Introduction to Multimodal Urban Transportation System
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Lecture-35
Non-Motorized Transportation (NMT) Planning: BLOS and Bicycle Compatibility Index (BCI)

Hello friends and welcome back! Now that we have looked at measuring the bicycle level of service using the highway capacity manual 2000 method, in this lecture, we are going to introduce you to another form of measuring the bicycle level of service that is using bicycle compatibility index.

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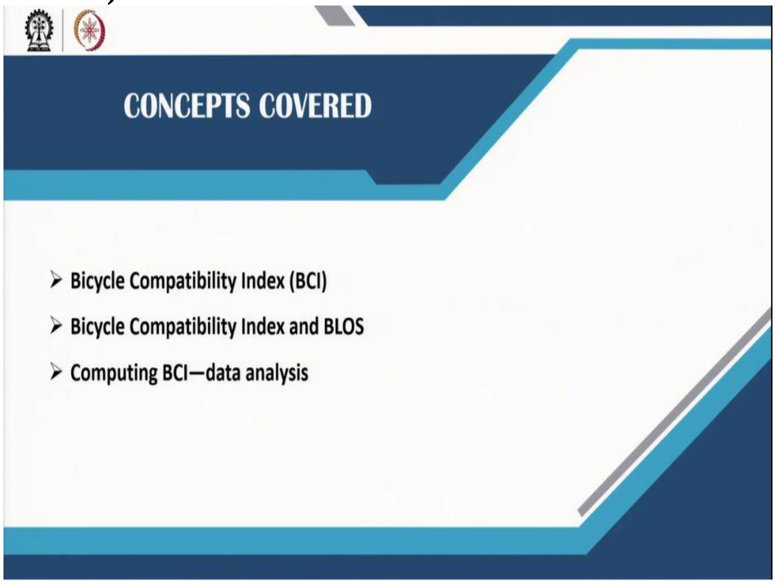

So, what we are going to tell you is in this lecture is what is bicycle compatibility index, how it is used for developing bicycle level of service and how it is different from the highway capacity manual for developing bicycle level service.

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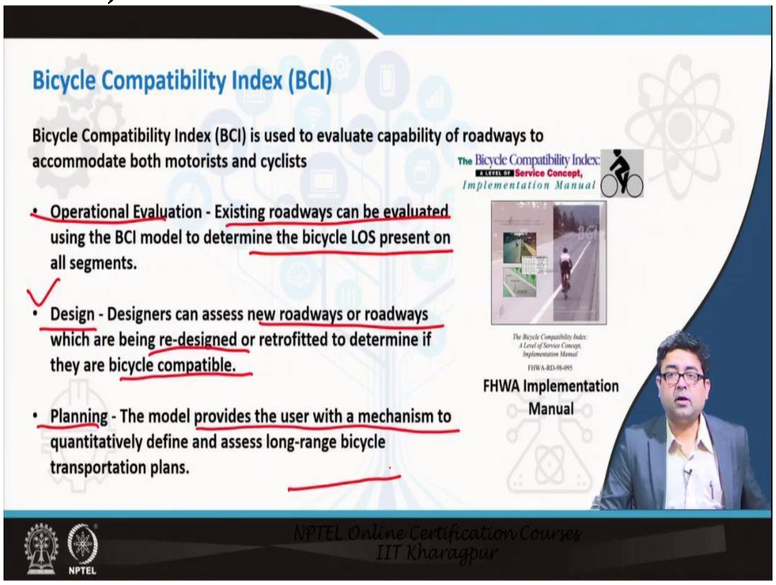

What the bicycle capacity compatibility index allows you to do is it allows you to conduct the bicycle operational evaluation, design evaluation and also planning. So it can be used at 3 different phases of evaluating your bicycle facilities on your urban streets. It gives you an operational evaluation for existing roadways and can be evaluated to determine how the bicycle level of service is present. On the other hand, designers can assess new roadways or roadways which have been redesigned or retrofitted to determine, if they are bicycle compatible. For planning stages the model provides users with the mechanism to quantitatively define and assess long range bicycle transportation plans. So this bicycle compatibility index can be used for different times or different phases of development of bicycle facilities. In the highway capacity manual method of determining BLOS we looked at that they must be existing bicycle facilities for which level of service can be determined using that method, but BCI allows you to do it for different phases of development.

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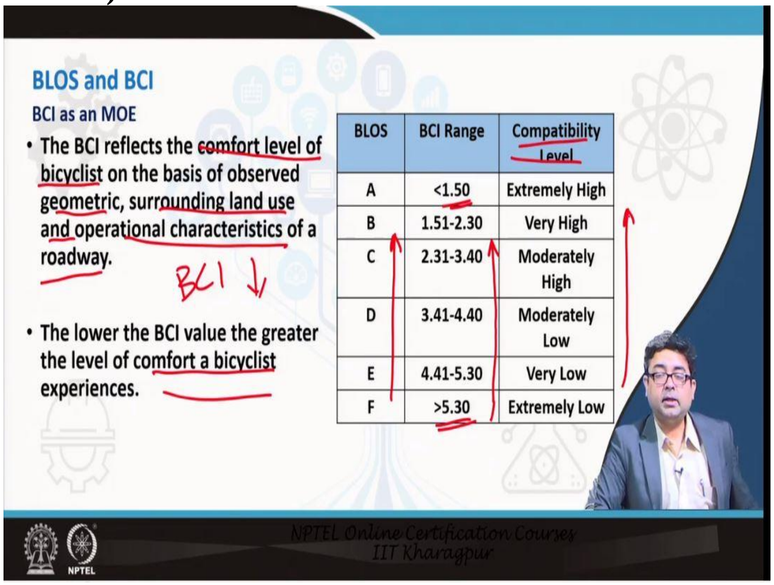

What it tells, what essentially BCI is an index. So, bicycle compatibility index reflects the comfort level of bicyclists on the basis of observed geometry, surrounding land use and operational characteristics. So, there are 3 different things that the compatibility index looks at, it looks at the geometric considerations, the surrounding land use and also the operational characteristics of the roadway. So, in essence, it is taking a little bit of a holistic picture of what a bicyclist may encounter while he or she is riding a bicycle on the roadway. So, these are not for dedicated bicycle paths or shared use bicycle lanes, which pedestrians can also use. So, these are purely for bicycle lanes that are on the streets that are that are sharing the right of way with the other motorists on the road. What it says is that if BCI index value is low, the greater will be the comfort level. So the greater is the comfort level the better is the level of service. So you see, as the bicycle index reduces from 5.3 to 1.5, the level of service improves and the compatibility level also improves. This is what essentially we mean by bicycle compatibility index.

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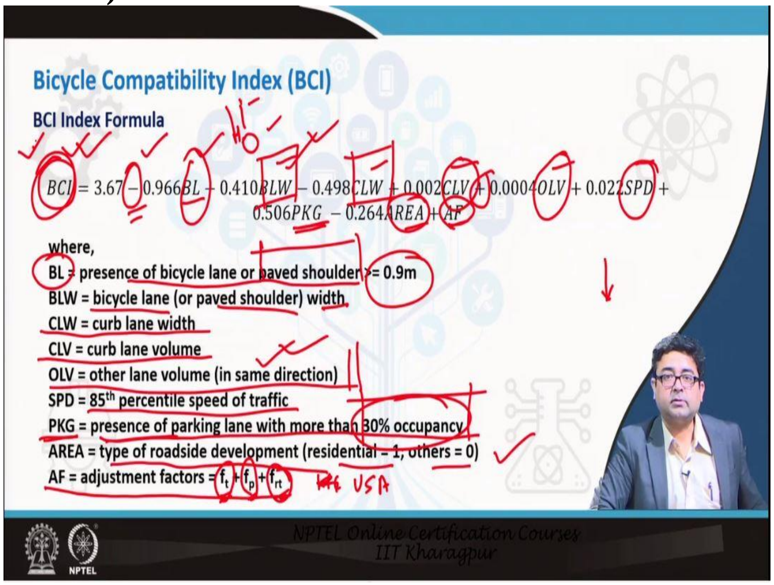

The index develops a relationship between different characteristics of the traffic and the area that a bicyclist may face.

$$BCI = 3.67 - 0.966BL - 0.410BLW - 0.498CLW + 0.002CLV + 0.0004OLV + 0.022SPD + 0.506PKG - 0.264AREA + AF$$

So, it is a multiple linear regression equation that gives you this compatibility index, which in turn determines how well the comfort level of the bicyclist is when he or she is riding the bicycle, on the roadway on the pavement or on the street shared with other types of motorized vehicles. So, if you start looking at each and every term of this, you will see that the first term that the compatibility index depends upon is the presence of a bicycle lane or paved shoulder, if there is a presence of bicycle lane or also if the road has a paved shoulder which is greater than 0.9 meter in width, then the bicycle compatibility index depends upon this factor called BL. The next factor that it depends upon is what is called BLW a BLW is the bicycle lane or the paved shoulder width. So, the first variable is a yes or no kind of a variable. Is there a paved shoulder greater than 0.9 meter or is there a bicycle lane? If the answer is yes, then that will have a value of 1. If the answer is no, then it will have a value of 0. It is a yes or no kind of dichotomous variable, whereas BLW is actually the width of the paved shoulder or the bicycle lane. So if BL is 1, this BLW can have some value. If this is 0, this cannot have any value. Next variable is called CLW. Now CLW is the curb lane width. What is the curb lane, the vehicular traffic lane that is closest to the curb, because the cyclists will usually bicycle very close to the curb. So the lane that is next to the bicyclists and closes to the curb is called curb lane. And the width of that curb lane is what plays an important role in impacting the compatibility index. The next one is the curb lane volume. So width of that lane and what is the volume of traffic on that curb lane. Next is other lane volume. All other lanes in the same direction there may be 2 lane in one direction and 2 lane in the other direction. Out of the 2 lanes, the outermost lane would be the curb lane and the other inner lane will be the other lane. So the volume of traffic on that other lane is what we are worried about. And we will not be worried about the volume of the traffic in the opposite direction. Next thing is speed. So the presence is again the 85th percentile speed of traffic. Remember how to determine 85th percentile speed, we have already told you. The next variable is PKG or the presence of a parking lane with more than 30% occupancy. So if there is a parking lane again, it is usually right next to the curb where the bicyclists usually bicycle. You will see very few bicyclists trying to bicycle in the middle of the road, they would rather bicycle on the side of the road which is alongside the curb. So, if there is presence of parking in that segment and that parking then is 30% or more occupied. Occupied meaning there are more than 30% of the spaces are filled with parked vehicles, then the variable is called the variable PKG will be 1 otherwise it will be 0 again this is a 0 or 1 type of a dichotomous variable. The next variable is AREA which is type of roadside development if it is a residential, then the value is 1 if it is others, it is 0. So there has been it has been noticed that the bicyclists' comfort depends upon the area if it is a residential area, they feel more comfortable versus bicycling in non-residential areas. So, it has been only for simplicity's sake it has been only divided up into 2 such areas. And the last thing are 3 different adjustment factors that have to be taken into account and we'll see what those adjustment factors are -right turning adjustment factors, i.e. if you have bicycles that is turning right, (because this is developed in the US it is right for our case, it will be left turning vehicles) and parking adjustment factor. If there is heavy vehicles moving on the road, so they have to have an adjustment factor for that as well. So you see when we were talking about highway capacity manual method of determining level of service of bicycles of dedicated bicycle lanes, they were dependent upon the number of events, how many events passing or opposing that a bicycles meet. Whereas, when we are talking about bicycle compatibility index, it depends upon a larger number of factors, because these bicyclists are on the right of way, that are riding their bicycles on the pavement sharing with other motorized vehicles. So, it takes into consideration a whole lot of factors in order to determine this compatibility index. So, we have looked at all of these factors, one by one, you have to also then look at their signs in order to understand their impact on BCI so, if it is a negative sign meaning the bicycle compatibility index is going to decrease by the presence or absence of a bicycle bicycle lane, so, if it goes from 1 to 0 that means if there are no bicycle lanes, so, this is a reduction and then the bicycle compatibility index is negative sign. So it will go up the number in bicycle compatible index goes up the bicycle level of service or the comfort level really goes down. So not only do you have to understand the sign with the compatibility index, but you have to also understand the compatible indexes relationship to level of service. So you have to understand both of those relationships when you are looking at the compatibility index and this linear regression equation.

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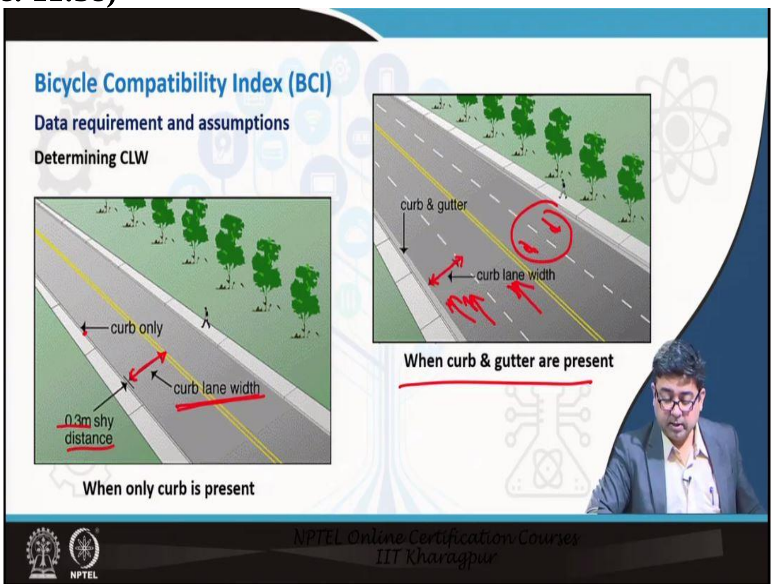

So here are some pictures which allows you to understand, what are all the different types of terminologies that we are looking at? So when we are talking about curb lane width, so if there is a curb, if there is a curb only here, and the curb it is about 0.3 meter shy distance because bicyclists will not hug the curb very closely. So when you are determining the curb lane width, it will be that width from the centerline to about 0.3 meters away from the curb. When there is a curb and gutter, then you also you can just determine the curb lane width from the end of the gutter line to the lane so again see this is a 2 lane road with 2 lanes going this way and 2 lanes going the other way. So we only are worried about when we are determining the bicycle level of service for the up direction. We are not worried about the volume of traffic in the other direction. We are only worried about the volume, direction the curb lane, which is this and if you are talking about other lanes it will be only the other lane present there.

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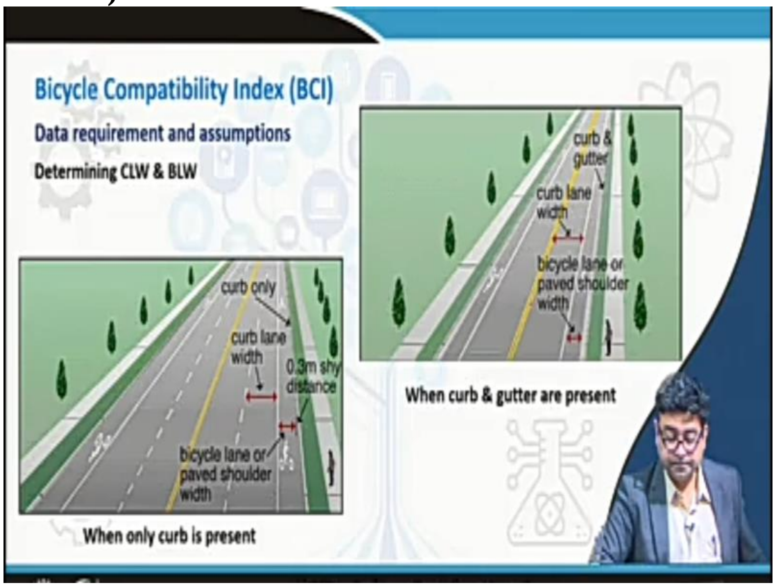

We also want to determine in the presence of a bicycle lane, then when we are determining the curb lane width would be width from the bicycle lane towards to the lane demarcation here. If there is only a curb present, again the width of the bicycle lane or the paved shoulder should be 0.3 meters should be incorporating the 0.3 meter shy distance from the curb. Similarly when both curb and gutter are present it is just from the gutters' line to the paved shoulder or the bicycle lane that will give you the width.

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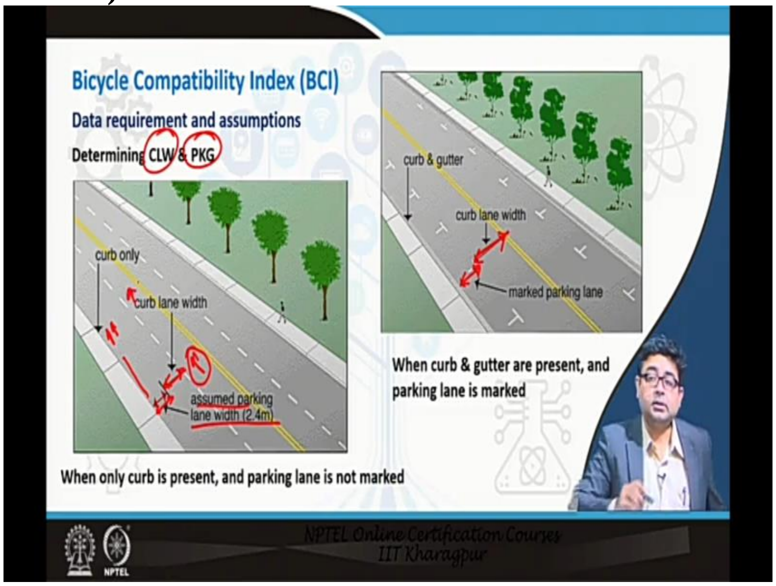

Now when determining parking, if there is parking and you want to determine the curb lane width, so it is assumed if it is not marked, i.e., if the parking lane is not marked, but parking is allowed along the curb, you can say that the assumed parking lane width is 2.4 meter wide. So you leave 2.4 meters and then you determine the curb lane width has to be that much, whereas if it is marked, then you already know where parking is available and the rest of it is the curb lane width. Curb lane width is the most essential because the width and the volume of vehicles on that curb lane impacts the comfort levels of the bicyclist in a greater degree as opposed to if there is another lane in the same direction. The volume of the vehicles on that lane does not usually affect because most of the bicycles, as they usually ride along the curb and not too much along the middle of the road or the outer lanes regularly.

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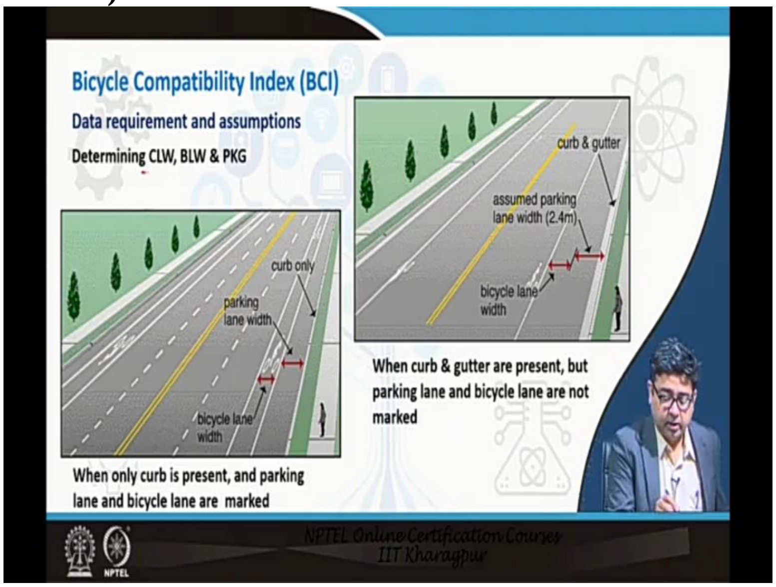

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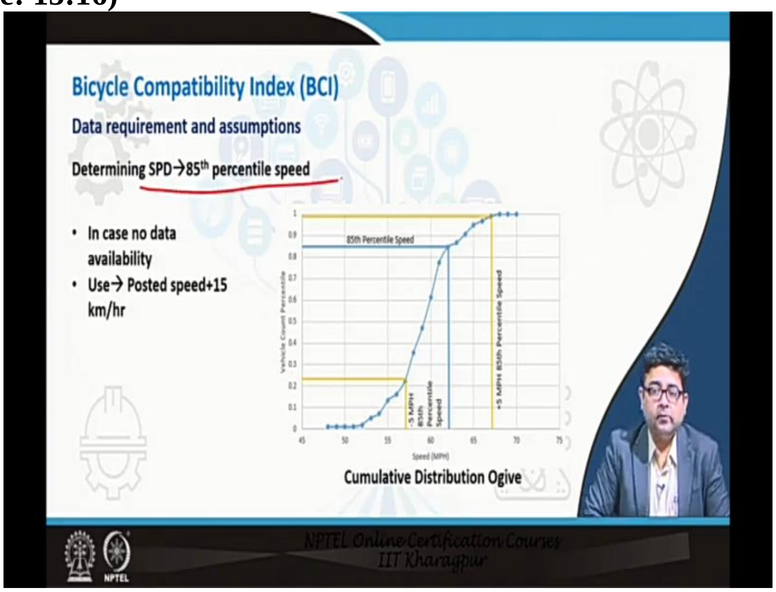

Similarly, if you are to determine curb lane width when both bicycle lane and parking are present, the dimensions are shown here once again. How do you determine the speed? We have already told you in the previous lectures -- 85th percentile speed is nothing but the vehicle count and the speed above which only 15% of the vehicles are traveling, that is called the 85th percentile speed. And that can be calculated in the field just by developing a cumulative distribution or Ogive. If you do not have data available, you usually assume that the speed on the regular speed is 15 kilometers per hour higher than the posted speed limit because usually the posted speed limits are on the conservative side and people drive at a higher speed than what is posted for that road.

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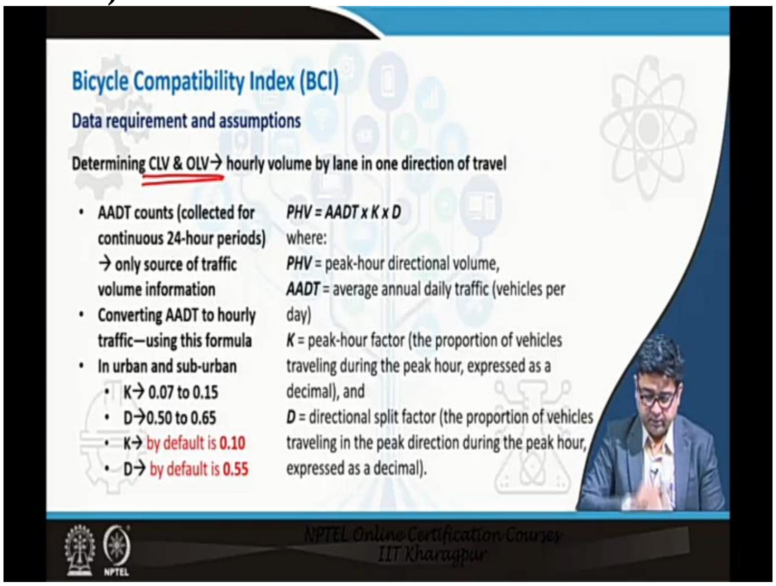

So, now how do you determine the curb lane volume and the other lane volumes? You know the curb lane width impacts the bicycle compatibility index and you also have to calculate the other lane volume, which impacts the bicycle compatibility index. So, how do you measure them? If you have AADT, it has to be converted into hourly traffic volume. AADT is annual average daily traffic collected continuously for a 24 hour period. This is the best source for traffic volume information, not the only source but sometimes it is the only source, but it is usually the best source of understanding what the traffic volume on that road is. So once you have the AADT, you can convert it to peak hour volumes by using by using k-factor, conversion factor that allows you to convert the proportion of vehicles traveling during the peak hour. You always are worried about peak hour traffic and that is the traffic volume for which you usually design facilities or you measure any measures of effectiveness. So if you know the AADT, you multiply that with the peak hour factor and the directional split. Again, directional split is the standard values are given here, 0.10 and 0.55, but it may be different for your street. And you can calculate that once you know the peak hour volume.

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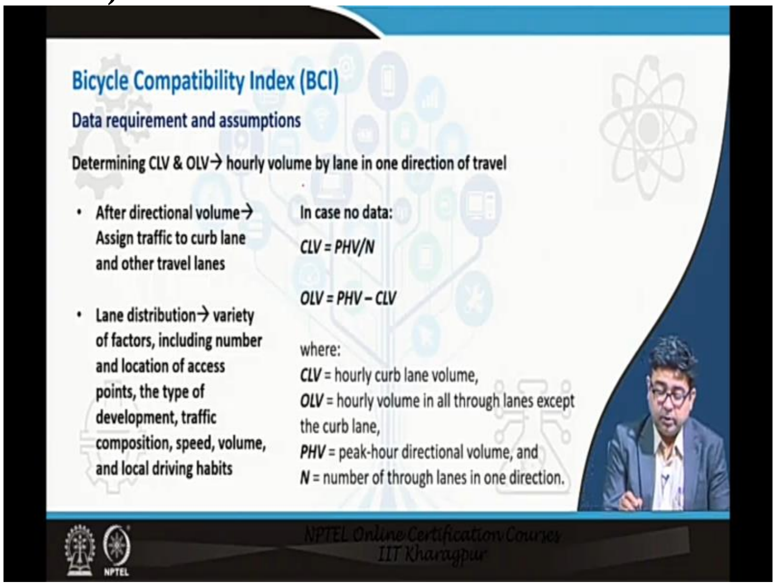

You can then use the peak hour volume to calculate the curb lane volume by dividing with the number of lanes in that direction. And if you have only 2 lanes, then the rest of the volume is going in the other lane. If you have more than 2 lanes, then you can just sum up the other volumes to be in the other 2 lanes. You do not have to know individually, what is the volume of traffic in the other lanes if the lanes are more than 2. So you calculate those.

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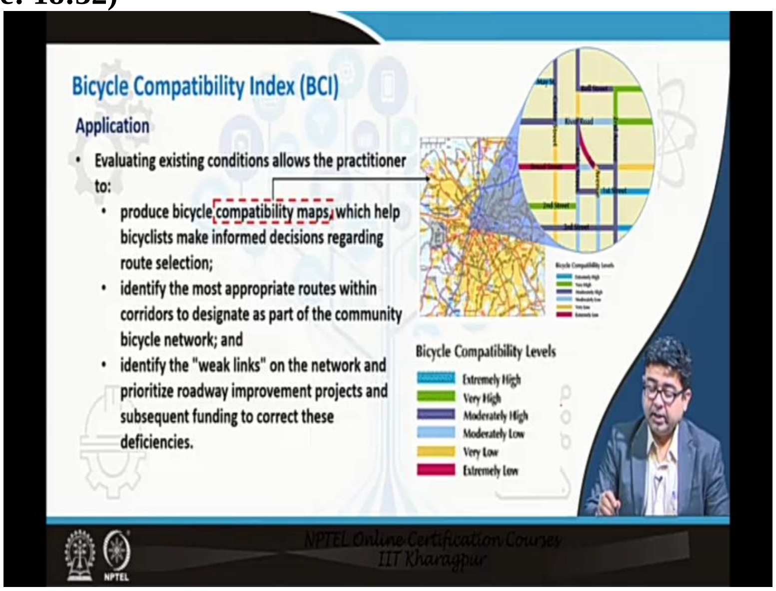

And once you know that, you can develop their compatibility index. So what happens is, once you know the compatibility index of each of these streets, then you can develop a map for your city or your region, highlighting the streets that are extremely compatible for bicyclists, i.e.,the ones that have low compatible index. This allows your bicyclists to have an idea of where to bicycle based on their own comfort levels. This is for an average bicyclist, we are talking about maybe bicyclists who are very young versus the bicyclists who are professionally good at bicycling. So their compatibility index may be different, but this is for overall average bicyclists. This also allows you to understand where the weak links are, how you can improve the compatibility index or the comfort level for an average bicyclist and work in that direction. So this is a very handy tool for your local urban local bodies, or your public works department in order to improve whenever they are either improving the travel lanes and they wanted to put in a bicycle lane. They can easily assess how the compatibility index will improve.

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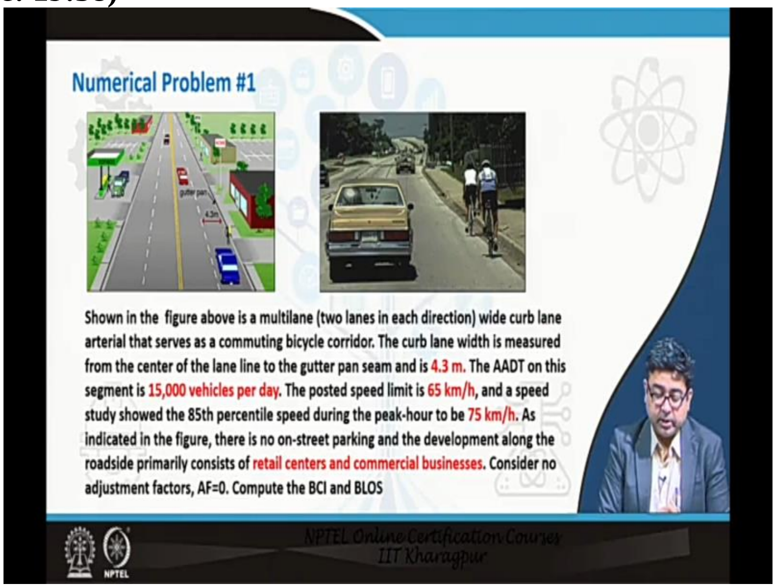

Now to solve a problem you can see that shown in these 2 pictures are multi-lane road, two lanes in each direction, wide curb lane, arterial that serves commuting bicycle corridor. It serves both the commuters and the commuting bicycle corridor. The curb lane width is measured from the center of the lane line to the gutter pan seam and is 4.3 meters. The AADT is 15,000. The vehicles speed limit posted is this. The study shows that the 85th percentile speed is however 75 kilometers per hour. As indicated there is no on street parking and the development along the road side primarily consists of retail and commercial businesses, and not residential. Also consider that the adjustment factors are nil. So there are no heavy vehicles or no parking and no right turn or left turn events so there are no adjustment factors available. How do you calculate the bicycle compatible index and eventually the level of service?

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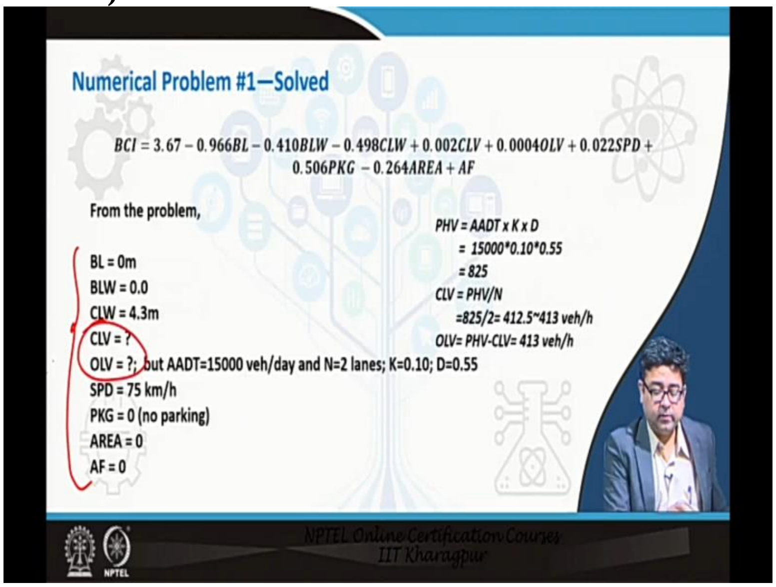

So, you are already given all of these factors, first thing to find out would be the curb lane volume and the other lane volumes. So, you already have the AADT, you have standard values of k and D. So, you know the peak hour volume, you know, it is a 2 lane road. So, you divide the peak hour volume by 2 you get approximately the curb lane width and the other half is the other lane. So, you know, now you have calculated both of them. You know that there are no paved shoulder. So BL is 0. Automatically there is no width curb lane with this given. Speed is given on the 85th percentile speed. It is also given no parking, and the AREA is 0 because it is not residential, more commercial and retail and there are no adjustment factors. So you plug in all these values in the BCI model.

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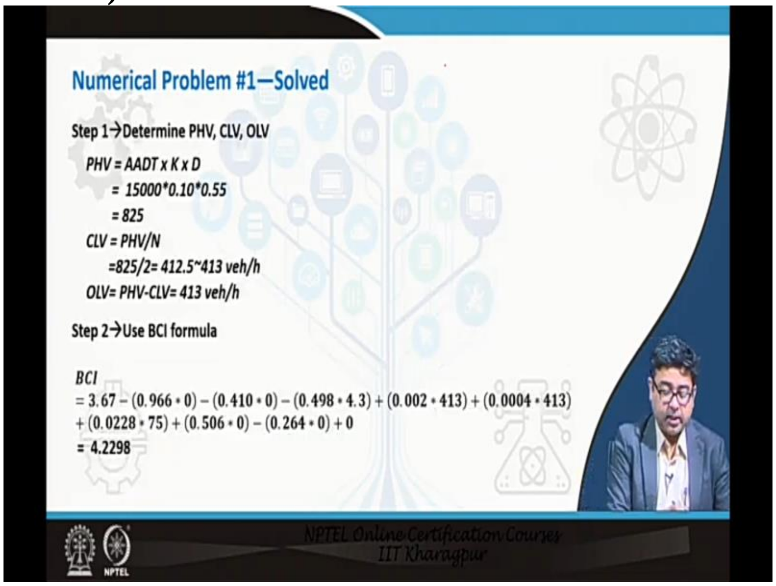

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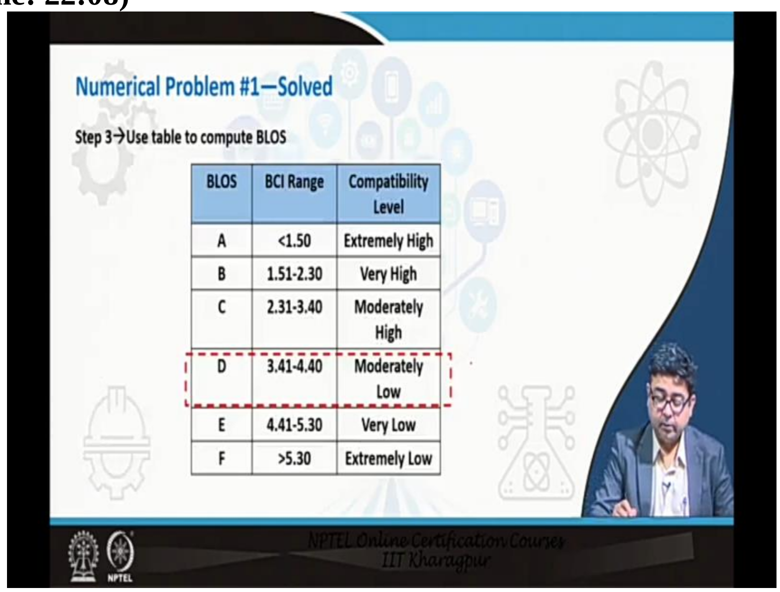

What you get is a BCI value of 4.22 or approximately 4.3. And if you go back to your standard table, you will see that 4.3 falls in the BLOS of D. So, then you can now say that for an average bicyclist who is bicycling on this road, for them the compatibility index is very poor or moderately low. So, a number of other steps have to be taken. And if people ask you what steps you might have to take, then you can easily tell them that based on these equations, you have to possibly maybe put in a bicycle lane there, demarcate a bicycle lane of a certain width, so that will help in improving the compatibility index, or improving the bicycle level of service. So, these factors will allow the urban local bodies to know on which improvement measures that they have to bring in in order to impact the BCI and furthermore the BLOS.

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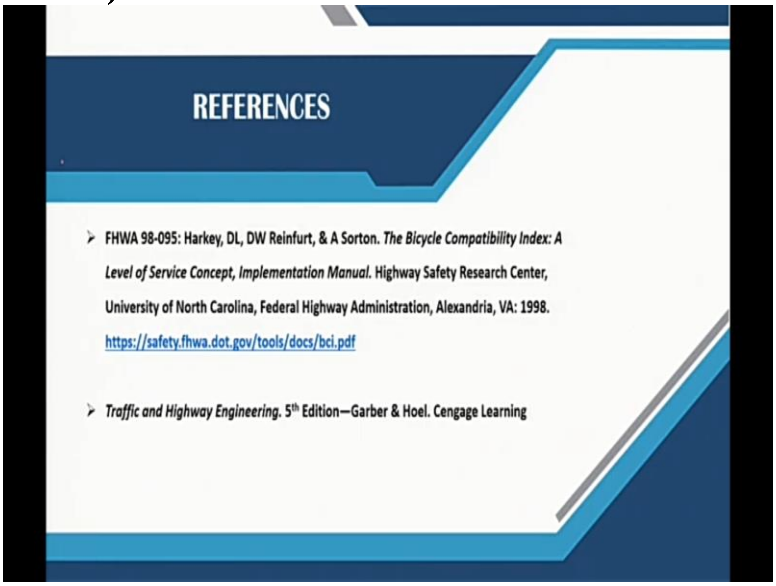

That is how you have to use your bicycle level of service. So, hopefully you have now got an overview on understanding how bicycle level of service and compatibility index can be calculated. As we have already told you, this is a very new phenomenon in India, and we are yet to develop our own measures, but giving you an idea about this about the international best practices helps you take it forward and developing an India specific bicycle level of service.

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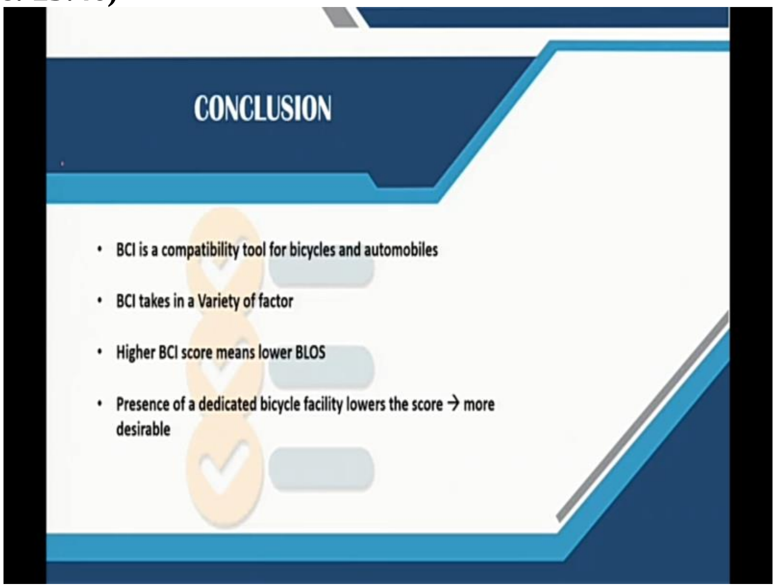

In conclusion, what we have looked at is—what is BCI? What are the factors on which BCI depends upon and we have also understood that a higher BCI score means a lower BLOS value. So that is something that is important to remember. Thank you.