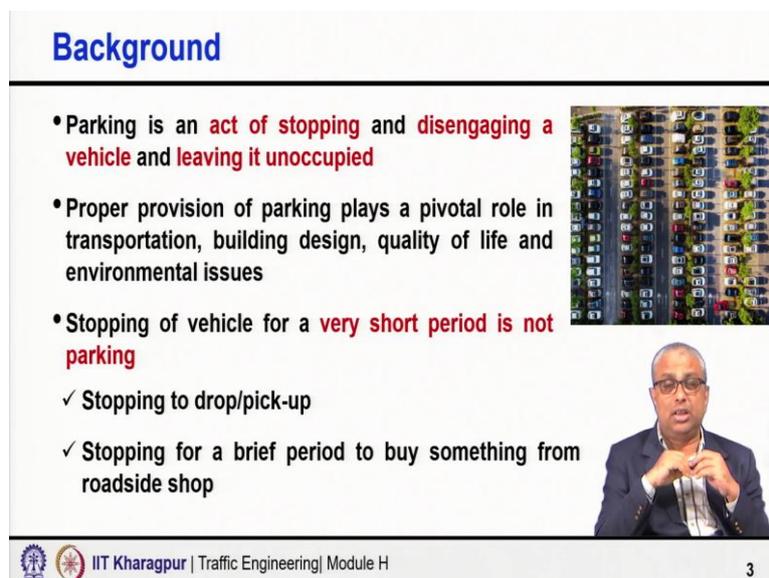
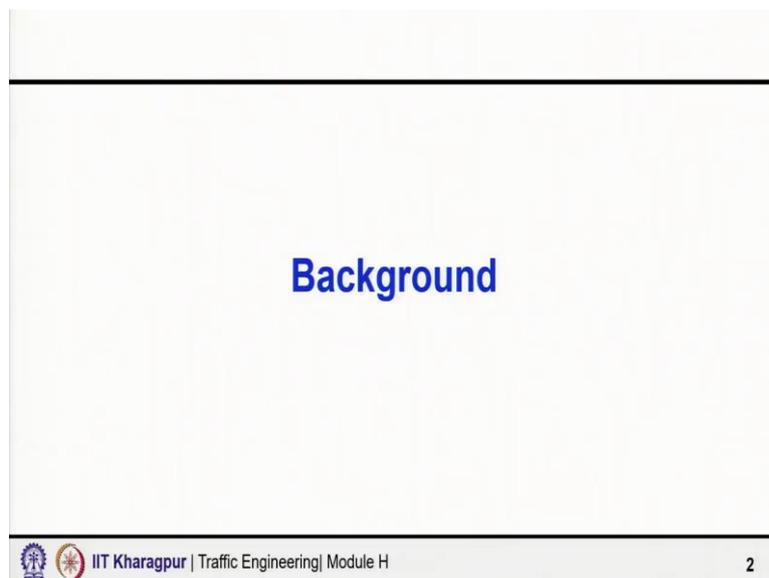


Traffic Engineering
Professor Bhargab Maitra
Department of Civil Engineering
Indian Institute of Technology, Kharagpur
Lecture 56
Parking Management - I

Welcome to module 8 lecture 1, this module is on Parking Management. We shall have 3 lectures on this topic Parking Management.

(Refer Slide Time: 00:25)



A slide with a white background and a thin black border. The word "Background" is centered at the top in a blue, sans-serif font. Below it, there is a list of bullet points. To the right of the text, there is a small image of a multi-story parking garage. At the bottom right, there is a small inset image of Professor Bhargab Maitra speaking. At the bottom left, there are logos for IIT Kharagpur and the text "IIT Kharagpur | Traffic Engineering | Module H". At the bottom right, the number "3" is displayed.

- Parking is an **act of stopping** and **disengaging a vehicle** and **leaving it unoccupied**
- Proper provision of parking plays a pivotal role in transportation, building design, quality of life and environmental issues
- Stopping of vehicle for a **very short period is not parking**
 - ✓ Stopping to drop/pick-up
 - ✓ Stopping for a brief period to buy something from roadside shop

Today is the first part of that. What is parking? Parking is an act of stopping or disengaging a vehicle and leaving it unoccupied. Please carefully note that we are talking about the act of stopping, so stopping a vehicle. Second, disengaging a vehicle. Third, leaving it unoccupied. That means, if you are stopping the vehicle for a very short period or for a short period just for

the purpose of pickup or drop up, or just stop to buy something from a roadside shop that is not or those are not really called as parking.

So, there is a difference between stopping and parking. That is what we said it is only called parking when this is, the there is an act of stopping, disengaging a vehicle and also leaving it unoccupied. Proper provision of parking plays a very vital role in transportation, design of building multistoried specifically, quality of life and also addressing the environmental issues which are very, very prominent and very important in the context of urban transport, specially in developing countries such as India.

(Refer Slide Time: 02:07)

Background

Need for Parking Management

Congestion Management

- Road traffic and private vehicle ownership are growing rapidly with the economic progression
- Demand for parking space is also growing at a faster pace
- Supply of road space and parking space is restricted with limited scope for augmentation
- Parking policy may also be used as an effective **demand management instrument**

Total Number of Registered Motor Vehicles in India

Year	Number of total registered Motor Vehicles in India
1987	1.9
1988	2.4
1989	3.0
1990	3.7
1991	4.4
1992	5.2
1993	6.1
1994	7.1
1995	8.2
1996	9.4
1997	10.7
1998	12.1
1999	13.6
2000	15.2
2001	16.9
2002	18.7
2003	20.6
2004	22.6
2005	24.7
2006	26.9
2007	29.3
2008	31.8
2009	34.4
2010	37.1
2011	39.9
2012	42.8
2013	45.8
2014	48.9
2015	52.1
2016	55.4
2017	58.7

Source: Transport Year Book, Government of India

IIT Kharagpur | Traffic Engineering | Module H

4

Why we need Parking Management, there are multiple reasons the first Congestion management or for doing proper Congestion management. As you know, most of our Indian cities are not developed as planned cities and the available road space is not adequate, which is allocated for development of roads. So, that percentage of road space is on a lower side.

Moreover, the urban population is growing overall urban traffic is growing and the private vehicle ownership is also growing among young or there are increasingly higher aspirations of owning private vehicles various reasons are there. So, with limited road space and the growth of transport demand particularly growth of private vehicles, creating imbalance and this imbalance between the demand and supply is actually aggravating condition. So, how to do a better condition management in urban area is really a big challenge to traffic engineers.

As the demand for road is growing for moving vehicle, because of the growth of private vehicle ownership or higher share of private vehicle ownership in the overall traffic stream, there is

also growth for the demand for parking because as you know if you are traveling to an urban area, if you are going to offices if you are people are going to business centers, commercial establishments, they would also like to park their vehicle.

So, it is the same road space which is used for moving vehicle and also for parking purpose. So, supply of road space and parking space is restricted and overall the scope for capacity augmentation of road and therefore the capacity augmentation of the infrastructure for particularly on-street parking, and also for giving more capacity for vehicle movements. Both are highly restricted by physical constraints. There are also fiscal constraints, but I would focus more or highlight more on the physical constraints. Look at our urban areas, there is hardly any scope for road widening. So, you cannot. So, the demand one way is growing, but the augmentation scope is restricted highly restricted.

So, parking policy may also be used as an effective demand management instrument, how we can, you know if you consider the CBD area, the demand management can play a vital role, how to bring or how to encourage the use of private a public transport in lieu of private vehicles, how we can discourage people to bring private vehicles in the CBD area where there is so much of congestion and so much parking problem and so on. So, demand management, parking management can also help to do better and effective demand management

(Refer Slide Time: 06:00)

Background

- Enhancing Road Safety**
 - Improper parking may lead to road crashes
- Clear Obstruction to Fire-Fighting Operations**
 - Improper parking may obstruct fire hydrants and impede fire fighting operations – may also obstruct movements of emergency vehicles
- Other Benefits**
 - Well-managed & well-designed parking facilities
 - ✓ May help to reduce vehicular **emission**
 - ✓ Can generate **economic opportunities and good revenue**

IIT Kharagpur | Traffic Engineering | Module H

5

Then, improper parking may also lead to road crashes, you will know that in Indian context, we have serious issues. And road safety is a major concern. We have so many road crashes, so many fatalities and improper parking may also cause road crashes. If you do not allocate

parking, proper parking space, if you do not design the parking properly the kind of maneuver which will be required, all those actually may cause more number of crashes in urban areas.

So, if we do proper parking management, we can also reduce the number of crashes. Then improper parking or vehicle parked in an improper manner may also cause obstruction to fire hydrants, roadside fire hydrants will be there. So, maybe you just go and park your vehicle in front of fire hydrants without when there is no control on parking or when the proper management of parking is absent in an urban area, this kind of situation may happen and this may create obstructions because in case of any fire breakout, people will not be able to, the firefighting authority would not be able to access the fire hydrants.

Similarly, if the improper parking may also obstruct movement of emergency vehicles, you have done double parking, triple parking and the, you have not left probably proper space for movement of emergency vehicles in case of an emergency. So, that all sorts of issues may come and if we do proper parking management, then there are benefits because well managed and well-designed parking facilities may also help to reduce vehicular emission.

It is again doing a balance, because sometimes if you are how much space to be located for moving vehicle and how much space to be given for parking, how much on-street parking, how much off-street parking, off-street generally roadside parking, I will define it properly in the next on next to next slide.

So, altogether a proper parking management can help you to reduce congestion and can also help us to improve or reduce vehicular emission. And in the same spirit, well managed and well-designed parking facilities can generate economic opportunities and good revenue. That is again a potential because in country like India, where the unemployment is such a big issue, right big social issue. So, if properly and parking is a requirement, so if we can do proper management, proper control and then the operation or the management of parking facilities that can create economic opportunities and good revenue.

So, altogether, the necessity for parking is parking management is enormous. I have shown you some of the photographs they are in any urban area you go you find the parking is so chaotic, and you know always we feel like lot of improvements is possible in the overall parking management.

(Refer Slide Time: 09:41)

Background

Types of Parking

On-Street Parking

- Area allotted for parking is located at the side of the road
- Such parking area, generally, has no definite entry & exit
- Considered good for short duration parking
- **Based on the angle** at which the vehicles are parked with respect to the road alignment, the on-street parking is classified as

- ✓ Parallel Parking
- ✓ Perpendicular Parking
- ✓ Angular Parking



Then going to the types of parking. There are 2 types of parking broadly. One we can call on-street parking, the other is called off-street parking. People, road users they always prefer on-street parking. What is on-street parking here the area allocated for parking or allotted for parking is located at the side of the road. I have typically shown here some photographs you can see here by the side of the road.

So, typically part of the carriageway and part of the shoulder, part of the carriageway and the shoulder together is used for parking of vehicles by the side of the road, it is very easy because you just simply take out the vehicle and park it there by the road side and easily you can take out your vehicle as well, you can go to the parking, you can take out the vehicle very easily no extra travel, you want to park near a shop, you can simply go and park the vehicle near the shop if there is a space of course and that is what is easy.

So, every user road users or car users, they always prefer on-street parking. And so, what is on-street parking, 2 characteristics we can say parking is done using part of the carriageway and shoulder. Second, such parking facilities or places do not have a definite entry or exit, just by the side of the road the vehicle is parked, there is no definite entry that you have to enter to these and exit through this nothing like that which is normally there for the upstream.

So, that is again a major point to be noted for on-street parking. It is considered good for short duration parking because if you want to park your vehicle say for 15 minutes, half an hour or maximum 1 hour so, you do not feel like traveling to another place and accessing an off-street facility, park your vehicle and then walk up to the shop or up to your place of work right you

do not may not like. So, for short duration parking people always prefer and it is considered good also the on-street facility.

Now, based on the angle at which the vehicles are parked with respect to the road alignment, the on-street parking may be classified as parallel parking, where the vehicles are parked parallelly along the if we consider the movement of the vehicles, then along that movement of the vehicle only facing the direction of traffic the vehicles are parked. That is typically by the side of the whole length of the vehicle is occupied the car plinth so, that is what is parallel parking.

Angular parking at an angle vehicle is parked obviously we are occupying more space you are taking larger part of the carriageway while the vehicle is parked because vehicle if it is parked parallelly least encroachment to the carriageway and of course, you can for the same length of the car you can park lesser number of vehicle.

If you are going for Angular parking is a 30-degree, 45-degree, 60 degree, you can increase the number of vehicles that can be parked but you are occupying more road space perpendicular parking at an angle 90 degree. So, if the vehicles are moving like this the vehicle parked vehicle are placed like this at an angle 90 degree.

(Refer Slide Time: 13:41)

Background

- **Advantages of On-Street Parking**
 - ✓ Acts as **safety barrier for pedestrians**
 - ✓ Helps to reduce speed of the traffic stream thus enhance safety of the non-motorized modes
 - ✓ Lesser investment as compared to off-street parking facilities
- **Downsides of On-Street Parking**
 - ✓ **Reduced capacity** of the road by consuming right-of-way
 - ✓ Safety hazard to traffic stream due to parking manoeuvring
 - ✓ Door **hazard to cyclists**
 - ✓ On-street parking near crosswalk creates a visual barrier between motor vehicle traffic and crossing pedestrians



IIT Kharagpur | Traffic Engineering | Module H

7

So, little bit description of that will have but let us see what are the advantages of on street parking? as I said, on street parking acts as safety barrier for pedestrians, you can see when the vehicles are parked and beyond that pedestrians are walking. So, if a moving vehicle even if you even if the vehicle is out of control, it will directly not go and hit the pedestrians and

vulnerable road users, who are of walking by the side the road. So, it acts something like a safety barrier for pedestrians who are using the footpath.

Also helps to reduce speed of traffic stream thus enhance safety of the non-motorized mode you cannot travel so fast because the parking will reduce the capacity. So, the condition will be higher there will be less freedom of movement for the moving vehicle. So, naturally speed will come down. So, in some of the areas like residential area, busy areas, we actually want traffic coming. That means we do not want the traffic to move very fast. So, that can be achieved and once the traffic is less, it is good for the non-motorized vehicle non-motorized in empty non-motorized transport for pedestrians for bicyclists who are even crossing the road.

Then lesser investment is required as compared to off-street parking facility if you want to develop a multi storied off-street parking facility, you need a different area space, you need to invest develop construction maintenance operation here nothing is required. So, lesser investment as compared to off-street parking facility. But there are downsides of on-street parking for example, the capacity is reduced for the moving vehicles, because you are taking away the carriageway part of the carriageway.

How much you are taking depends on the angle for what angle the parking is done, but you are anyhow taking away the road space then it may cause safety hazard to traffic stream due to parking maneuver as I say that you are taking out your vehicle or placing the vehicle in the parking lot, that will cause inconvenience and sometimes safety issues also because there will be interaction with the moving traffic.

Sometimes you may mistakenly or in a wrong way open the door and it will also cause road crash. So, door hazards to cyclist yes on-street parking near crosswalk creates the visual barrier between motor traffic and the crossing pedestrian block the line of sight sometimes vehicle approaching may not be able to notice that if pedestrians is trying to cross. Similarly, the pedestrian while crossing may not be able to see that there is a vehicle which is approaching.

(Refer Slide Time: 16:42)

Background

Off-Street Parking

- These are surface parking lots and car park structures either underground or elevated
- Located **at some distance** from the main traffic stream on the road
- Access to these facilities can be made for either public or private use: Can be managed by the municipality or by private or semi-public enterprises
- The area allotted for parking has definite entry and exit
- Considered good for **long duration parking**



IIT Kharagpur | Traffic Engineering | Module H

8

Now Off-Street facility on the other hand overcome will overcome the disadvantages of the On-Street facility. These are basically surface parking lots and carpark structure, it could be underground or also elevated you may have a multi storied car parking space or it may be underground parking as well, many areas the CBD area the underground is used for parking.

These are often located at some distance from the main traffic stream on road, because you need the proper place not in every route, you will be able to develop an Off-Street facility. So, you need a space. So, it is often at a distance from the main traffic stream and where you want to actually go it may not be just next to that building or nearby that building may be a little bit away from that.

Access to these facilities can made either public or private use for either private or public use also can be managed by the municipality sometimes corporation municipality or by private or sometimes semi private enterprises. It all depends what structure and what procedure the city is following.

The area allocated for parking has definite entry and exit this is one major difference, between on-Street and off-Street, off-Street always will have a definite entry definite exit, it may be the same point for entry and exit, it may be different but definite entry and exit if you want to enter you have to enter through some points or locations if you want to exit you have to exit through some locations. The area located for parking has definite entry and exit it is considered good normally for long duration parking.

(Refer Slide Time: 18:38)

Background

- Advantages of Off-Street Parking
 - ✓ Roads are free for the traffic stream
 - ✓ **High capacity**
 - ✓ Ensures safety of the vehicle
- Downsides of Off-Street Parking
 - ✓ Higher access and egress time
 - ✓ Sometimes, developing off-street parking facility is **capital intensive**
 - ✓ It is often difficult to get free space to develop off-street parking facilities in the busy areas



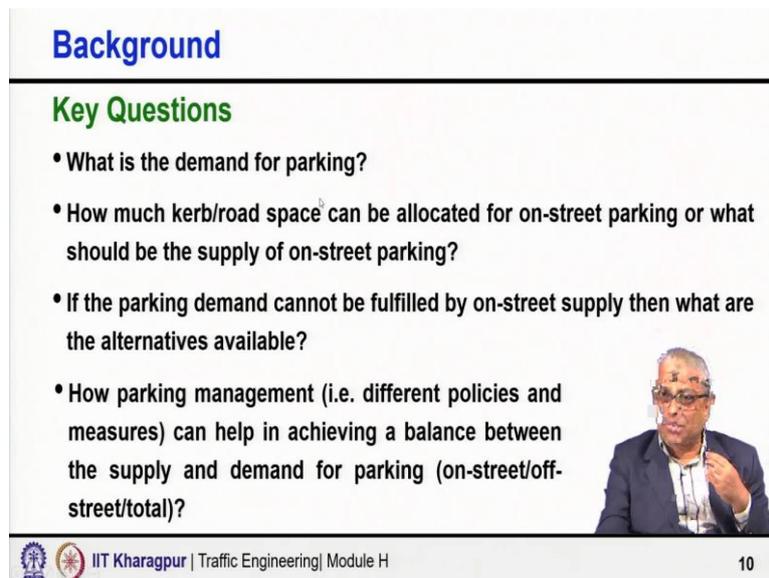
IIT Kharagpur | Traffic Engineering | Module H

9

So, there are also advantages of off-street parking and there are also downside the advantages may include the road surfing to traffic stream, you get maximum capacity to for movement of vehicle. So, road capacity can be utilized in a better way for the moving traffic stream. You can get high capacity and the higher safety to vehicles, but the downside may include higher access egress time, and people may not be interested in some cases because they may dislike it because of the walking distance to and from the Off-Street facility.

Sometimes developing Off-Street facilities capital intensive, if you want really the kind of facility this kind of high-end Off-Street parking facility, underground facility or even multistoried facilities capital intensive. It is often difficult to even get free space for development off-street parking facility in the busy areas.

(Refer Slide Time: 19:40)



Background

Key Questions

- What is the demand for parking?
- How much kerb/road space can be allocated for on-street parking or what should be the supply of on-street parking?
- If the parking demand cannot be fulfilled by on-street supply then what are the alternatives available?
- How parking management (i.e. different policies and measures) can help in achieving a balance between the supply and demand for parking (on-street/off-street/total)?

IIT Kharagpur | Traffic Engineering | Module H

10

So, with this background, let us now try to understand what are the key questions that we often face and we need to answer as a Traffic Engineer. First, what is the demand for parking? How much is the real demand? Consider a typical CBD area in mind, just keep the typical CBD area in mind and this thing, the first thing we want to do want to know, what is the demand for parking, how many vehicles want to park actually, what is the demand.

Second, how much car space or road space can be allocated for on-street parking or what should be the supply of on-street parking, the demand is so much now, how much supply we can give looking at the car space looking at all the other restrictions, where parking cannot be done number of places where you cannot do parking, because of safety reasons, because of other reasons, also looking at the traffic volume on the road available carriages width and so on.

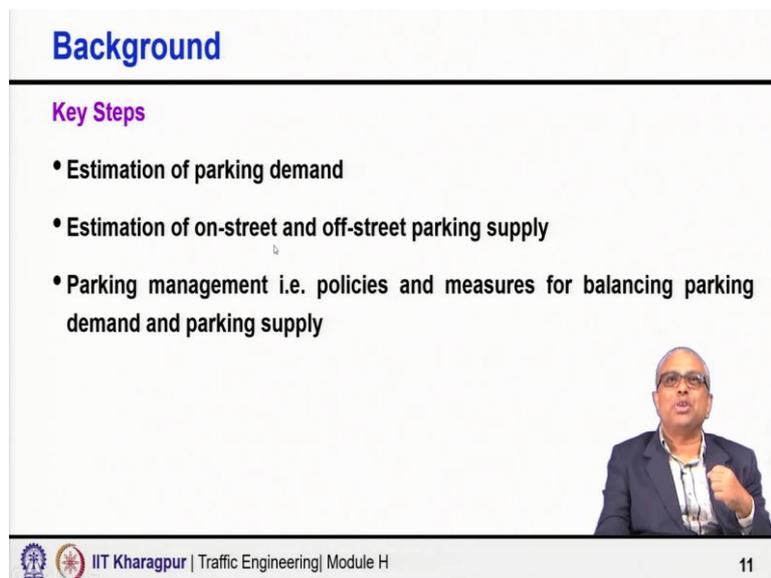
And then considering all those, what could be my rational supply on street, where I can allow parking where I can allow what kind of parking arrangement is possible, how much length of the car was actually available for parking, considering all these to understand how much supply is possible. Third, if the parking demand cannot be fulfilled by on-street supply, if it can be fulfilled, then your problem is simple. If your overall traffic volume, road space and everything is so favorable, that whatever is the parking demand everything can be fulfilled by providing on-street parking facility then there is no problem but often it will not be so.

Take any urban area typically will find that the demand will be higher than the available supply. So, in that case or in such cases, what are the alternatives available? What are the things that are possible? Should I develop off-Street facility? If I develop off-Street facility, which are the

vehicles that I should push to off-Street facilities, what should be my basis and then how the parking management that is lot of policy methods or management interventions altogether how parking management is helpful in achieving a balance between the supply and demand for parking considering on-street separately off-Street separately and the total as a whole.

How my policies and measures for management can help all together to achieve a reasonable balance between the supply and demand for parking. It may be what is the supply of on-street versus what is the demand for on-street, what is the supply of off-Street, what is the demand for off-Street or altogether how much is the parking demand and how much is the parking supply. So, what is the role of the Parking Management? How parking management can help what all alternatives are there in case there is an imbalance and how this parking management can help.

(Refer Slide Time: 23:40)



Background

Key Steps

- Estimation of parking demand
- Estimation of on-street and off-street parking supply
- Parking management i.e. policies and measures for balancing parking demand and parking supply

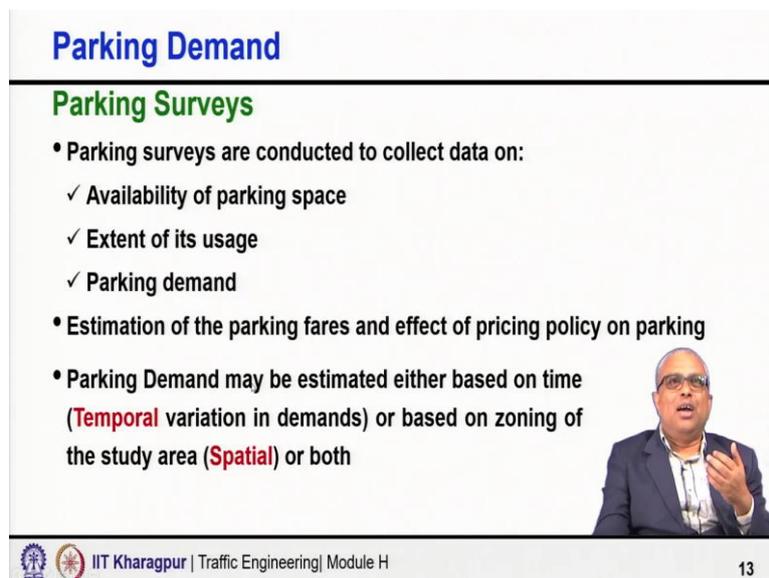
IIT Kharagpur | Traffic Engineering | Module H 11

Now to answer to these key questions, there are certain key steps first estimation of parking demand second estimation of on-street and off-street parking supply third, parking management and that is policies and methods for balancing parking demand and parking supply.

(Refer Slide Time: 23:59)



A presentation slide with a white background. The title "Parking Demand" is centered in a large, bold, blue font. In the bottom right corner, there is a small video inset of a man with glasses, wearing a dark suit jacket over a light-colored shirt, gesturing with his right hand. At the bottom left, there are logos for IIT Kharagpur and the text "IIT Kharagpur | Traffic Engineering | Module H". At the bottom right, the number "12" is displayed.



A presentation slide with a white background. The title "Parking Demand" is at the top in blue. Below it, the subtitle "Parking Surveys" is in green. The main content consists of a bulleted list of points. In the bottom right corner, there is a small video inset of the same man as in slide 12. At the bottom left, there are logos for IIT Kharagpur and the text "IIT Kharagpur | Traffic Engineering | Module H". At the bottom right, the number "13" is displayed.

Parking Demand

Parking Surveys

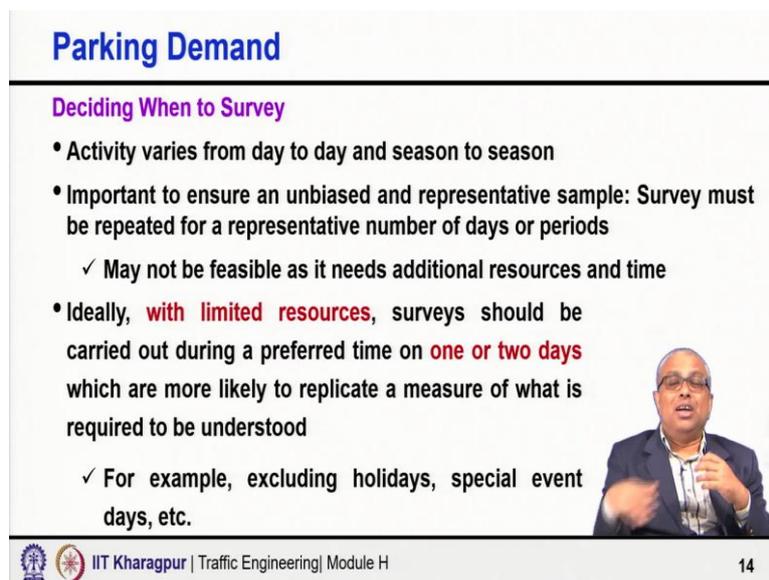
- Parking surveys are conducted to collect data on:
 - ✓ Availability of parking space
 - ✓ Extent of its usage
 - ✓ Parking demand
- Estimation of the parking fares and effect of pricing policy on parking
- Parking Demand may be estimated either based on time (**Temporal** variation in demands) or based on zoning of the study area (**Spatial**) or both

So, now we go stepwise first estimation of parking demand, parking service are conducted to estimate the parking demand on we carry out set parking service on availability of parking space extent of its use, what is the parking demand and estimation of the parking fair and effective parking policy on parking demand?

Parking demand may be estimated based on time because there is a temporal variation of parking a road at 9 o'clock in the morning 10 o'clock in the morning and 10 o'clock in the night. The parking demand is not same. So, the parking demand varies over time. Also, the weekday weekend it may be different also the longer timeframe monsoon wise also there could be different some festive season somewhere there may be very high demand somewhere there may be low demand.

Also, it could be based on zoning of the study area, because there is a spatial characteristic of the parking demand. For example, if there is a big restaurant, then parking is required around that place, if there is CBD area and some big building, buildings are there and offices are located people want to go there, they need to park their vehicle around that, not 2 kilometers, 3 kilometer away. So, parking demand is temporal parking demand is also Spatial. So, we can study on measured the parking demand considering the temporal variation or considering the spatial variation or both.

(Refer Slide Time: 25:55)



Parking Demand

Deciding When to Survey

- Activity varies from day to day and season to season
- Important to ensure an unbiased and representative sample: Survey must be repeated for a representative number of days or periods
 - ✓ May not be feasible as it needs additional resources and time
- Ideally, **with limited resources**, surveys should be carried out during a preferred time on **one or two days** which are more likely to replicate a measure of what is required to be understood
 - ✓ For example, excluding holidays, special event days, etc.

IIT Kharagpur | Traffic Engineering | Module H 14

Deciding when to survey. Now, this activity varies from day to day, season to season, different hours of the day. So, it is important to ensure an unbiased and representative sample what I am measuring from the field, is it really representative of the situation what I am trying to analyze. So, survey must be repeated for a representative number of days or periods.

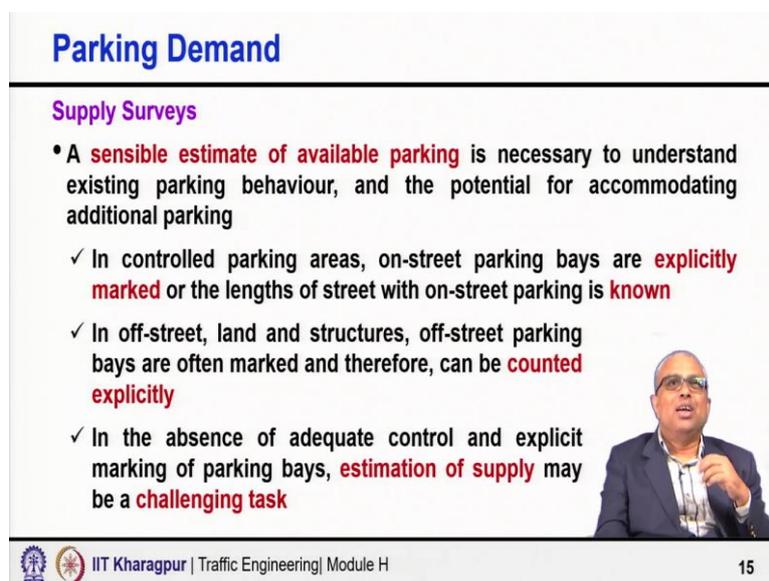
But often you may not be able to do such kind of thing because of limited resources and time, we cannot keep on doing surveys for a longer period on multiple days we are only counting because often the resource will be limited financial resources and time resource both will be limited.

So, ideally with limited resource surveys should be carried out during a preferred time on 1 or 2 days, which are more likely to replicate a measure of what is required to be understood, what is required to be understood we are actually collecting data for a limited time period, but during those time periods, which replicate that situation what is required to be understood.

So, this is very important, which are more likely to replicate a measure of what is required to be understood. For example, if we are trying to understand typical weekdays parking demand which is caused by work trips, we should not do the survey on holidays, we should not do it on special event days there is a cricket match. That is a special event or there is some festival day.

So, always there is an increase in the demand or some specific exam is going on around that time, we should avoid, we want to capture typical weekday parking demand, which is primarily caused by work trips. So, we should take a typical working day which is representative and then try to collect the data.

(Refer Slide Time: 28:16)



Parking Demand

Supply Surveys

- A **sensible estimate of available parking** is necessary to understand existing parking behaviour, and the potential for accommodating additional parking
 - ✓ In controlled parking areas, on-street parking bays are **explicitly marked** or the lengths of street with on-street parking is **known**
 - ✓ In off-street, land and structures, off-street parking bays are often marked and therefore, can be **counted explicitly**
 - ✓ In the absence of adequate control and explicit marking of parking bays, **estimation of supply** may be a **challenging task**

IIT Kharagpur | Traffic Engineering | Module H 15

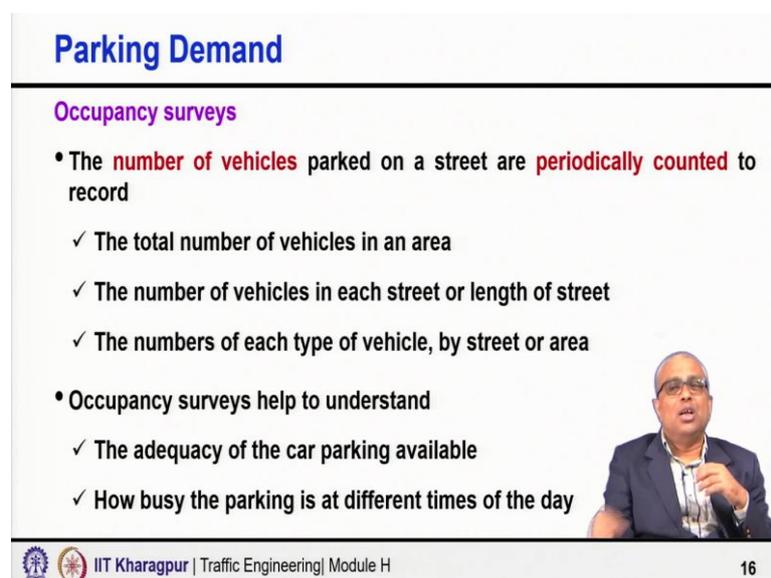
Supply service sensitive sensible estimates of available parking is necessary to understand the existing parking behavior, how much is the demand, what is the duration of parking and also the potential for accommodating additional parking, we want to see also if we know the supply survey. If we can do the supply survey, we know how much is the demand now and whether there is any scope to accommodate even more.

In control parking area where already there is a some reasonable level of control on parking. On-street parking bays are explicitly marks supposed to be not in all cases in India, but supposed to be explicitly marked or the length of the street with on-street parking is known. So, if you know the length, if you know the arrangement for parking, you know how much length each park vehicle will consume. So, you can get the number of vehicles easily and if the number of the base are explicitly marked, then it is easy again for you to get account.

In case of Off-Street land or structure. Off-Street parking bays are also often mark and therefore can be counted explicitly. Off-Street parking bays more or less everywhere is marked. So, you can get a count, but the real problem comes when you do not have adequate control. Which is the situation maybe a majority of the Indian urban areas and where explicit parking marking of parking bays is absent.

Often you will find, this road parking is allowed but parking bays are not marked and look at the way the vehicles are parked it is very unsafe. And it is really irritating in a way unsafe inconvenient, but that is the way it is going on. Nobody has any control, authority does not have any control. So, in those cases estimation of supply may be a challenging task.

(Refer Slide Time: 30:38)



Parking Demand

Occupancy surveys

- The **number of vehicles** parked on a street are **periodically counted to record**
 - ✓ The total number of vehicles in an area
 - ✓ The number of vehicles in each street or length of street
 - ✓ The numbers of each type of vehicle, by street or area
- Occupancy surveys help to understand
 - ✓ The adequacy of the car parking available
 - ✓ How busy the parking is at different times of the day

IIT Kharagpur | Traffic Engineering | Module H 16

There are 2 types of service we will discuss today. 1 is the occupancy survey. And maybe 3 types of survey 1 is occupancy survey, here, the number of vehicles parked on street are periodically counted to record the total number of vehicles in an area or could be on a street. Also, by each vehicle type on each street. Simple, maybe we want to decide we decided that we will do the parking occupancy survey from 8 o'clock in the morning to 8 o'clock in the evening and every hour we will count the number of vehicles parked.

So, we will simply travel from A to B and B to A separately considering maybe A to B when I am traveling as per Indian convention, I will probably count the number of vehicles which are parked on the left side and again B to A when I will travel I will consider the number of vehicles which are parked on the left side, so streetwise every hour we count how many vehicles are

parked and also vehicle category wise, we record the number So, like that different roads in a parking zone like the traffic analysis zone.

So, parking analysis zone all the roads can be combined together that we can see this is the overall parking zone demand and all zones together the whole urban area or the whole CBD area or the area under study we can say whatever is the total parking and such kind of occupancy service are very helpful because we can understand the adequacy of the car parking available and how busy the parking is at different times of the day because it will show you the variation during different hours of the day how the parking demand is changing on each street in in every zone and the whole study area as a whole.

(Refer Slide Time: 32:39)

Parking Demand

- **Advantages**
 - ✓ Used appropriately where the data is being collected to give either a broad understanding of the **adequacy of the parking supply** or an understanding of **changes in demand over time**
 - ✓ Allows a large amount of parking to be surveyed quickly and so **requires fewer survey resources**
- **Downside**
 - ✓ Does not provide information about the vehicles, in terms of their arrival, departure and duration of stay

IIT Kharagpur | Traffic Engineering | Module H 17

Advantages are a primary advantages include that this kind of service used appropriately where the data is being collected to give either a broad understanding of the adequacy of parking supply whether my parking supply is adequate or if you see which way they are parked also, sometimes they may be parked in an organized manner as far the safety norms and everything. Sometimes you may find that in the intersection area, they are parked, near the bus stop they are parked, double parking is parked the pedestrian pathways and growth.

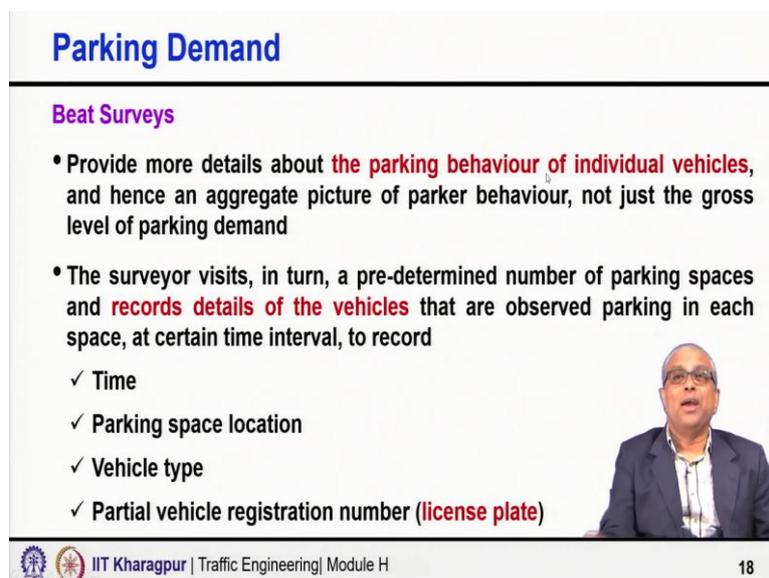
So, you know what are the problems and you know, the way that the parking supply is adequate or not compared to the demand, or also the most importantly, that is what is the real strength of the occupancy survey and understanding of the changes in demand over time. I have the data demand data every hour. So, I know throughout the day starting from morning 8 o'clock to evening, 8 o'clock, how the demand is varying, excellent.

And another great advantage is it allows you to get large amount of parking to be surveyed quickly and so requires fewer survey resources. So, every hour you are taking one counting. So, one person can actually cover a good length of the road or carpet length in one round, maybe 30, 40 minutes, the person will work on several along several streets and come back to the original point. So, maybe just creating a loop in whatever way so many ways you can create the loop you can go and go and then come back or you can go and take a U turn and come back so many possible loops are there.

So, one person can count so many, you know, streets are so many roads, the parking occupancy, the parking demand can be counted. And you really do not need too many people to count such number of vehicle. But the reasonable data you get, you get every hour how the parking demand is changing and vehicle category wise road wise parking zone wise overall study area wide how it is upping so. Both spatial aggregation is possible time wise variation you can understand and all this the downside is the parking occupancy survey does not provide information about the vehicles in terms of when the vehicle has arrived.

When the vehicle is going to the departure is happening and what is the duration of stay such kind of data is not there, because, I am observing the vehicle at 9 o'clock at 10 o'clock also I am observing a vehicle I really am not actually counting or checking whether it is the same vehicle or it is a different vehicle and so on. Only I know that demand, but we do not know much more about the vehicle in terms of when they arrive when the departure is happening, what is the duration of stay and so on.

(Refer Slide Time: 35:56)



Parking Demand

Beat Surveys

- Provide more details about **the parking behaviour of individual vehicles**, and hence an aggregate picture of parker behaviour, not just the gross level of parking demand
- The surveyor visits, in turn, a pre-determined number of parking spaces and **records details of the vehicles** that are observed parking in each space, at certain time interval, to record
 - ✓ Time
 - ✓ Parking space location
 - ✓ Vehicle type
 - ✓ Partial vehicle registration number (**license plate**)

IIT Kharagpur | Traffic Engineering | Module H

18

The next is the Beat survey, beat surveys provide more information in detail information about the parking behavior of individual vehicle and hence an aggregate picture of the parking behavior not just the gross level of parking demand something beyond that, that is what we do the beat survey specifically what we do, we can select a few segments specific segments representative segments and where the parking lots are either marked or even if it is a non-mark you know a certain type of parking is happening maybe parallel maybe at an angle specific angle or maybe perpendicular whatever it is.

So, what do we do at certain intervals, we actually go and note down the registration number say every half an hour maybe I am taking a beat. So, I will go and count the record the number of vehicles which are registration number of vehicles, which are actually parked here, then matching the registration number you can know what is the approximate duration of parking every vehicle has done and then you observe so many vehicles during the day throughout this period study period.

So, you can get a distribution say among the vehicles what percentage is parking up to 1 hour what percent is coming, parking from 1 hour to 2 hours, then 2 hour to 3 hour and so on and so forth. So, the survey are visits in turn a predetermined number of parking spaces and record details of the vehicle that are observed parking in each space at certain interval time interval and to record time, parking space location, vehicle type and partial vehicle registration number maybe the last 4 digits of the vehicle, that should be good enough.

(Refer Slide Time: 37:55)

Parking Demand

- Generally, a beat survey is undertaken at regular intervals and so the time is recorded to an appropriate time block (**Beat Frequency**)
 - ✓ Determined by the purpose of survey (15 min/ 30 min/ 1 hr/ 2 hr)
- Beat surveys are used to understand **patterns of arrival and departure** and **duration of stay** during the study period
 - ✓ Used to distinguish between **long-term** and **short-term** parking activity
 - ✓ Frequency must be higher to identify short-term parking
- Useful for both the surveys of on-street or off-street parking area

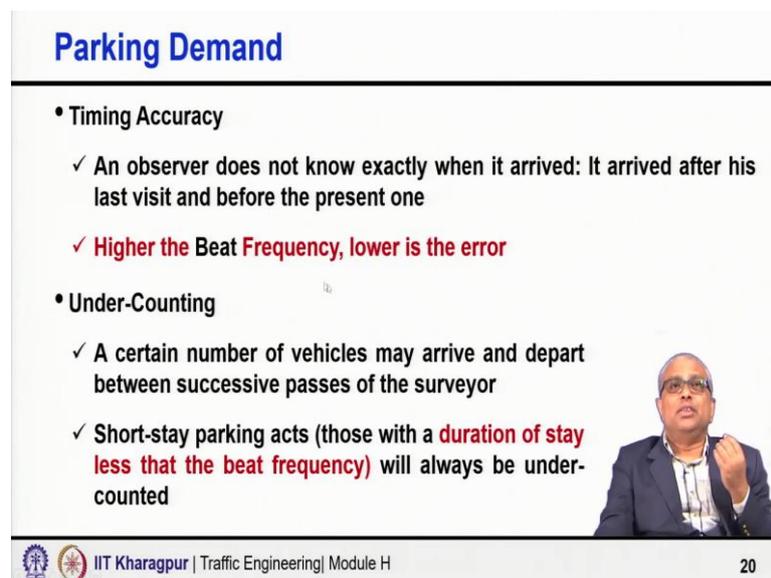


IIT Kharagpur | Traffic Engineering | Module H 19

Then generally a beat survey is undertaken at regular intervals that we call beat and so, the time is recorded at an appropriate time block, you can often call it as beat frequency and which is determined by the purpose of the survey it you may do it 1 beat in every 15 minutes or 1 beat every 30 minute or 1 hour it depends on your objective and how much accuracy is expected and so on.

Beat surveys are used to understand the pattern of arrival and departure and of course, the main thing is the duration of stay, what is the nature of parking short term, long term? What is the nature that is important? So, it is used to distinguish between the long term and short-term parking activity and frequency must be higher to identify short term parking and is useful for both service on-street and off-street both cases you can do that.

(Refer Slide Time: 38:51)



Parking Demand

- **Timing Accuracy**
 - ✓ An observer does not know exactly when it arrived: It arrived after his last visit and before the present one
 - ✓ **Higher the Beat Frequency, lower is the error**
- **Under-Counting**
 - ✓ A certain number of vehicles may arrive and depart between successive passes of the surveyor
 - ✓ **Short-stay parking acts (those with a duration of stay less than the beat frequency) will always be under-counted**

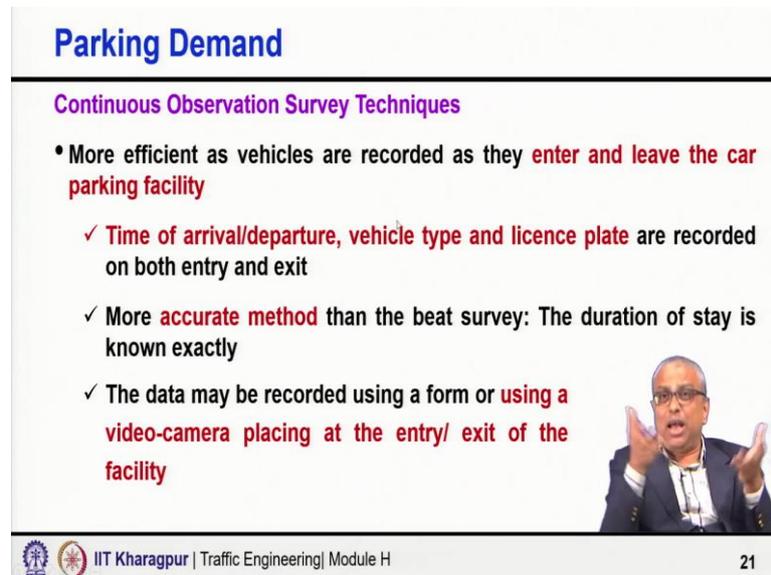
IIT Kharagpur | Traffic Engineering | Module H 20

The time accuracy is an issue because an observer does not know exactly when a vehicle has arrived, what all he notes it arrived after his last visit and before the present one because last during the last bit this that vehicle was not observed first time when a vehicle is being captured. So, he all what the server notes last time the vehicle was not here and now it is here.

So, in between some time it has come it does not know the exact time but higher the beat frequency lower will be the error if instead of 1 hour we do 30 minutes, 30 minutes in place of that we do 15 minute beat, our accuracy will be better and also the undercounting may happen because certain number of vehicles you are doing it every half an hour maybe in between one vehicle came and left. Obviously, it will happen.

So, if you are doing it half an hour or even 1-hour beat, then such possibilities will be even higher. So, short stay parking acts. Those with a duration of stay less than the beat frequency will always be under counted, but such numbers you have to decide how much it is important for you and accordingly you can decide the beat frequency.

(Refer Slide Time: 40:06)



Parking Demand

Continuous Observation Survey Techniques

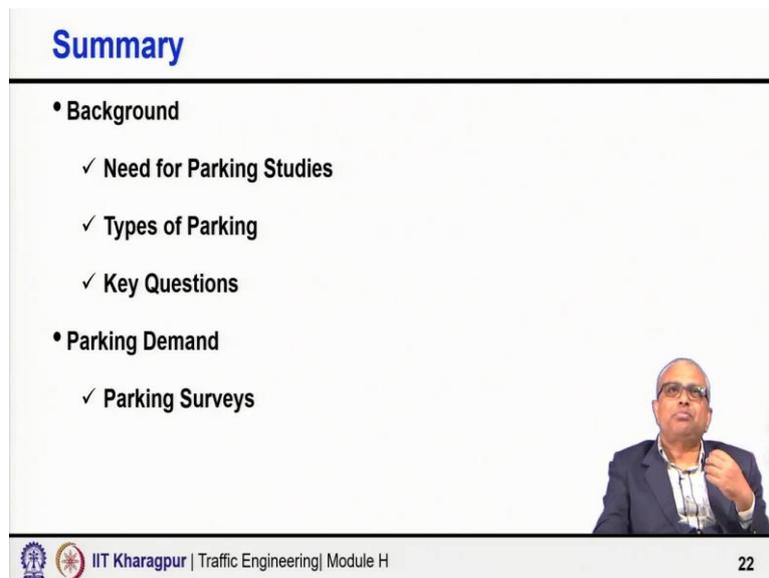
- More efficient as vehicles are recorded as they **enter and leave the car parking facility**
- ✓ **Time of arrival/departure, vehicle type and licence plate** are recorded on both entry and exit
- ✓ More **accurate method** than the beat survey: The duration of stay is known exactly
- ✓ The data may be recorded using a form or **using a video-camera placing at the entry/ exit of the facility**

IIT Kharagpur | Traffic Engineering | Module H 21

The last is basically the continuous observant techniques it is basically applied and very suitable for Off-street facility there are definite entry definite exit. So, as an when the vehicle is entering or exiting you record the registration number and also record the time. So, for the same registration number you know the exact in time exact out time you can match you can know what is the exact duration of stay. So, here it is not approximate the exact time is known. So, more efficient as vehicles are recorded as they enter or leave the car parking facility.

So, the time of arrival also the time of departure vehicle type license plate all are recorded at both entry and exit and this method is more accurate than the beat survey because the exact duration is known, the data may data may be recorded using a form a simple form you can design and then write the registration number and the time or you can do video graphic survey and then from video graphic survey you can extract the vehicle registration number and the time.

(Refer Slide Time: 41:11)



Summary

- **Background**
 - ✓ **Need for Parking Studies**
 - ✓ **Types of Parking**
 - ✓ **Key Questions**
- **Parking Demand**
 - ✓ **Parking Surveys**

IIT Kharagpur | Traffic Engineering | Module H

22

So, these are all different methods and we shall continue our discussion in the next lecture. So, what we discussed today is about the background which is why we need parking, what is parking, why we need parking studies, what are the types of parking what are the key questions that we are expected to, you know, face and we as a traffic engineer are expected to answer to those questions, then the key steps and then started discussion about the parking demand. We only discussed today about the parking service and we shall continue our discussion about the parking demand other aspects in the next class. With this I close this lecture. Thank you so much.