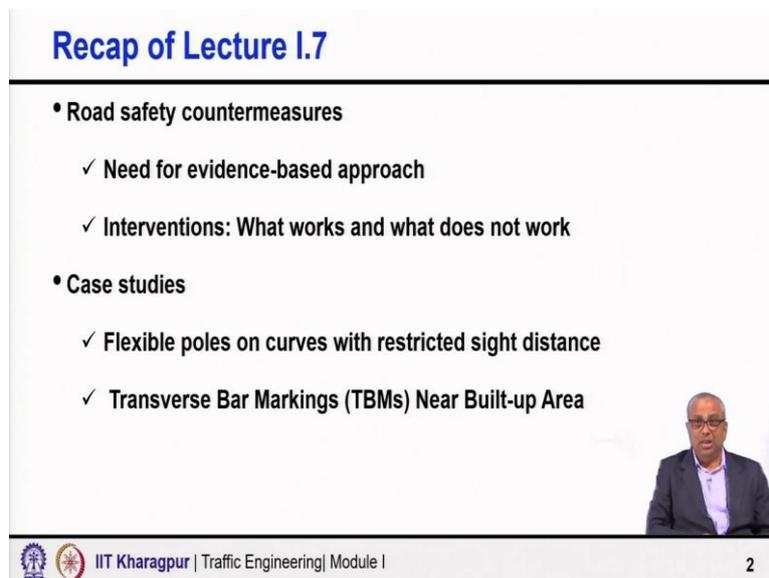


Traffic Engineering
Professor Bhargab Maitra
Department of Civil Engineering
Indian Institute of Technology, Kharagpur
Lecture - 66
Speed Management Measures

Welcome to module I, lecture 8. In this lecture, we shall discuss about the Speed Management Measures.

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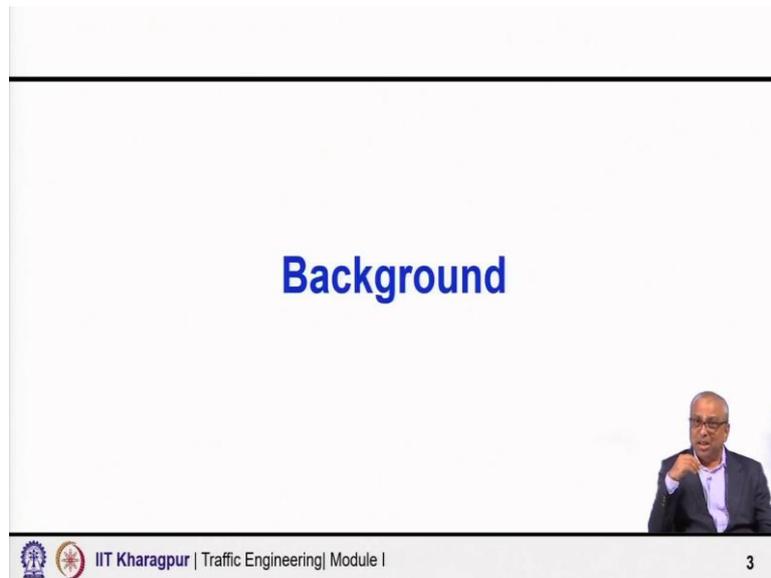


The slide is titled "Recap of Lecture 1.7" in blue text. It contains a bulleted list of topics covered in the previous lecture. The list includes "Road safety countermeasures" with sub-points "Need for evidence-based approach" and "Interventions: What works and what does not work". It also includes "Case studies" with sub-points "Flexible poles on curves with restricted sight distance" and "Transverse Bar Markings (TBMs) Near Built-up Area". A small video inset of Professor Bhargab Maitra is visible in the bottom right corner of the slide. The footer of the slide shows the IIT Kharagpur logo and the text "IIT Kharagpur | Traffic Engineering | Module I" and the number "2".

- Road safety countermeasures
 - ✓ Need for evidence-based approach
 - ✓ Interventions: What works and what does not work
- Case studies
 - ✓ Flexible poles on curves with restricted sight distance
 - ✓ Transverse Bar Markings (TBMs) Near Built-up Area

In lecture 7, I mentioned to you about the Road Safety countermeasures, why we need to focus on evidence based approach. Which are the interventions found to work well and which did not work so, well. As per the evidence and then what are the interventions under safe road, a safe infrastructure, speed management, a safe speed and then the safe road users. Then took also two case studies, one with the reference to use a Flexible poles on curves with restricted sight distance. And the other one is related to the use of Transverse Bar markings near built up area.

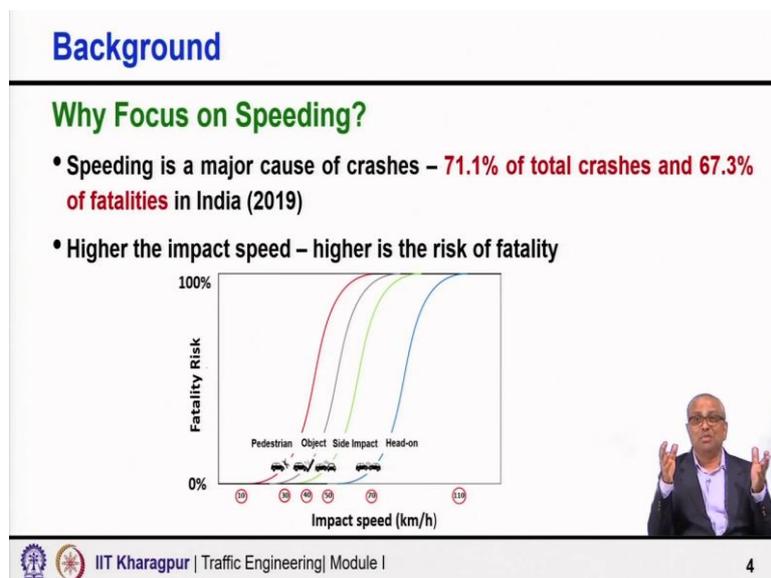
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The slide features the word "Background" in a large, bold, blue font centered on a white background. In the bottom right corner, there is a small inset video of a man in a suit and glasses speaking. At the bottom of the slide, there is a footer with the IIT Kharagpur logo, the text "IIT Kharagpur | Traffic Engineering| Module I", and the number "3".

With this background, today, we shall discuss about the speed management measures.

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The slide is titled "Background" in blue. Below the title, the text "Why Focus on Speeding?" is written in green. There are two bullet points: "Speeding is a major cause of crashes – 71.1% of total crashes and 67.3% of fatalities in India (2019)" and "Higher the impact speed – higher is the risk of fatality". Below the text is a line graph showing "Fatality Risk" on the y-axis (0% to 100%) and "Impact speed (km/h)" on the x-axis (0 to 119). Four curves represent different crash types: Pedestrian (red), Object (green), Side Impact (blue), and Head-on (purple). Each curve shows an increasing fatality risk as impact speed increases, with Head-on collisions showing the steepest increase. Small icons of vehicles are placed along the x-axis corresponding to the curves. In the bottom right corner, there is a small inset video of the same man from the previous slide. The footer contains the IIT Kharagpur logo, the text "IIT Kharagpur | Traffic Engineering| Module I", and the number "4".

Why we are saying that it is important to focus on speeding? The very fundamental question which we should get convinced with the answers. And we should believe from the core of our heart that yes, it is important. What are the results? First, speeding is a major cause of crashes. If you see the data in Indian context, I have shown many data in the beginning in the introductory lecture on this module. First lecture on this module I, 71 percent of total crashes more than that, and more than 67 percent of the fatalities.

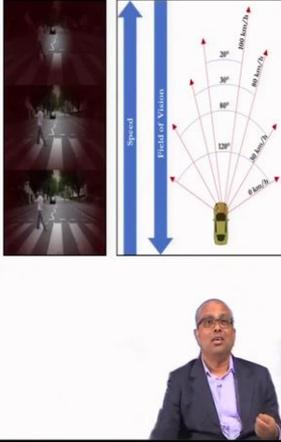
The reason is speeding, as per the data record, that means speed is a major contributing factor in more than 70 percent of the crashes, and more than two third of the fatalities. This itself could be the argument good enough to justify why we need to focus on speeding. Over and above, scientific evidences, clearly indicate higher the impact speed, higher is the risk of fatality. I am showing you the graph very interesting.

You can see when a pedestrian is hit by a car, when the vehicle is hitting an object, when side-impact or side crash is happening, when head-on collision is happening on undivided road, then at different speeds starting from very low to high as the speed increases, how the fatality risk in a scale of 0 to 100 percent how it changes. Obviously, lower the speed, lower is the fatality risk and you are increasing the speed you are increasing the risk of fatality. So, if we have to control fatality, if we have to bring down the fatality, we have to do proper speed management, focus on speed.

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Background

- ✓ Increase in average speed by **1 km/h ~ 3% higher risk of crash involving injury and 4-5% increase of fatal crashes** (WHO, 2004)
- ✓ Car occupant involved in a crash with an **impact speed of 80 km/h - the likelihood of death is 20 times higher** as compared to the impact speed of **30 km/h** (WHO, 2008)
- Higher speed **narrows field of vision**



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Increase in average speed just by 1 kilometer on an average, increase the risk of crash by 3 percent, per kilometer increase 3 percent increase in second involving injury and 4 to 5 percent increase of fatal crashes. How that is what the risk is increasing getting influence whatever is my speed limit, now if I increase it compared to my present thing. My risk will be 3 percent Higher involving injury, crash involving injury and 4 to 5 percent increase in fatal crashes.

Now typically, a car occupant involved in a crash with an impact speed of 80 kilometers per hour, which again does not sound too very unrealistic to you because 80 kilometers speed in terms of the speed value I am saying, you feel like yes, it is common with our new highway

development and so, but remember, always the environment is road environment, traffic environment is not even favorable for this 80 Kilometer because the likelihood of death is 20 times higher as compared to the impact speed of 30 kilometers per hour.

That means, the if a car occupant is involved in a crash and the speed of the car is 30 kilometers per hour, then instead of 30, if it is 80 kilometer per hour, the likely of hood of death will be 20 times higher, it does not mean that everywhere we will be at 30 kilometer per hour. No, that is not the intention. But what we are trying to say we must realize the evidences, scientific, basic scientific findings, why it is so, what is the human injury tolerance and how all these things are coming.

So, it only says wherever it is necessary where the likelihood of a crash is high, where the likelihood of fatality is high, speed is an instrument for us, we can control the speed, if we reduce the speed, our risk of fatality will come down distinctly also, higher speed narrows the field of vision, I have shown it here. And you are also familiar to this figure. I have shown it earlier in the beginning when I talked about various drivers characteristics and how these characteristics are linked to road safety.

So, higher the speed as the speed is increasing, you can see here this is 0 30 kilometer per hour 80 kilometer per hour 100 kilometers per hour, the angle is changing 120 degree to 80 degree to 30 degree to 20 degree. So, it matters because if you say Indian roads, many cases the road is passing through busy area, where it might be children are crossing, might be a bicyclist came in between, a pedestrian is trying to cross the road.

So, a driver has to be vigilant. So, field of vision will be better. If the speed is a little lower these are the benefit, again does not mean that we do not need high-speed facility, we can develop high-speed facility, we should develop high-speed facility, but not at the cost of safety. So, wherever situation is favorable, we can go for higher speed, where such kind of land use is not there a road is passing through an area where no roadside development exists and no such possibilities is there or the complete access control is there, there you do not have to think probably about the field of vision may not be necessary.

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Background

- Higher speed increases Stopping Sight Distance (SSD)
- ✓ In a heterogeneous traffic, **exceeding the speed limit by a seemingly consequential 10km/h can not only significantly increase the risk of crash but also endanger the lives of other road users**

Speed (kmph)	Perception-Reaction Time (m)	Braking Distance (m)	SSD (m)	Outcome
30	~5	~5	~10	Stops in time
40	~5	~10	~15	Stops in time
50	~5	~20	~25	Hits at 29 kmph
60	~5	~40	~45	Hits at 52 kmph
70	~5	~70	~75	Hits at 69 kmph
80	~5	~110	~115	Hits at 89 kmph

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Next, very important point why we should focus on speeding. Higher speed increases the stopping sight distance, I have shown it here that if the distance is like this, then at a different speeds based on the initial speed, how the situation may change, if the vehicle is traveling at 30 kilometer, 40 kilometer per hour or so, nothing will happen to this boy nothing is going to happen maybe 50 kilometers the boy will be hit by a vehicle at a speed of 29 kilometers per hour. But if the speed is even higher, the stopping sight distance will increase, the distance to stop will increase.

So at 60 the speed will be 52 kilometer per hour. The vehicle may go and hit the boy, it may be 69 if the speed is 70 and if the speed 80, it will in the perception reaction time itself it will go and hit, the blue one is the time required for perception reaction and this is the braking one the yellow one. So, within perception reaction time itself it will go and hit, probably.

So, in a heterogeneous traffic exceeding the speed limit by a seemingly consequential 10 kilometer per hour can not only significantly increase the risk of crash but also endanger the life of other road users. And this is schematic, all of us we know it that SSD stopping sight distance depend on the speed, but the consequence on safety, the consequence on fatality just see it is it comes out very clearly.

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Background

- Physical and Fiscal Constraints
 - ✓ High Population Density
 - ✓ Land Availability issue
 - ✓ Significant Roadside development and activities
 - ✓ Mix of Non-Motorized Traffic (NMT) and Motorized Traffic
 - ✓ Lack of Lane Discipline
 - ✓ Slow and Unauthorized Motor Vehicles
 - ✓ Economical issues



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Next very important point. We have tremendous physical and fiscal constraints in countries like India and also in general the LMIC's, the low and medium income countries. If you consider India, high population density in many areas take West Bengal as a state, the population density is so high you will not get even a 10 15 kilometer stretch of highway probably, very difficult to get such sections, where there is no activities.

Villages are there, people are living there, activities are there. The so much high population density. Getting land is a major issue. We do not get the land. You may have money but you do not have the you may have the fund but you may not have the land getting the land is even more difficult than getting the financial resource for the project. You can borrow the government can borrow the road authority can borrow.

But physically the land is not available. So many cases the footpaths, the regular underpass, the pedestrian underpass could not be the other kinds of facilities could not be developed, because simply land is not available. Even many cases I know, the footover bridge, also could not be constructed simply because the land is not there. The land availability is an issue. There are significant roadside development, mix of traffic with slow moving fast moving together.

Lack of lane disciplines, we have never taught our drivers how to drive on multi-lane highways how to select lane there are reasons, but look at the reality. People do not know how to use, there are multi lane roads if two or three lanes are there, how one should drive, you will find a slow moving vehicle taking the rightmost lane in our Indian condition which is the supposed

to be for the fastest vehicle are supposed to be used only for what taking very comfortably continuously traveling.

Taking the rightmost lane, a slow moving vehicle. Maybe sometimes the vehicle cannot travel more than 40-50 kilometer per hour speed, vehicle capability wise itself the restriction is there. Slow and unauthorized motor vehicle sometimes look at this vehicle locally manufactured and modified vehicle, no as per the standard carrying passengers in a very dangerous manner, but these are the realities. Also economical issues, roadside markets are there, involvement of people are there, there are many other issues linked.

So, all these clearly show that within such deficiencies, our driver education is low because we have not trained the driver the way we are thinking now, earlier it has been more like employment generation. So, little bit of skill give them, complexity was also not that high, but now the complexity is there, but we cannot take out all these drivers from the our present system. Huge number of drivers are there.

It takes time, population density, land issue, mix of traffic, lack of lane discipline, mix of slow and fast moving vehicle, can we change the things overnight? No, it takes much longer time to make such changes and remove the bottlenecks. So, as per scientific evidences, as per you know that major cause is speeding, higher the speed, higher the fatality, SSD narrow down, speeding narrow's down, the field of vision.

Higher the speed, higher will be the SSD, the chance of hitting or fatality will also be high. And we have so many physical and physical constraints. So the only way is, if we want to still reduce the speed, we have to go for the speed management and focus on speeding, that is the way out if we want to improve our performance, if we want to reduce fatality and severe injury, we have to focus on speed.

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Background

Factors Influencing Speed

- **Driver** related (age, gender, alcohol level)
- **Vehicle** related (power, maximum speed, acceleration)
- **Road** related (road layout, surface quality)
- **Traffic condition** (traffic density and composition, prevailing speed)
- **Environment** related (weather conditions)

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There are several factors which affect the speed. Driver-related factors, Vehicle-related factor, road-related factor, traffic-related factor, environment-related factors, I am not going to details you can see. So, these are all the factors which decides the speed what the driver is using for travel.

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Background

Speed Management

- A large set of measures for balancing safety and efficiency of vehicle speeds on a road network
- Coordinated speed management measures: **Reduce crash count by up to 40%** (WHO, 2008)

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What is speed management? It is a large set of methods for balancing safety and efficiency of vehicle speed on a road network. And speed management does not include only the deciding the speed limit, no. This is one of the components on overall speed management. Coordinated

speed management measures. Again, this vital evidence is found to reduce crash count up to 40 percent as high as 40 percent.

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Background

- Significant impact on reducing severity and socio-economic losses
- Balance between safety and mobility



- Drivers **do not recognise the risk** associated with speeding and often compromise safety instead of mobility: **Increasing number and severity of crashes**

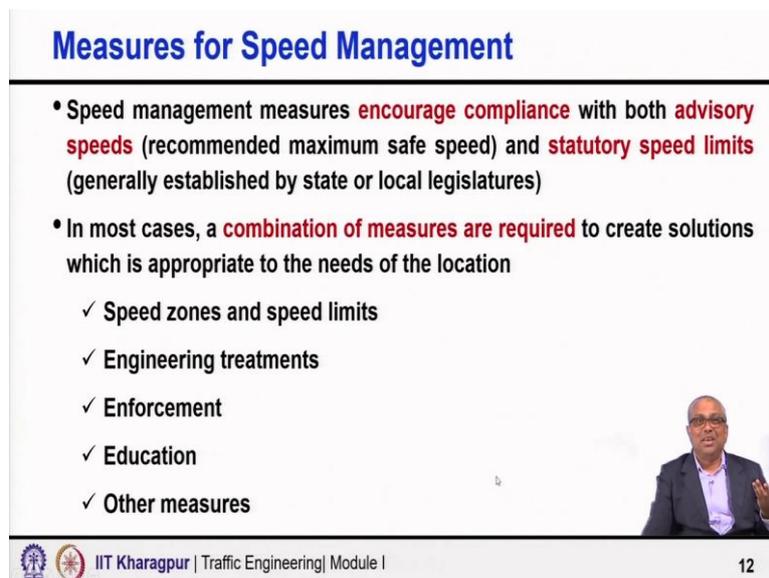


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See the impact, see the potential. Significant impact speed management has got significant impact on reducing severity and socioeconomic loss and it helps us speed management to strike a balance between the safety and mobility. Mobility is also important; safety is also important we cannot get mobility at the cost of safety.

And especially the fatal accidents, fatal crashes or the severe injury crashes. So a balance is to be maintained. Speed management helps us to maintain that balance. Drivers do not recognize the risk associated with speeding and therefore often compromise safety instead of mobility and the result is increasing number and severity of crashes.

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Measures for Speed Management

- Speed management measures **encourage compliance** with both **advisory speeds** (recommended maximum safe speed) and **statutory speed limits** (generally established by state or local legislatures)
- In most cases, a **combination of measures are required** to create solutions which is appropriate to the needs of the location
 - ✓ Speed zones and speed limits
 - ✓ Engineering treatments
 - ✓ Enforcement
 - ✓ Education
 - ✓ Other measures

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What are the measures for speed management? Speed management measures, encourage compliance with both advisory speed some of the design the roadway for 80 kilometer per hour. And accordingly there is the speed limit, accordingly, there is the speed limits that what is the posted speed limit and also it could be so, in some situation the road is passing through urbanized section or semi-urban development or passing through school zone and you have study to the speed limit, which is generally established by the state or the local authorities on the local police.

So, speed management measures encourage compliance with both advisory speed and steady to the speed limits if any. And in most cases, a combination of measures are required to create solutions, which is appropriate to the needs of the location. Given the location, what are the problems, what are the characteristics and you need a combination of measures, which are the key measures? Speed zones and speed limits, engineering treatments, physical changes what you do? Engineering treatments. Enforcement very important anything you do if you do not enforce it will fail. Education, also there are other methods, let us discuss very briefly about each of these aspects.

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Measures for Speed Management

Speed Zonings and Speed Limits

Based on Classification of Roads

- Road functions differ considerably based on the type of service of the road
- **Classification of roads helps in speed zoning** which recognizes the high-risk sections that call for different speed limits commensurate with relative risk
 - ✓ Vehicles usually travel faster (as per the design standards) on highways and arterials, as the function of these roads is to provide mobility

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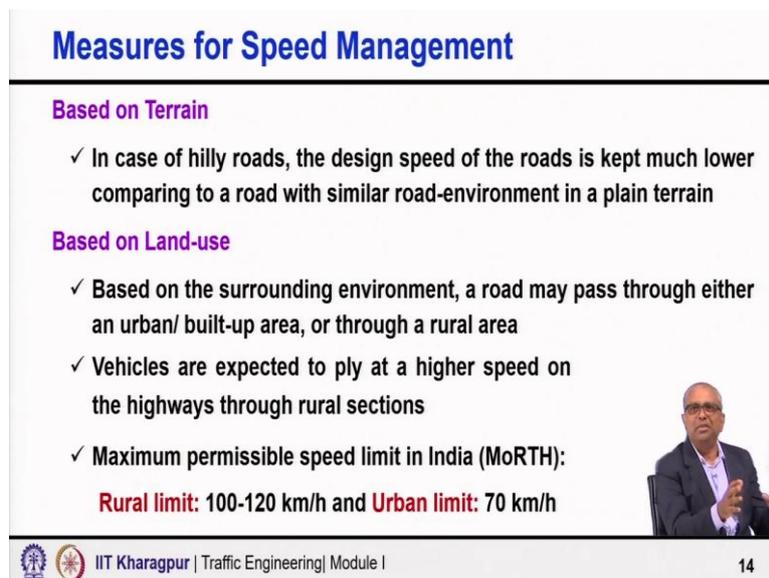
13

First, speed zoning and speed limits. How the speed zoning and speed limits are done one side is based on classification of roads, we all know the functional classification different categories of road have different functions in terms of providing accessibility and in terms of providing the mobility. If you take clearly the national and state highways maximum the primary thing is the mobility not the accessibility, it is the mobility.

So, obviously, my expectation or requirement of speed will be higher as compared to that major district road, other district road or go to a village road no more probability it is basically the accessibility. So, as per the functions, we know what speed grouping is necessary. So, we can do speed zonings as per the classification of the road.

Similarly, go to urban area, expressways or urban arterioles and local streets, do not have the same accessibility and mobility functions. So, the once I am doing grouping, zoning, I will obviously try to sure, that my arterials have a different speed environment and my local streets will have another speed environment. So, based on the classification.

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Measures for Speed Management

Based on Terrain

- ✓ In case of hilly roads, the design speed of the roads is kept much lower comparing to a road with similar road-environment in a plain terrain

Based on Land-use

- ✓ Based on the surrounding environment, a road may pass through either an urban/ built-up area, or through a rural area
- ✓ Vehicles are expected to ply at a higher speed on the highways through rural sections
- ✓ **Maximum permissible speed limit in India (MoRTH):**
Rural limit: 100-120 km/h and Urban limit: 70 km/h

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Second, based on the Terrain. What we are getting in plain terrain, in mountainous or hilly terrain, I do not even expect the same design speed. So, my even the whatever we you say the posted speed limits also the speed expectation should not be the same. So, as per the terrain, I can decide, this is the hilly region, this is the plain region. So, different classifications of terrains, according to terrain, this speed will be decided.

Third based on the land use, based on the land use, rural area, urban area, yes according to that also we can decide the speed because the overall road environment is expected to be different in urban and rural areas. So, based on the land use, that will surrounding environment, whether it is an urban built up area or passing through rural and open area, the speed depends on that land use also.

In fact, the Ministry of road transport and highways MORTH, tells the speed maximum speed limit for rural areas 100 120 kilometer per hour and urban speed limit 70 kilometers per hour, that is the maximum, it does not mean that every local context that has to be the maximum, maybe we can consider them as the limiting value under most favorable condition.

Yes it could be, but if the condition is not favorable, then this should not be there, we should have a lower speed limit. So, wherever things are not favorable, we should not have this high-speed limits, you have favorable conditions or favorable infrastructure, environment everything you can have a high-speed or higher speed values.

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Measures for Speed Management

Location Specific Speed Zones

- Based on injury minimization criteria

Road Type	Speed Limit (km/h)
Roads with a mix of motorized and unprotected/vulnerable road users (i.e., pedestrians, bicyclists etc.)	30
Roads with uncontrolled access (side impact crashes can result)	50
Undivided roads where head-on crashes can result	70
Controlled access facilities with a physical median separation, without at-grade access and non-motorized road users	>=80



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Location specific speed zones. This is another way of doing the speed zoning. Location specific my highway is passing through, my it is a national highway, it is plain terrain, but that does not mean throughout the length of the National Highway or a stretch of 100 200 300 kilometer passing through a state I will be able to maintain the same speed we may have to restrict the speed bring down the speed limit as per the location specific requirements.

For example, road with mix of motorized and unprotected vulnerable user, market area, urban, semi-urban, development lot of movement of pedestrians bicyclists school zone, reduces 30 kilometer per hour, human injury tolerance criteria you know that if a person is hit driver may make error and because the pedestrians are unprotected bicyclists are unprotected so crash might happen. So I am bringing down the speed of the crash chances there are high chances there for crashes. I am bringing down the chances of fatality and severe injury 30 kilometer per hour.

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Background

Why Focus on Speeding?

- Speeding is a major cause of crashes – **71.1% of total crashes and 67.3% of fatalities** in India (2019)
- Higher the impact speed – higher is the risk of fatality

The graph plots Fatality Risk (0% to 100%) against Impact speed (0 to 110 km/h). Four curves represent different collision types: Pedestrian (red), Object (green), Side Impact (blue), and Head-on (purple). Pedestrian collisions reach 100% risk at approximately 30 km/h. Object collisions reach 100% at about 40 km/h. Side Impact collisions reach 100% at about 50 km/h. Head-on collisions reach 100% at about 70 km/h. Small icons of a pedestrian, car, and truck are shown below the x-axis labels.

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Measures for Speed Management

Location Specific Speed Zones

- Based on injury minimization criteria

Road Type	Speed Limit (km/h)
Roads with a mix of motorized and unprotected/vulnerable road users (i.e., pedestrians, bicyclists etc.)	30
Roads with uncontrolled access (side impact crashes can result)	50
Undivided roads where head-on crashes can result	70
Controlled access facilities with a physical median separation, without at-grade access and non-motorized road users	>=80

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You have seen that I have shown you this figure earlier also have shown you, here if you are 30 kilometer per hour, your chances of fatality risk will be only about 10 percent in the scale up 0 to 100. So, make it 30 Then roads with uncontrolled access, side-impact, uncontrolled intersection where we have a crash history and such kind of crashes have occurred bring down, bring it to 50 kilometer per hour.

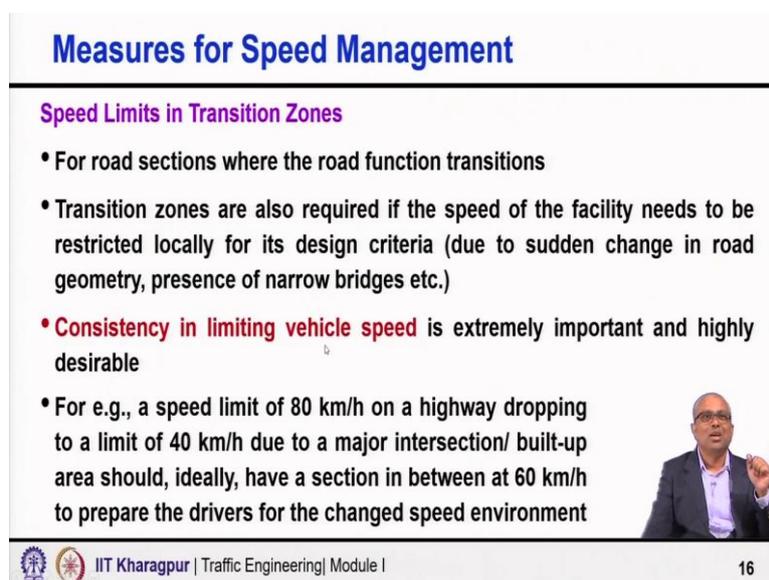
Again based on scientific evidences and I am saying it based on injury minimization criteria. Then undivided road head-on collision may happen 70 kilometer per hour should be the speed limit. So, that means these are 30 50 70 focus is not the road, more on the road environment, vulnerable road, user the crash history and the scientific evidences, pedestrian vehicle side, impact head-on coalition, what we want to minimize the injury, injury minimization criteria or

human injury tolerance criteria 30 50 70, generally I would say 80 and above you can go but, you should only for go, for those sections where you have control access facility.

Completely access control with the physical median separation, no chance of head-on collision, no question of unprotected pedestrians and vulnerable users. Segregation of slow-moving vehicle, development of or provision of the service roads, wherever the land use and things are demand, so, to take away the slow-moving vehicle, slow-moving traffic non-motorized, traffic out of the main carriageway, complete access control facilities for crossing there, if the road engineering if the road has been designed and can support if the vehicles are favorable.

You have to think also you cannot use non-standard vehicles and vehicles where the maximum travel speed is 40 kilometer per hour and you cannot allow them to travel without any lane discipline, lane usage must be defined, with all such conditions, you go for 80 and above, go for higher speed limits you have to also think that speed limit, road is important, vehicle type is important, lane usage is important, roadside is important and most important thing in the context of safe system approach is the human injury tolerance criteria for different types of characteristics. We cannot afford to accept fatality and serious injury.

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Measures for Speed Management

Speed Limits in Transition Zones

- For road sections where the road function transitions
- Transition zones are also required if the speed of the facility needs to be restricted locally for its design criteria (due to sudden change in road geometry, presence of narrow bridges etc.)
- **Consistency in limiting vehicle speed** is extremely important and highly desirable
- For e.g., a speed limit of 80 km/h on a highway dropping to a limit of 40 km/h due to a major intersection/ built-up area should, ideally, have a section in between at 60 km/h to prepare the drivers for the changed speed environment

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Speed limit in transition zone for roads where the road function transitions happen, transition zones are also required the speed of the facility needs to be restricted locally that means 80, you cannot make it suddenly 40, you have to need a transition from 80 to 40. Directly 40 kilometer speed change cannot happen. So, that is what we have said. So, if you have 80 to 40

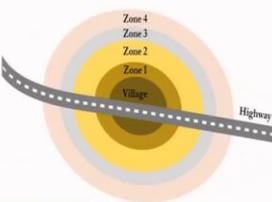
probably you need somewhere in between also a 60 limit, so that the gradual speed change happens.

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Measures for Speed Management

Speed zoning when a highway passes through a built-up area (IRC):

- For a highway (with posted speed limit of 60 km/h or higher) navigating through a village
- To achieve smooth transition in the speed zoning near built-up areas, the recommended speed limits could be:



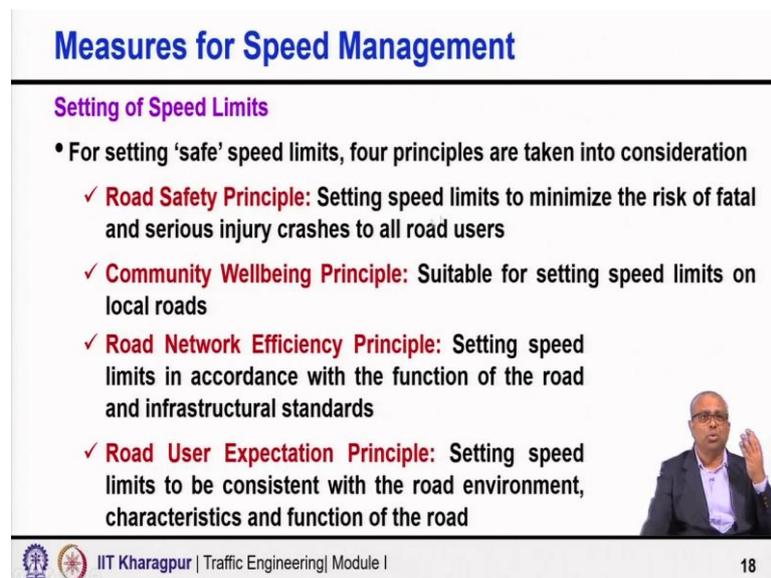
Zone	Length (m)	Recommended speed (km/h)	
		Heavy vehicles	All other vehicles
Village / Town	Within boundary	20	25
Zone 1	150	25	30
Zone 2	180	35	40
Zone 3	220	45	50
Zone 4	260	55	60

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And here speed zoning when a highway passing through a built up area our Indian Roads Congress guideline give this example. Suppose it is at 60 kilometer and you the road is passing through village. So it is not that within the village suppose if you want heavy vehicles 20 kilometers, or all other vehicle let us consider 25 Kilometer then it cannot come from 60 to 25 Suddenly, you need zone 1, zone 2, zone 3, zone 4, different areas, different distance.

So I should start from maybe zone 4 could have 60 but the moment the road enters say as 60 to I am making 50 and then enters to zone 2, it is 40, 40 to 30 and then you make it 25, gradually. So there are provisions, there are manuals, guidelines, which tells this thing the transition should happen smoothly not all of a sudden 80 to 40.

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Measures for Speed Management

Setting of Speed Limits

- For setting 'safe' speed limits, four principles are taken into consideration
 - ✓ **Road Safety Principle:** Setting speed limits to minimize the risk of fatal and serious injury crashes to all road users
 - ✓ **Community Wellbeing Principle:** Suitable for setting speed limits on local roads
 - ✓ **Road Network Efficiency Principle:** Setting speed limits in accordance with the function of the road and infrastructural standards
 - ✓ **Road User Expectation Principle:** Setting speed limits to be consistent with the road environment, characteristics and function of the road

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Setting up speed limit the 4 basic principles. I am not discussing in detail, but 4 basic principles. One is road safety principle setting up speed limit to minimize the risk of fatal and injury crashes to all road user, this is basically the human injury tolerance criteria. Then second community well-being principle suitable for the setting speed limits on these local roads.

Because your fundamental then is basically community well-being. Third road network efficiency principle, what I said the function of the road, highway to district road to village road or expressway, urban expressway to the arterioles to even down the line local streets. So, these are important for setting speed limits in accordance with the function of the road and infrastructure standards as per the infrastructure standards and functions, set up the speed.

Road user expectations principle setting speed limits to be consistent with the road environment characteristics and function of the road. I cannot have an environment which is encouraging people to travel at a higher speed because the surface condition is very good maybe. So do it is very good. But I know that the road environment is contradicting.

So, it is important that the function, road used expectation, community well-being, and the road safety or the human injury tolerance criteria, some kind of harmony or some kind of compatibility consistency is important. Because you do something which will encourage the drivers to travel at high-speed and you will say no, I do not want, so, if you do not, your infrastructure should not raise the expectation of the road user, that is also a point.

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Measures for Speed Management

Engineering Treatments

- Include techniques to control traffic flow and speed
- **Does not deal with the road design aspects**, such as, design speed, curve design considerations, camber and super-elevation, skid resistance, etc.
- Mainly be classified as:
 - ✓ Treatment for slowing down (traffic calming)
 - ✓ Treatments for separation of vulnerable road users



Next, these were all about so far, speed zonings and speed limits. Now quickly engineering treatments, you have to do something, not setting the speed limit alone will work. It includes techniques to control traffic flow and speed, does not deal with the road design aspect. That means I am not deciding the design speed or curve design consideration or camber, super elevation consideration, no.

Mainly these engineering treatments are for two purposes one is treatments for slowing down, then using kinds of traffic calming measures. I want the vehicle to come reduce the speed as I was telling if the speed is not high-speed is not desirable a low speed is desirable, then my infrastructure should also help me to achieve that. Not that the road will be 2 and I will expect only sign will do the work it will not be possible.

Second, engineering treatment is required for separation of vulnerable road users, footpaths, you are pedestrian underpass, pedestrian overpass, foot over bridge any kinds of infrastructure facilities you create for separation of vulnerable road users, from the mainstream high-speed motorized traffic, those are engineering. So engineering treatments are aim to achieve these two things, one for treatments for slowing down or doing traffic calming. The other is treatment for separation of vulnerable road user.

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Measures for Speed Management

Enforcement

- Enforcement is an effective mechanism to administer penalties for offending vehicles, thereby creating a deterrent
- Some of the tools are:
 - ✓ Red light cameras
 - ✓ Speed cameras
 - ✓ Interceptor vehicles
 - ✓ Penalties and fines



The slide features a collage of four images. Top left: A white car driving on a road with a speed limit sign showing '65'. Top right: A green and blue speed camera. Bottom left: A red light camera sign that reads 'RED LIGHT PHOTO ENFORCED'. Bottom right: A man in a suit speaking with his hands raised.

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Next enforcement, very, very important as part of speed management, whatever is your speed limit, whatever you do, there will be engineering treatment, there will be limitation. And nothing will give you result unless you have enforcement that has to be there. People should be afraid if I violate, I will be caught and I will be punished. That is also important. So enforcement is an effective mechanism to administer penalties for offending vehicle.

It act as a deterrence and some tools are for example, these are all part of speed management, the use of red light cameras, speed cameras, interceptor vehicle, proper penalties and fines. You fine but fine something which has got no impact. So is so small a value it is not at all a deterrence, that is also you cannot desirable because my objective is not to collect money, but to create a deterrence. So, the penalty must be effective enough to create that deterrence.

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Measures for Speed Management

Education

- Safety campaigns can change the knowledge and attitude of the public, but there is little evidence that the change happens without enforcement
- Important tool but **should not be used alone**
- May be conducted by:
 - ✓ Social media and advertisements
 - ✓ Changing public perception
 - ✓ Compliance incentives
 - ✓ Community based programs
 - ✓ Training and licensing



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Education and awareness. Also part of the overall speed management. I need to educate drivers. Driver training is again very important. Before licensing, train the driver, give them required knowledge, give them required skill. And also since countries like India, our overall awareness of road user awareness is slow, we may use different tools. So for example, social media, changing public perception, compliance incentive, community based programs, training and licensing all the things may be useful.

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Measures for Speed Management

Other Measures

Psychological Measures

- Psychological measures are non-physical measures which force the driver to reduce the speed **by increasing the cognitive burden**
- Psychological measures generally produce smaller speed reductions than physical measures, although psychological measures may be more acceptable to drivers
- For example:
 - ✓ Presence of trees or overgrowth on the roadside
 - ✓ Rough road surfaces (e.g. a brick or cobbled road)



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Then there are other measures which may include maybe psychological measures, the physical measures is something but here we are trying to use psychological measures to increase the

cognitive burden and then change the behavior. So psychological measure generally is produced smaller speed reduction, but sometimes they are more acceptable to drivers and yes, that small reduction also may be quite useful.

Example may be presence of trees or overgrowth on the road-side , and drivers generally or maybe rough road surface, road surface is not so proper. I mean, there are other counter arguments could be there and other things, but trying to say that psychological measures influence the behavior, not through physical measures, but through psychological methods. There could be better examples also I am sure there will be better examples.

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Measures for Speed Management

Intelligent Speed Adaptation

- A system which ensures that vehicle speed does not exceed a safe or legally enforced speed
 - ✓ **Active systems** intervene and correct the speed of the vehicles to conform with the speed limit
 - ✓ **Passive systems** are generally driver advisory systems and display visual or audio cues to alert drivers of excessive speeds

Speed Governors

- Equipment generally used on vehicle fleets to limit the speed to a maximum specified speed

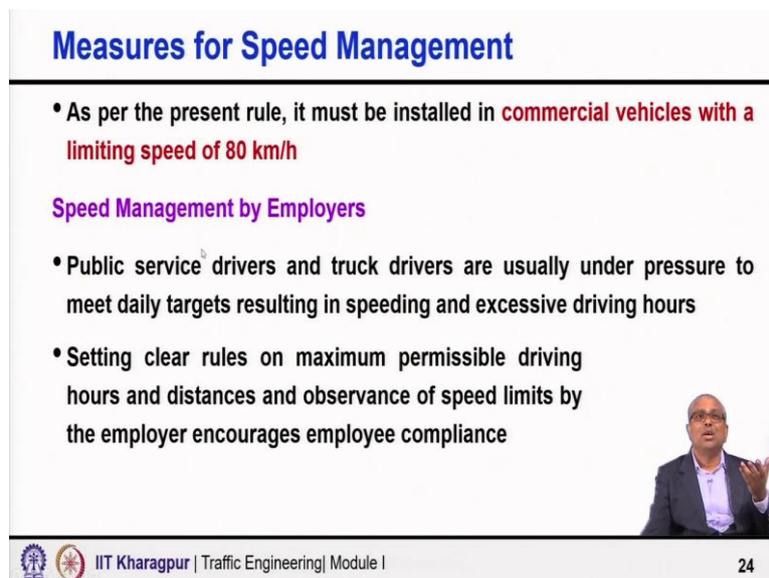
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Intelligent speed adoption a system which ensure that the vehicle speed does not exceed a safe or legally enforced speed. There are two kinds of system which are possible, active system, passive system. Passive systems are generally driver advisory system and display visual and audio basically, telling driver you are traveling at a high-speed, you are exceeding the speed limit, safe speed limit, you are not controlling you are only repeatedly sending message, sending alarms, all those.

Active systems actually interval also, so, it interval and correct the speed of the vehicles to confirm with the speed limit. Use of speed governors. Equipment generally used on vehicle fleets to limit the speed to maximum specified value.

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Measures for Speed Management

- As per the present rule, it must be installed in **commercial vehicles with a limiting speed of 80 km/h**

Speed Management by Employers

- Public service drivers and truck drivers are usually under pressure to meet daily targets resulting in speeding and excessive driving hours
- Setting clear rules on maximum permissible driving hours and distances and observance of speed limits by the employer encourages employee compliance

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For example, the commercial vehicle speed limiting into 80 kilometer per hour they cannot travel more than that, buses, public buses, school vehicles, very effective to use speed governors. Then, last but not the least other measures also use include speed management by employers. That means, public service drivers and truck drivers are usually under pressure to meet daily targets resulting in speeding and excessive driving.

They have to do the delivery time. The food delivery system is again a concern, sometimes the evidences are not so encouraging. Also the travel agencies, they are drivers. You do not know how long they are driving. You wanted a vehicle, a vehicle came and a driver came with that but you will never know how long the vehicle driver has been working continuously.

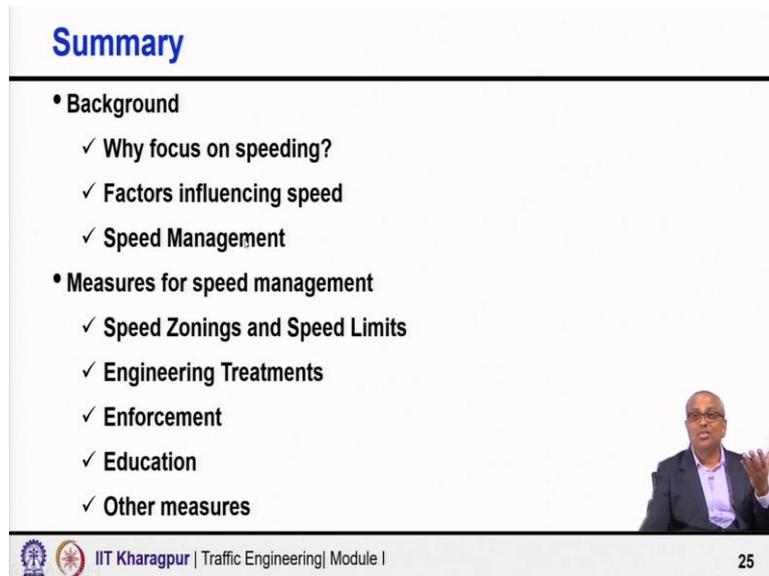
Or commercial vehicle drivers they will be given a target, that you have to reach the destination by this time there are reasons, maybe grocery, maybe if the vegetables and the perishable products they are carrying. So if they cannot reach in the mark to the destination by time, then they cannot be that they the vegetables and perishable goods cannot go to market.

So there therefore, so here the setting clear rules on maximum permissible driving hours. It is very important, which is actually the system is very good in developed world. And unfortunately, in nearly all the LMICs, this is very weak, you have no control on how long a driver is driving, how long continuously it is driving.

And maybe night, whole night the driver is driving and then next day also he is doing the duty. So, setting clear rules on maximum permissible driving hours and distance and observance of

speed limit by the employer, encourage employee compliance. So, that also the rules regulations framework is very important.

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Summary

- **Background**
 - ✓ Why focus on speeding?
 - ✓ Factors influencing speed
 - ✓ Speed Management
- **Measures for speed management**
 - ✓ Speed Zonings and Speed Limits
 - ✓ Engineering Treatments
 - ✓ Enforcement
 - ✓ Education
 - ✓ Other measures

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So, altogether what we discussed here, we discussed here about the speed management, why first focus on speeding out of all. Number of points I said which are very important. Then briefly what are the factors influencing speed, then what is really speed management, what all it includes, then the measures for speed management, the speed zoning, and speed limits the different bases for speed zoning and setting speed limits, engineering treatment, enforcement, education and also the other methods. So with this, I completed this lecture. And also with this, I complete this module and this course as well. Thank you so much for your patience.