Traffic Engineering
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Lecture - 65
Road Safety Countermeasures

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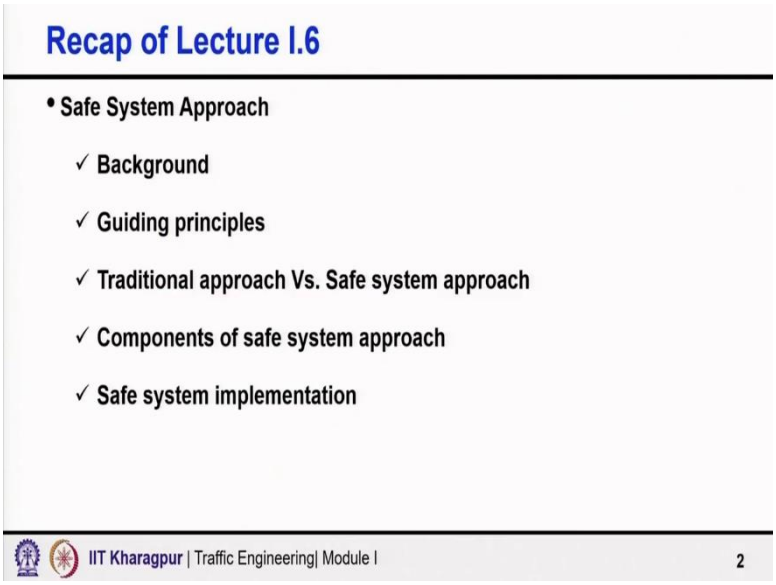

Welcome to module – I, lecture – 7. In this lecture, we shall discuss about Road Safety Countermeasures. In lecture 6, I mentioned to you about the safe system approach, what are the key elements, guiding principles, how the safe system approach is fundamentally different from the traditional approach? and what are the key components of the safe system approach? and then also a brief discussion about the safe system implementation.

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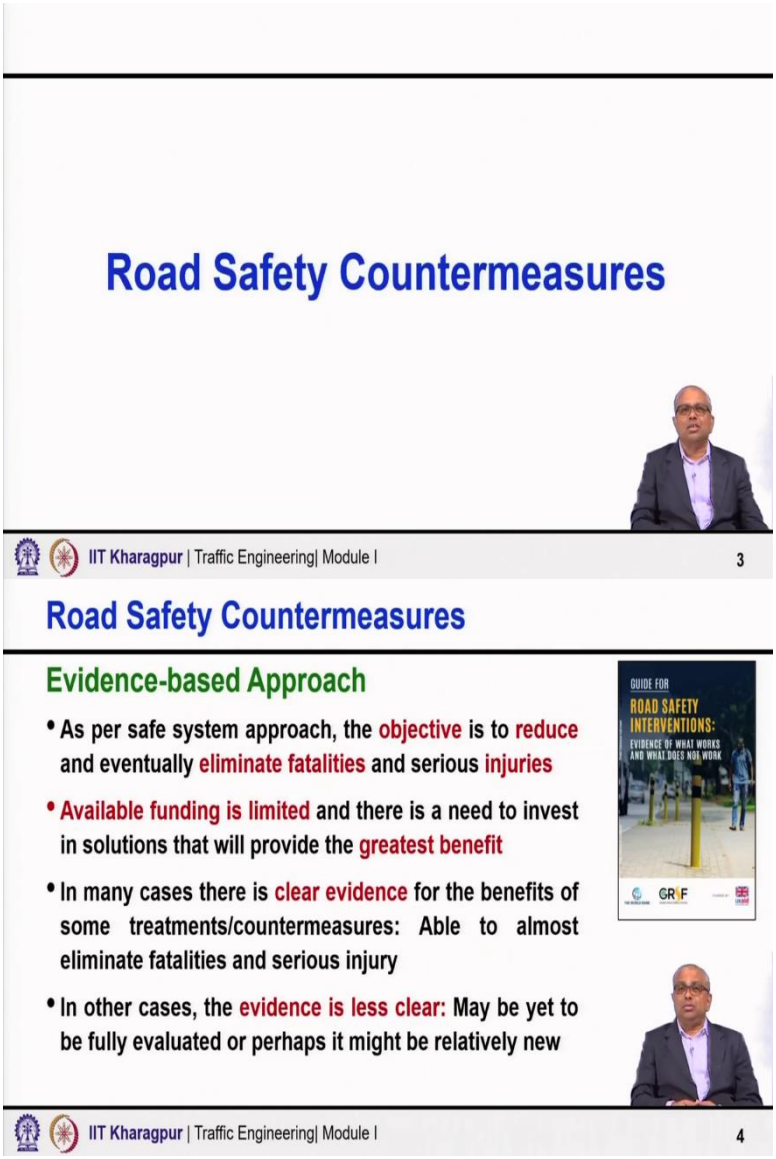

With that background, today, we are going to discuss the road safety countermeasures and coming to that, it may be mentioned that all over the world in different countries, different geographical regions, different cultures, different road control user environment, people have tried a number of things. Some of them in some context worked well, some of them did not work so well, and these days, the world bank and researchers, practitioners who are in the area of working in the area of road safety. And as per the safe system approach, with the basic principles, they are all focusing now or highlighting the importance of following evidence-based approach.

Remember that anything we are going to do as countermeasures, it has to be as for the safe system approach. That means the key objective has to be to reduce and eventually eliminate and fatalities as well as serious injuries leading to permanent disability. So, the key objective

is reduction and eventually elimination of fatalities, and serious injuries that remain unchanged. Second, why we are thinking of evidence-based approach, one primary reason is the available funding is limited.

As you have seen especially the low- and medium-income countries are worst affected due to fatalities and also disabilities. So, in these countries, especially the available financial resource is highly limited. There are many problems health issues to infrastructure to education to many things are there. So, it is really important that we all invest in solutions that will provide the greatest benefit to the community.

If you look at these countermeasures which have been applied by practitioners, recommended by researchers, different areas, different community, culture, road system, road environment, countries, in many cases there is clear evidence for the benefits of some treatments or countermeasures. In fact, these treatments or countermeasures are able to almost eliminate fatalities and serious injury, so they are proven, they are found to work well. In some other cases evidence is less clear maybe the reason could be that people have not yet fully evaluated those countermeasures or perhaps it might be also relatively new, so we do not have enough evidences to really judge and clearly say that the benefit is actually very positive.

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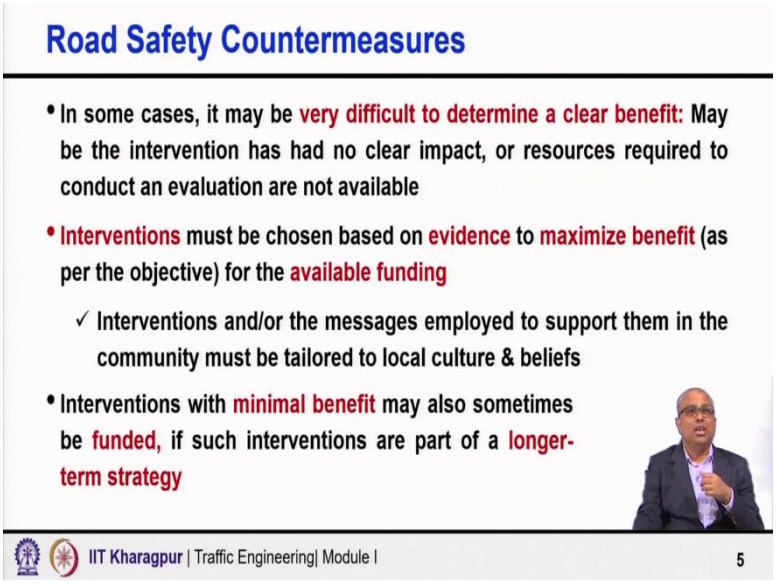

Also, we have cases where it might be difficult to determine a clear benefit. The reason could be because either the intervention has no clear impact or resources required to conduct an evaluation are not available, reasons could be many, but clearly there are evidences which are found to work well or countermeasures which are found to work well, and produce clear benefit

in nearly all cases which are which some are not so clear, some are no clear benefit, and some even failed to reduce significantly the fatality and serious injury in many of the cases.

So, the idea is when the problem is so severe in developing countries, when we have so many fatalities and serious injury leading to disabilities also, our resources limited and when such evidences are available, we must take advantage of those. Therefore, interventions must be chosen based on evidence and we must try to maximize the benefit as per the objective, that means reducing the fatality and serious injury that is what I referred to as objective for the available funding.

Now, interventions and or messages employed to support them in the community must be tailored to local culture and benefits, that is the necessity, right. So, some kind of tailoring to the messages or interventions to fit to the local culture and beliefs, that may be required, but still we can take things which are found to produce benefit as per the available evidence.

Sometimes, interventions even with minimal benefit may also be funded, but only in such cases where such interventions are part of a longer-term strategy, that means the full thing is not yet in practice, so you might have done something which produce only minimal benefit because it is part of a long term strategy, then it is worth, right, that also is a possibility in some cases.

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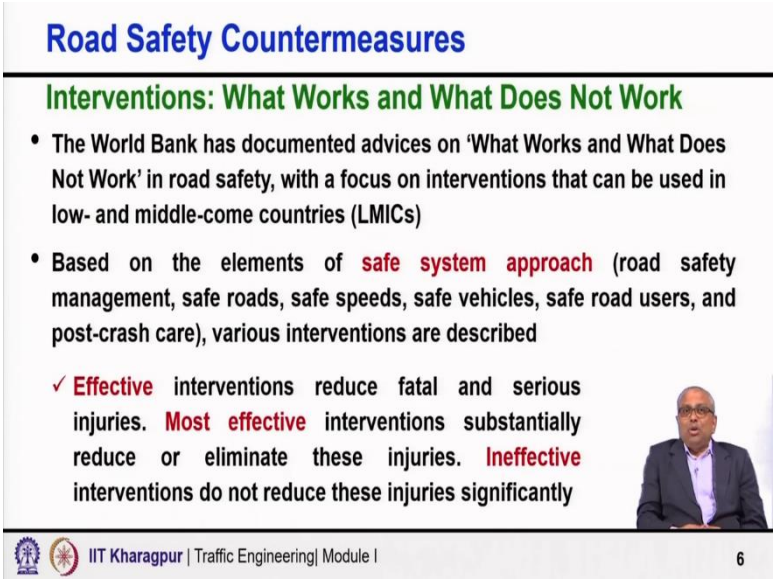

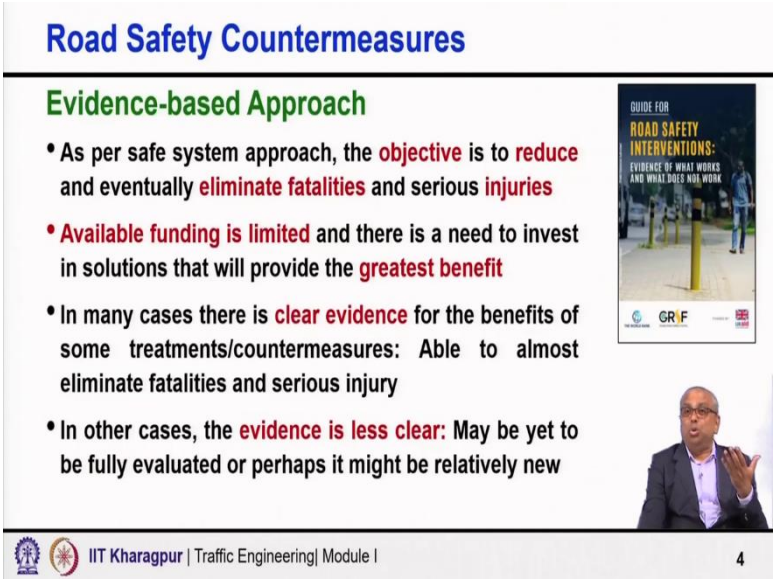

Now, coming to this intervention so why this says, why we should focus on evidence-based approach, why we should try to respect this. Second, interventions what works and what does not work. Actually, the world bank has documented advices on what works and what does not work in road safety with a clear focus on interventions that can be used in low- and medium-income countries. Because as I said the majority of the fatality the sufferer is low- and medium-income countries.

So, world bank developed a document as I have shown you earlier and what I am teaching is mostly from that because that really should be taken like a bible. So, this is the guide, you can even download the guide, and if you are interested you can go even in more details, you can study. So, based on the elements of safe system approach, I have mentioned earlier what are the key elements of system approach road safety management, the umbrella one, then safe road, safe speed, safe vehicle, safe road users, and post-crash care.

So, based on the elements of system approach all these key elements various interventions are described and they are classified under three groups. First, effective these are the interventions which are found to reduce fatalities and serious injuries. Most effective interventions also are classified within effective some are most effective, where interventions could substantially reduce or practically eliminate these injuries means fatal and serious injuries, so the top class is the most effective group, those kind of interventions and countermeasures.

Then, followed by effective interventions which could reduce and fatalities and serious injuries. Then, the last which is not desirable group is the ineffective interventions which do not use these injuries significantly, at least there is mixed responses or no such clear evidence that they could found to be instrumental in bringing down the fatalities and serious injuries.

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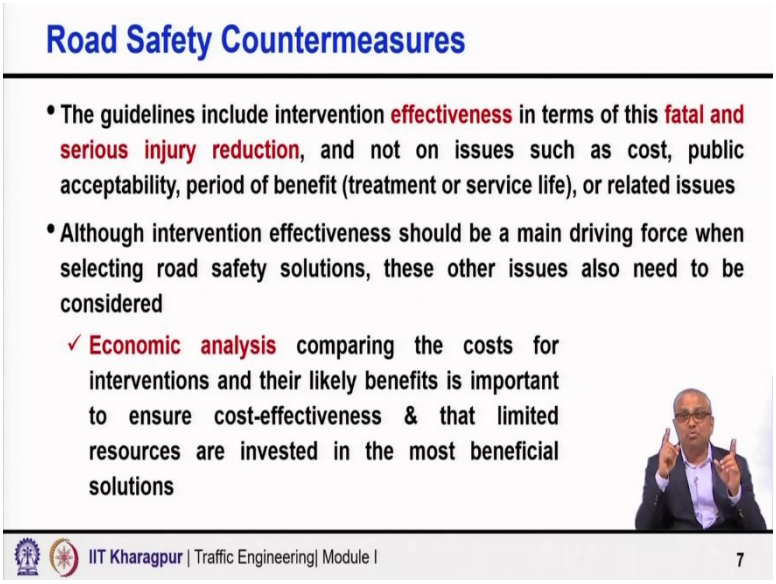

The guideline includes therefore interventions effectiveness in terms of this fatal and serious injury reduction, that is the focus and when I say that, it is also important to mention that that focus is not on issues such as cost, such as public acceptability, period of benefit, that means you do the treatment, I mean or do something, how long it will give the benefit or even other related issues, the focus is exclusively effectiveness on in terms of reducing the fatal and serious injury, not on cost, public acceptability, how long it is beneficial or other related issues.

Although, we should acknowledge and accept that, intervention effectiveness is important, right, that should be the driving force because our primary objective is to reduce fatal and serious injuries, but also other issues are important for example it is important to do the economic analysis to compare the life cycle cost and the benefits associated with the interventions or measures and accordingly select countermeasures to ensure the cost effectiveness. And also, that to limit the resource or to ensure that the resources are invested in the most beneficial solution which gives me better return of investment, because these are public resources, right, public money, public fund spent on welfare. So, wherever, obviously as per the economic analysis like we do in every infrastructure or every other kinds of project also these are important.

But primarily, whatever this document says in terms of effectiveness, it is the key objective or key focus is on fatal and serious injury reduction. Based on that not considering all other things and that is why it says some of the things you may have to tell it also, it has to be tailored, you have to customize this to suit to the local culture, local belief, and the to, you know rank high, or to ensure the public acceptability of social acceptability.

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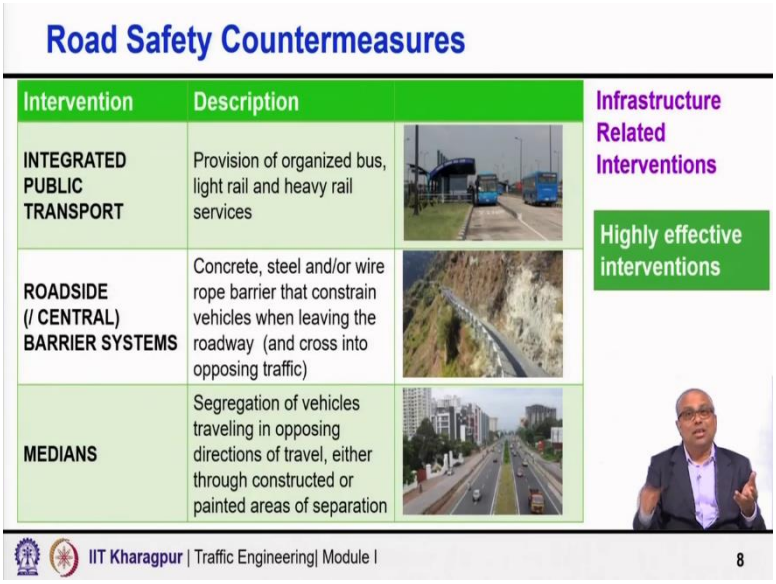

Now, with this, let us come to the intervention straight way and as I said the there are many elements. As I said that it has to be road safety management safe road, safe speed, safe vehicle, safe producer, and post-crash care. But, as per the spirit of the traffic engineering course and considering the time limited time and limited number of lectures we can offer. So, we are focusing particularly more on the safe road, safe speed and safe road user on these three major components.

Others are equally important, but I am not covering it. If you are interested to know more, please refer to this extremely valuable world bank document and you can get better understanding. So, coming to first road infrastructure related interventions, the green boxes wherever I am showing indicate highly effective interventions, I need not mention it again and again. So, the green boxes showed highly effective intervention.

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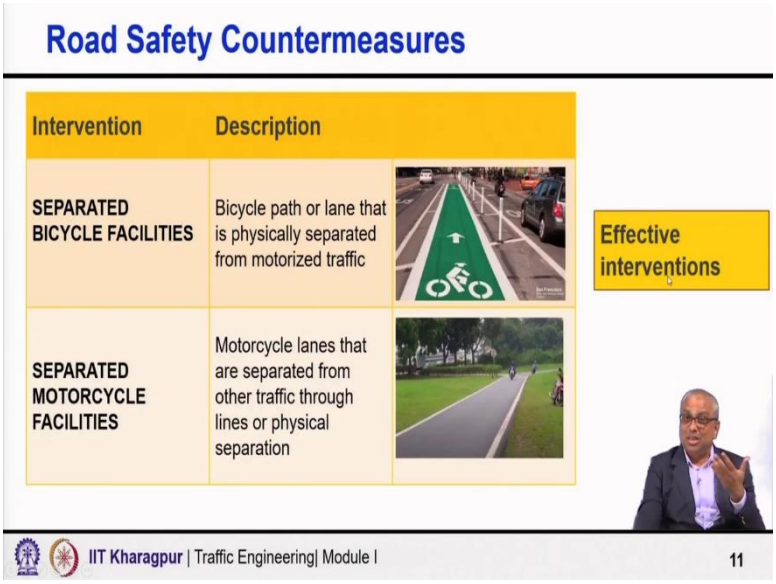

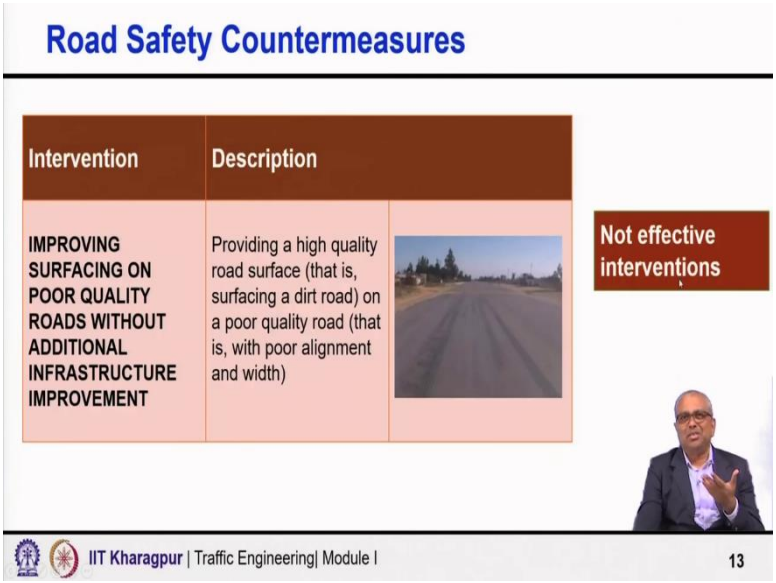

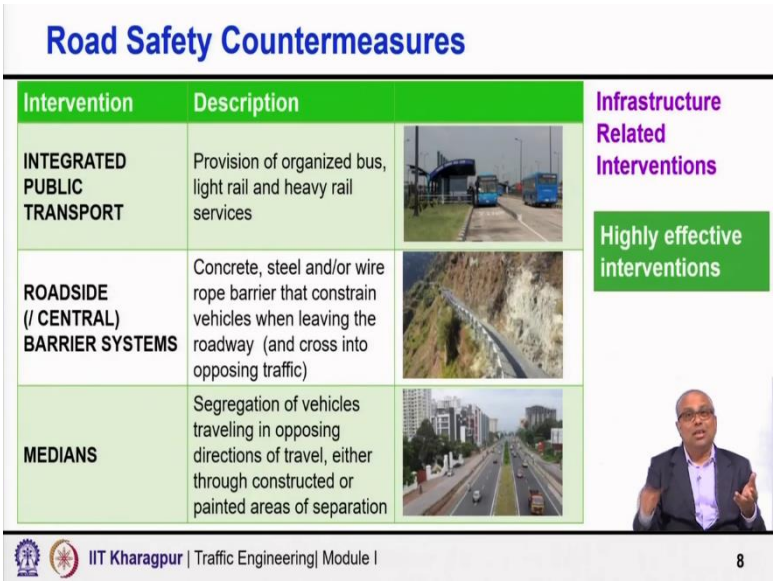

Then, this yellow indicates effective interventions, and this red indicates that they are not so effective or not effective interventions. So, by the colour code you can understand. So, first coming to the infrastructure say the highly effective interventions include integrated public transport that means provision of organized bus, light, rail, heavy rail services, allied infrastructure facilities, right, very effective, highly effective.

Then, roadside or central barrier system as I have shown here one of the photographs concrete steel or wire rope barrier that constrained vehicle when leaving the roadway and cross into opposing traffic or in hilly area just to prevent avoid crashes. So, roadside or central barrier system, the median segregation which will segregate vehicles travelling in opposite direction very very important and that is one of the key motivations of converting two lane highways into multi lane or with divided carriageway or with median.

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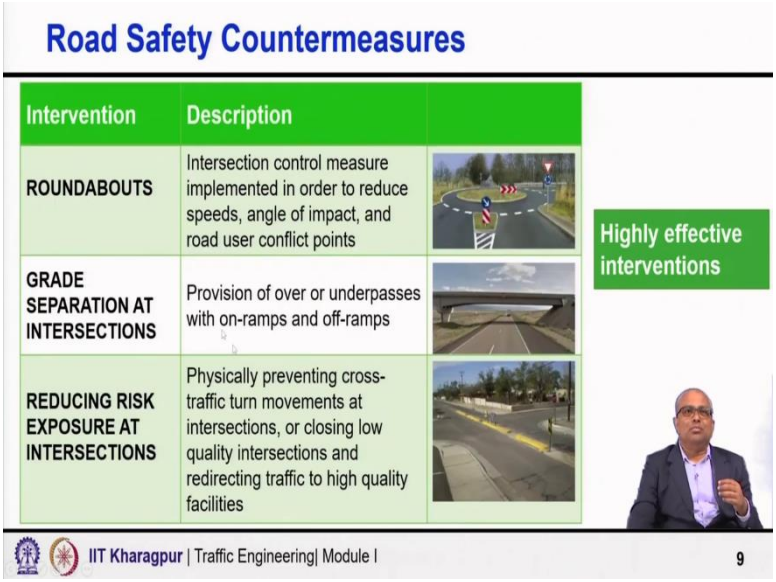

So, similarly roundabouts because intersection control measures implemented in order to reduce speed in order to control the angle of impact and also reduce the conflict point, type of conflicts, right, so such kind of things again are highly effective. Grade separator at intersection, yes, capital intensive it takes investment to develop such it requires investment to develop some infrastructure but again under highly effective intervention category.

Then, anything you do to reduce the risk exposure at intersection for example physically preventing cross traffic turn movements at intersection or closing low quality intersection and redirecting traffic to high quality facilities, you can see here, I mean we are not allowing that traffic coming from minor road, will take right turn right, that is prohibited or it is one way of blocking you can use different other types of infrastructure. But basically, we are encouraging

discouraging to take right turn I think some of the features, similar features I have shown you also earlier in little bit other context that we are not allowing right turn to happen.

So, they can go to left hand and then somewhere while wide median is available, proper storage lane can be done, so there we are giving you turn and then vehicle will come and then accordingly say may take left turn or may come straight, right. So, any such interventions which will, this is one of the examples, many things are possible, so anything which will reduce the risk exposure at intersection again comes under highly effective interventions.

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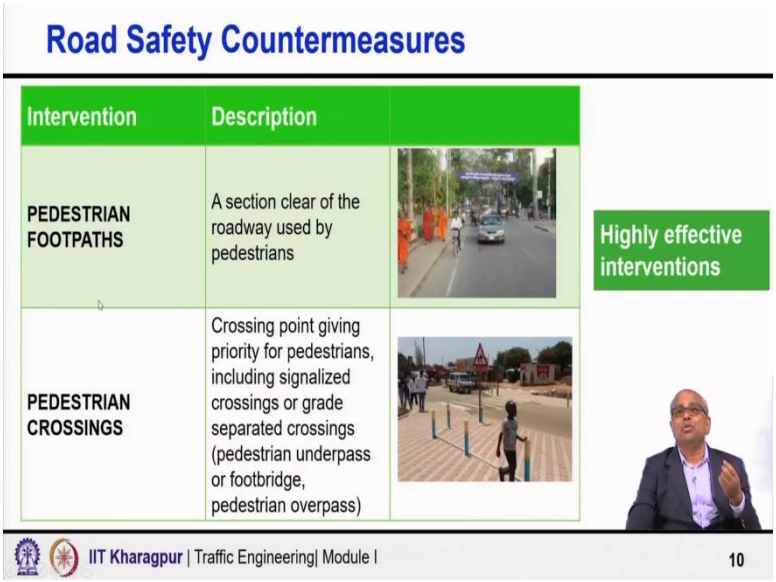

Pedestrian footpath, it shows clear benefit, highly effective in urban India, we have really lot of challenge many cases. The pedestrian footpath is either not available or it is there but lot of encroachment discontinuity not in good condition usable condition not at all attractive for pedestrians, so we must learn from such evidences that actually the pedestrian footpath and pedestrian crossing, both ship crossing of pedestrian crossing facility for pedestrians and pedestrian footpaths, both come under highly effective interventions.

So, we must promote we must try to encourage and have good pedestrian footpath and pedestrian crossing facilities. Because they are highly effective and can bring down the road fatality and serious injuries very significantly.

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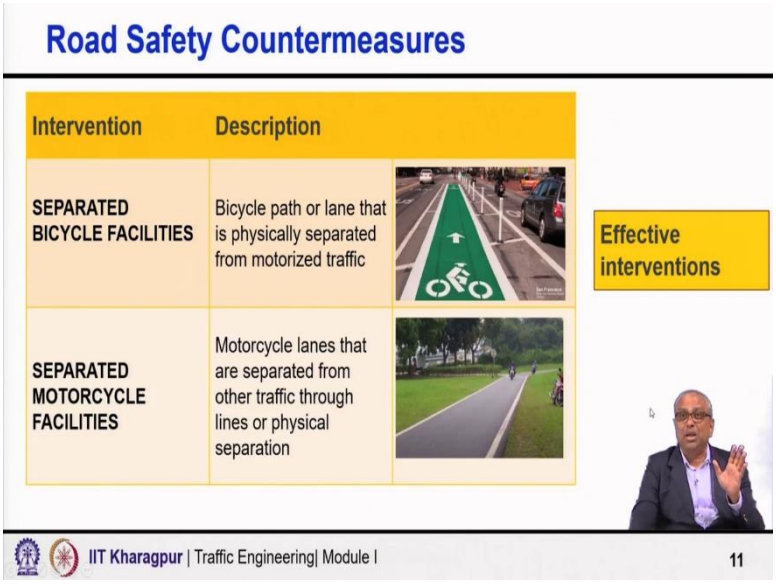

Coming to next level, still very not highly effective but these are effective interventions. Say, for example, separated by cycle facilities, one photograph is shown there here there are many other form of bicycle facilities are there, then separated motorcycle facilities in some cases not very common in India, but increasingly this bicycle facilities are gaining more and more popularity and acceptance in urban India, which is actually very positive sign from a sustainability point of view and it is the responsibility of the traffic engineer and the authorities, all related authorities to ensure that the safety is no way compromised, right. So, these are again effective interventions.

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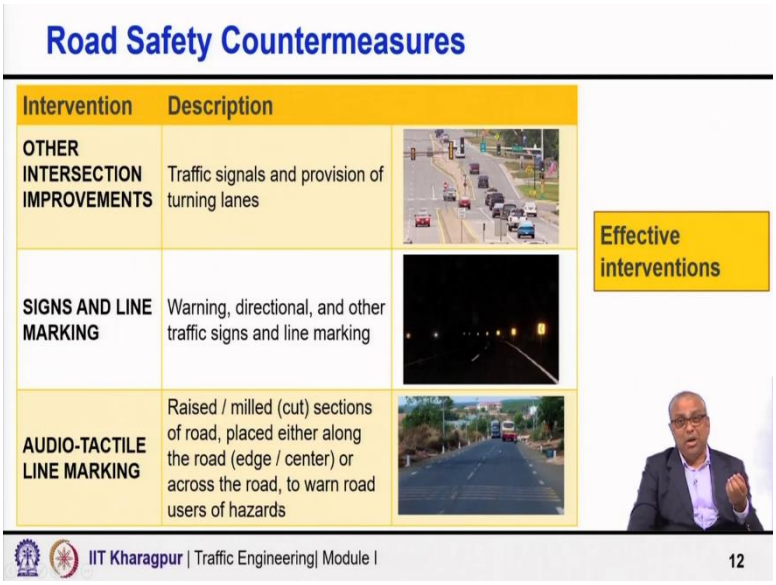

Then, also other intersection improvement for example installation of traffic signals, provision of turning lanes, these are also under effective intervention, sign and landmarking, then audio tactile landmarking, again all these come under effective solutions, they are effective.

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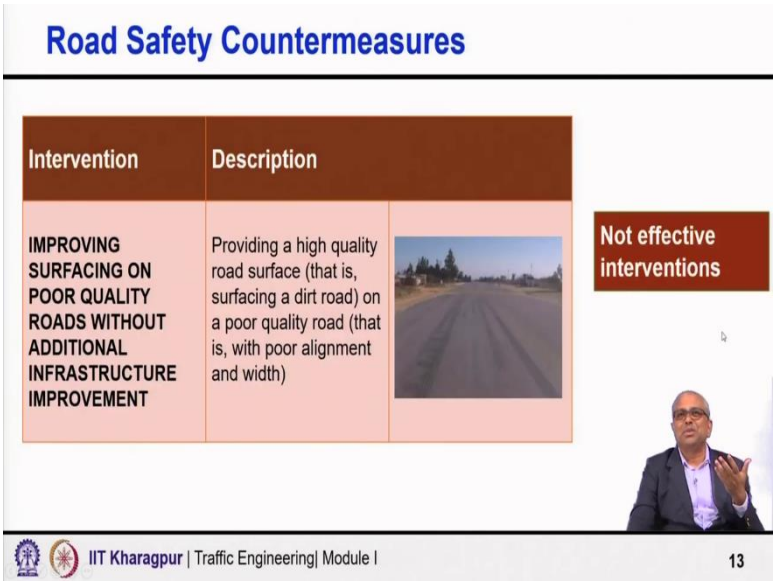

Similarly, one example of intervention which is not effective is to improve surface quality on poor quality roads without additional infrastructure improvement, that means you are improving servicing on poor quality roads, only the surface condition is improved. So, obviously what will happen, speed will increase, because motorized vehicle speed will increase, but you did not look at the other infrastructure improvement. For example, pedestrian facility, slow moving vehicle, how they will travel on the road, no separate facility, no safe crossing facility for bicyclist for you know the pedestrians and others.

So, without any other additional simply word in the road some cases in India, also we have done such kind of things. Just resurfacing, make good surface condition, without looking at the overall infrastructure improvement in a holistic manner.

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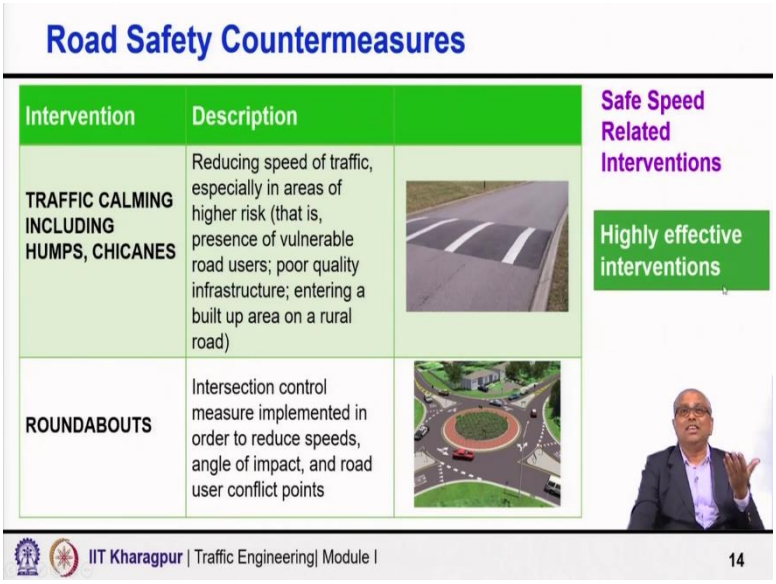

Then going to the next one, safe speed related intervention, obviously, firstly, highly effective interventions they may include traffic coming harms and different others kind of speed control measures, very common things, right. So, reducing the speed of traffic especially in areas of higher risk where vulnerable producers are present and therefore enhancing, you know reducing the road fatality and severity of crashes.

Roundabout, again I have told earlier also its useful but as a part of the safe speed also it is useful because intersection control measure implemented in order to reduce speed and along with that also angle of impact and reducer conflict points. So, again for reducing speed also these roundabouts are highly effective.

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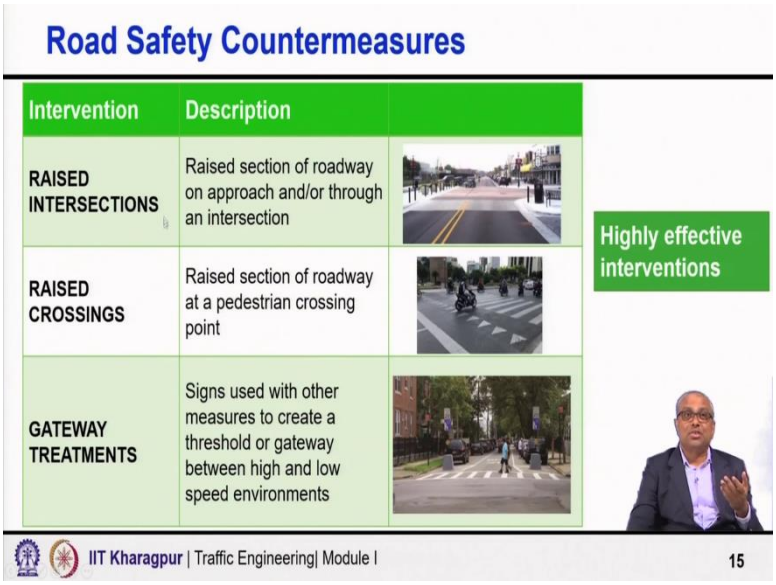

Case Studies

Flexible Poles on Curves with Restricted Sight Distance

Site Characteristics

- 3 curve locations treated with flexible poles @ 1m c/c compared
- Curve radius varied from 150 m – 300 m
- Sight distance less than 160 m in all locations
- Carriageway Width 7.0 – 7.2 m
- Paved shoulder 1.0 – 1.5 m
- Unpaved Shoulder 0.9 – 1.2 m

Case Studies

- 6hrs traffic data was studied for each location (9 – 12 hrs and 13 – 15 hrs)
- Spot Speed data collected for 200 vehicles at each location
- Traffic composition:
  - ✓ NMT 3-4%
  - ✓ 2W 40 – 45%
  - ✓ 3W <1%
  - ✓ Bus 6%
  - ✓ Car 30 – 35%
  - ✓ HCV 11-14%

Case Studies

Effectiveness of the Treatment

- **Before treatment Crash (2013 – 2015):**

	NMT	Two-Wheeler	Car	Bus	HCV/LCV	3w	Object	Total
Pedestrian	0	0	0	0	0	0	0	0
NMT	0	1	1	0	0	0	0	2
Two-Wheeler		0	4	1	3	1	0	10
Car			1	0	1	0	0	8
Bus				0	0	0	2	3
HCV/LCV					0	0	0	4
3w						0	0	1

- **After treatment Crash (2017 – 2019):**

	NMT	Two-Wheeler	Car	Bus	HCV/LCV	3w	Object	Total
Pedestrian	0	0	0	0	0	0	0	0
NMT	0	1	1	0	0	0	0	2
Two-Wheeler		1	1	0	1	0	0	5
Car			0	0	0	0	0	2
Bus				0	0	0	0	0
HCV/LCV					0	0	0	1
3w						0	0	0

- **100%** reduction in crashes involving buses
- **25%** reduction in HCV/LCV
- **50%** reduction in 2W crashes

Raised intersection, the whole intersection area is raised, so this section of roadway on approach and or through an intersection centre to centre and the all other characteristics are have been mentioned here, and what was done, the 6 hours traffic data was studied 9 to 12, and then 13 to 15 hours, spot speed data was collected, and this is this was the traffic composition and what was found, the before crash treatment, before putting this flexible pole during 2013 or 15, the data was collected, and also the after crash treatment, the data was collected from 17 to 19.

And surprisingly, it was found that 100 percent reductions in crashes involving buses that could be achieved. 25 Percent reduction in heavy commercial vehicle or light and light commercial vehicle and 50 percent reduction in two-wheeler crashes. So, this was this was really use of flexible pole on curves with restricted side distance was really found to be effective in reducing the road fatalities, road crashes.

And these were also additional statistical tests were done to see that whether the change in speed or change in the crashes, number of crashes, whether these are all statistically significant and not, those were all done, I have not reported it here.

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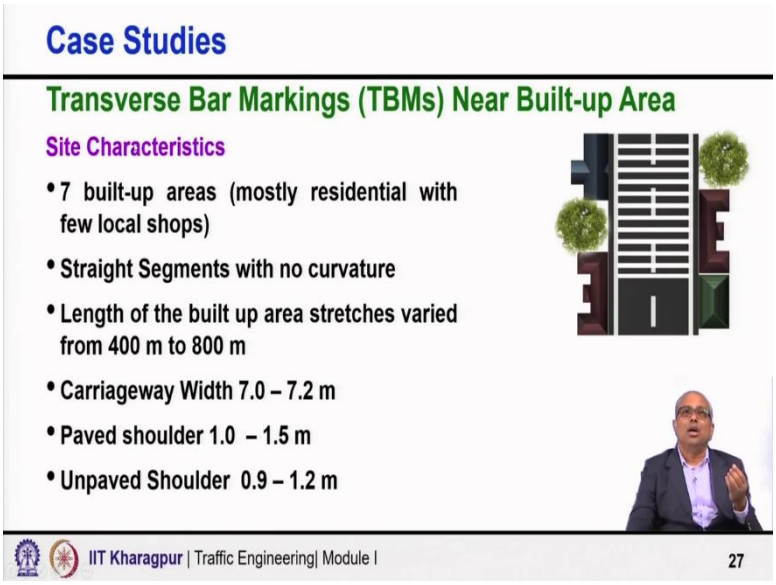

Then the second case study is related to Transverse Bar Marking TBMs Near Built-up Area. These are thermoplastic plant, multiple layers, so as I have seen 12 strips where you used and 15, 150 mm width and 450 mm spacing those were done, and here it sold seven built up areas were taken, what was the length, carriage will be it, what was the traffic situation, and you know the crash frequency distribution also, all are shown. And here also, the before treatment Crash rate of 13 to 15 and after treatment crash data 17 to 19 were collected and compared and

these are the benefits, and clear, there are clear benefit at least from this case studies, and all these benefits again as usual comparison was done.

Wherever it was necessary to check the validity or the acceptability of the result, based on statistical test all those were done. So, these were two. Like that there are many case studies which are available and we can be benefited from such case studies, and in fact such case studies form the basis for knowing that what kind of treatments or countermeasures worked in nearly all cases and where and which are the things which probably did not work so well or did not produce good results uniformly, across all sites or locations, these are only two small examples, there are plenty of such things are available.

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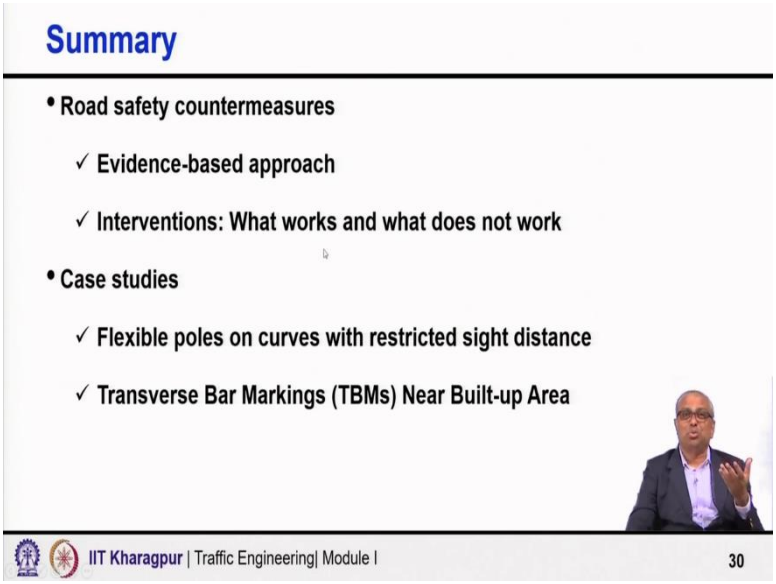

So, what we discussed today is basically the road safety countermeasures, why evidence based approach, why what is evidence based approach, then interventions, what works, what does not work, and then under different categories number of methods we said, which are highly effective, which are effective with respect to the safe infrastructure, and speed limit or speed management and also the road user, safe users, right. And then, also little bit discussed two small case studies one use of the flexible pole on curves with restricted side distance and the other one is use of transverse bar marking near build up areas. So, with this I close this lecture, thank you so much.