh people and governed by a municipal council and ‘Large cities’ starting from 5 lakh population size to ‘Mega polis’ with population more than 1 crore and managed by a municipal corporation. Thus, based on size, the urban local body along with its organizational and operational structure which manages a particular urban area is different which also influences the land-use and transportation system plans that are developed for that urban area. For example, in a small town we may not plan for transit corridors, because in small towns it may not be feasible to set up a BRT system or to set up a heavy rail system. On the other hand, small towns would be best supported by improving infrastructure and services related to walking, bicycling and to some extent paratransit. **(Refer Slide Time: 17:25)**

Land use structure

These guidelines vary for different types of cities and as per context.
While inner city areas may have a significantly different land use structure, new areas are developed following the guidelines given below.

Land use Category	Percentage of developed area			
	Small	Medium	Large Cities	Metropolitan Cities
Residential	45-50	43-48	36-39	36-38
Commercial	2-3	4-6	5-6	5-6
Industrial	8-10	7-9	7-8	7-8
Pub. & Semi Public	6-8	6-8	10-12	10-12
Recreational	12-14	12-14	14-16	14-16
Transport and Communication	10-12	10-12	12-14	12-14
Agriculture & water Bodies	Balance	Balance	Balance	Balance
Total Developed Area	100	100	100	100

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Land use structure is just a guideline which guides us on the type and the percentage of land use that should be suitable for a town of particular size. Thus depending on the town, different quantum of land is reserved for different kinds of land use while preparing a plan. For example, reserved residential land use category for small towns is almost 50%, whereas in a large metropolitan city it is only around 35%. Hence, there is a huge difference between a small city and a metropolitan city. This is because of the variety of activities in a metropolitan city. For example, in a metropolitan city we see that, the commercial area is relatively more compared to a small city. While, the industrial area could be more or less, public and semi-public land use and recreational land use is much higher. This is due to a lot of institutions in a big city which are missing in a small city. So, accordingly, the land use structure is also different in different cities.

While, designing the land use structure of an urban area we also consider the historical background of the city or how the city has grown. We have already seen that, in case the existing inner city area is very dense, it is difficult to make any change in the land use structure in that area. However, the new or proposed land use structure is adopted while planning for the surrounding area or new areas which should be taken up for development.

Hence, the transportation system, the land use structure, and even the governing systems could be different for different urban areas which lead to different kinds of development plans for different kinds of towns.

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Population density and carrying capacity(Town planning guidelines)

City structure is directly related to its density of development.

Urban density for residential areas:
 Houses per acre
 Habitable rooms per acre (Accommodation density)
 Persons per acre (Population Density)
 Floor Space Index(FSI)

Urban density for non-residential areas:
 Built up area per acre
 Floor Space Index(FSI)

Settlement Type	Persons per Hectare (pph) in	
	Plain Areas	Hill Areas
Small Towns	75-125	45-75
Medium Town	100-150	60-90
Large Cities	125-175	60-90
Metropolitan Cities	125-175	100-150
Magapolis	More than 200	--

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Factors influencing urban structure and form

Four factors which play a major role in determining the form or the structure of an urban area considering the land use and transportation planning context are population density, the carrying capacity, floor area index and ground coverage. These could be controlled to determine the structure of an urban area.

(Refer Slide Time: 20:47)

Population density and carrying capacity(Town planning guidelines)

City structure is directly related to its density of development.

Urban density for residential areas:
 Houses per acre
 Habitable rooms per acre (Accommodation density)
 Persons per acre (Population Density)
 Floor Space Index(FSI)

Urban density for non-residential areas:
 Built up area per acre
 Floor Space Index(FSI)

Settlement Type	Persons per Hectare (pph) in	
	Plain Areas	Hill Areas
Small Towns	75-125	45-75
Medium Town	100-150	60-90
Large Cities	125-175	60-90
Metropolitan Cities	125-175	100-150
Magapolis	More than 200	--

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Land use structure

These guidelines vary for different types of cities and as per context.
While inner city areas may have a significantly different land use structure, new areas are developed following the guidelines given below.

Land use Category	Percentage of developed area			
	Small	Medium	Large Cities	Metropolitan Cities
Residential	45-50	43-48	36-39	36-38
Commercial	2-3	4-6	5-6	5-6
Industrial	8-10	7-9	7-8	7-8
Pub. & Semi Public	6-8	6-8	10-12	10-12
Recreational	12-14	12-14	14-16	14-16
Transport and Communication	10-12	10-12	12-14	12-14
Agriculture & water Bodies	Balance	Balance	Balance	Balance
Total Developed Area	100	100	100	100

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Population density and carrying capacity are almost synonymous. For example, when we increase population in an area it actually increases the pressure in that area i.e., the roads become congested, people may not get enough space to live, the infrastructure may not be able to support so many people, the urban services of solid waste collection and other similar services may not be able to support the people living there and so on. Hence there are guidelines to determine optimum density for an urban area. While, URDFI provides generic guidelines, one can form their own guidelines to decide what kind of density is ideal for a particular urban area or a particular context.

Usually for small towns, suitable density is around 75 to 125 persons per hectare, whereas, for large towns it is around 125 to 175 people per hectare and for megalopolis it could be even higher. Hilly areas have lower suitable density than the plain areas. However, more compact development is possible provided, infrastructure or other kind of support facilities are provided to support this extra population. For normal areas with standard infrastructure and standard urban structure (that we have discussed previously) it is better to stick to the prescribed densities. Density can be population density or, can be also based on the amount of residential land use or on the number of houses or number of habitable rooms per acre etc.

The next factor is floor space index which can also help in determining the density of the developed area. For example, if we increase the floor space index for a particular area it implies that, we can construct more square footage/built up area for a particular plot of land which will result in more number of families residing in those buildings leading to higher

residential density. Thus, we can control urban residential densities and controlling it can result in changing the form or the structure of an urban area. This also impacts the transportation and the land use of the particular area.

For residential areas, we use both population density and residential floor area density, but for commercial or non-residential areas, we use built-up area per acre or the floor space index for that particular area.

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The slide is titled "Carrying capacity" and features a background with various icons including a gear, a tree, a person, and a molecular structure. The text on the slide reads: "Carrying capacity of an urban area can be defined as the maximum number of people that can be supported by that area considering:" followed by a list of five criteria, each with a checkbox: "Desired levels of congestion", "Infrastructure capacity", "Institutional capacity", "Environmental capacity", and "Sustainable capacity level". In the bottom right corner, there is a small video inset of a man with glasses speaking. At the bottom of the slide, there are logos for NPTEL and IIT Kharagpur, along with the text "NPTEL Online Certification Courses IIT Kharagpur".

Next, is the concept of carrying capacity. It is similar to density, but the only difference is that, we define the maximum number of people that could be supported in a particular area. The maximum limit any particular area can hold is based on multiple criteria : it could be based on the desired levels of congestion in the particular area, the infrastructure capacity, the institutional capacity, the environmental capacity or the sustainable levels or number of people that stay in that particular area.

If any one of these fails we have to stick to the failing limit. For example, if the capacity of water supply is limited, we cannot have more number of people even though other capacities are available. The roads might be wide and can support a lot of people and vehicles but we have to stick to the one which is failing, in this case - the water supply limit. The capacity limit is decided by the criteria which is the most vulnerable among all.

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F.S.I and ground coverage(Municipal bye laws)

FSI/Floor Area Ratio (FAR)
 Ratio between total covered floor area (Built up Area) to the plot area (land) of the building.
 Indicator of built up area per acre (Based on FAR consumed)

FAR for a particular zone/plot is set based on:

- Width of street
- Present and future traffic load
- Parking availability
- Land use and locality
- Utilities and infrastructure(Drainage, water supply)
- Population Density
- Type of construction
- Firefighting services

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Floor Space Index (FSI) and ground coverage are two factors which can be used by the municipal bodies to control the urban density, structure and the urban form. Floor Area Ratio (FAR) or FSI is defined as the ratio between total covered floor area (built-up area) to the plot area of the building. It is an indicator of the built-up area per acre based on FAR consumed. FAR for a particular area is set by the municipal corporation considering multiple factors out of which the most important is the width of the street. If the street is not wide enough, we cannot allow construction of a very high rise building or rather we cannot allow very high FAR. The present and the future traffic load in that particular street is also considered since higher FAR may result in the construction of a shopping mall in that particular street and the road may not be able to take the resulting traffic load. Similarly, parking availability along the street is another factor. For example, higher FAR in an area may result in more number of people coming in which will require cars to be parked along the street whereas, required parking space may not be available.

Other factors are the land use structure in the neighbourhood, utilities and infrastructure available, the existing population density, type of buildings, availability of fire-fighting services, etc. All these determine what kind of FAR could be allowed for a particular area.

Urban structure and form can be controlled using FAR. This means, for transit oriented development, FAR of the area surrounding the transit node has to be increased. However, to do that, urban planners have to ensure that the area has got wide streets, has enough parking availability, different land-use categories and the infrastructure supporting this kind of intense development.

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Ground coverage

Setbacks in plots based on:

- building height
- road width
- plot size
- fire safety requirements

In case of gated communities and plotted development, ground coverage standards are defined.

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The slide features a background with a stylized tree of icons and a speaker video inset in the bottom right corner.

The second tool that municipal authorities can use to determine urban form or urban structure are setbacks i.e., from the edge of the plot to the building's edge there has to be certain amount of land which has to be reserved and kept open to sky. Setback is decided by municipal authorities based on the building height, the road width, the plot size, fire safety requirements (because if we do not allow this setback then a fire tender cannot get inside the plot) etc. However, if the setbacks are too large, we are allowing only a small part of the plot to be built, which may result in a tall building particularly when FAR is high. This is how the urban structure and the urban form can be controlled. In case of gated communities or plotted developments where large plots with multiple buildings are involved, instead of setbacks, ground coverage(GC) standards are set which means certain percentage of the ground should be left empty.

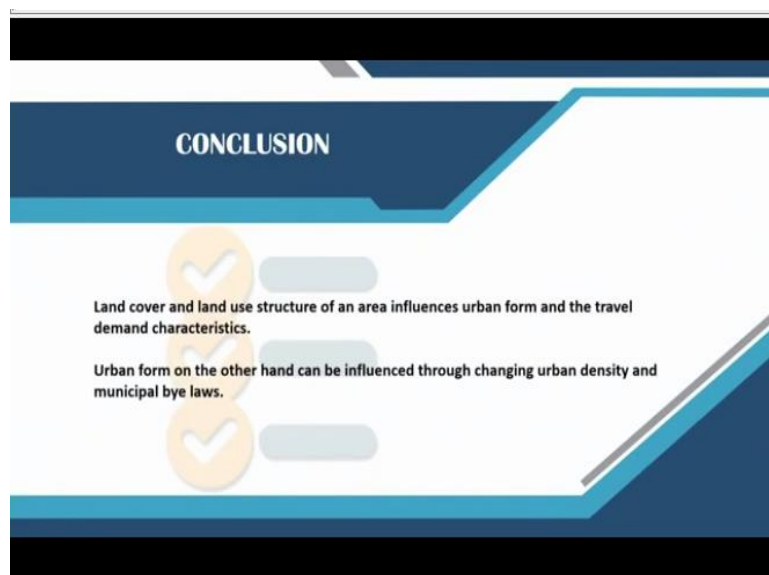
Thus, these are the different tools a municipality or an urban planner uses to decide on the urban structure and these influence the land use and transport interaction in an urban area.

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You can refer to the URDPFI guidelines from the ministry of housing and urban development as reference for this particular lecture and it will show you the different tools and techniques available to control urban land use and urban form for a particular urban local body.

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And to conclude this particular lecture:

Land cover and land use structure of an area influences urban form and the travel demand characteristics of that particular area.

Urban form on the other hand can be influenced through changing urban density and municipal bye laws.

Thank you.