Audio System Engineering
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Lecture -15
Room Acoustics- II

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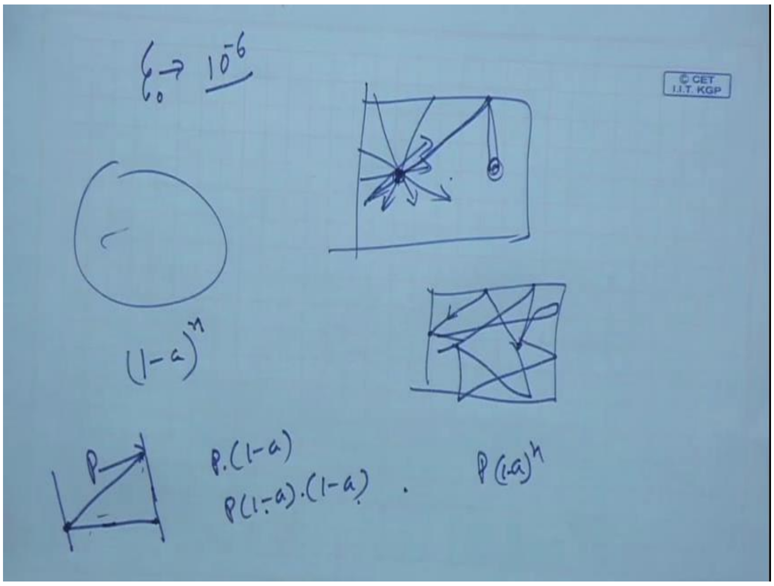

Now, we said that we have calculated the (Refer Time: 00:23) time, at 60 db down. So, you know that at 60 that the psi 0 and the net down sixty degree down means psi 0 has to be down by 10 to the power minus 6 times so that way we calculate at 60 is equal to that part. Now I said let us suppose in a room, at this point, there is there is a source in here, so at this point, there may be reflection passing, this time, this point, this, this direction, this direction, this direction, and this direction, all the direction the reflection is possible. So, there is a total number of reflection path, there is a different reflection length path, now can I calculate the mean free path, mean reflection path, (Refer Time: 01:17) expression.

Now, suppose that within let us there is a n reflection, let suppose I there is a sound enclose, I produce a sound and that creates n reflection that can create this way that can go this way that can go this way then this way, so n number of reflection is possible. So, single way has a n number of reflection from different angle, different wall from different angle, so every time the range strike the wall, it will be absorption coefficient is a, so it will be one by a will be reflected. So, if it is n times it is fall on the wall, so it will be to the power n time. So, you are understood. Let us P is you see that in the wall pass time, so what is the reflected power, P into 1 minus a that is reflected that is incident in the another wall, so it will be P into 1 minus a into 1 minus a then it is reflected in another wall, so that n time reflection is time. Let us n time it is reflected, so this is 1 minus a 1 minus a n time, so it is nothing but a P into 1 minus a to the power n.

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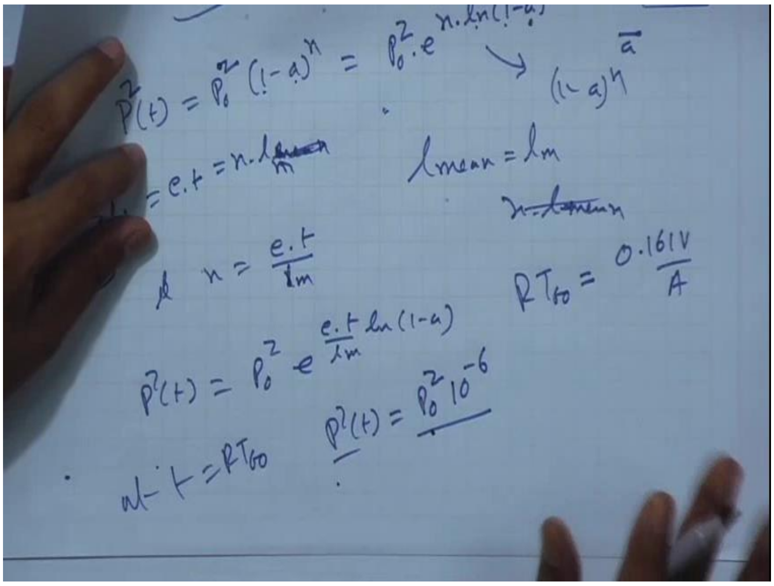

So, after n time reflection let us what is P square t, lets after n time reflection it is P square t is nothing but a P 0 which is initial power square minus 1 by a to the power n power also same, my intensity will be absorb by a time 1 minus a. Now, if it is that then what is this, this can be represented as a P 0 square into e to the power n into l n 1 minus a. So, absorptivity is a 1 minus a I can say n into l n of 1 minus a (Refer Time: 03:41) absorptivity, you can say the average absorptivity is a bar, so a bar and a is lets same a. So, I can say e to the power same, a to the power n can be a to the power n into l n 1 minus a. So, e to the power n into ln into a, so that formula is we use that, because e to the power n into ln 1 minus a is nothing but a 1 minus a to the power n represent like this.

So, lets the total path travel by that ray is nothing but a summation of l j; J is the number of times it is. So, it is nothing but a c into t, which is nothing but a n into lets l mean l mean is the lets average reflection path is l mean. So, if it is n time reflected, so n into l mean. So, let us l mean is defined l m. So, it is nothing but a n into l m, which is nothing but a c into t, total time taken to reflected into multiply by the c.

Now, let us l mean, so n is nothing but a c into t divided by l m. I put the value there. So, it is nothing but a P square t is nothing but a P 0 square e to the power n is nothing but a c into t divided by lm into l m 1 minus a. So, what is R T 60? R T 60 reverberation time, reverberation time is said that it is nothing but a 0.161 V by A, which said that the time required declaring the pressure 60 db when the source is off. So, I can say at t equal to R T 60 degree, the P square t is nothing but a P 0 square into 10 to the power minus 6, 6 db time 10 to the power minus 6 time down. If it P 0 is the initial rho c, here will be rho c and here will be rho c, so rho c I will not be consider, P 0 square into 10 to the power minus 6.

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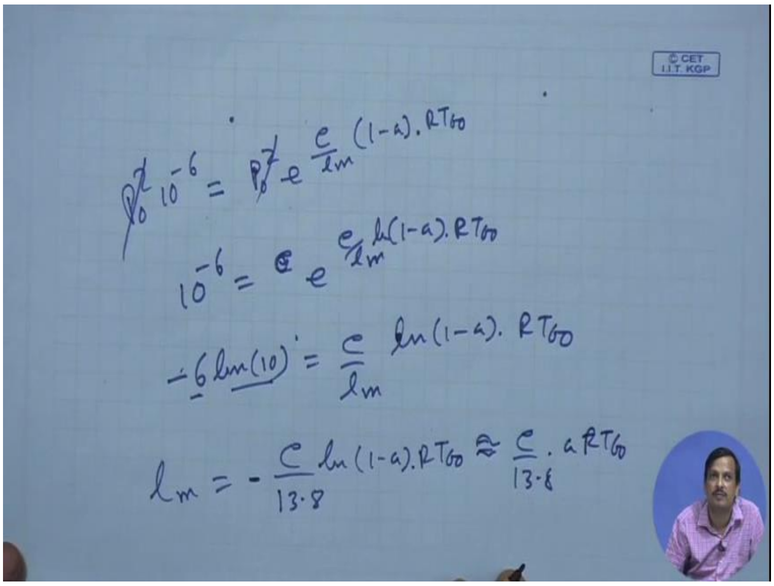

So, it is nothing but a P 0 square 10 to the power minus 6 is equal to what is that P 0 square e to the power C by l m into 1 minus a into t is nothing but a R T 60. So, P 0, P 0 is cancel; 10 to the power minus 6 is equal to e to the power c by lm 1 minus a into R T 60. Now, I do that. So, I take the l m left side, so it is 6 minus 6 lm 10 is equal to c by lm lm 1 minus a into R T 60. So, I can say calculate this, this value lm is nothing but a c by minus this will be minus and this 6 l m 10 is nothing but a 13.8 into lm 1 minus R T 60, which is equal to almost equal to c by 13.8 into a R T 60.

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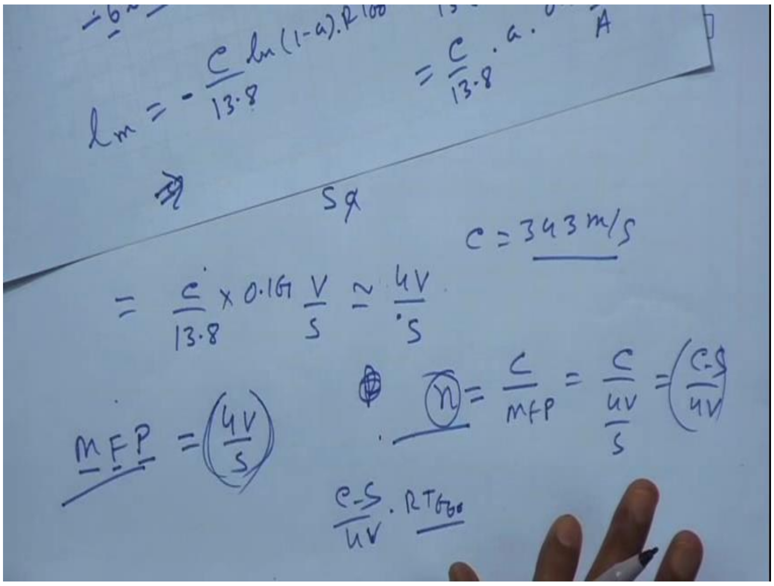

What is R T 60? I can said c by 13.8 into a into 0.161 V by A. So, what is A, again I can write this, this is equal to c by 13.8 into a into 0.161 V by S into a, so a and a cancel. So, it is nothing but a C by 13.8 into 0.161 V by S which will equal to for V by S, if C is equal to three forty three meter per second. So, l m mean free path, M F P, l m means free path is equal to 4 V by S. Is it clear or not, it is clear.

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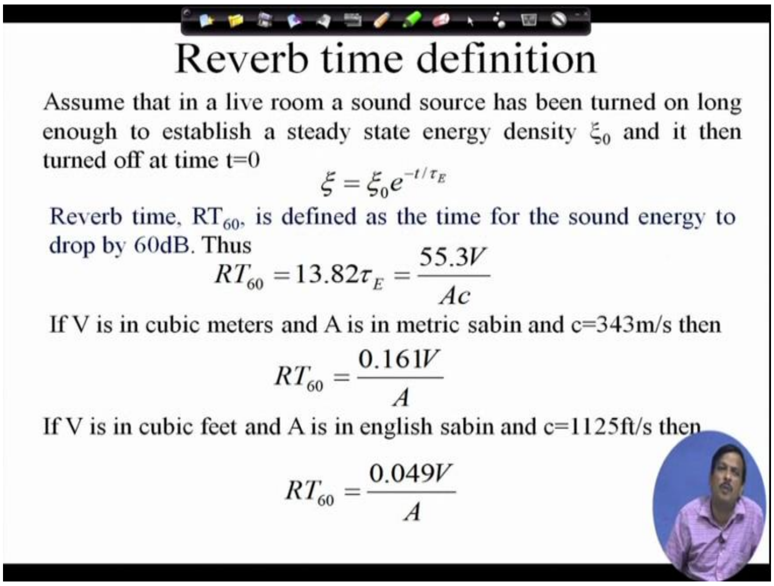

Now, if I say number of reflection, let us say harmony mean free path is 4 V by S, so if I say harmony reflection will be present during at one second; number of reflection number of reflection per second n. It is mean free path means average path so it is nothing but a C by M F P C by 4 V by S, so C into S by 4 V; V is the volume of the room, C is the velocity of the light, S is the surface are of the room, number of reflection. So, depending on the number of reflection, I can say (Refer Time: 10:27) this room is supports statistical reverberation time or not. So, for a given room dimension, I can calculate mean free path, I can calculate number reflection per second. And if I say number of reflection is per second is this then the number of reflection in the reverberation time C into S by 4 V into R T 60 – number of reflection within the reverberation time. So, I can calculate all those parameters.

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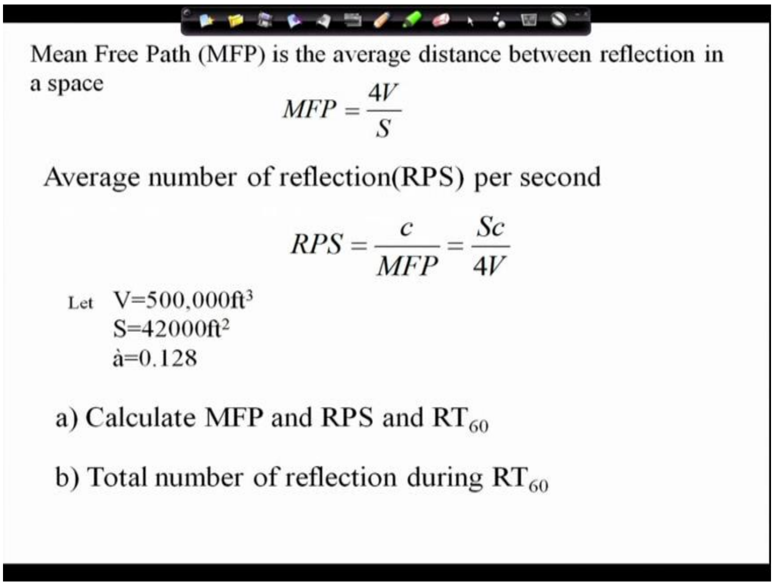

So, this is the more or less reverberation time length, there is examples are given here. Let V is given and auditorium has a volume is this, S is there, (Refer Time: 11:09) is given. Calculate MFP and RPS – reflection per second, reflection per second and R T 60.

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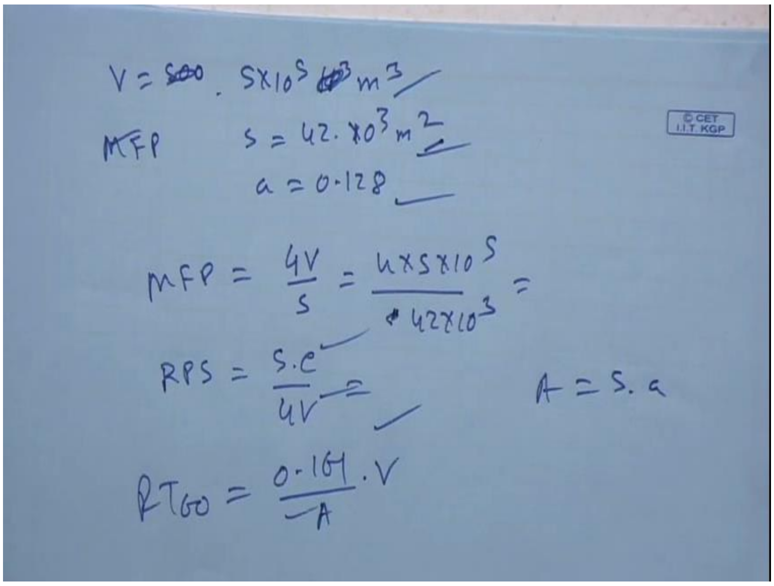

So, first one is MFP, what is V, V is equal to 1500, so it is 5 into 10 to the power I can say 3255 feet cube, it is feet, let us meter cube. And S is equal to 42 into 10 to the power 3 meter square. And a is equal to 0.128. So, V is given, S is given, a is given. What is MFP is nothing but a 4 V by S, so 4 into 5 into 10 to the power 5 divided by S; S is nothing but a forty two into ten to the power three. So, I can calculate it number of reflection. Then what is RPS - reflection per second; it is nothing but a S C – sound velocity divided by 4 V. So, what is S I know, C I know, V I know, I can calculate. R T 60 is nothing but a since I change to meter, so it is nothing but a 0.161 divided by A into V. I know V, I know A; what is A, A is nothing but a S into a. So, for a given or now I will come for a practical example, suppose I have an auditorium, what will be given on a design an auditorium. Let say I want to design an auditorium for some purpose, so from the purpose, I know the reverberation time range.

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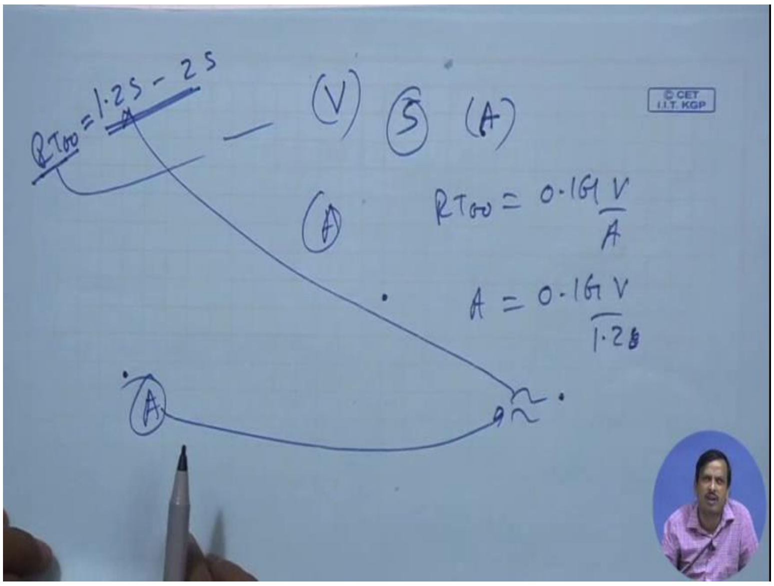

Let us I have to design an auditorium for reverberation time 1.2 second to 2 second. So, R T 60 is given - reverberation time is given 1.25 to 2 seconds. You did these range my R T 60 would be. Now, if I said within these range my R T 60 would be then what has given, civil drawing is given. So the volume I know, surface are I know – different surface are I know, there is a wall, there is door, there is window, there is a stage, there is a hall floor, there is a chair everything absolutely given and there surface is given. Then I can say A, I can calculate – capital A I can calculate, average total absorbity of whole surface.

Once I know A, I know V, I know V and R T 60, I can estimate what kind of A I required. So, it is R T 60, it is nothing but a 0.161 V by A, so A is nothing but a 0.161 V by A, let us I put 1.2 second then I calculate what kind of range of A I required. Then I know surface area and absorbity, and calculate that A from that design angle where I put a acoustic cloth or I put a gypsum board, so I know the absorption coefficient based on that I can calculate A. So, if A is match with this a, then I can say my reverberation would be close to one point two second so that way I can design. So, I will discuss what kind of specimen is made in which area, why it is done that will discuss in design the studio.

So, more or less you have an idea about reverberation time then mean free path then number of reflection in second, so that kind of information now we will have. So, we can calculate those things for a given.

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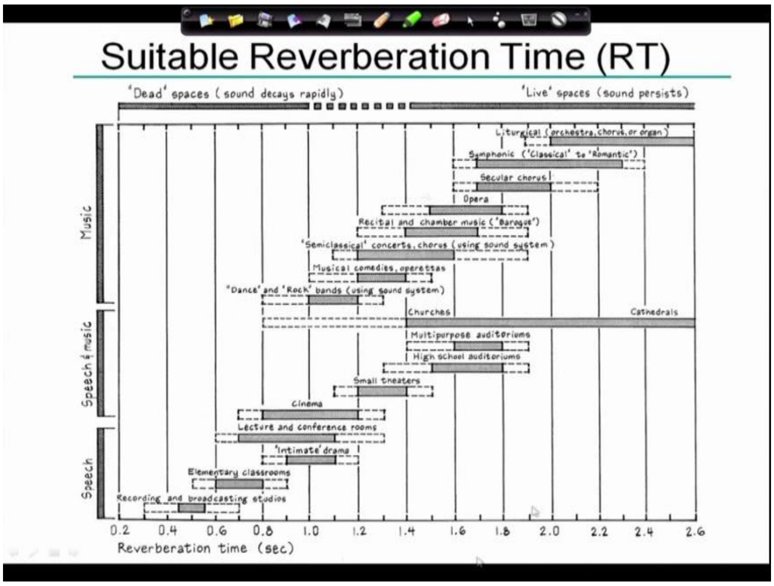

So, there is a 1, other slides, where I taken from the internet it is. Again, there is different kind of reverberation time; you can read it from the video file which we supply to you that different kind of different purpose and the reverberation time range is given. If it is a cinema then the reverberation time 0.8 to 1.2 second. If it is small theatre, it is 1.2 to 1.4. If it is a multipurpose auditorium, reverberation time 1.4 to 1.8. So, there is a different reverberation time for different purpose which is used or which is standardized by the architecture form is there or it is standardized by the (Refer Time: 15:59) from say that there is that is readily available.

So, if I want to design a classroom then I required R T 60 from 0.6 to 0.8. So, within that range, I can design my classroom. So, what that R T 60 define once that civil drawing is given and RT 60 range is given then my what kind of acoustic frequent is required is can be designed from that parameter.

So, let us stop here. Next lecture, I talk about the small room acoustic, what is small room acoustics and large room acoustics.

Thank you.