Introduction to Multimodal Urban Transportation System
Prof. Arkopal Kishore Goswami
Department of Ranbir and Chitra Gupta School of Infrastructure Design and Management
Indian Institute of Technology – Kharagpur

Module No # 08
Lecture No # 37
Non-Motorized Transportation (NMT) Planning: Design of Pedestrian Infrastructure

Welcome back friends. Now that you have looked at the 10 guiding principles and the 6 supportive principles in NMT infrastructure design. Let us now focus at the design of pedestrian facilities in particular.

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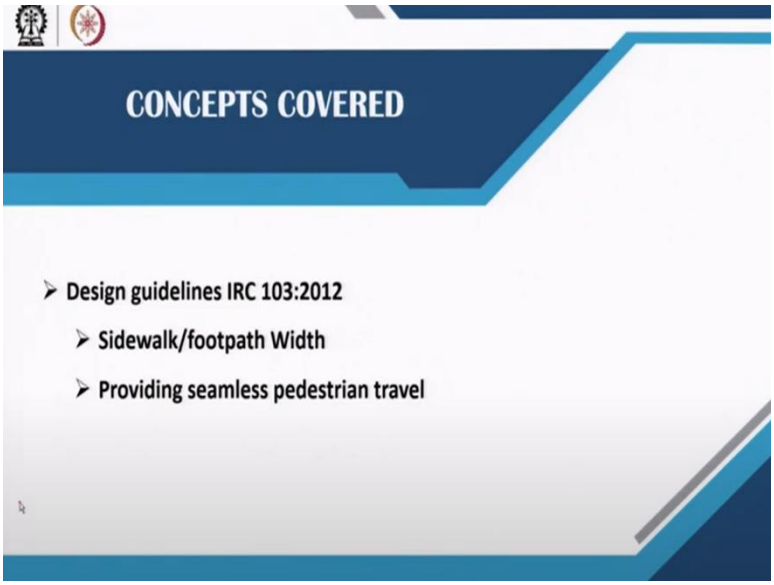

In this lecture we will give you an overview of design guidelines as per IRC 103 version 2012. And look at how you can design for effective sidewalk width and also provide for seamless pedestrian travel.

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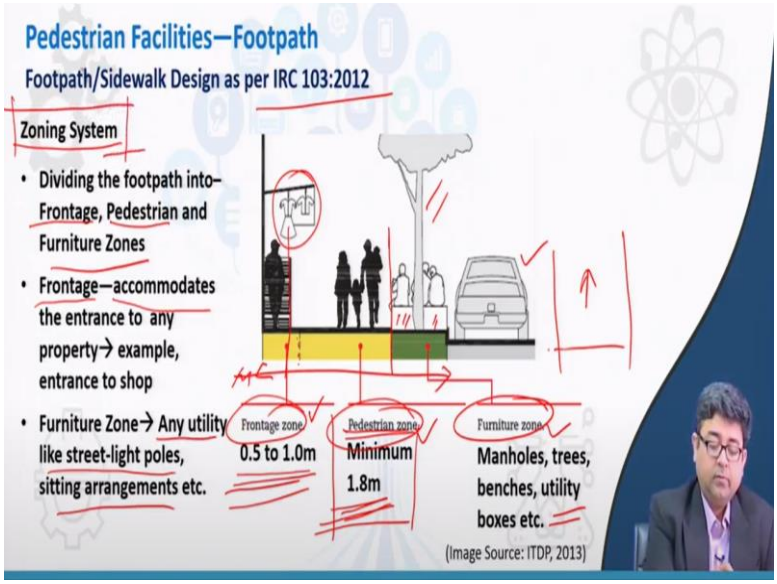

What IRC 103 tells us is that pedestrian design should be as per different zones. There is a zoning system that helps us understand or helps us design good pedestrian infrastructure. So what is this zoning system? It tells us that a sidewalk is divided into a frontage zone, a pedestrian zone and a furniture zone. So there are 3 different zones. Frontage zone, a pedestrian zone, a furniture zone and then comes the right-of-way or the carriage-way where you may have on-street parking and then you have lanes for the vehicles to move around. So what do you mean by a frontage zone? Frontage zone accommodates the entrance to any property, for example, entrance to a shop. So maybe there is an entrance to a shop or there are clothes hanging in the shop and that zone is called a frontage zone, which usually is anywhere between half a meter to 1 meter of your entire foot path. Next comes, the furniture zone which is on the other edge of the sidewalk. In the furniture zone all utilities like street poles, sitting arrangements etc., should be provided. So everybody are sitting on the benches and there are trees as well, such areas should be demarcated from the actual walking zone. IRC recommends that should be at least a minimum 1.8 meters of pedestrian zone. That depends upon what type of area you are in but it says no less than 1.8 meter clear pedestrian zone. Frontage zone should be different and a furniture zone should be different. So that is what is called the zoning system for a foot path or a sidewalk as per IRC.

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Here is the good example of the effect of zoning. So this is an unplanned picture. You do not know where the pedestrian zone is. You do not know where should, people walk. People then end up walking on the carriage way or on the pavement. Whereas if you have planned it in a proper manner, you would have demarcated the pedestrian zone and the frontage zone. Shops here and people can sit along the shops or do their business along the shops. There is furniture zone where all the trees are so on so forth and there is a clear pedestrian zone. This is how you should design for a sidewalk when you are looking at any urban area in India. So this is as per IRC. All the image source are taken from ITDP, and ITDP usually refers to IRC. Thus you will see that we have interchangeably used IRC and ITDP. ITDP have developed images whereas IRC is the primary document and that tells us what these zones are about.

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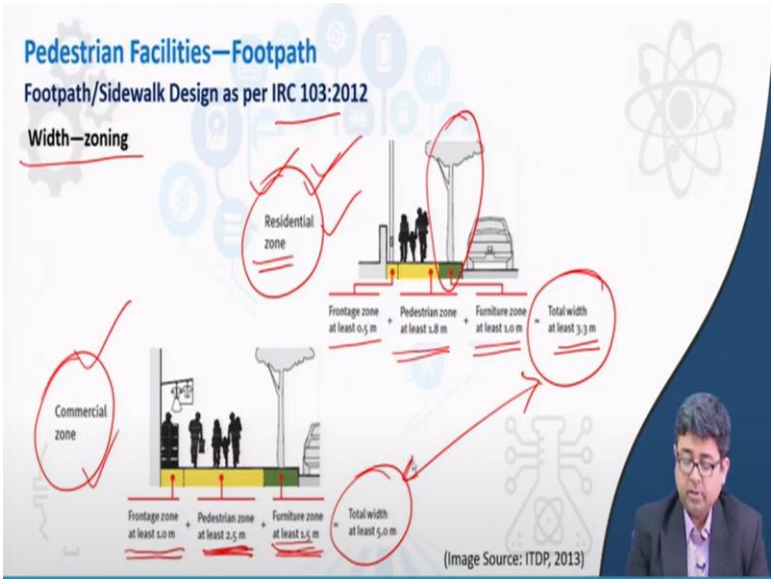

Now it also says that the width of the sidewalk depends upon which area you are talking about or which zone you are talking about. So when you are in a residential area, what IRC recommends is that, you have at least 0.5 meter of your frontage. Because there are not many stores or shops or anything you do not require a whole lot of space for your frontage zone. Have at least 1.8 meter of pedestrian zone and then you have a furniture zone of at least 1 meter. So total width of at least 3.3 meter that we are talking about. When you see very narrow foot paths you should always talk to your urban local bodies and say that do not provide anything less than 3.3 meters in front of my residence. There is no point just providing them with a 1.5 meter pedestrian zone that will not help them. Because then you will not have any trees along-side or the trees will be in a middle of the pedestrian zone which will affect your movement. And then you will not feel comfortable while walking and that will result in you not undertaking walking trips. So that is what IRC says about the residential zone. Similarly, for the commercial zone what it says is that, now your frontage should be increased at least 1 meter because there will be a lot of activity along the frontage especially because you are in a commercial zone. And your pedestrian zone should be wider as well. Now lots of people would be walking there, doing their shopping, coming in and out of the store. So the pedestrian activity will be greater. Hence there is a wider space required to accommodate them. Also little bit wider furniture zone should also be provided, because you may be required to provide dustbins, seating, etc. So there should be wider furniture zone and a total width of at least 5 meter should be provided. So when you go

from a residential zone to a commercial zone you see that your width of your sidewalk increases from 3.3 to 5 meters.

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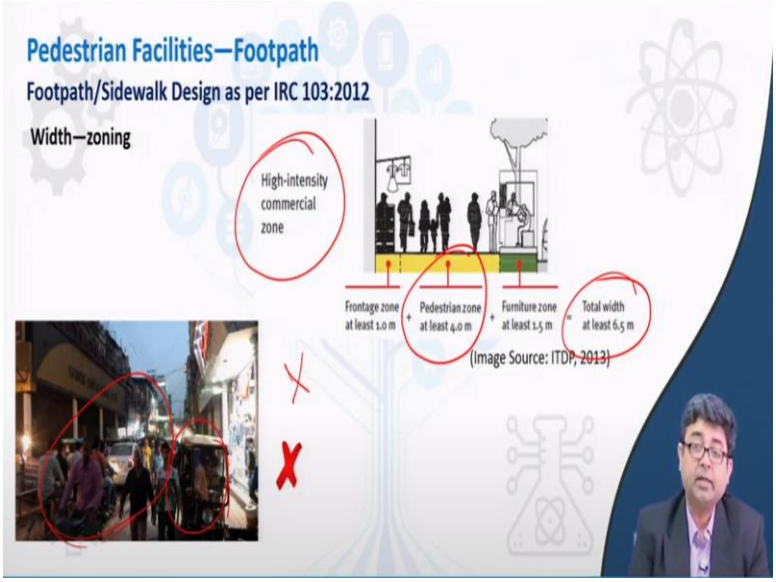

Finally if you have at a very high intensity commercial zone, you are in the central business district. So when you are in central business district what happens is that your pedestrian zone increases to 4 meters. So you have to really provide for wide sidewalks. So that people be comfortable while they are walking and more and more people do actually walk rather than use their motorized 2 wheelers or 4 wheelers. Then a total width of at least 6.5 meters is recommended. In many of the large metropolitan areas and their CBDs, you would actually see much wider sidewalks than when compared to smaller commercial zone or even the residential areas. This type of situations has to be avoided where you see that there is no demarcation between the pedestrian zone and the frontage zone as well as the furniture zone and everybody is intermingling in the area. So this causes not only congestion for the motorized vehicle but it gives an unsafe walking and bicycling environment and as a result the number of people trying to walk or bicycle always reduce. So this type of situation, where the area does not have any designated parking, and vehicles stops anywhere it wishes to stop, such things should be avoided.

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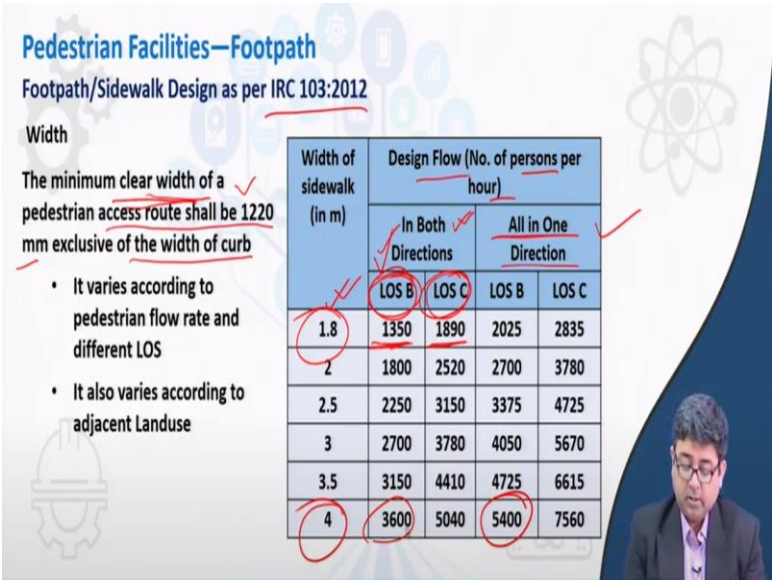

Width of sidewalk (in m)	Design Flow (No. of persons per hour)			
	In Both Directions		All in One Direction	
	LOS B	LOS C	LOS B	LOS C
1.8	1350	1890	2025	2835
2	1800	2520	2700	3780
2.5	2250	3150	3375	4725
3	2700	3780	4050	5670
3.5	3150	4410	4725	6615
4	3600	5040	5400	7560

If you look at IRC and try to determine the level of service, what it also says is that, a minimum clear width of pedestrian access route shall be 1220 millimeter exclusive of the width of the curb. At least that much width should be given if people are walking in both direction. Then if you see that we provided a minimum sidewalk width of 1.8, your number of people per hour should not be greater than 1350, if you want to maintain a level of service B; or if you want to maintain a level of service C you can go up to 1890 people per hour, if you only provide the minimum of 1.8 m. However, if you can go up to 4 meters then you can accommodate a whole lot of people but still maintain the level of service B. Similarly this column shows you if it is a unidirectional i.e., only in 1 direction then you can have even more people. If it is multi-direction, then remember it provides friction between people moving up and down, so usually the flow or the capacity reduces.

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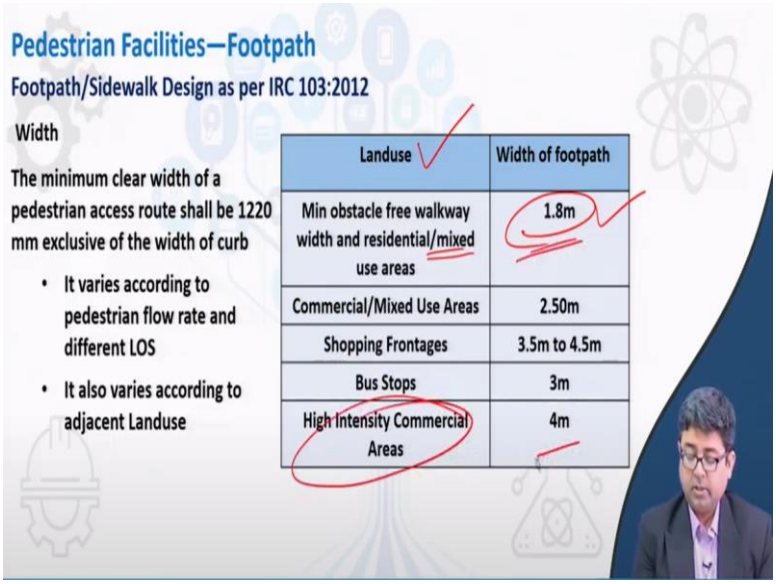

Similarly based on land use again, what it says is that, in the residential areas you have to provide at least 1.8 meter width of footpath. Again when we are saying 1.8 meter width remember, it is pedestrian zone we are talking about. In addition to the pedestrian zone you will always have to have your frontage zone as well as your furniture zone. So residential areas minimum foot path width of 1.8 meter whereas in high intensity commercial zone you have to have at least 4 meter of footpath.

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The next is once you have catered to the width of the footpath you also have to look at the height of the curb or the height of the footpath. See, sometimes in many cities you would see that the

footpath is very high when compared to the carriage-way. But what IRC says is that it should not be any more than 150 millimeter high. This is what IRC recommends. There are multiple other design failures which we will get to hear. But what IRC says is that, if you have such a high foot path what is likely to happen is that, if there is a motor vehicle that is lying on the edge of the road here that may hit this raised sidewalk and then it may topple over into the pedestrian zone. If it is a lower foot path the chances of toppling of vehicles is less, and that is why this is a much safer sidewalk height to have. The other design issues we will get to in a minute.

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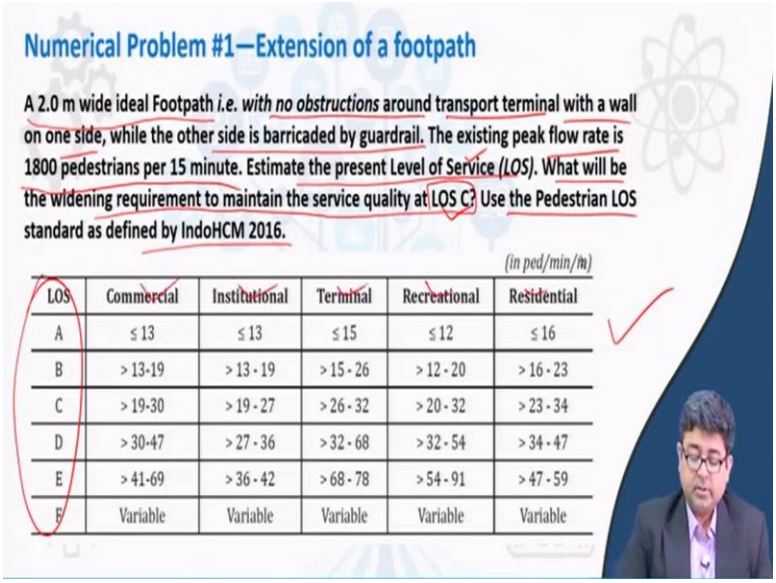

So let us now take you to an example. How would do you determine the width that is necessary as per the number of people or the flow of pedestrian in your area? So say for example there is 2 meter wide ideal foot path, i.e. with no obstructions around a transport terminal with a wall on one-side and is barricaded by guardrail on the other side. The existing peak flow rate is 1800 pedestrians per 15 minutes. You are first asked to estimate the present level of service. Secondly what will be the widening requirement to maintain the service quality at level of service C? So once you know the present level of service, do you have to widen it to maintain a level of service C? You are told that use the IndoHCM 2016 method. We have already given you examples of couples of problems how to determine level of service based on IndoHCM 2016. So we will use the same standard table that tells you about the different levels of service for different land uses

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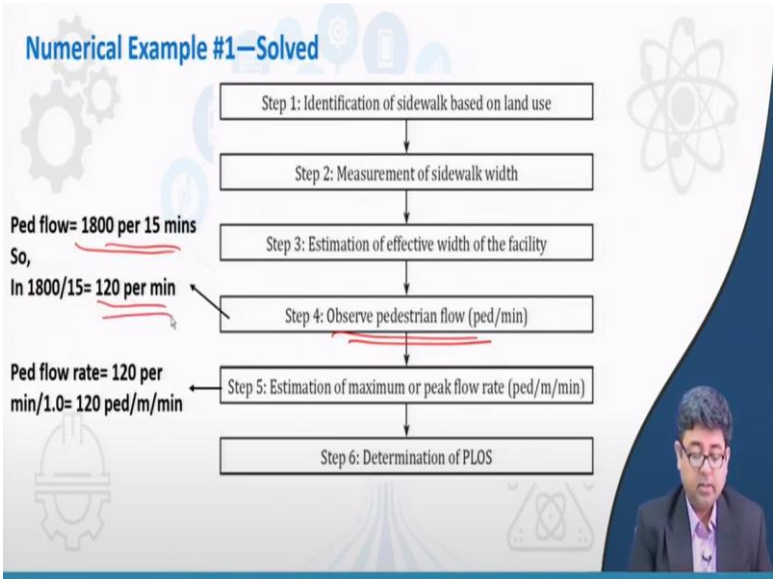

So if you remember you remember the 6 steps of developing the level of service. First one is identification of the land use, which we are told is the terminal land use; width of the sidewalk, which we have told is 2 meter width; the next step is to determine the effective width. And if you may remember effective width is given by what all obstacles it has on both sides. So here it has guardrail on both sides. Shy distance of 0.4 to 0.6 meter in both cases, so if you just subtract the shy width or shy distance you will get the effective width as 1 meter. Once you know the effective width you are also given the pedestrian flow which is 1800 pedestrian per 15 minute and that will be 120 pedestrian per minute. And because it is only 1 meter effective width so the flow rate will be 120 pedestrians per meter per minute.

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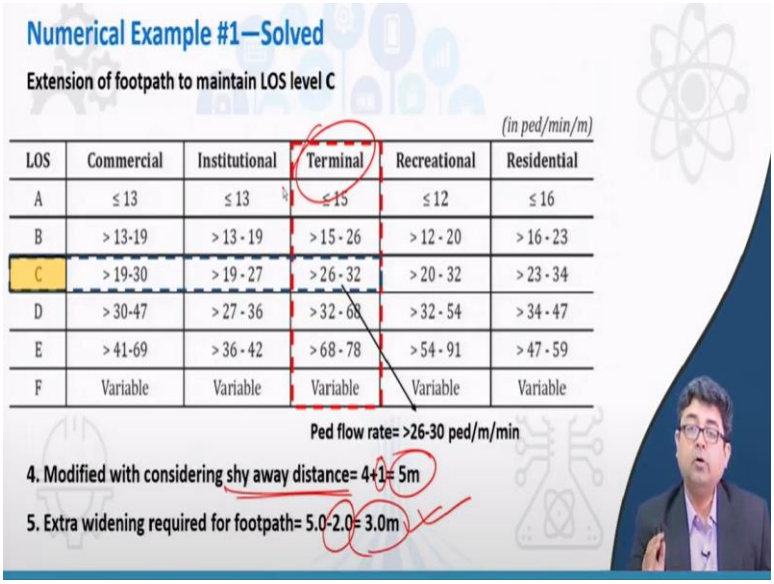

Now that you know that pedestrian flow rate is 120 pedestrian per meter per minute and it is a terminal land use, it falls in the category of F. This means variable pedestrian flow rate or anything greater than 78. So you see that your pedestrian your sidewalk currently is at a level of service F. Now the second part of the question is what do you have to do or a how a how much do you have to widen in order for it to maintain a level of service C. In order for it to maintain a level of service C for a terminal land use you know that it has to fall or the flow rate has to be anywhere between 26 to 32 pedestrian per meter per minute. So let us assume on the higher end say that we will accommodate 30 pedestrians per meter per minute. So now you know how much should be the effective width, you already know that your flow rate 120 pedestrian per minute. 120 pedestrian per minute divided by the flow rate of the foot path, which is 30, is gives you the effective width of the sidewalk. So the effective width of the side walk should be 4 meters in order for you to maintain a level of service C in a terminal land use. Now if your effective width is 4 meter considering a shy distance of 1. So you should have at least a 5 meter wide foot path. So how much do you have to widen it by? You have already have 2 meter foot path. So you have to widen it by 3 meter. This is a very easy way for you to understand the deficiency of pedestrian infrastructure in your neighborhood. In your any different types of land uses. And, once you know the deficiency you can then advice as to what can be done to overcome that deficiency. So if you say if you the urban local bodies now knows that well in order to maintain a level of service C, which is a ideally what everybody would like to maintain in at, we would have to at

least widen the foot path by 3 more meter in that particular terminal land use so that people feel comfortable while walking. So that is a good example of how to measure what is the width that is necessary in order to maintain a certain level of service.

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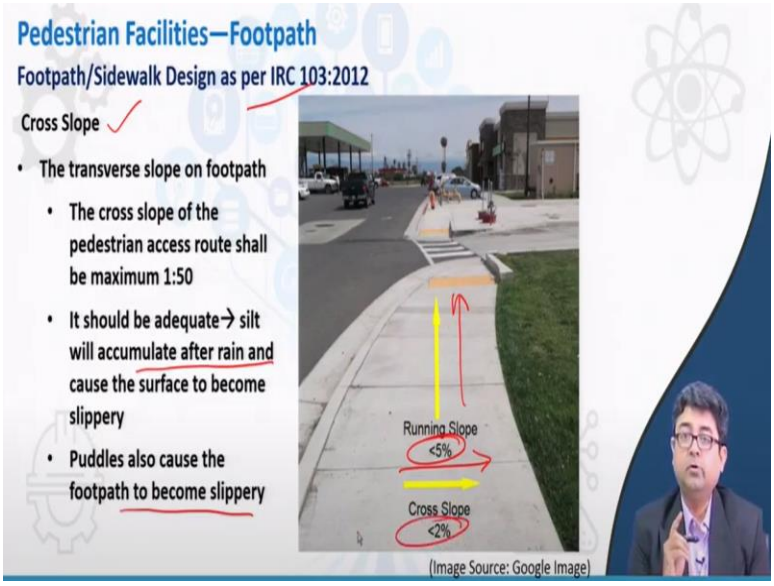

Now the other aspect that is highlighted in IRC 103 is the cross slope. The cross slope is very essential because when silt accumulates after rain it may cause the sidewalks to be slippery. Puddles can cause the footpath to become slippery. So they has to always running slope as well as a cross slope. As per IRC the running slope should be no more than 5% and the cross slope should be no more than 2%. So you have to ensure that your sidewalks are designed in such a manner.

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Next comes the surface quality. This is effective when we are looking at different types of pedestrian infrastructure in our urban areas. We always find such a facility which is extremely unusable for pedestrians. So it is always recommended that while you are designing for pedestrian facilities we have to provide for universal accessibility. You are taking into account the specially-abled as well as children and elderly people. So when you are developing any surface quality you need to know universal accessible design. And you have to make sure that there is a clear space for pedestrians to walk along the foot path.

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When we talk about surface quality, we either look at paver tiles, sandblasted, checkered tile or nonskid tiles. What they do is that they allow you to walk on the surface without the fear of slipping. So that is one of the fears while you walk on any surface during rain or after cleaning of the surface. It should not become slippery. So these are examples of different types of surface quality that can be provided along your urban pedestrian facilities.

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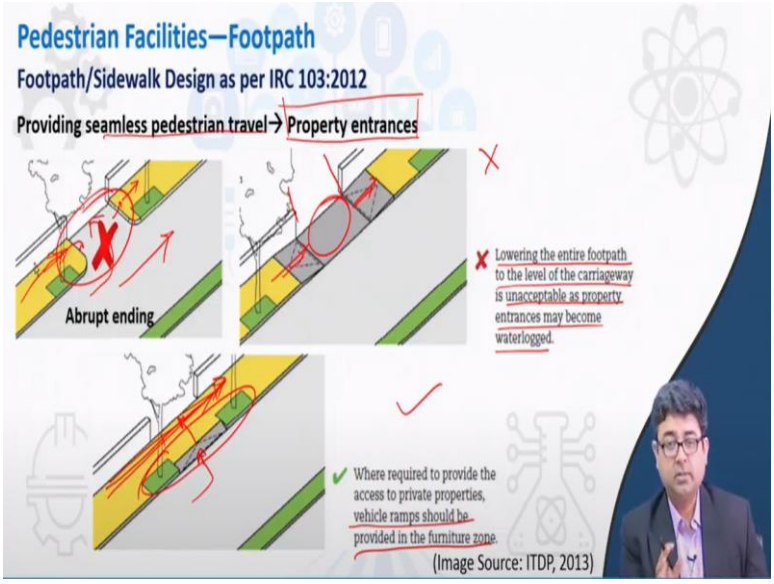

The next most important thing is how you deal with property entrances. How do you design for property entrance in order to provide seamless pedestrian travel? Many times you will be encountering such a situation, right. So here is your right-of-way, here is an entrance to a residential building or to a commercial building and so what happens is this foot path ends here and again starts back up here to provide for direct access to the motor cycle or to the motor vehicle. But this is not taking into account that there are, lot of people walking on those footpaths. So, why should we not provide them with a seamless travel as well? So what essentially, what people should do is they should provide such kind of slopes at the property entrances. Lowering the entire foot path to the level of the carriage way be unacceptable as property entrances may become water logged. So this is also not a right design to provide because now you are, since the slope is this way and this is up slope. So there may be lot of water accumulation at this point and the property owners here would not like it. Instead what has to be done is, there has to be a small slope up here provided for the vehicles and that also makes the footpath continuous. The footpath should be continuous here. That should be a small up

slope that allows vehicles to enter or access their home or property. In this manner both pedestrians and the vehicle are accommodated. So this is the right way where vehicle ramps should be provided in the furniture zone. Again this is the furniture zone right, there is a clear pedestrian zone, so in the furniture zone vehicles ramps are provided which goes up and then the vehicles can access the properties keeping in mind the pedestrians walking on that. So this provides seamless walking platform for the pedestrians rather than having them get off here, then get up here, and do all kinds of things. So we have to always keep in mind that we want to provide vehicular access but not at the cost of the pedestrians walking along side on the sidewalks. We have to consider both the pedestrians as well as the vehicles while we are designing for property entrances.

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So, here is an example like I was talking earlier in one of the pictures. Not only is the height of this foot path not as per design. But also several property entrances are along the way due to which discontinuity arises on the sidewalk. You would often end up with such a situation where people are walking along the side-walk. Because this is an uncomfortable situation where pedestrian, has to get down and get up repeatedly. There are so many breaks in the sidewalks that the pedestrians decides that I might as well just walk alongside the side walk and not use it at all. This kind of design should be avoided. Again lot of parking on the foot path and completely encroaches the footpath. So this is the proper design for property entrances, from the right of way you have up slope in the furniture zone and then there is a clear pedestrian zone.

After the up slope the vehicle can then slowly go ahead and access this. So this, I believe, any of the new smart cities that are looking at developing pedestrian infrastructure, are keeping this in mind while they are designing for property entrances.

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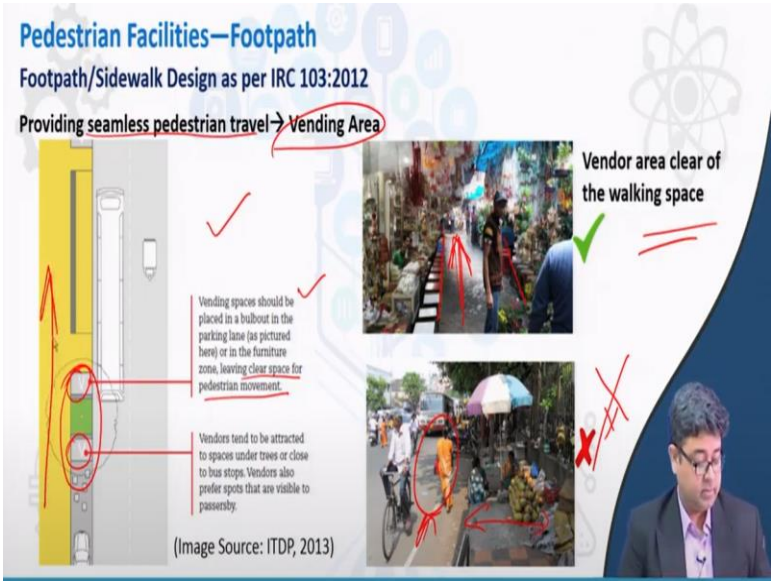

Next is vending area so when you try to provide seamless pedestrian travel, vending area always almost becomes an obstacle. We should not always think that these vendors should be rehabilitated or taken away from here, since vending is their livelihood. So when we say that they should be rehabilitated the situation is very complex. Rather than making situation complex and uncomfortable for the vendors, we should design in such a way that the vendor should also incorporated into your foot path. At the same time there is a clear pedestrian walking zone as well right. This sort of situation where the vendors have completed encroached is not desirable and the pedestrian then start walking on the pavement which is also not desirable. Whereas this type of situation where you have the frontage zone and you have the furniture zone here and you have a clear pedestrian zone or a walking space. That is something you have to design for such a situation and not for such situation. Similar things are shown in this picture as well. Vending spaces should be placed in a bulb out in a parking lane or in the furniture zone leaving clear space for pedestrian movement. If this is the furniture zone you can have the vending zone right here leaving a clear space for the pedestrians.

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Similarly, when you have bus shelters, or bus stop that has shelters, how do you design for seamless pedestrian travel? If you have the bus stop right here then people who do not want to go to the bus shelter or are looking to walk past it, now do not have a clear path. It is not a seamless travel now; they have to get down and then get back up on the footpath or they have to be troubled by all the people that are waiting for the bus here. So it does not provide for a seamless transfer. So what has to be done is, the bus stop is already available but the foot path has to be extended towards the left. Now this provides a clear walking path for the pedestrians who do not wants to access the bus stop. And also people who want to access the bus stop can now easily go here and follow a clear path. So that is how seamless pedestrian travel should be ensured near bus shelters. Similarly if there is parking, this is the situation when there is no on-street parking. When there is on street parking you have to make sure that the bus at least has direct access to the bus shelter. If the bus does not, it cannot squeeze into this place then what will happen is people will start getting off here. This is again a pavement area. And then go to the bus shelter. So nobody would be waiting at the bus shelter everybody will come on pavement and start waiting. So instead this sidewalk has to be now extended the bus shelter and it still remains a true access for pedestrians for those who do not want to access the bus. Then there is parking alongside. See this situation, it is should be avoided because the bus is not coming all the way here or parking shelter has not been extended all the way here. Now people are ending up on the pavement trying to use or trying to access the bus. Instead, you should have the curb extended

outwards so that now people can directly access the bus from the sidewalk itself and not go on to the pavement.

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So that brings us to the end of this lecture where we have given you some examples of how to design for pedestrian facilities in urban area and ensure that there is seamless access to the pedestrians. These are some of the references that we have used, the pictures have also have been taken from a previous NPTEL course which you should also be looking at if you are need any in-depth understanding of a traffic engineering principles.

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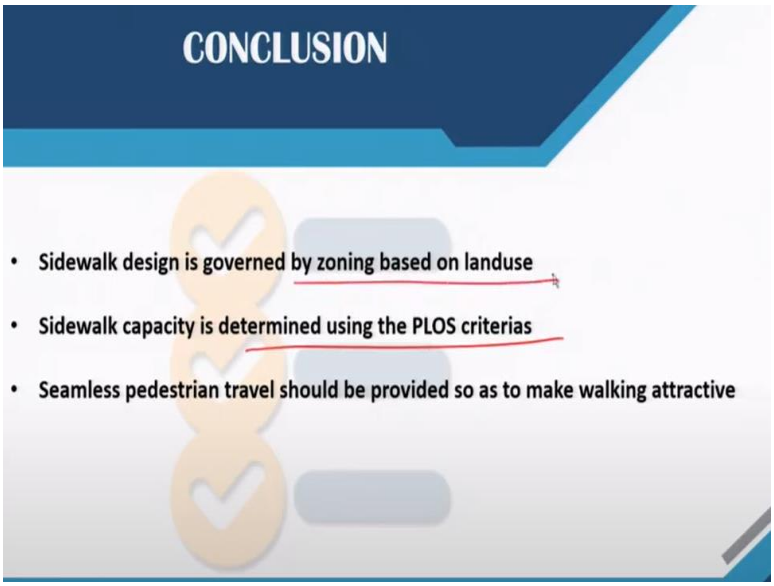

For this lecture, we have also given you an understanding of how width plays an important role in keeping up with the level of service criteria of pedestrian facilities. And, how you can re-design your pedestrian facilities in order to maintain a certain level of service. Remember again, in a nutshell pedestrian design is governed by zoning which is based on land use. Thank you!