Energy Efficiency, Acoustics & Daylighting in building

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Lecture - 44
Isolation (contd.)

So, you cannot talk, look into random noises. You know we can look into random noises like I said that footfall noises right in you know corridor or somewhere people are going and supposing I have a corridor and I have a studio below or I have some reading room below. Now, these are random noises. Generally libraries you do not want noise to, you do not want noise generated within the source, you do not want it to come back, but do you also do not want it to go to the next level.

So, it is a structured wrong footfall noise is a typical random structure borne noise, right. Now, I cannot, what I do in this case, we do what is called floating construction. Floating construction now what is the floating construction because one way is to put a carpet onto the floor or linoleum flooring you know resilient flooring floor itself should be resilient like you know a timber flooring like that you see in this particular room or in a badminton court. In a badminton court, you know they do when they are smashing or doing something, they actually stamp it.

So, if it is a first floor or a dancing floor, you know dancing floor western dancing floor and so on. So, that is actually would have wooden tiles or some kind of resilient flooring itself, right. So, these resilient flooring acts almost like same thing as isolater. It is like isolator and when it becomes I mean let slightly more than we do what we call floating construction.

So, floating construction is something of this kind. A floating construction looks like this. So, a floating construction will look like this.

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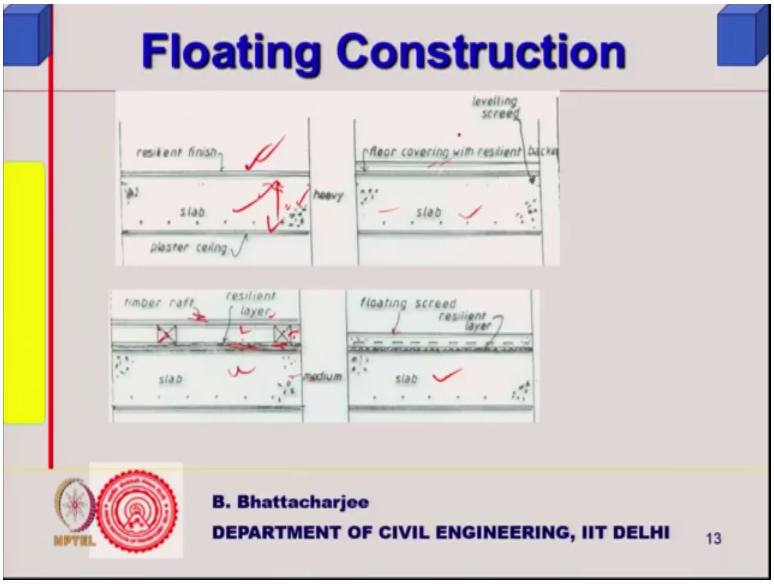

You know I will have a resilient finish of the top oh.

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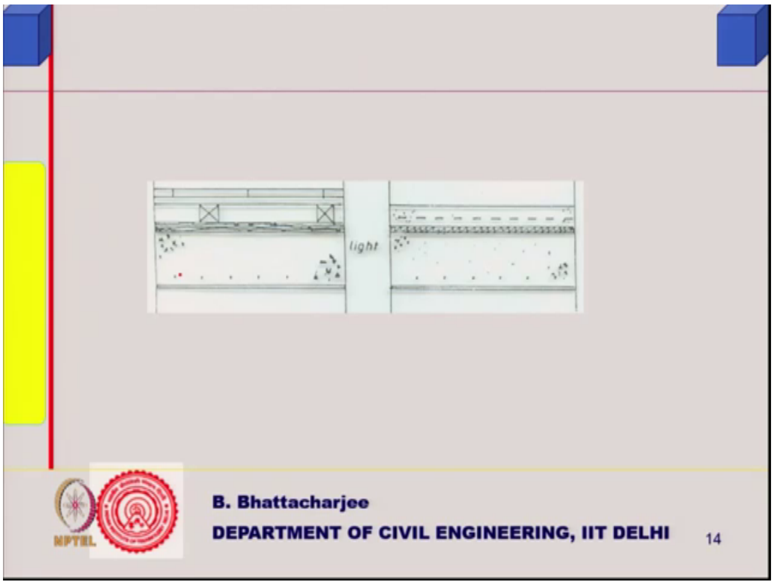

I will have resilient finish at the top, a resilient finish at the top, the mass, then of course plaster or ceiling or whatever it is. Now, this could be heavy because structure for noise is never structure borne noise alone. It also generates air borne noise. That is what we have seen earlier. Then, machines are similar kind of thing. It also cause you know it causes vibration or imparts vibration to the floor or the structure, but does impart you know causes air borne noise also.

So, you would like to trans stop that airborne noise also going down. Therefore, this is mass law. We have seen that 18 log m, right. Remember that mass flow we talked about t l is equals to 18 log m plus whatever f and all that, right. So, mass per unit area is important. So, you put it heavy, right and you want to you know if you go on increasing the mass, then you have a problem supposing that is airborne noise is increasing. So, resilient cushion actually resilient finish or resilient cushion actually reduces down or increases you know reduces the transmitibility delta t v becomes higher one by tau. It reduces; the mass reduces that air borne noise transmission loss properties. So, you got to combine both of them and when airborne noise is very heavy, you may not have, you cannot go on increasing the floor thickness.

So, what you do? You use double lift system increase lift. So, you see you put in between a timber or similar sort of resilient material connector that is put a button, two buttons or similar kind of material. Today one might have fiber. Fiber you know fiber reinforced material polymer and so on. Resilience property should be there. It should have property like able to you know come back to its original position like spring does so, that kind of property stored the energy and release it, store the energy and release it.

So, you might have timber buttons resilient layer, then this connector, then the slab and it might be on a quilt resilient again in a resilient layer. So, timber raft at the top or timber flooring, right and then, this is the buttons and then, there is a resilient cushion and then, the slab. Now, here the mass can be medium, need not be very heavy because now it is double lift. It is double if it is double lift. So, it can be you know light relatively medium.

So, slab again resilient layer and this is floating screed or something floating screed. Similarly slab here can be heavy and with a resilient blacking backing floor covering with resilient backing etcetera and leveling screen or something like that kind. So, essentially the principle is that if you want to reduce down the airborne noise together with the random structure borne noise, you have a resilient layer at the top or you have a rough kind of thing one leaf supported with resilient material. You cannot put steel here. You put the steel, it will transmit and then, you have a resilient cushion, then the heavy mass or you can have simply resilient flooring and heavy mass or medium mass etcetera. You can use those combinations.

You understand the principle. A resilient material at the top of the flooring level ensures that random noises will not be transmitted. Structure borne noises and the mass ensures that airborne noise would be reduced. If mass you cannot increase make doubly leaf. It is the idea. That is the idea, right. So, this is another example of some floating construction, right. If it is light, light here quite light put something up there and so on. So, mass you can decide if it is light material, you can use if it is double leaf wall, then double leaf as we have seen the double leaf wall actually transmission losses are here.

So, that is it actually ah, ok. So, strategy wise I must strategy wise for air borne noise and structure borne noise if it is first, we have discussed earlier that if it is within the source, sources within that room, then you know you put on absorbers. If the source is in the next room or outside this room, either it would be structure borne or it will be airborne or combinations usually you know everyone or combination of structure borne the strategies, then we looked into if I know the frequency. In case of structure borne noise, what I do I put an isolater. If I do not know the frequency is random footfall noise or utensil falling or something of that kind, then nitrogen in the current, right.

So, we have actually noise criteria curves as we call it how much because we have said that earlier I said that dB a, remember we talked in terms of dB a. So, permissible noises are quite defined, quite often defined in terms of dB a particularly external scenario. For example, you know like n g t suggests in residential area should not be more than some 40 or 45 dB during night time, 50 dB in day time or something of that kind of their criteria. They are very gross dBa level coming from different sources, but there can be other kind of, there can be other kind of you know other kind of within space. I can have other kind of criteria frequency dependent. Earlier we talked of dBa is largely across one single value combined all the frequencies.

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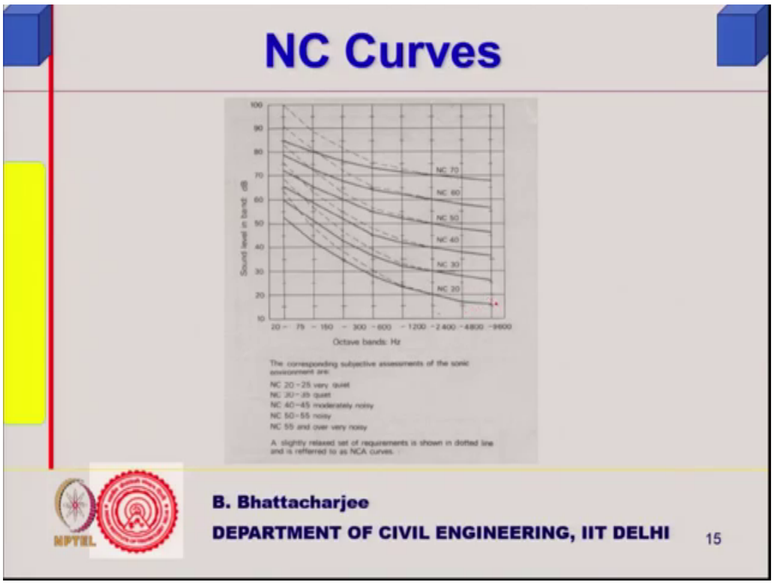

You can have for example, NC 20 nice criteria curve. 20 represents very quiet scenario and it takes into account of the sensitivity of the air and you know that air is less sensitive at low frequency. You can tolerate more; remember that equal loudness level contour.

So, NC 20 is somewhere like this, right very quiet. 20 to 25 and NC70 is somewhere there. So, you can you know there is one is somewhat stringent curve. Another is less stringent curves. So, these are called noise criteria curves. Noise criteria curves basically give you acceptable noise level as a function of frequency acceptable dB level as a function of frequency. So, NC20 to 25 is very quiet. So, you want very quiet scenario, you must maintain NC20 to 25 within the space.

Now, we are talking about inside the space 30 to 35 is just quiet, 40 to 45 moderately noisy and 50 to 55 noisy and over 55 very noisy. So, somewhere acceptability would be there, somewhere acceptability will be there, right n the sense that you would specify within the classroom, you know as ambient noise level should follow NC35 time. So, it is frequency dependent. Now, it is frequency dependent, right. So, if I know this, these are known, these are standardized actually, right. Some of them are as I said the stiffer once are one of them are stringent; one is less stringent, alright.

So, that dotted lines are it tolerates more. So, less stringent delta the dark lines are all stringent curves. So, this is given, this is known acceptable values internationally known.

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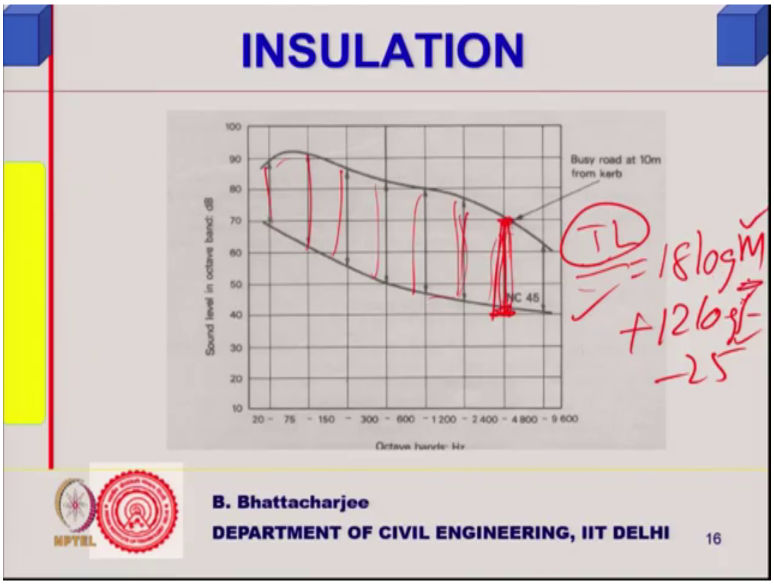

Now, supposing this is I know and NC45 is my requirement is specified that within this room I require NC45 and I also know the noise level, outside noise level. The load if I may call it, this is my requirement, this is the load, then how much insulation I need is that difference every frequency. How much insulation I need, I know how much insulation I need at different frequency I know and then, I can use mass law if it is all airborne noise.

So, I know that you know I said how much was, it transmission losses. Loss was equal to 18 log m plus 12 log f minus 25. So, if every frequency how much my transmission loss value I can find out because TL is equal to you know you remember 18 log m plus 12 log f minus 25. So, if you know how much TL I require I know from here if it is true insulation, I am trying to design the insulation, right. Obviously, whatever comes in a part of it will be absorbed in the system. Also, that I might neglect for the time being, but because that would always make it things a little bit more conservative.

So, I can calculate out from this because at every f corresponding NC45, this difference is the actual outside load. This is what I should have. This should be equals to the transmission loss value and at a given frequency. So, I know the value of frequency m at every frequency. I can find out m. Take the highest value of m, take the highest value of m and that will be the design mass per unit area. If you are able to provide with the mass by thickness of the you know wall or ceiling or roof whatever it is, then it is fine, but if you are not able to do it, go for double leaf wall, go for double leaf wall, right.

So, this diagram allows us to actually determine the insulation required and then, calculate based on whatever principle write down term, alright. So, that is what it is, ok. So, before going to expose that you see first of all I think I would there is no slide here, but I like to hear any of these issues as we have seen in thermal issue as well we have seen that it starts from the urban planning stage and here also, I might have told you the external noise control that you do zoning, right. Try to keep the noise.

Now, similar thing you can do inside the building also.

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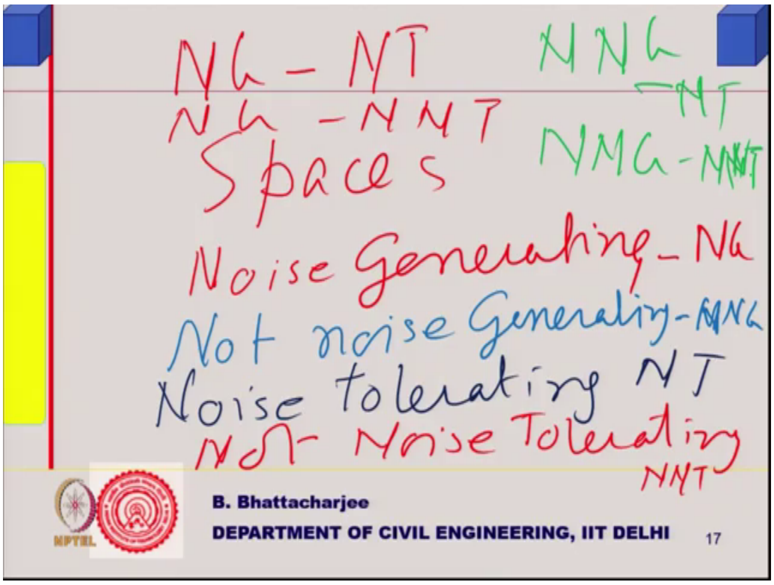

So, you can classify space. Spaces can be classified. First of all, noise generating let me call this as NG noise generating and I might have something called not noise generating NG. So, I can classify the spaces as NG and NG some sources, some space generate noise, some space do not generate noise. I can now define two types of room again i.e. noise tolerating and not noise tolerating, right.

So, noise tolerating and not noise tolerating you know noise tolerating and not noise tolerating, ok. Let me use some other color. So, noise tolerating NT and not noise tolerating let me put it as another color, not noise tolerating. So, you see I can have a room which is noise generating and noise tolerating. I can have noise generating and not noise tolerating. So, NNT. So, this will give me combinations four types of spaces. A space should be either you know it has to be NG NT NG.

Student: NNT.

NNT and the other one is.

not noise generating NT and not noise generating NNt, right and not tolerating also does not generate. Now, let us see noise generating and also noise tolerating, right a kind of students canteen. It would generate noise, but they do not mind the noise we know is all I see it can be I mean it is expected. It is fine. There is no problem.

So, such a space is noise generating and it tolerates the noise also noise generating, but not noise tolerating a classroom. Obviously, you know whatever is going on here is there noise for another room, right. A classroom is such kind of thing and then, noise not nice generating, but it can tolerate noise. It does not generate noise, but it can tolerate noise, right. So, something like of course the last one I will give a storeroom. For example, usually it does not generate noise, but it tolerates. Also you know it tolerates noise. You know it does not matter store room whether there is, it does not generate, but noise comes who cares. It is not a problem.

So, not noise generating and not noise tolerating operation theater, right. Operation theater does not generate any noise. Very quietly people are working or even you know like these days you may not have that kind of thing, but good old days used to have a server room or rather no mainframe computer and then, as there will be all kind of mainframe or you know even a computer room, some supposing you know computer lab it does not generate, but does not tolerate. It also does not tolerate those.

So, now how do you go about you to segregate this room in the room planning itself? So, this planning stage itself there is a kind of strategy than.

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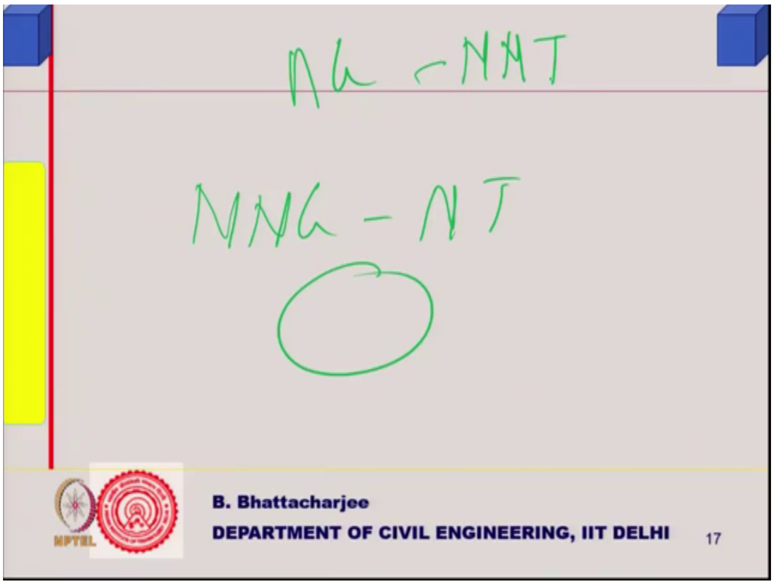

I am talking of C note, not noise generating and noise tolerating. These kind of spaces can go anywhere. You do not need any buffer, but if something is not noise tolerating, noise generating one space which is not generating and not noise tolerating generates, but does not tolerate to have such space cannot come together because no one is here. So, compatibility of this, this is very compatible. It can go anywhere, does not generate, can tolerate. The one does not generate. They cannot go any time with next to next with noise tolerating.

So, all that I am trying to say is while doing space planning proximity of spaces, these ideas can be kept in mind and then, if you cannot separate them, I mean there is a reason to keep them as much as possible close. Put a buffer in between and this will act always as buffer or some fire or such places. You know this will react always as buffer something of that kind you put in. So, in the planning stage within the building itself, you can segregate areas or locate these areas in such a manner that you can cut down on your insulation requirement and you know absorption and those requirement provided, you planned it accordingly.

So, but then remember noise planning is not the only planning. You are planning for traffic movement, planning for thermal issues, might be because you want to something, you do not want to heat up too much, do not keep towards a radiation receiving side website or something of that kind in the afternoon. So, all this is all together. There are traffic, private traffic. You know traffic movement is very important in functional buildings.

So, it is all together, but this can also be taken into account. While planning that must be kept in mind, right. So, strategy should be first for internal noise control. Identify the type of spaces, plan them accordingly and possible sources, then you identify structure borne or structure borne or what you call airborne noise and then, all this planning you do.

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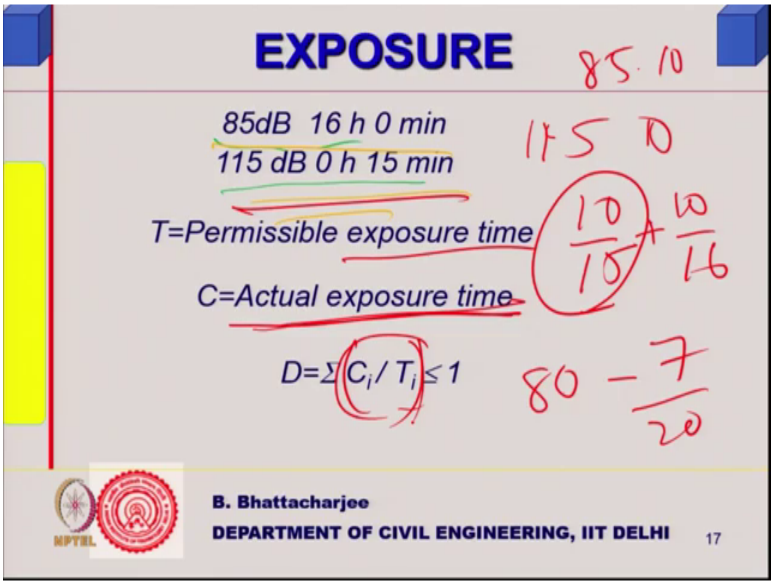

Then, you can decide on this one. Just one more point related to this exposure condition is very important from health point of view.

For example, you know 115 dB for 15 minutes 0 hour 15 minutes can create same damage as 85 dB in 16 hours. So, exposure levels are given, lower noise level can be taller, but this is an industrial situation. You won't be somebody would not be subjected to 85 dB all the time. That usually would not be the case, right. That will not be the case. So, you know 85 dB 115, these are equivalent. So, these are the exposure level at as it is called.

So, T is the permissible exposure time that is given from various soil health consideration in national building code or similar bodies and it will be given as actual exposure time C, right. So, some during all the day time and T is a permissible exposure time, P is of at that given dB, right permissible is. So, for example, you know what is this given is it for example, if you are subjected to 115 dB for 10 minutes. So, it will be 10 divided by 15 and then, you are exposed to 85 dB let us say for 10 hours plus 10 divided by 16.

So, this is the kind of cumulative damage we are talking about. So, sigma C i by T i , this should be sum sigma T i by C i by T i should be less than 1 because in industrial situation or many other situations, maybe 1 is exposure to different dB levels are different for different durations. C i is actual exposure divided by T i is a permissible exposure at a given dB level.

So, if you are exposed to 80 db, let us say for 7 hours and permissible is let say 20 hours or whatever it is, the fraction of damage would be given by that sum total of all the damages must be less than equals to 1. So, that is the thing you know. So, that is basically exposing you know this kind of cumulative damage we use in many other places also. So, sigma T i C i by T i actually there should have been a bracket should be less than Y, where C i is the actual exposure time, T i is the permissible exposure time for i th level of ith, you know some i th value which corresponds to a dB value. So, ith dB level and sum it up for all the dB levels that should be less than 1. Then, you are safe. If it is more than 1, that means it is not so safe, right. This is not so safe.

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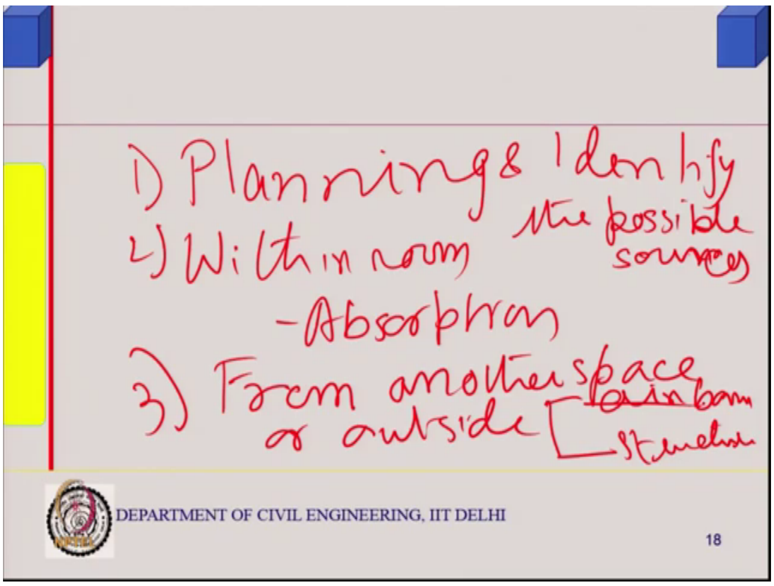

So, that is what it is. So, what if I sum up the strategies for internal noise? We must first do the planning part of it. So, first step is planning. As I just mentioned also identify planning and identify the kind of sources that you have identify the possible sources and in the planning stage itself, you know you can actually take care of it quite a bit. Second stages you find out where the source is. Is it within that room, within room absorbers, absorption coming from the next room? So, from outside, from another space or outside or outside you know you will have two cases; airborne or structure borne. If it is airborne, then obviously mass law insulation right or double leaf wall.

So, airborne means mass law double. Leaf wall structure borne means if it is known frequency, then isolation if it is random noise may go to floating construction or combine both air borne noise etcetera, resilient flooring, resilient cushion in a floating construction and so on. So, that is the strategy of control of noise within the space and we have noise criteria curve which specifies how much noise the space can tolerate based on that you can design the whole system, ok.

So, I think with that we by and large finish our discussion on noise control. We look into auditorium design next.