Introduction to Multimodal Urban Transportation Systems (MUTS)
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Module No # 11
Lecture No # 54
Urban Transport & Sustainability: Design of multimodal transfer facilities

Welcome back students and friends. In the last lecture we looked at a developing level of service of the multimodal facilities such as stretch of a road. Now we will look at some of the design aspects of multimodal transfer facilities.

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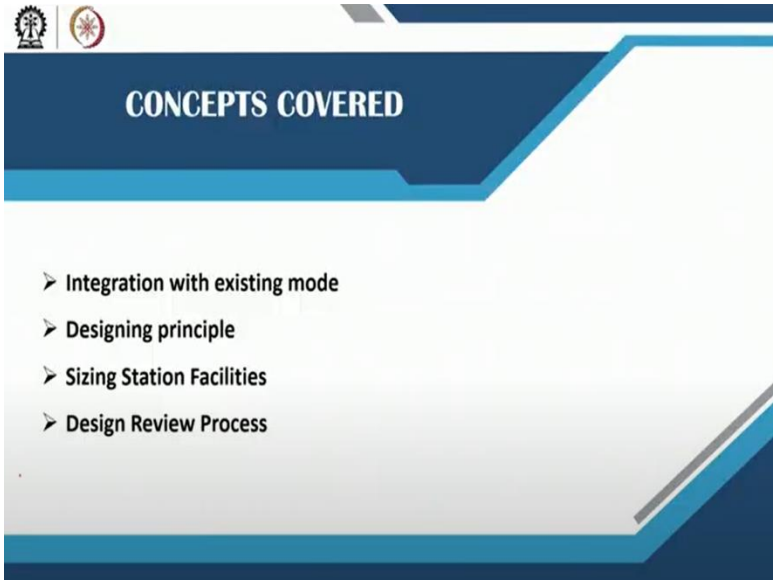

In this lecture we will be introducing you to the 6 different design principles that have to be followed when you designing an intermodal or multimodal facility which actually integrates the different modes. Then we will see what type and how much area or size of each of the elements within the transport terminals that you have to provide. And then we will introduce you to certain steps that need to be followed in order to review the design process.

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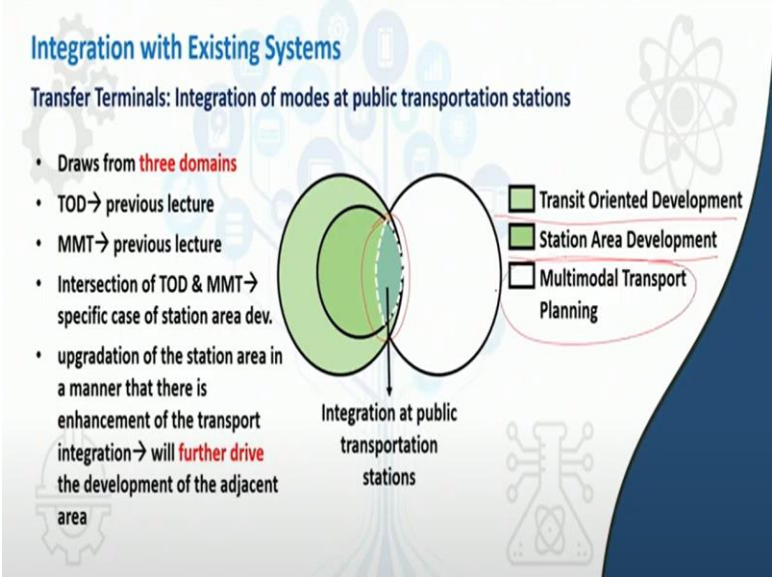

So when we talk about transfer terminals what essentially we are talking about is that there is a small domain which is an overlap between your understandings of a transit oriented development, a station area development and this larger concept of multimodal transport plans. So if you look at multimodal transportation planning and TOD then the intersection of those 2 sets is where this transport terminal concept lies in. That means you have to have facilities that cater 2 different types of modes. Just having it standalone or believing that the station facilities is just a standalone facilities for 1 mode will not promote multimodal transportation. It will only promote individual modes of transportation. So when you design a station say for example for a bus you also have to keep in mind that maybe at this stop you have to provide good facilities for say for example bicycle parking. Because maybe the people will come here using their bicycles park the bicycles and then take the bus or the rail. So all though we may look at the terminal design as design for bus or rail transportation, but when we start thinking along the lines of multimodalism then we have to think that this terminal is not only catering to the bus or the train mode. But also it is catering to the bicycle mode or may be it is also catering to the 2 wheeler mode. Lot of motorized 2 wheeler people will come and park and the take the transit service. So we have to revise our thinking in this manner so that the design element in the station building also cater to these other mode. It should not only exclusively cater to the bus or the rail mode but it also to cater to these other supporting modes. That is how you encourage or you promote the use of these larger public transportation systems and hence these terminal areas become very

important. So that is the entire concept behind you wanting to develop the multimodal transfer facilities or multimodal hubs or transit centers. You have to keep in mind this ideology.

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So when we talk about say first type of facility which we call them as transfer facilities. What essentially we are saying is that every station has to be viewed from the point of view of a transfer facility. Now if you think of a bus stop as the facility that is only needed for the bus. If it is only needed for the bus then we would be amiss in our thinking because eventually once we get down from the bus we have to take another mode to reach to our destination or our home or where ever we are going. So the bus stop is also in a sense a transfer facility or a multimodal facility where 2 or more modes have to be well integrated. So the simplest example is may be the bus stop should be connected with a good network of sidewalks for example. So if you have good sidewalk then the bus stop essentially becomes a transfer point between the bus and the pedestrian mode, now, the people have a safe facility to walk back to the home or walk to the final destination. And also they facilitate the increasing use or the greater use of the bus mode as the means of travel within the city. So this is how we should frame or think when we talk about multimodal transport in the urban transportation concept. Every transfer terminal that we design we should not think that that is only for one mode. For example a BRT station that you see here it is not only for the bus rapid transit. You have to have good facilities for the pedestrian to cross once they get on or get off the bus. Otherwise since this is median type of BRT, nobody would be able to access this station from the foot path that is on the sides of the road. In order to access

this you need good connection and provide a zebra crossing to cross. Otherwise if you just think of this BRT station terminal as a terminal that serves only the bus then you would not be able to develop a multimodal transportation network for you city. You have to think of these terminals as multimodal terminals. So that is a simple example of a transfer terminal and it is just transferring a set of people or users from one mode to the other mode. Now you should look at various points that you should take it into consideration. The station elements should be present in the existing station. So once you are building a new station may not design the station differently than any of the existing station. Then there will not be this ease of the movement for the people and they would be lost, suddenly. When they come to new station they may be thinking how I should get off because they are not familiar with the new design. So you may aesthetically make it a different looking station but at least have functional elements within the station that have some consistency within your network. The station area vehicle requirement should be consistent, I mean 1 station area has 2 platforms versus the other station area has only 1 platform, that makes it again a complex situation. So have your vehicle requirements consistently across the station. Your garage facilities have to be now coordinated so may be your BRT buses are little bit longer to accommodate more passenger. Whereas the regular buses that run on the street are shorter buses with fewer capacity. So the garage facility that you had maybe was only for those shorter buses. But now the BRT system has come in and you have to have garage that also facilitates these longer buses. Facilitate meaning you have to have a bus bays that are long enough for the buses to park. So again when you are designing these thing do not just design different garage for the buses that are going to run on the BRT corridor. Maybe retrofit the existing bus garage so that they can now be used for different types of buses that also becomes non-multimodal. In this case both are buses so they are not multiple modes but they are different categories of the buses. So think in those lines even within one mode.

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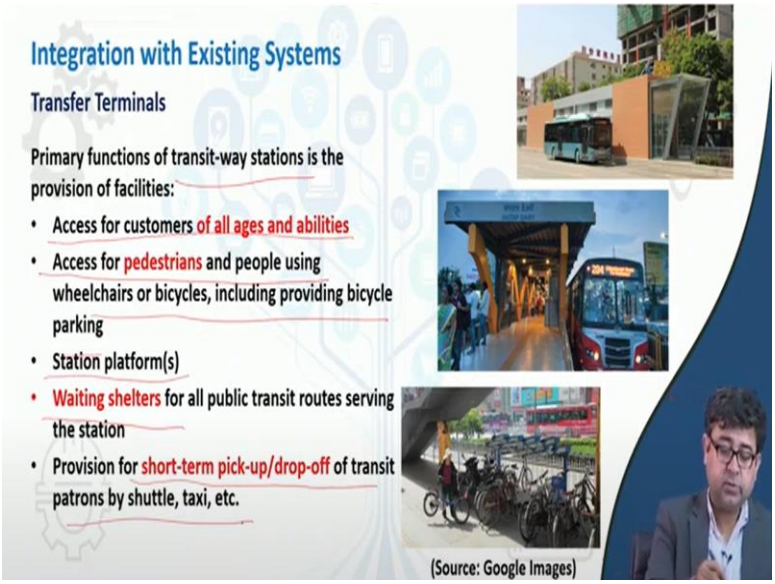

In transport terminals, if you look at the primary functions of these stations, you have to remember some elements are functional elements where as other elements that are maybe aesthetical elements. So functional elements are very crucial in a designing of any station and that is what should be consistent across station. So the first function they have to be providing is to provide access to customers of all ages and abilities. So you have to have ramps so that differently abled people can access the stations. You should have those ramps for disabled people. Even abled people can carry their luggage to the station. It will help older aged people to change levels if your stations has multiple levels. So, all of these are a functional element that has to be taken care of by each of these stations. Access for pedestrian and people using wheelchair or providing bicycle path. Parking is another element that every station design has to consider. Platforms has to be of certain size and width. Platform that have been provided with requisite sizes would enable the circulation of users that are using this station. Waiting shelters should be provided for all public transit route serving the station. You have to have shelter more and more as public transport agencies are now providing at least some basic type of shelter at every stop or at every station. In any good public transportation network you hardly find any stops bus stops or train stops that just has sign post and nothing else. There has to be a shelter or protection against harsh weather so that people who are trying to access these public transportation systems are taken care of. Provision for short term pickup drop off of transit patrons by shuttle taxi etc. should also be provided. The other thing that usually people are

against is providing permanent parking at the station. Because what that encourages or what that allows people to do is drive to these metro stations or BRT stations and then park and then take the metro or BRT. That usually does not solve the purpose of public transportation because you are still making a part of your trip by private vehicle or single occupancy vehicle. So it is not fulfilling the sustainability that we are trying to achieve in urban transportation. Hence you do not provide long term parking or full day parking for vehicles. But you should provide some minimum basic parking that will allow people to may be pick up and drop off passengers from those stations. Now these may not be provided at all stations but may be terminal station or may be at major stations where there is lot of activity, big residential complex or a big commercial complex is present. So such station should have at least a circulation plan for example to pick up and drop off or 10 minute parking where people can wait for pick up and drop of either child or friend or spouse or whoever it is. So that type of facilities should also been thought of as one of the primary functions of any station.

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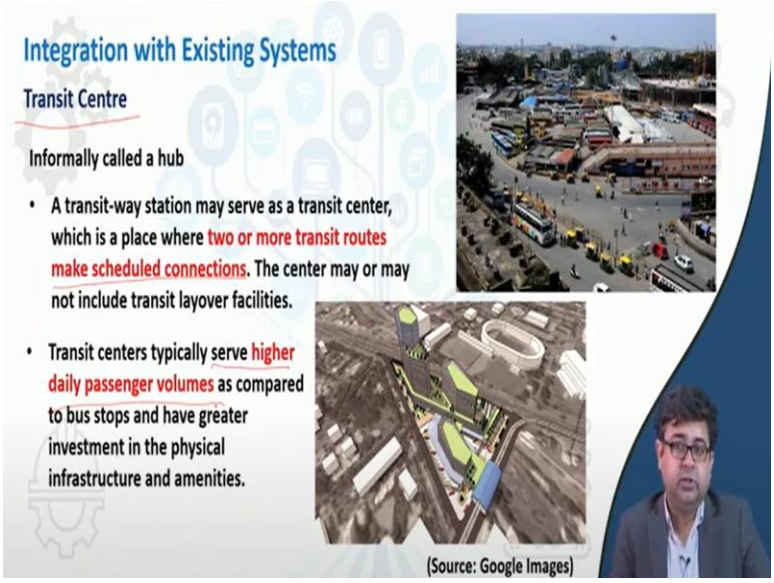

Similarly you can then think of another category of station calling a transit center. Now a transit center is little bit bigger and has more infrastructures associated with it because now at a transit center what happens is you are connecting 2 modes that have scheduled connection. So you may be developing a transit center where suburban or an intercity rail is connected to intercity bus. Scheduled connection means they run on some fixed schedule. So these centers are large center with infrastructure which needs lot of lands. And what happens is once people arrive from a

smaller city to this transit hub or this transit center by bus then they will wait a considerable amount of time before the schedule departure of the train maybe from the same hub or transit center. This requires you will see that these usually serve higher daily passenger volumes and it requires larger passenger waiting area. Because there will be passengers who will be waiting for a longer period of time at these centers. But these are very effective centers now otherwise you would have had 2 different pieces of infrastructure one is the bus terminal versus the other is a rail terminal and both of these are integrated into one big transit center. So that allows for saving of land which is prime in many of urban areas and also makes the transfer much more seamless between these 2 modes.

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A smaller variety of those hubs are transit centers could be something called transit layover which may serve as a location where transit vehicles, either bus or rail layover or wait to enter the service location. So these are end of line stations or even a station that is beyond the end of the line where the transit is waiting for to start its service. We have learnt about what is layover time. So at the end of a run the transit vehicle have to turn around to begin a new run. So when they turn around there may be a facility there for the drivers to wait and that may be a transit layover facility. Park and ride have been tried extensively in the urban areas to promote public transportation where people do drive their vehicles, and they have whole day parking or even for overnight parking sometimes. They park the private vehicles there and then they take some other form of public transportation either the bus or you even have park and fly facilities. You have

remote parking places for airports nowadays because lands, especially for airport that is within the city boundaries, is becoming sparse. So what happens is you have remote parking from where you have shuttles that will take you to actual airport terminal. So those are park and fly hubs or centers. I think now that you understand the multimodal system, you may realize that every kind of station area or a hub or a center that not just serves for that one particular mode but serves multiple mode. So you have to design that center keeping in mind the necessity of these 2 or 3 modes that it is serving and not just design it keeping in mind one particular mode. So that is the entire idea. We will look into park and ride in a little bit more detail because it is has been extensively tried out and has been found to be beneficial in attracting people to undertake urban public transportation.

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Now if you look at 6 design principles for these stations, first design principle is to how to locate a station. And we have extensively looked at and given you mathematical formulation of how should we determine spacing between stations. So keeping those formulations in mind you already know where to locate the stations usually these station should be in places that attract visitor or workers near major trip generator. For example movie hall, shopping mall, schools, etc. And hence land use plays a very important role of where you locate these stations to provide frequently used services near transit stations, shops, restaurants and childcare. So that is the whole idea of transit oriented development. It is to design your station as not just as a station terminal but as multiuse facilities. You can have restaurants you can have even office block. You

can have essential blocks around or even multi stored building on top of transit hub or station. And that makes it TOD or transit oriented development and which becomes a very good example of achieving sustainability in urban transportation. To encourage patronage of business, place them between vehicle parking areas and the transit stops. So all of these points, where to exactly locate a transit station is one of the design principle that you have to keep in mind.

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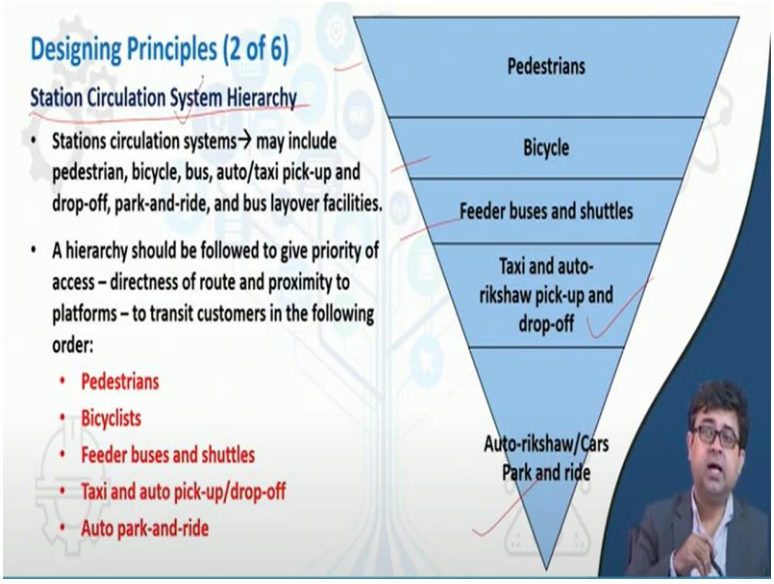

The second is station circulation so once you have decided where you have to locate your station then you have to design appropriately for the circulation within the station area. And your hierarchy of circulation is obviously the pedestrians comes first because the people will be walking mostly within your station area. So you need to appropriately incorporate all the pedestrian space requirement which we have already looked at when we develop level of service for pedestrians. There was an example on terminal for a station area level of service as well. So that will help you in designing the circulation areas for pedestrian. Then of course bicycle, feeder buses these are all outside the station come in the picture. When you design a transit building you have to have a circulation areas for feeder buses, taxi, auto-rikshaw drop off and also cars if you decide to provide some parking for cars. So stations circulation is the second principle that you have to remember while designing station area.

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The third is pedestrian and bicycle parking obviously there is no pedestrian parking. So when we talk about parking areas bicycle parking was never given much thought until the turn of the century where urban planners and urban transportation engineers started to research much more into how bicycle can be beneficial to the public transportation network. They found that bicycle is an inexpensive mode and is also environment friendly although they cannot take you long distances. But they can definitely bring you to the nearest metro station or a BRT station or a bus station. An average bicyclist can bicycle at least 3 to 5 kilometers effortlessly. If you are a regular bicyclist you can go even further but even an average bicyclist can bicycle every day for 3-4 kilometers. And if you have a metro station or BRT station within that range then you should be encouraged to get your bicycle to the station. And once you get it into the station then you have to have proper parking. Otherwise informal parking of bicycle that we often witness around stations does not attract new people to take the metro station. Those are mostly people who are big captive riders who would be using the metro station if you do not provide appropriate parking because nowadays even bicycles are expensive. Some of the new bicycles are expensive so you have to provide safe parking spots in order to encourage people to use BRT or MRT.

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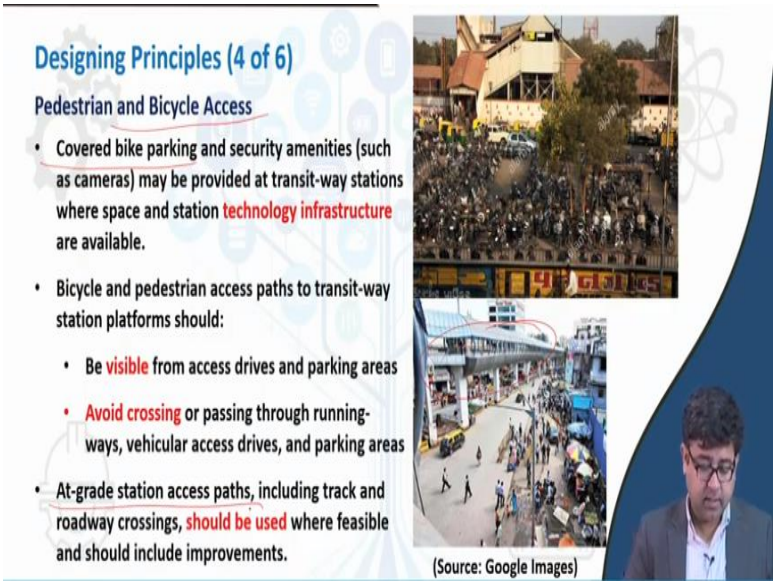

Then the next designing principle is access. We have already look at access, it is usually encouraged that access be provided at grade. So for example if you have such a grade separated facilities which have been extensively built to connect the Mumbai sub urban railways to various points of the road network. But they often face the criticism that are not well maintained does not provide security at nights. So it becomes a different challenge once you have that expensive piece of infrastructure which then requires continuous maintenance. You can have them especially in Mumbai where you have to separate pedestrian traffic with the motorized traffic. But more often than not for your city which may not be as large as Mumbai you would rather recommend to provide at-grade facilities rather than grade separated access facilities to metro stations or BRT stations. These are less attractive because once you provide grade separated facilities then people with luggage usually do not want to take or climb up or down the stair with it. Old people would also not use it. Even people in a hurry would not use it they would say that well I have minimal risk if I cross the road at grade versus if I take the stairs. Grade separated access has to be very carefully designed, provided they are not for every location or not even for an average location. They may be for specialized location. But mostly you have to have at grade access to these station areas.

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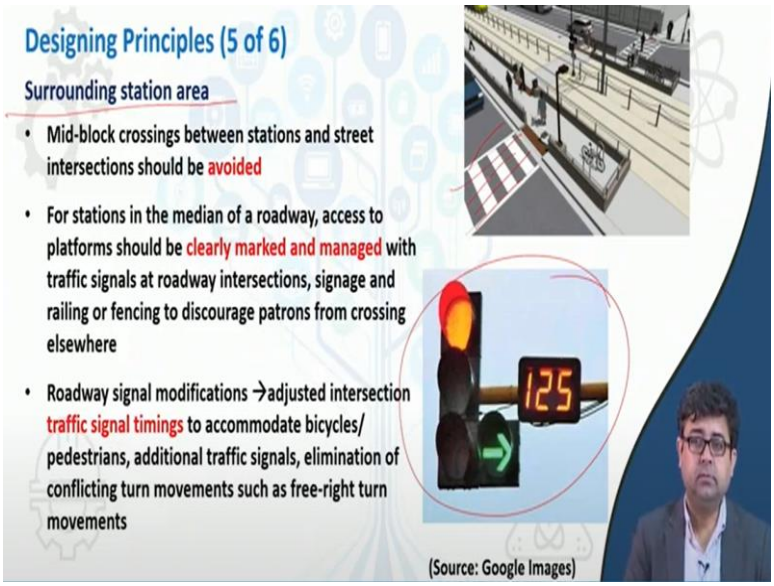

The fifth design principle is to design your station surrounding areas carefully. Do not only look at your station building itself and believe that is the your only jurisdiction for planning and designing. Your design should incorporate some of these surrounding areas as well. Make sure you have good pedestrian connection. Make sure you have signalized connection close to your station areas the signal timings are such that they benefit the people getting in and out of your station. Because that signalized intersection should benefit the station users rather than the vehicles that are going through or not stopping at the station. Those pedestrian crossings are allowing people to get into the station and thus have to be also the part of your design of this station building. Often what happens is transit authority does not have jurisdiction over the surrounding area and they leave it to another entity to design that. And then when you do not coordinate with that entity then you end up with station area with no proper access and then people patronage of public transportation goes down. So rather you take it into your jurisdiction itself and say that 100 meter radius around my station perimeter is what my jurisdiction is. And everything within that jurisdiction should be designed and planned to safely take my user from the station building from the station area to the urban transportation network of the city. So keep that in mind always include the station area in your design.

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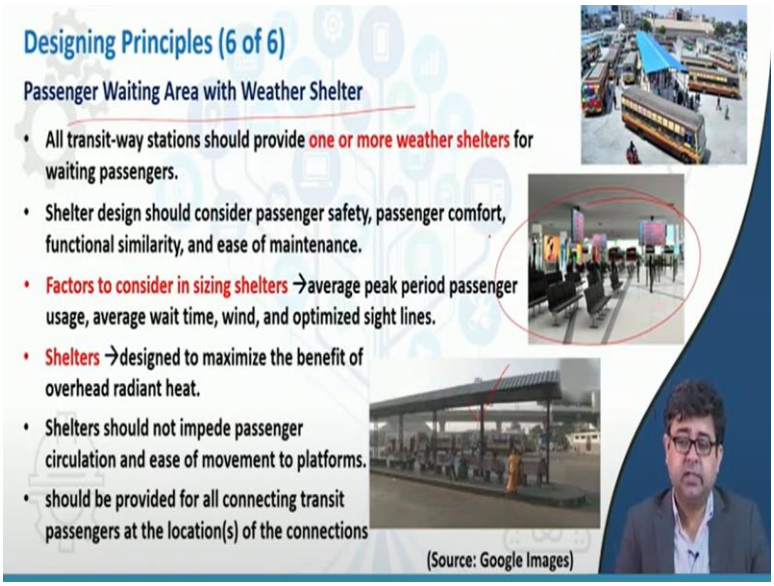

And finally the passenger waiting area and weather shelter. We have already looked at this very important aspect. You have to have a shelter even if you have basic shelter like that. For it better to have a basic shelter than not having it. This place a huge role in attracting people to ride public transportation because especially in India we have heavy monsoon season and summer heat is extreme. So these do provide lot of comfort when people are accessing public transportation. Of course, some transit center need to have even more sophisticated facilities because people are going to be transferring between 2 modes. For example so they will be sitting for longer period of time so maybe they need to have eatery and other amenities. So for designing a station you need to be thinking of all of these elements.

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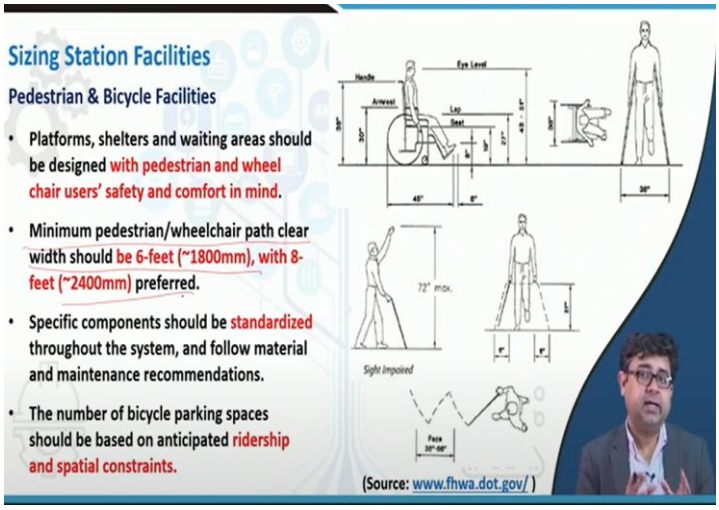

Once now that you have followed all these design principle, you have to look at certain standard for sizing different facilities you provide within the station. And many of these sizes you have already looked at when we were individually look at for each of these modes. You have to provide for minimum pedestrian wheelchair, clear path width of 6 feet to 8 feet, is preferred. So when you provide a path it cannot be any narrow than 6 feet. Then the wheelchair person would not able to access that station. So such standards may not be available for our context in India but best practices are available. From the best practices we can adopt and adapt these standards to our necessity, suited to our requirements. And that is what the whole point of this class or exercise is to make you aware of the standard so that you can take it forward in your city.

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When you are sizing you are waiting in shelter area you should not be just putting in a canopy. For example you should you should understand what size of the shelter that will allow you to or that will allow your passengers to be comfortably seated under the shelter right. So bus shelter provides should provide a minimum of 5 square per person during the peak period. So that should be at least 5 square feet for 1 person that is comfortably sitting or standing under shelter. So that based on how many people would be there then you can determine the size of the shelter in that station right. Just do not arbitrarily pick a size or pick a length and width of your shade. Again rail station shelter should assume approximately 3.5 to 6 square feet per person. So there are some ranges there are some standards there are some best practices that you need to follow station waiting and shelter areas.

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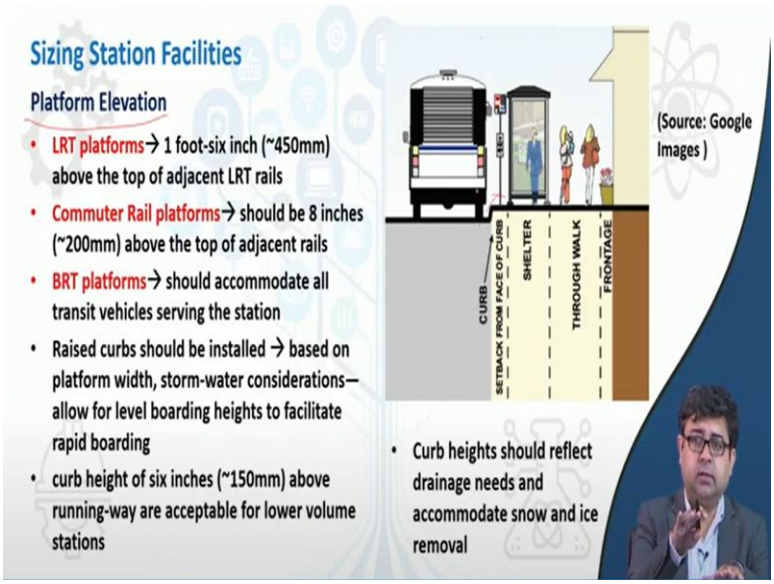

Similarly for platform elevation you should always try to have the platform area little bit above the curb. But how ever how much align to the foot board that you want to have your platform is something that you have to decide if there are if you have it have at grade with a foot board then you have to have a much thicker height of your platform. Otherwise that that enables for example people with old age or people in old age or people with disabilities to easily enter into your transit vehicle right. If there is a grade separate if your platform is not level with the bus platform or the rail platform then there is level different it becomes difficult for people to access it.

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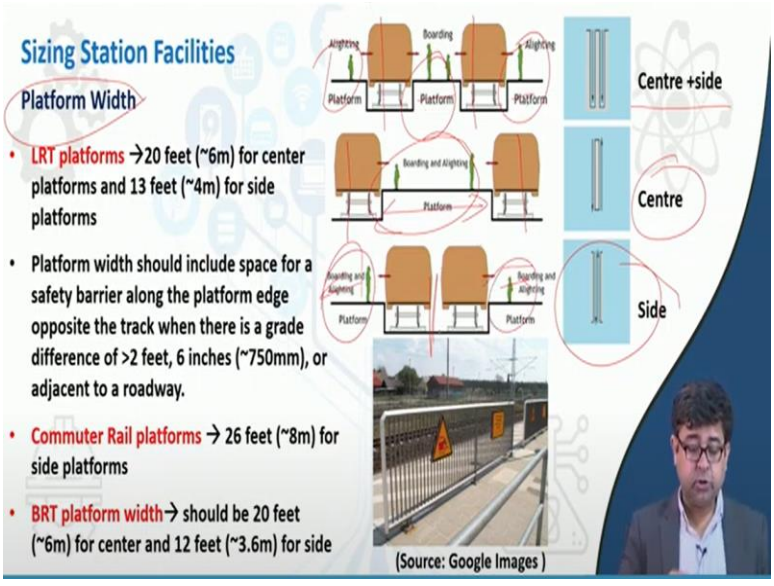

If there are platform widths can be different based on how platforms are oriented if you have a centered plus side platform. So if you are 2 rail lines are here and if you have platform here and also 2 platforms on the other side then the width of each of the platform would be different verses. If you only have a centered platform where both of the lines are served by only 1 platform then the width of that would be different versus if you have only side platform on either side and no center platform then you have your width different. So all of these have to be thought about for your purpose for your particular station and you have to design it accordingly.

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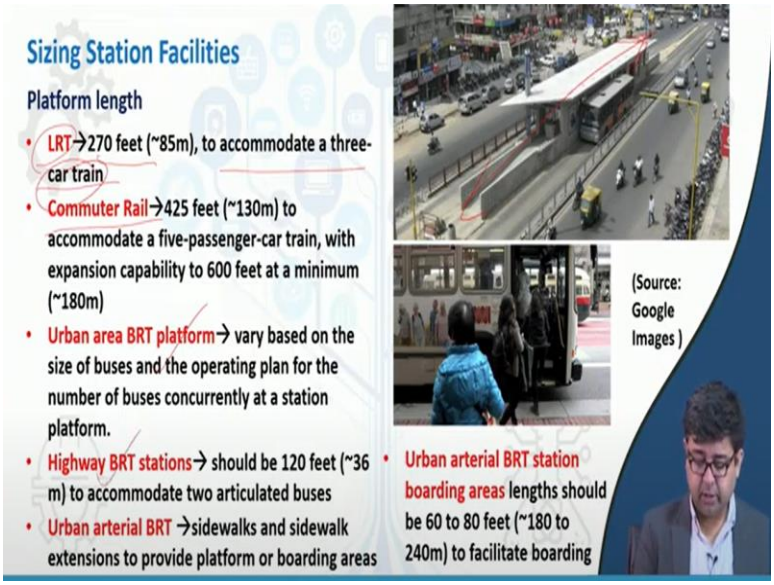

Platform length is the next element. How long should be your platform? So from best practices for light rail transit systems 270 feet is needed to accommodate a 3 car train. So 3 car train could be accommodate into the length of the platform because you know no point having long platform because the middle of the urban area. It would be taking a lot of space and becomes expensive to build. So you have to have an optimal amount of platform length also. But then you have to have some cushion as well right. If you add an additional car to the train then if you do not have appropriate platform length then you would not be able to add that. So add some cushion but you do not have whole lot of platform length because the land becomes expensive to build. So similarly commuter rails have different lengths platform lengths for standard BRT based on where it is. It is on highway or urban arterial they will have different length standard.

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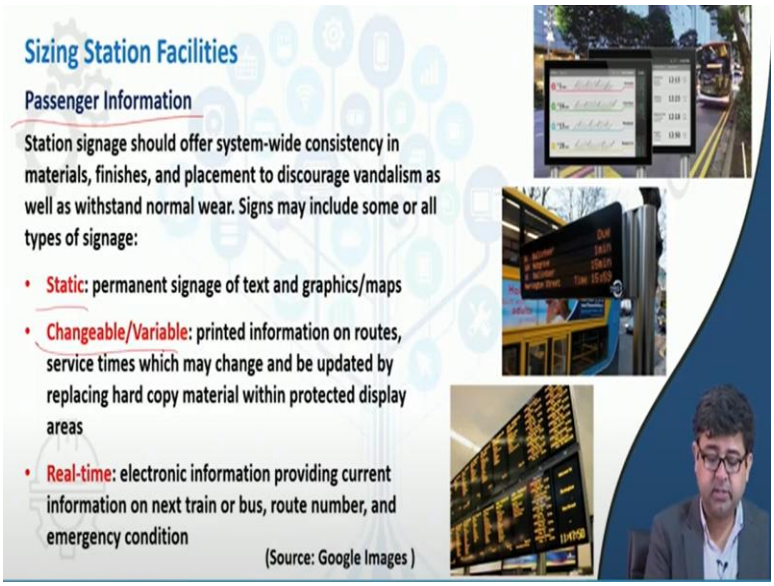

Passenger information is something that is becoming essential especially if it is transit center or transit hub where people wait for the next bus or next train to arrive and they have to have information that is at appropriate location. So that they should not miss the train or bus. The information display could be a static signs or changeable variable signs or sometime real time information can also be provided to passengers while they are waiting at these facilities.

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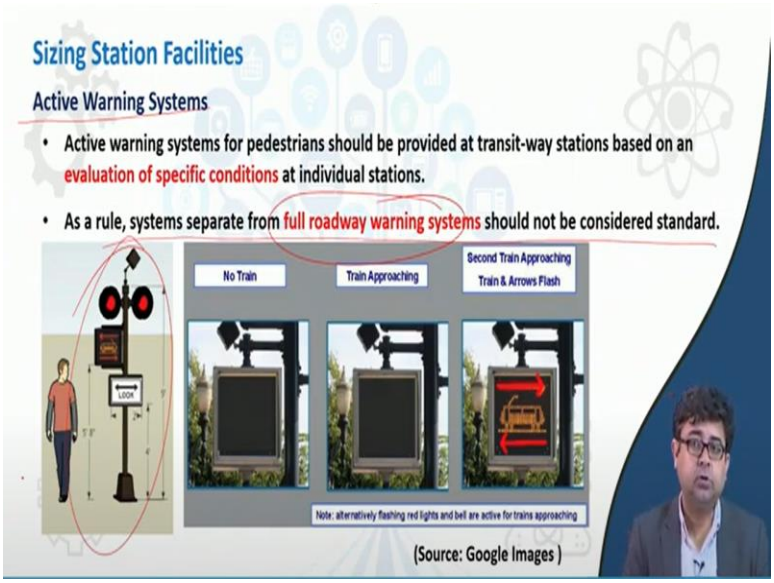

Warning signs are usually regarding the notification that the train or bus is arriving so those kind of system have to be also in place these are more for safety and security, and as a rule, systems separate from full road warning systems should not be considered standard. So do not provide

active warning system that provides warning systems for the roadway as a whole and provide for your transit system separately so that you do not have to. For example if your station is at grade with road and the road has a traffic signal associated with it, you need to have your own standalone warning system as well. That will warn that the bus is arriving or the train is arriving at this station. And so you may be coordinated with the traffic signal at the road but do not just rely on the roads signaling system have your own active warning system.

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Finally the design review process allow you to gives you checklist of all the items that we just went through. And if you have a checklist you go at each of your station on your metro route or on you BRT route and make observation that whether they are following your design principle or not and once you have this checklist it is easy to review, what are the change that needs to be done at this station versus that station. Maybe one station is perfectly fine whereas the other station needs a lot of help. So this allow you to keep a check on all of your station in your system and allows you to develop a priority improvement program for improving your station design plan keeping in mind again that these are done for multimodal transportation system.

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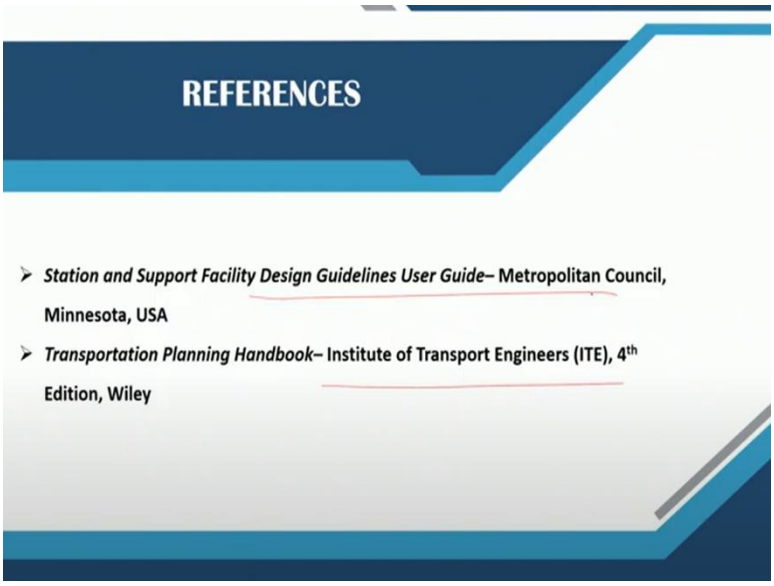

So that is it for this lecture series. These are the references from which we have collected all the information. The ITE handbook is the older version that is available for free. So you should be able to look at it and this is one of the best practices that we were able to pick up from the United States and you should look at that. But may be keep in mind that when you developing it for your city catering to local conditions.

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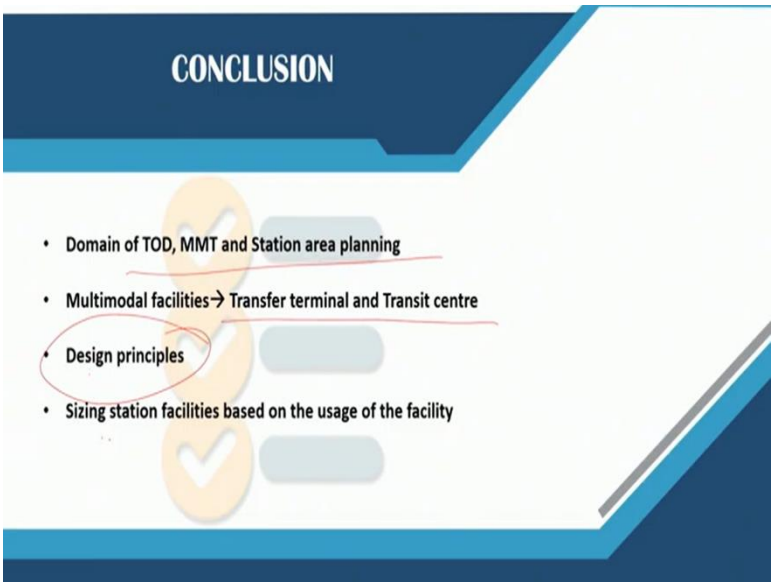

So in conclusion today we looked at where the station area design plan fall and how it turns in the intersection between TOD and MMT and station area planning. And we looked at transfer terminals and transit center how they differ and their similarities and then we got into how to

design these station areas. What are the 6 design principles? And we finally looked sizing each of the different elements in the station. Thank you very much for your attention.