Architectural Acoustics
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Lecture – 38
Urban Noise Control: Planning Consideration

Good morning. Welcome to the NPTEL course on course on the Architectural Acoustics. We are in the last week, the week number-8 and this is the lecture 38. In this lecture, we will discuss about the urban noise control and through a planning consideration, the urban planning consideration, and this is a lecture 1 on that. If you remember in the last two lecture, what we have discuss is the environmental noise in general.

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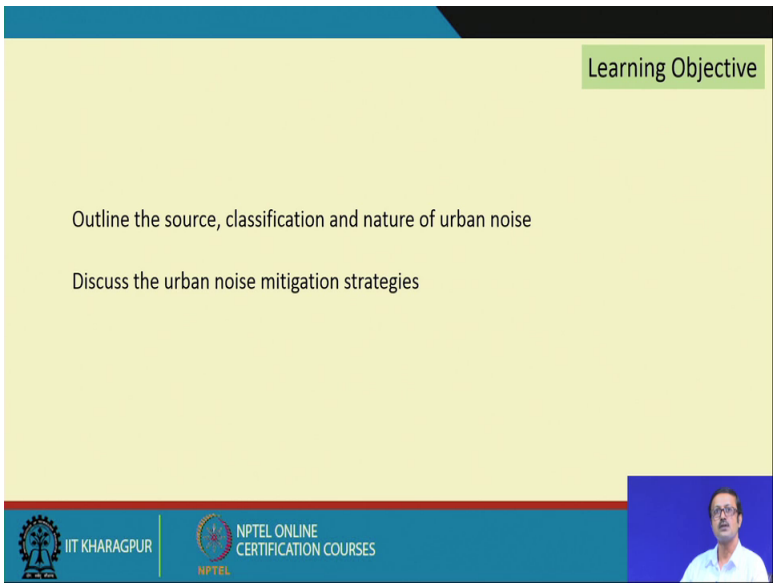

And now we will try to see the urban noise, and from how the from the planning aspect, the urban planning and the city planning aspect, how it this can be mitigate this urban noise, which is day by day these things are increasing. And creating a huge problem in the citizens and the urban's people. The outline the learning objectives includes the outline of the source classification and the urban nature of the urban noise, we will try to do the classification, and try to find out what are the sources and all. And will also going to discuss some of the mitigation strategies for the urban noise.

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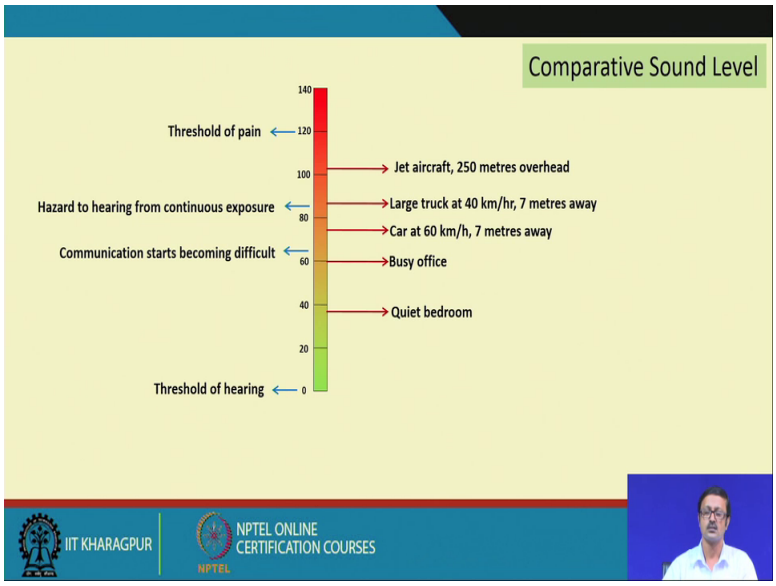

So, let us compare first the noise level. So, this is this particular vertical scale indicates the 0 to 140 dB scale. And as you know, the left hand side about I have put is in that the different subjective feeling for any such noise. The 0 dB is threshold of hearing, and almost to 120 dB is the threshold of pain. Intermediately there are a communication starts become very difficult to win the noise level is just a little above 60.

Then the this communication between one people to the other people will be gradually become difficult that is the one of the benchmark, the minimum level of that particular communication is required some kind of a less amount of background noise. And if it is a little more than 80 (Refer Time: 02:34) 85 also. It is can be (Refer Time: 02:38) as a hazard is and that is kind of a dangerous from the health point of view, if the any person is continuously exposed, within that amount of sound for a longer duration.

Now, let us in the right hand side, let us see what are the situation in different atmosphere inside building and the outside building, this around 37, 38 is a quite bedroom really quiet bedroom, and busy office is almost about 60 also. And a car at a speed of 60 km per hour around 6 to 7 meter away is almost about 75 dB or something like that. But, if it is a truck, it is having almost speed of 40 kilometer or which is a normal speed for a truck, and again 7 meter away almost gives 80, 85 dB sound. And of course is depend upon the condition of the truck also the condition of the road condition etcetera. But, if there is a

jet aircraft, and even if you are 250 meter away from the jet aircraft, its process 100 dB sound limit also.

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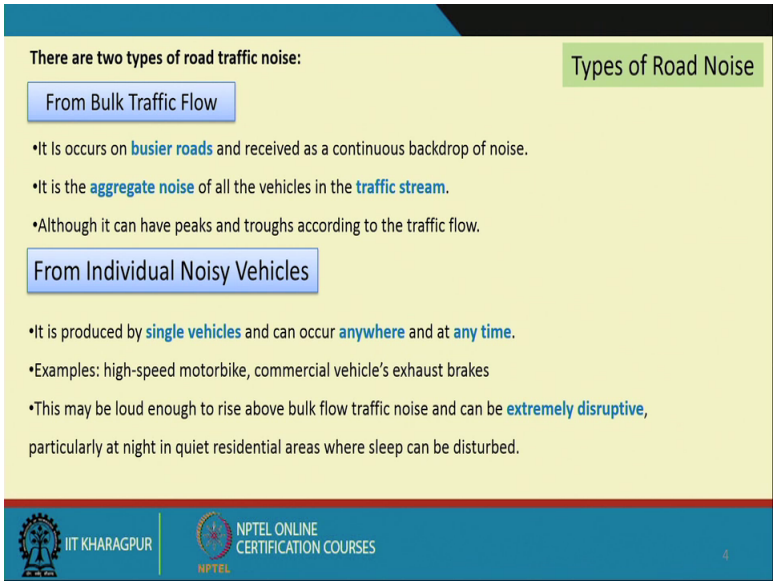

The type of road noise, there are two types of road noise. And one called from the bulk traffic flow, and it is because of the mainstream traffic flow. And it is aggregate noise of a particular busier road, which is have a kind of a continuous noise level also. And there are sometimes there is a peak, and there is a troughs, but it is depend upon normally it is a aggregate noise source.

The second one is called from any noisy vehicle from individual noisy vehicle. Suppose it is a quite road, but there is a vehicle moves, which is a noisy vehicle kind of a thing with a siren or maybe some kind of a horn or something like that or sometime which is sports motorbike, very high speed motor bike, and some kind of a commercial vehicle, so that is actually from a noisy vehicle or noisy source individual noisy source also.

So, it is loud enough and because of it is a loud enough, and it is a again intermediate kind of a scenario, it is kind of a overshoot, and then go down, and it is sometime extremely disruptive. And if it is very frequent in a nature also, then it is a extremely disturbing and because of that in the residential zone in a quite residential zone, this is going to hamper the sleep. It is a problematic for the old age people or also for the infant.

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So, there are let us see there in a traffic noise, the individual traffic or individual a automobile has produce noise because of this particular reasons. The engine produce noise; the transmission also produce noise; exhaust that also produce the produce noise; interaction between the tyre and the road pavement that also produce kind of a noise; the air turbulence and also the bodies; and the load rattles and although kind of things are also produces noise.

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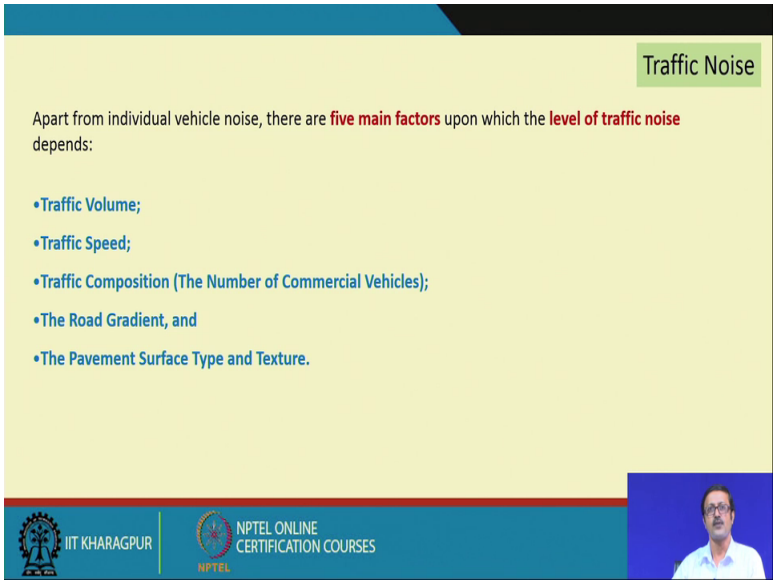

Then there are some five factors has been strategically pointed out in are the Central Pollution Control Board by lot of thorough examination, and the thorough research that the level of the traffic noise is also depend upon this five main factor. The first one is the volume of the traffic. The second one is the speed of the traffic, the average speed of the traffic, it is vice versa.

Sometimes volume of the traffic if it is high, quite normal that the noise is also going to be high; the speed is also it is again, it is not directly proportional, but it is if it is high also going to be high the noise. But sometimes if it is a day speed also, it is a congestion kind of a thing, which is also sometimes give you kind of a noise because of the exhaust and some kind of a motor always running, so that also gives you a noise.

So, even though if there is a traffic congestion that does not mean that there is no noise pollution or the know, it is also produce some kind of a noise. Then the traffic composition is a also one of the issues. It is a issue like the traffic composition is a mix traffic scenario. It is a slow moving cars, slow moving vehicles, so slow moving some rickshaw, and all those kind of a [FL] and all and with that there is a car or may be some kind of a lorry and busses, and all those kind of a thing bikes, which is bit of high speed.

So, if this kind of a compositions are there, and normally there are noise scenario more noise scenario. So, a composite kind of a character of the traffic gives you a noise. If it is uniform kind of a traffic, it is may not give you that I mean there may be a less amount of noise. Of course, there are also some different opinion about that or may be some you should not be on only this factor there are other factors also. In general again a road gradient is also one of the issue. The gradient of the road, how it is a steep or it may be a flat road also. The pavement type and the pavement type texture surface quality is a definitely one of the factor that also import the noise, I mean the amount of the noise.

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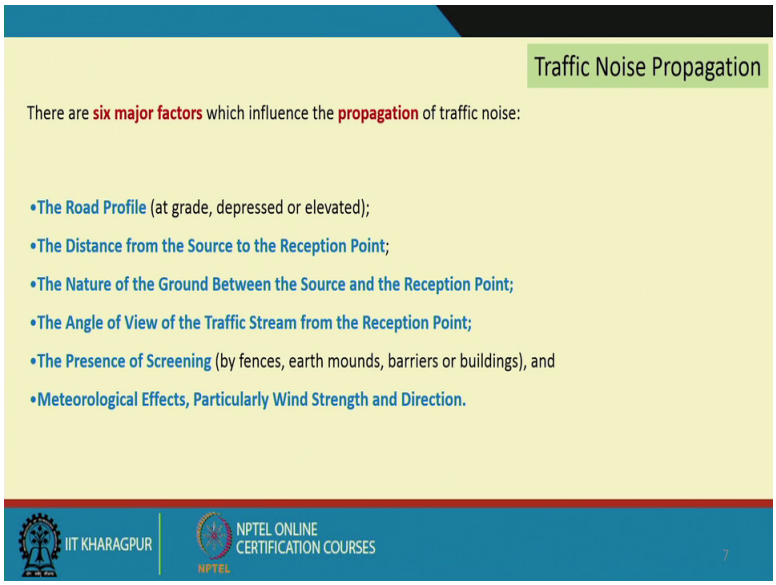

Again so those are the first what I have discussed is the which component of a particular automobile produces the noise and then the five those factors of a road or the compositions of the traffic. And then the six major factor also identified in our code are this pollution control literature that which actually propagate the from the propagation point of view, which six major factor contributes in more. The first one is the road profile, the grade, the depressed or the elevated road or the depressed road also. The distance from the source to the reception point that is also important, if you are further away from the noisy road, so definitely you are less exposed to the noise also.

The nature of the ground between the source and the reflection the reception point; if the nature of the ground is very much hard, it is reflective stay back. If it is kind of a soft, the greenery is an all definitely it is absorptive, it will not propagate that much amount of sound. The angle of view of the traffic stream from reception point; so, is it a direct angle of view, the view and sound are actually correlated, very strongly correlated. If the line of sight, and the line of hearing or the line of sound, actually going to match with each other.

So, if you cannot we shall I, if you cannot see that particular noise source because of some kind of a barrier in front, it may be natural barrier or it may be a man made barrier, it will reduce the sound also. The presence of a screening on how you are going to screen out, the particular noise source, barriers or building and all will discuss in detail in the

next lecture on that. And the meteorological effect like the winds and the strength of the wind, and the direction on the of the wind also, in sometimes rains also can create a kind of a changes of the propagation of the sound. So, those are the six factor, which from which a noise propagation will going to here.

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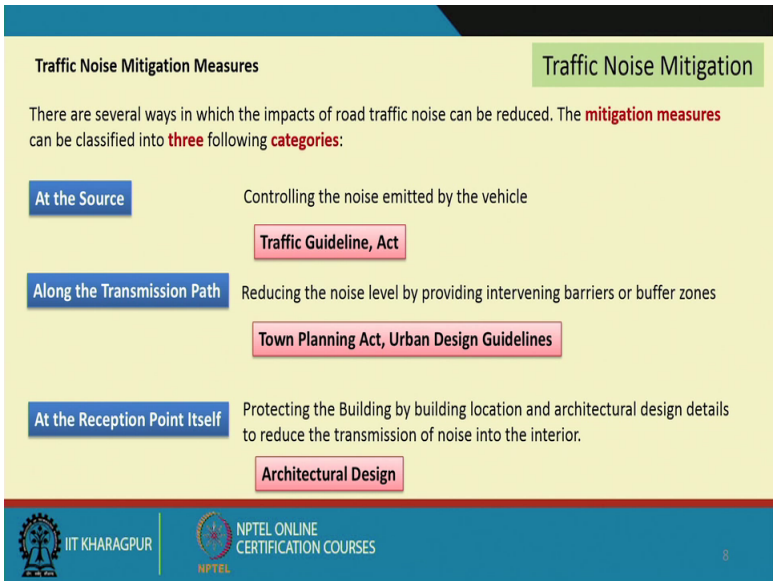

Though now, in the traffic noise mitigation measures. So, in that but now our objective of this particular lecture is or maybe, this subsequent lecture is how to mitigate that traffic noise, how to minimize, how to you cannot just avoid the traffic noise, now it is it is impossible. Of course, you can actually reduce down the impact of that, because with the some strategies.

And in these mitigation strategies or the measures of the mitigations is broadly classified into three categories. One at source, you can control the noise from the emission point or the emitted point from the source of the noise source that is from the vehicle itself you can actually control. And if you want to do that, you can minimize the huge amount of sound as such.

Sometimes we can go to the second category, which is along the path of the transmission. The along the path of the transmission means from the source to the transmission, source of the noise may be a road. And the transmission there is a transmission path. And the finally there is receiving in which is my building, my may be hospital may be a residential zone. So, this travel this particular portion of the travel portion, this travel

path also we can do some kind of interference, we can do some changes, we can do some kind of a barriers. And lot of the some kind of a landscaping or maybe some kind of a human barriers, and all that can also help us from the (Refer Time: 12:41) I am the reducing the noise.

And the third and the final one, at the reception point itself that means, at the building level itself. So, you may not do anything on the source, you may not do anything on the path or may be path is too small that your building is very near to the sources. There is no amount of path is available for a trees, spinning or anything. So, you what you have to do is that other reception point, you have you have to actually design your building such away, architecturally you are the way architecturally some way are that many from the orientation point of view some kind of the site, landscaping or the site planning point of view such a way that you reduce the sound.

So, if I want to do the first one at the source level, I need to do some kind of a the act, I need to do put some kind of a very strong act maybe some kind of a traffic guidelines. Those at the source level, so you can reduce the source sound. If I want to do the second one the along with the transmission path in between the receiver and the source, then I need to have some kind of a town planning act that this much amount of area to leave, you this much I cannot construct anything, this has to be this much of are the wall and whatever. You can do some impose some kind of the urban design guidelines by virtue of that you can actually reduce the transmission of the noise or you can sometimes bifurcate the noise in the other directions also which will not going to actually disturb you are sensitive zone, my sensitive zone.

And if you want to do the third one is that the reception point, so you have to actually back on the architectural design. Because, in that case the third case you have to receive a reception point that is a building you have to think, so it is the duty of an architect to design a building, and the shield that noise the shield in the building from the noise the out outdoor noise point of view. So, in a nutshell this is the traffic noise mitigation technique.

So, in this particular lecture, we will discuss on the first one only the at source how we will do. In the next lecture, in the lecture number 39, we will do the second one the urban

noise mitigation through the transmission path and all. And in the last lecture, in the lecture number 40, we will do with the architectural consideration.

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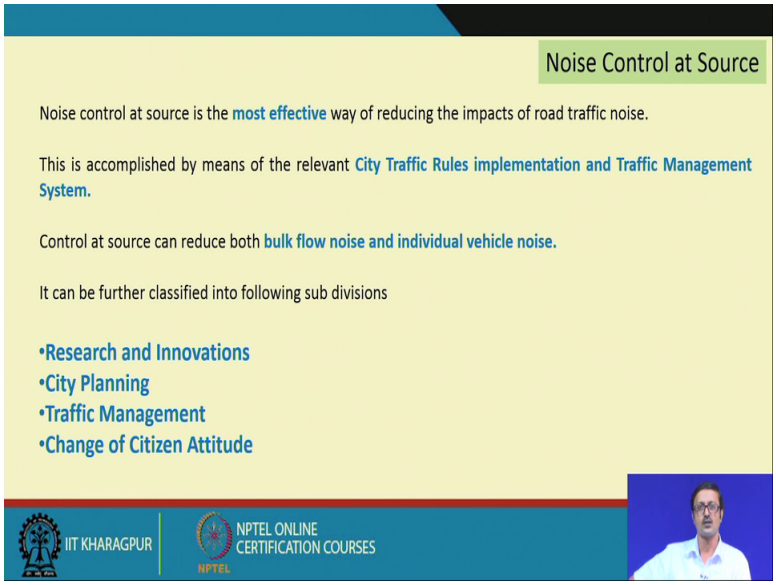

So, the noise control at source yes I have already told you, it is some kind of a most effective way to reduce the noise. Because, if the source is weak definitely weak in the sense of the from the noise producing point of view it is weak, then definitely you are all problem solve though, but though it is very tough to do. It has to do some with some kind of a city rules implementation, and due to some kind of a traffic management system.

It control of this reduction has to be implemented both for the bulk flow for the noise and also from the vehicle noise. And those are the following subdivisions can be made from this particular point of view. This noise control at source one is research and innovations, then the city planning, then the traffic management and also from the citizen.

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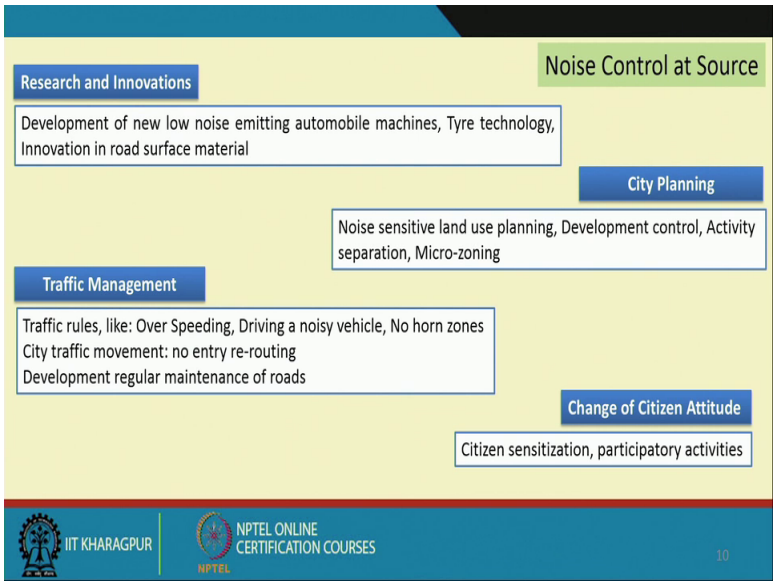

So, what is the research and innovation point of view is that the development of the some kind of a new low noise emitting machines, automobile machine some kind of a new tyre technology. Even some kind of a new road surface material those are the areas, which the research and innovations can be thought of or may be implemented in our automobile industry or maybe in the construction road construction sector that can reduce the noise.

The second one is the city planning, city planning the town planning. And the city planners are actually may do some kind of a zoning or maybe some kind of a by I mean the distribution of the noise sensitive zone. And the proper use of the land use planning that two which actually areas of a city is very noisy. So, you have segregate the in the master plan that this part of will be used for the commercial zone. And this part will be the residential are the noise sensitive zone, so that kind of a things, they can the implement or propose. They can do some kind of a development control rules also. Development control rules in the sense that, this area this particular building type is not permitted or this particular area if you have to construction some building, you have to give minimum amount of this much amount of setback.

All those kind of a development controller or maybe sometimes, you know the high rise buildings also may be exposed to the noise, because there may be a boundary wall or there may be some kind of the barrier. So, the upper floors are very much exposed to the noise. So, you can also develop some kind of a development control act for the high rise.

The what will be the height of the buildings, definitely city plane has do those, but may not be a for the noise point of view, but they control the height of the building because of the some the vicinity of the airport sometimes or sometimes, it is because of the gradation from one point to the other one point to the deeper point from the road point of view.

And for the further sometimes it if it is a commercial zones, utilize an a maximum fi are and all. For those kind of a area cases the do the limit the height, but may not be from the noise point of view. Sometimes we can they can also think of are they definitely do some kind of a micro zoning. In a zone and in between there are some kind of a micro zoning a suppose kind of a satellite city, a part of the city is actually now look into in the various micro sectors. And those micro sectors can be segregated or may be differentiated because of the noise sensitivity point of view.

The third one is the traffic management. This is another important area, where we can thought of and that can be actually minimize some kind of the noise from the source. Some traffic rules, some kind of over speeding rules for over speeding. So, then driving a noisy vehicle, so there may be some kind of a penalty, no horn zone can be created in some areas. The city traffic movement, and then no entry zone or re-routing zone can be think of in a particular area.

And definitely the last point is very much important, this point is very much important that is a development regular maintenance of the road, some sometimes you develop some kind of a road. And you forget to maintain it properly, so that is very much sometimes problematic in sense of that also give you a directly penalty to the vehicles, which is actually going are on the particular bad road. Penalty in the sense of that the wear and tear and all and also it create noise scenarios.

And the last one what is that is the change of citizens attitude. And this is another one, we just cannot ignore that one so. Citizens sensitization some kind of the kind of a participate reactivity is required particularly in from the very beginning, from the very school or the kindergarten age to a particular class or may be in a the with the matric standard or the board standard students. Because, if you sensitize the children, then the next generation is prepared to take care of yours all those issues and all. So, those are required, of course the government is doing so. Lot of NGO’s are also doing and our

administrative police and all those things are also doing, but citizen is also has to be change their attitude.

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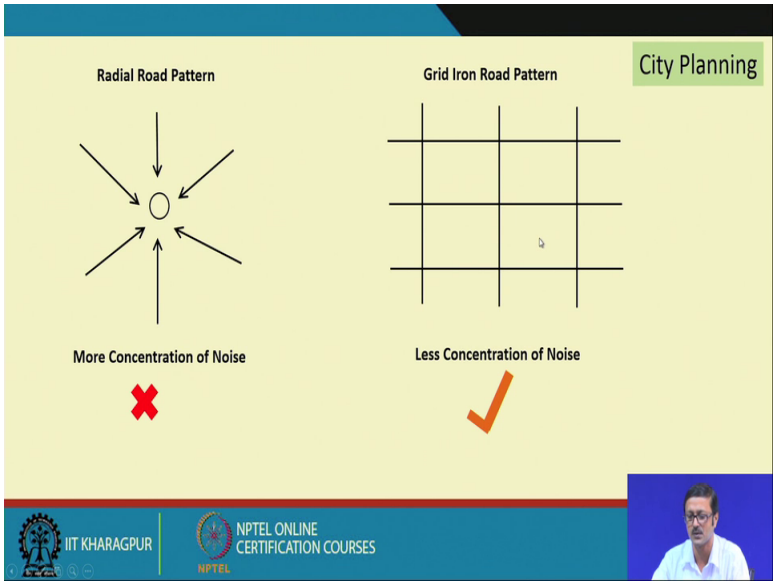

So, from the city planning point of view there are few fundamental things, which I have noted for this lecture. So, there are some road pattern, and from that road pattern there are some grid iron road pattern. And the cities fall in a grid iron way. Sometimes there is a radial pattern, if you see the so plan of New Delhi is a radial pattern road, if you see the Chandigarh is a grid iron kind of thing.

So, out of these two if I want to compare these two particular kind of a situation or the road network situation from the noise point of view, I must say this grid iron is good. Grid iron is good in the sense of that its provide less concentration of the noise. Whereas in case of the radial pattern, so all vehicles actually a concentrated in a rotary or in a particulars concentrated area. So, the noise concentration is more practically in this particular area.

So, there you own get a the silent zone or the noise sensitivity zone over here. Here because of that may be in the central pocket in each sector you may get a kind of a school, space for the schools may be this particular can be one school or one central space may be for some kind of a park, and another one may be for some kind of the hospitals or residential zone also.

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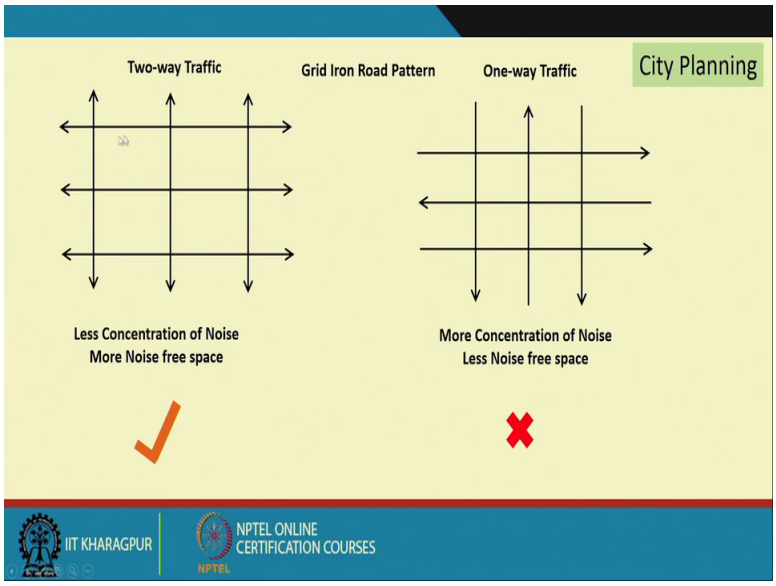

Now, next one suppose you take a grid iron pattern. And in that grid iron pattern, you have two type of traffic scenario. One is a two-way traffic, so from this road. So, this arrow, this is black color arrows are actually indicating the road. And these arrows are indicating the direction. So, here suppose there are the two-way traffic. So, in this road both way traffic can flow.

And here suppose this is an one-way. So, from this road only the upper direction, and the from this two-way the lower direction an the right and left side direction flows are possible. So, out of these two choice, let us see if I want to see that what will be the effect of the noise, then the we must preferred the two-way traffic system, because the two-way traffic system you will get I mean its theoretically. If you concentrate a two-way over here, so will get my larger area larger pocket area, where there are will be a smaller pocket area that is number 1.

Number 2 as we know that from our very beginning, if two equal sources added together, the decibel level increased by only 3 dB. So, suppose this is source a, and this is source b this is again a source, suppose another source c. So, if this two sources are added together, and put one source the only this particular road will be increased by 3 dB. If I assume that both road output is same, so it is nothing it is just only 3 dB increment in one you can avoid a central road of the other direction road also. So, you will get much more

wider space of road to road concentration, road to road distance. So, there is a much more noise sensitive area can be found out from there.

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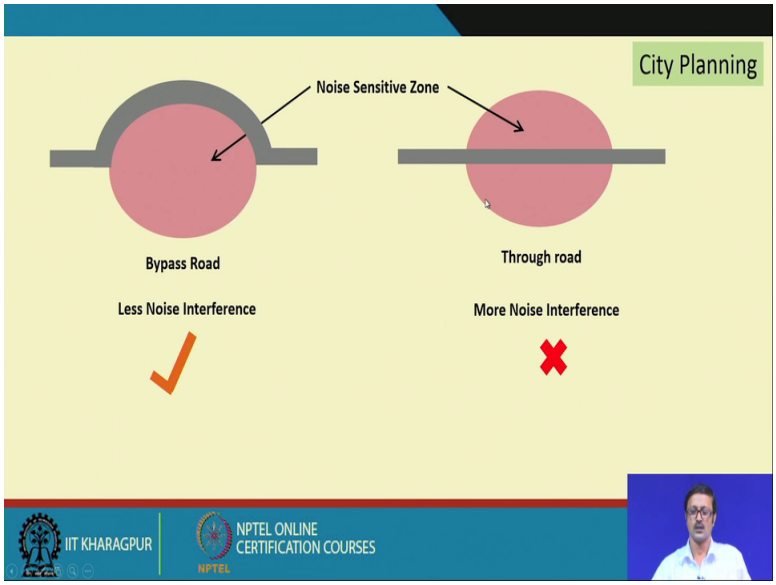

So, this is very obvious a bypass road is always good; a bypass road is always good, because that will not go through in your the zone, which is demarcated as a noise sensitive zone.

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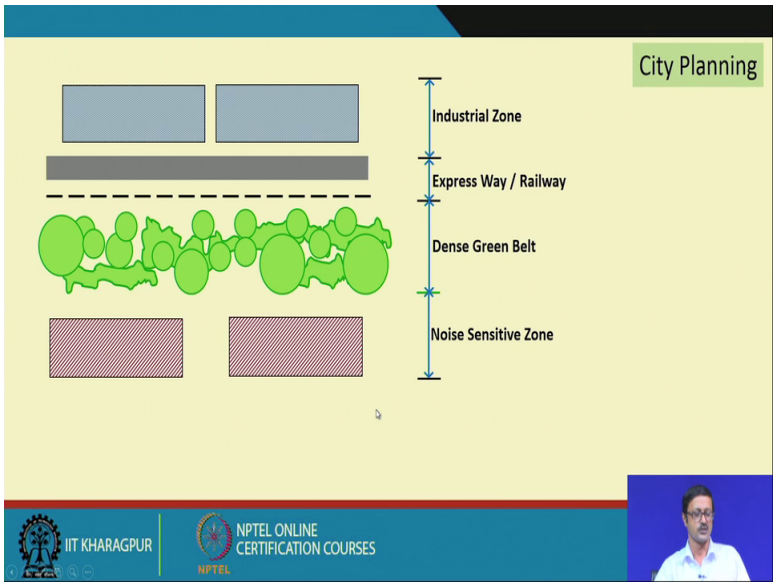

Then for a city guidelines point of view also follow this particular rule sometimes. This is in segregate the industrial zone in the outer direction of you are city. And then put you

are all the express ways and the corridor the transportation corridor. And that can be shielded from through a green zone or the dense green belt, which will help you actually shielding the noise. And also purify any kind of air movement because, of the dusty air from the industry also. And your noise sensitive city zone or city areas can be the other side of this green zone, so that is also one of the way city planners actually make for any kind of a new cities also.

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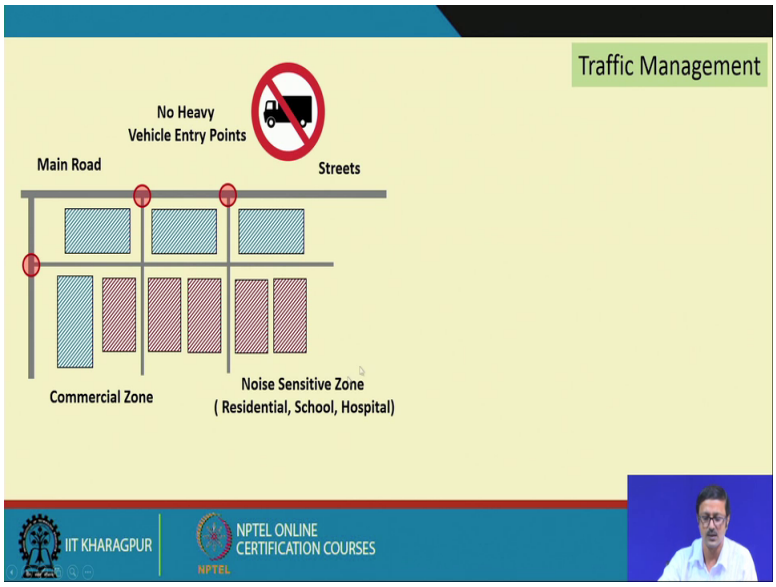

So, traffic management systems also is also one of the impartment issues. So, suppose this is the this are the street, and these the red color this blocks are your noise sensitive zone or noise sensitive building. So, this is your main road wider. And those blue color buildings are of some commercial building, which is in the periphery which is near to the main road. This will be the tentative distribution of the zoning, the micro zoning of this particular level and there some lanes.

And maybe what we can do is that we can put some kind of a no entry point here for the heavy vehicles. For those streets at least for sometimes in the night hours or may be some kind of the hours, day hours or maybe depending upon what are the activities around here. And that will going to help you in reducing the noise and from the source point level itself.

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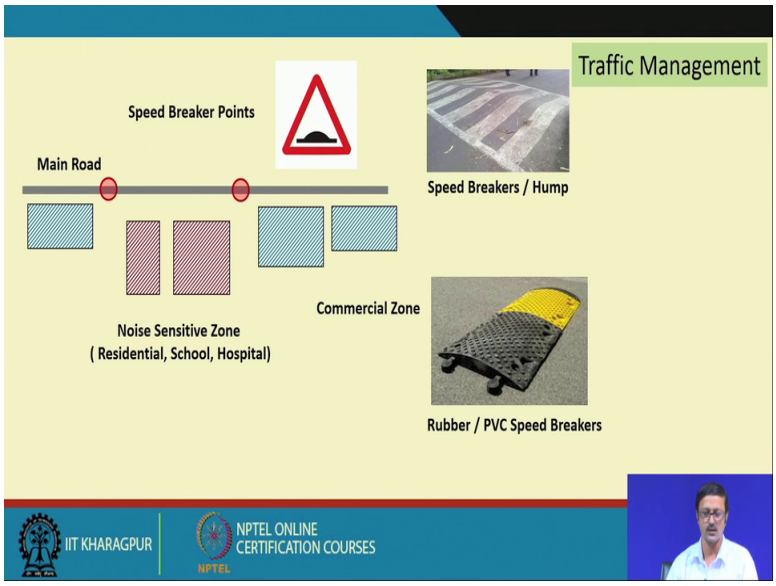

Then suppose you have a main road, and there is a noise sensitive zone in between and there are commercial zone, those buildings or nor that much sensitive. So, you can provide hump or the speed breakers over here, and you reduces speed of this things we can put some kind of a no horn signal signage also. Just to provide there should not be any kind of a disturbance in between this patch of the road near to the noise sensitive zone.

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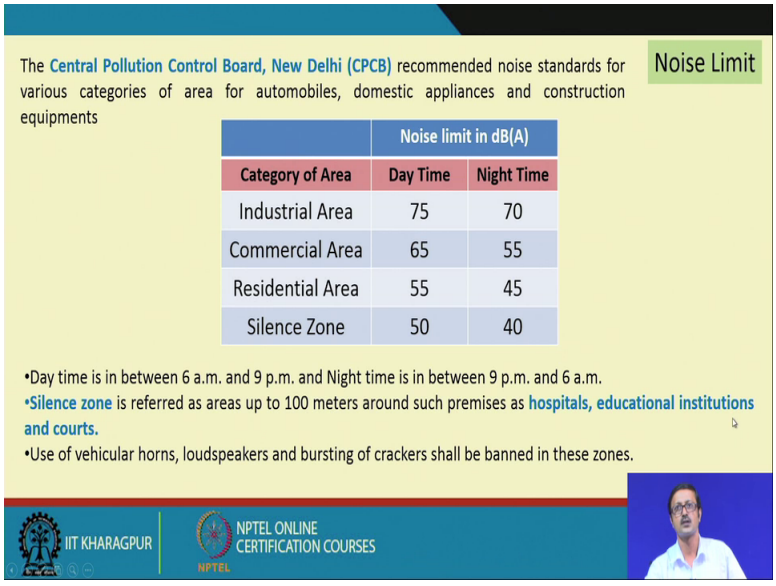

So, again CPCB gives are some kind of criteria of our noise, which in day time the industrial area should not be exposed more than 75, night time 65, commercial area 65, 55. Residential area is important this 55 in the day time and the night time it is consider as a 45 degree not more than that. In fact, the silent zone which is actually 50 and 40 in day and night time. In as per the our Indian standard and this day time and night time also mention from 6 to 9 and 9 to 6 in the night. And silent zone includes as for then as for the code is the hospitals, educational institute like school, college and all an also courts.

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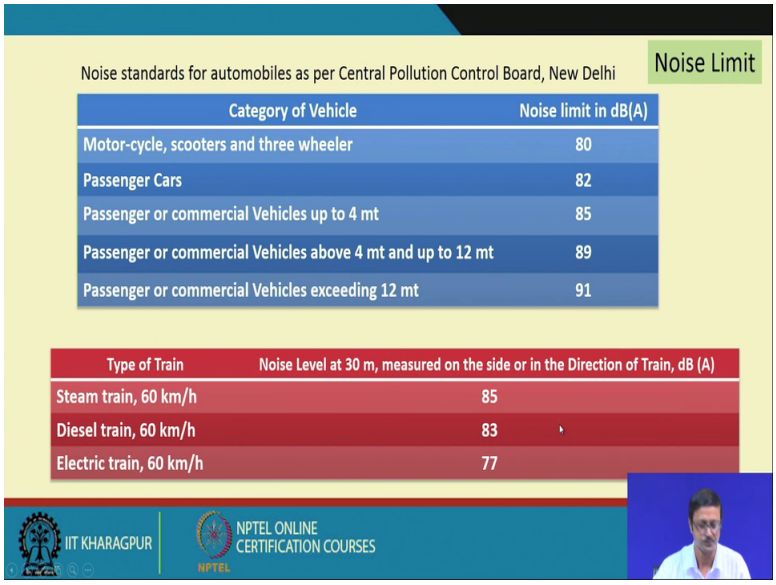

And though this is the some of the category of the vehicle passenger car, commercial vehicle from how much distance 4 meter, 4 to 12 meter, or above 12 meter and what is the noise limit. So, if you want to just to check that this particular passenger car is producing 82 dB or 85 dB at 4 meter also, so it is ok. If it is more than that, so this is noise producing more than that limit. Similarly, we have some kind of a limit for the trains also for electric diesel and the steam train; steam trains are actually nowadays not used in Indian Railway, but diesel and the electric train in at 60 kilometer per hour should be less than are maximum up to 77 and 83 dB A that is the limit are of our as per our standard.

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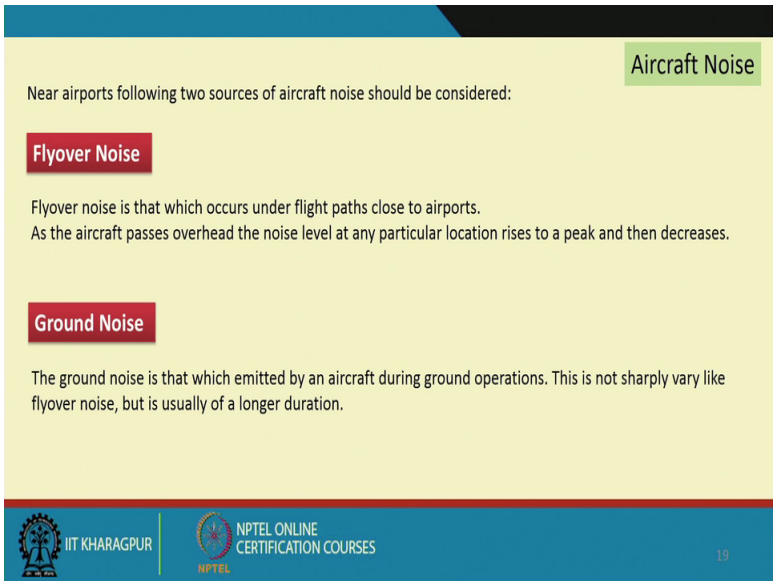

The aircraft noise are also very important. And this aircraft noise is also considered as one of the annoying noise in those who live near the airport the actually can you tell better. I mean it is the if they in the very near to the aircraft, and it is very near to this landing or the for the flight the take off zone, so it is really annoying. And the and this noise has two type of noise has been the classified as a aircraft noise is concerned, one is called the flyover noise. The flyover noise at is actually occur due to the flight path which is actually because of the takeoff and the landing.

And another one is called is a ground noise, flight noise or the flyover noise is having a high peak and there is a drop, and high peak and a drop if you take a large amount of a time segment or so because, it is due to the high peak and a drop and again a high peak because of the landing or the takeoff activities. But the ground noise is for the emitting the sound emitting from the aircraft when it is a ground operation, the movement and all other activities during and that is little bit low, it is not that much sharp of all this is kind of a static kind of a scenario.

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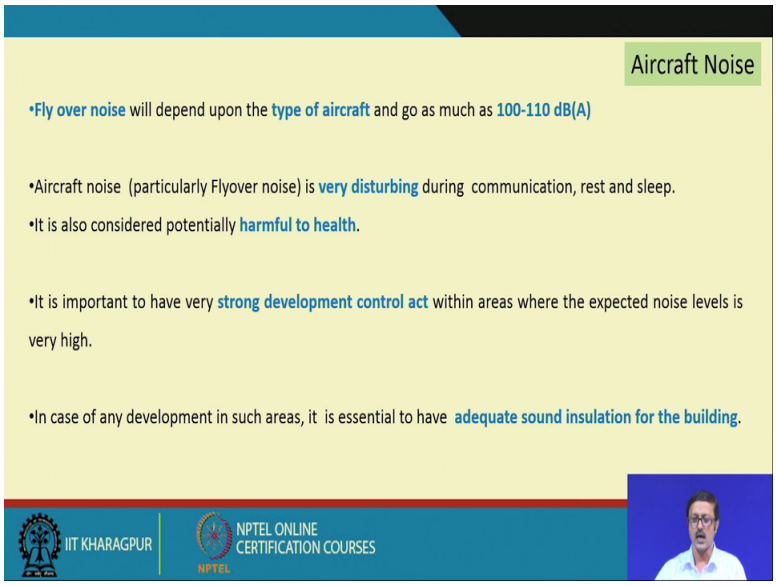

So, it is harmful to the health of course, and this is sometimes go as much as 100 to 110 dB A. And it is important that a strong development act control act has to be implemented very nearby areas of the airport, air traffic zone or the airport. And if it is still there are some development need to be happened of that you have to be adequate insulate your building from that sound.

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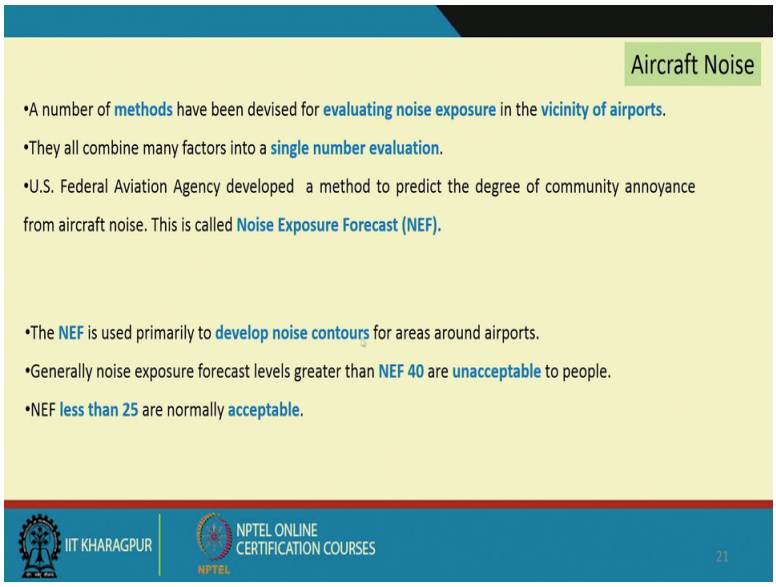

And this aircraft zone which is in the vicinity of any airport actually you need to major that way how actually what is the noise, and what is the amount of this particular noise

effect and all. So, it a single number evaluation system is developed by the U. S. Federal Aviation Agency and that has been followed by almost everywhere and that is called a Noise Exposure Forecast: NEF, which is a single number. And the procedure of achieving the particular single number is little elaborated and little complicated. So, we are not going to going to detail in that. So, this single number is something like a contour kind of thing. It is actually a primary used for some kind to develop a noise counter; that means, this area is having high noisy zone.

And then next ring is having little less and then there is a next ring is a little less than that. So, those are the some numbers has been created because of due to the number of aircraft and the number of the peaks and troughs and peaks and troughs due to the landing and the takeoff scenario. And this total this particular NEF that is the noise exposure forecast are given with some number like NEF 40. If it is NEF 40 or more than that is unacceptable I mean any kind of a development over there is on acceptable. So, it is very noisy zone. So, only the aircraft and those of the this the particular may be some particular airport, and those activities can be happened, but not any kind of the day to day the hospital or may be residential area or may be school or may be anything cannot be accepted in the particular area anything. Anything NEF less than 25 is normally accepted.

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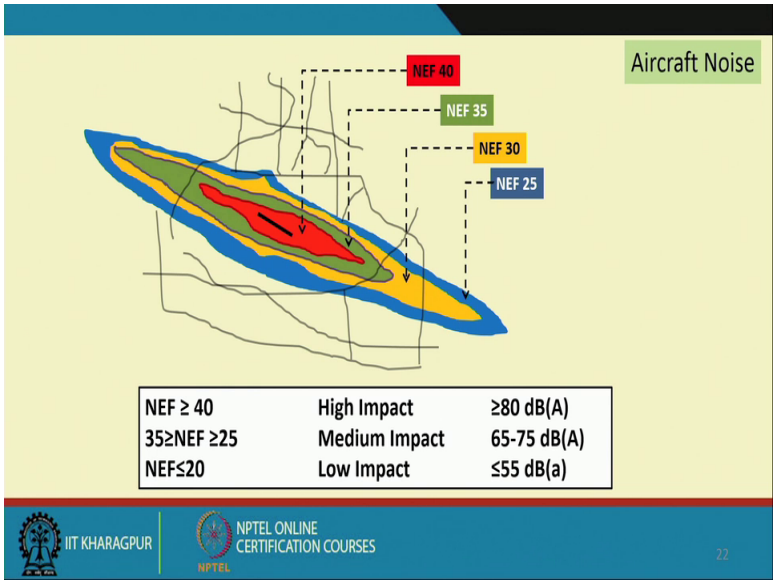

So, there are situation, suppose this is a city map, I will just draw is sketching form a city map and this is suppose a landing steep and this is you are airport area. So, if you do this NEF, you will find this is the red zone which NEF is 40. So, there should be some kind of a developmental control. So, there are should not one. Mostly it will common that the airport zone itself may be here may be some part of the since may be go little bit away which may be there are may be some kind of a residential area, but still there should be some kind of a development act.

Next we will be another ring which is again a kind of a stretched ring a contour which is green color. I have not here suppose it is if it is N 40 is a red one, this is N 35, and then third one is little bit soft and larger also, and this is N 30. So, and this is suppose the blue one is the N 25, so which is which can be thought of that yes any kind of a residential area may start from this yellow blue boundary onwards. This part can be have the your growth of the city. So, this is the real of the sound exposed to a huge amount of sound and gradually it diminishing down.

So, this is the NEF and that will be demarcated. And then the town planners and the they will actually do some kind of a development contour act on it. So, anything like NEF is more than 40 is high impact which is equivalent almost 80 more than 80 dB A. And in between 35 to 25 NEF that is my this probably this yellow to this green zone, which is medium impact 65 to 75. And NEF less than 20, which is beyond this zone is less than 55 dB A, there is small mistake this should be capital A.

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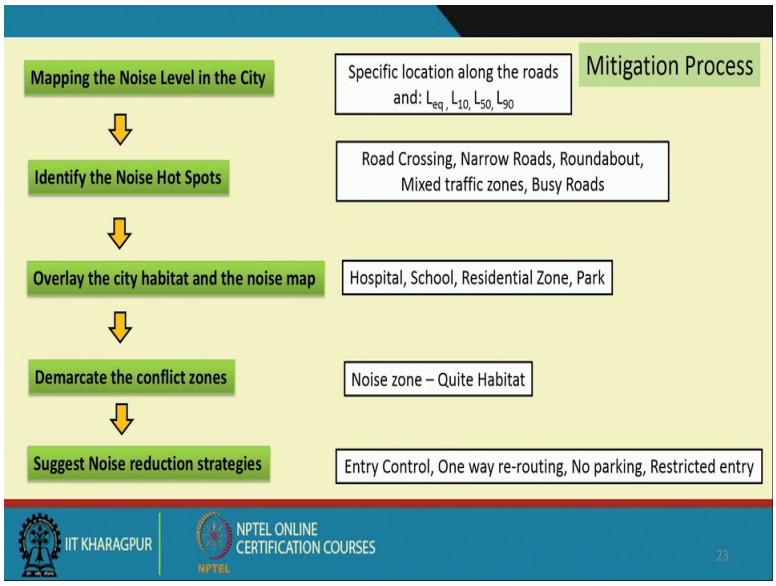

So, from the mapping point of view, the mapping of the noise is concerned with the specifically with this. I have already told you have to find out the L equivalent, L 10, L 50, L 90. And then you have to identify the noise hotspot which is maybe a road crossing, narrow roads, a roundabouts mixed traffic zone busy road etcetera. And then in the third stage in the mitigation process you to overlay the other sensitive zone like park, residential zone – school, hospital on this map. So, overlay you are on the noise map, overlay your sensitive zone map.

Next you find out the demarcate the conflict zone. So, if your hospital is under the silent zone, not noisy zone, fine no problem, but if it is in a noisy zone then there is a conflict demarcated that conflict zone. Now, you have to take the strategies whether you go for any kind of a entry control, whether you rule it re-route the traffic. Whether there should be no parking if suppose there is a very narrow road, and due to narrow road people are parking over there, road become much more narrower and there is a honk and there is a kind of sound so you may go for no parking zone over here and you can increase the width of the road and give the passage away. And sometimes it may be restricted entry for the trucks and heavy vehicles for that so you can take some kind of suggestions. So, those are the typical stage or the steps we will follow for mitigation process.

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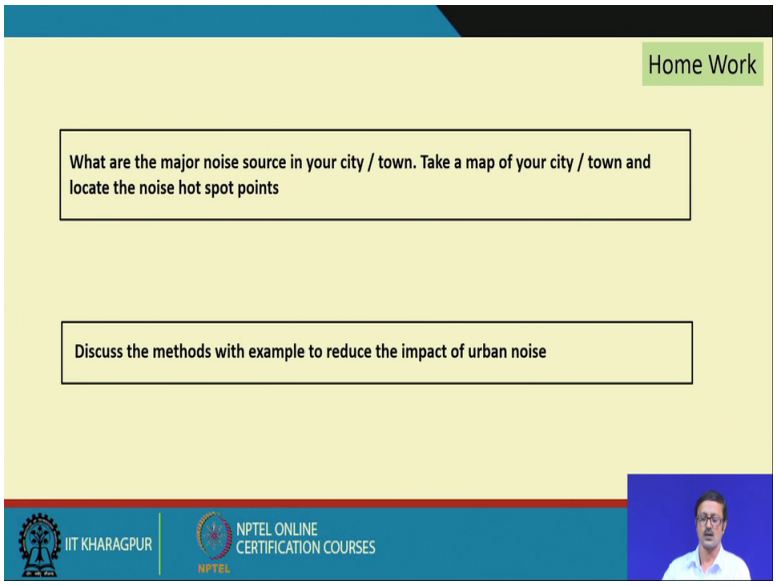

I think that is all for this lecture. So, I will give you the small exercise as you from the different city of my country. You are locate your noise source of your city you think. Locate your noise source of your city whether the noise what are the sources of the noise in your city or in your town. And take a map of your town, map of your city, locate the hotspots point of your noise hotspot of course, point or so.

And second one is that and with the some example you can actually you can link this with your the first assignment that how to reduce the impact of the urban noise, what are the methods and what are the examples you can think for your city or any may be a for a school not may be a whole city, but for a stretch of the road or stretch of the some the noise hotspot point like a roundabout or so.

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So, thank you very much for hearing me in the our the lecturer number 38 the urban noise control planning consideration.

So, thank you.