Noise Management & Its Control

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Lecture - 52
Noise Coming from Pumps & Motors Working Simultaneously

Hello. Welcome to Noise Control and its Management. Today is the fourth day of the ongoing week and what we plan to do today is we will start with a problem where, we will have a pump which is driven by a motor and both this combination of these 2 individual machines is placed in a large room. And what we are interested in finding out is that if we place this combination in a room. Then let us say at a distance 2-3 meters away from that; what is the sound power level.

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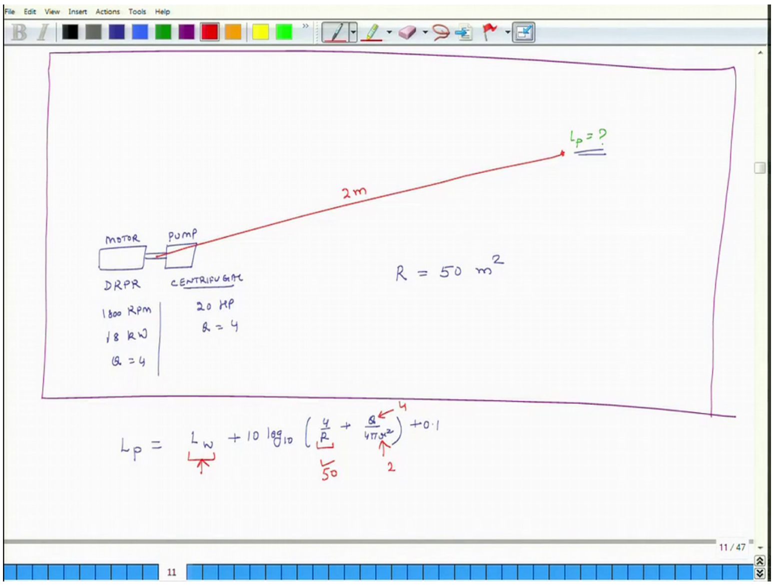

So, let us look at all the specific details of the problem statement. So, let us say I have a large room. And here I have a motor and the motor is driving the pump.

So, this is my motor and this is driving a pump. And let us say the pump is of DRPR motor is of DRPR type. And this is a centrifugal pump. So, what we are interested in finding out is that suppose I am 2 meters away. So, this distance is 2 meters. So, what is the sound power level here LP? What is the sound power level at this location; so some data on different things. So, what do we know? We know that this motor is running at 1800 rpm. It is wattage is 18 kilowatts and it is directivity factor is 4. And then for the pump so this runs at produces 18 kilowatts this pump it is power rating is 20 horse powers. The directivity of this pump is also 4.

And it is a centrifugal pump and this large room in which this combination of these 2 machines is placed. It has a room constant and the room constant is 50 meters square. So, this is the data and we are interested in finding out the sound power level at this location. So, how do we do it? We know that the sound power level, LP equals for a closed room we have a relation for this equals LW plus 10 log of 10, 4 over R plus Q by 4 pi r square plus 0.1.

So, in this relation we know R, R is 50 meters square we know this little R which is 2 this capital R is 50. We also know the directivity and it just happens that both machines have the same directivity. So, things become easier, but this value is 4, but what we do not know is the overall sound power level. Do not know the overall sound power level. So, we have to compute the sound power level for pump, we have to compute the sound power level for the motor and then we have to add it up somehow. And then that will give us the overall sound power level.

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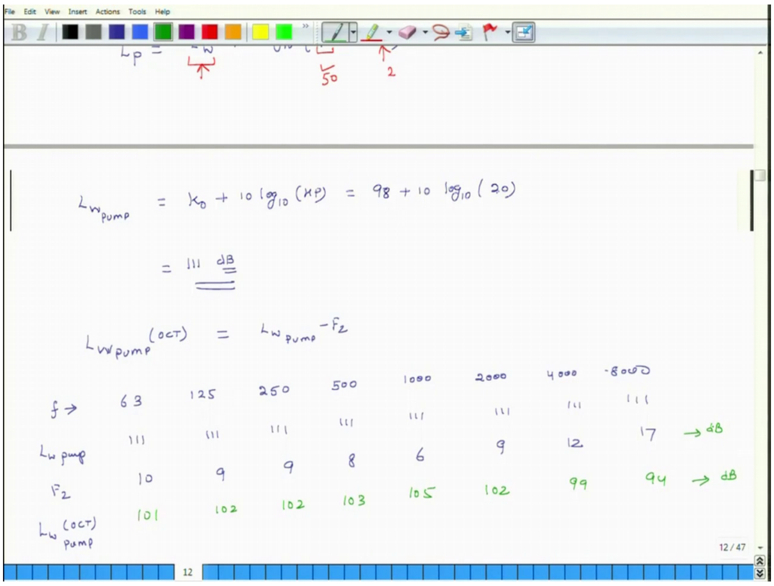

So, let us first compute the sound power level for the pump. So, LW pump and we know that the rpm of the motor is how much? What is the rpm of the motor?

Student: 1800.

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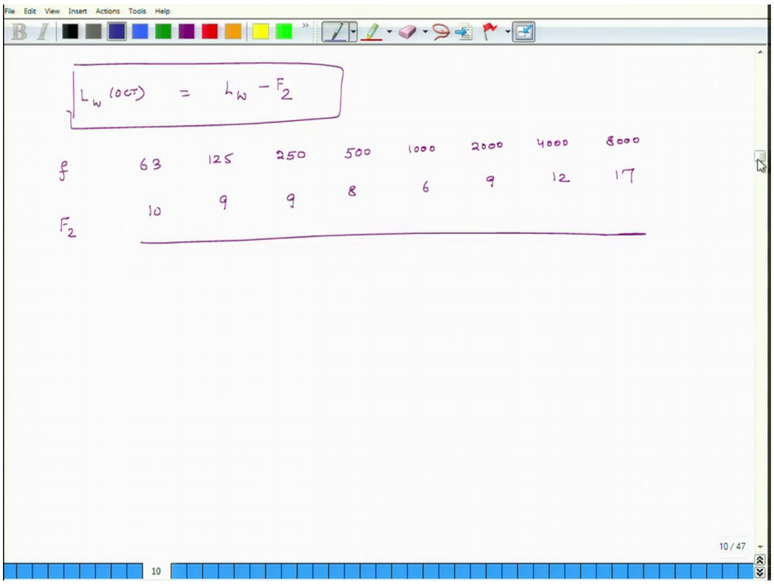

It is 1800 because the motor is driving it at 1800. So, it is same. So, it is 1800.

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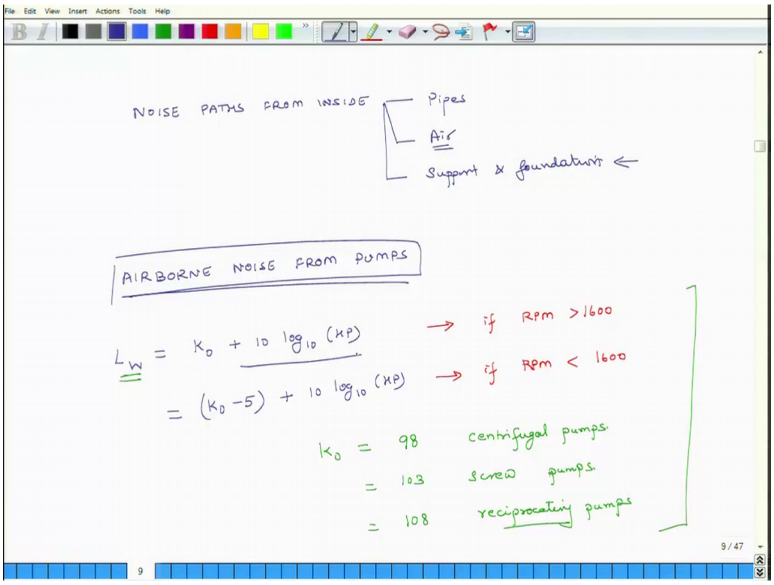

So, what we will do is, we will use this relation this relation. The first one k naught plus 10 log 10 and the value of k naught will be 98 because it is a centrifugal pump. So, it is equal to k naught plus 10 log 10 of horsepower. And k naught is 98 plus log a base 10. And the horsepower of the pump is 20. So, I put in 20 there. So, if I do all the math I get 101 or 100 and 11 decibels. So, this is the sound power level of the pump alone. Now I have to do the combination of the sound power level from the pump and also from the motor, but remember when we add 2 powers, you may have different proportions of powers and different octave bands. So, we have to first break up this power into different octave bands. So, first we have to compute this LW pump at the for each octave band.

So, our next step is to compute LW pump for each octave bands. And that we know is equal to what? We have a relation LW minus F2. And the value of F2 is given in this table. So, LW we have calculated for the pump and now we are going to compute F2 not F2. I mean we will take the f value of F2 from this table and we will compute LW oct.

So, it is LW pump minus F2. So, what do I have. So, I have central frequencies. What are the central frequency; 63, 125, 250, 500, 1000, 2000, 4000, 8000. And LW pump is 111 in all cases. And the value of F2 is 10, 9, 9, 8, 6, 9, 12, 17. So, my LW octave for the pump is how much? It comes to 1 0 actually I will write this in a different color. 1 0 1 1 naught 2 1 naught 2 1 naught 3 on1e naught 5 1 naught 299 and 94; what are the units of these? DB. What are the units here? This is still dB, because it is LW. So, I have computed for different octave bends the power levels.

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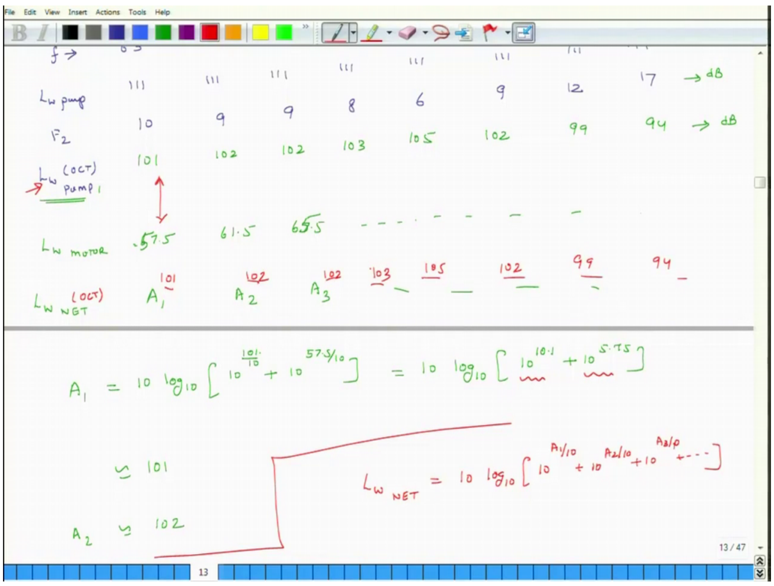

So, this is the power level for the pump. Similarly, I should also calculate the power level for the motor. So, LW motor and we have actually already done that, because I have deliberately chosen the specifications of the motor in such a way which are same of the motor which we had solved earlier. If you look at all the specifications 18 kilowatts 1800 rpm it is exactly the same motor. So, I have also actually calculated LW Oct for these.

So, it is 57.5 61.5 and so on and so forth. 65.5. For the motor it is 67.5. What is it 57.5?

Student: ah?

57.5.

Student: 61.5.

61.5, 67.5.

Student: 65.5.

65.5 And so on and so forth. Now I have to compute LW net for each octave band. Their some contribution coming from the pump in each octave band and some contribution coming from the motor in each octave band and I have to compute net. So, how do I do that? So, let us call this number as A 1 let us call this number as A2 let us call this number as A3 and so on so forth.

We will just do one computation to show you. So, A 1 I cannot just add as I told earlier 1 0 1 plus 57.5 is 58 I have to add the powers. So, that is equal to 10, log of 10 and then what 10 to the power of 101 by 10 plus 10 to the power of 57.5 by 10. So, if you do the math what you get is 10, log of 10, 10 to the power of 10.1 plus 10 to the power of 5.75.

Now, when we look at these numbers 10 to the power of 10.1 is extremely large compared to 10 to the power of 5.75. So, I do not have to I do not even have to do the math when I add them up the sum will be same as 10 to the power of 10.1 roughly we write, and if I take it is 10 log it will be still 101 decibels, because the difference between these 2 is. So, large roughly like forty plus decibels, when I do add up the powers it does not make a whole lot of difference of difference. So, it is approximately equal to 101 decibels. So, approximately I mean it will be changing maybe or second place of decimal or something like that.

Similarly, A2 is also same thing because these differences are large or more than something like 13 to 14 30 to 45 decibel difference. So, so these are large differences. So, A2 is also similar approximately equal to 1 0 to 2 decibels. So, these values are same 1 0 1 because of that I am just directly writing that. So, the point is that if you come across such large differences you do not have to bother too much about spend too much of time in computing you know adding up the power levels you can directly write, but you have to have a feel I mean how much difference will it create. So, that is there. So, LW net is this thing. Now based on this understanding what does this mean see if this is the for each octave band, this is the power level which is same as the overall power level for each octave band and this oct.

So, this power level corresponds to how much LW 1 way I can compute is LW net. So, this is in octave for octave bands. So, LW net I can calculate it as. So, what is our goal I have to compute LW net. So, it is 10 log of 10, 10 to the power of A 1 by 10 plus 10 to the 10 to the power of ops 10 to the power of A2 by 10 plus 10 to the power of A3 by 10 either I can do it. And I will, but what I will eventually get is this number because this energy has been broken up into different energy bands, you know different frequency bands. So, the overall power level will still be 100 and 11 decibels. And it will remain hundred and 11 decibels because the contribution from motor is negligible.

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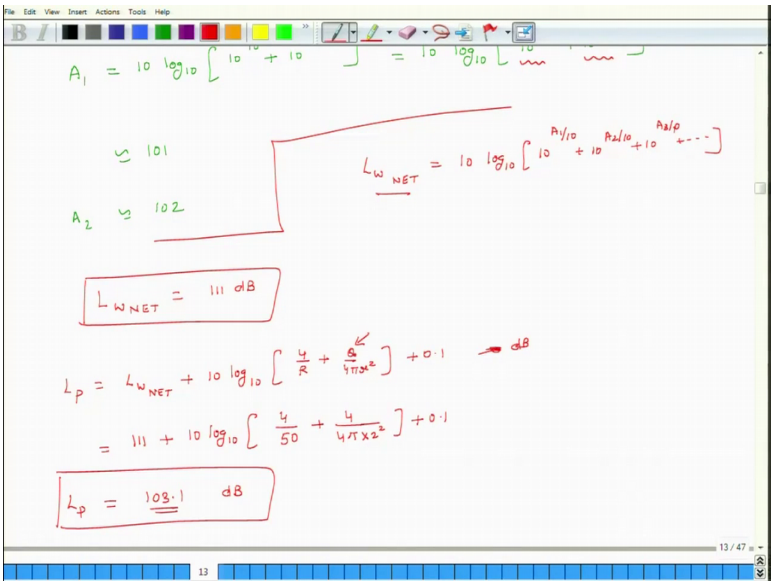

If the motor was providing sufficient power contribution, then this number LW net would have changed.

So, based on all this understanding I can say that LW net is equal to how much hundred and 11 decibels. Now once I have done that; this is hundred and 11 decibels. So, what is our original question? I have to compute sound pressure level L P. So, now, I know LP LW. So, now, I do all the math. So, LP is equal to LW; and in place of L W I have to write LW net plus 10 log 10 of 4 over R plus Q by 4 pi r square plus 0.1 and the units are in decibels. So, I substitute everything. So, I put 100 and 11 here, plus 10 log 10. And what is 4 over R? 4 over 50, room constant is 50-meter square plus Q by 4 pi r square what is directivity?

Student: 14.

And this directivity is same for?

Student: motor.

Motor; so I will put 4 by 4 pi r square, and r square is?

Student: 2.

2 square, plus 0.1. And then see if you do all the math you end up getting 103.1 decibels. So, that is what we get.

Now, the question is that suppose; so, in this case we assumed that the directivity is Q and it is same for both the guys. So, then the question is that what would happen if the directivity was different. If the directivity was different, how would you deal with it? The way to address that problem is that here we have computed LW net.

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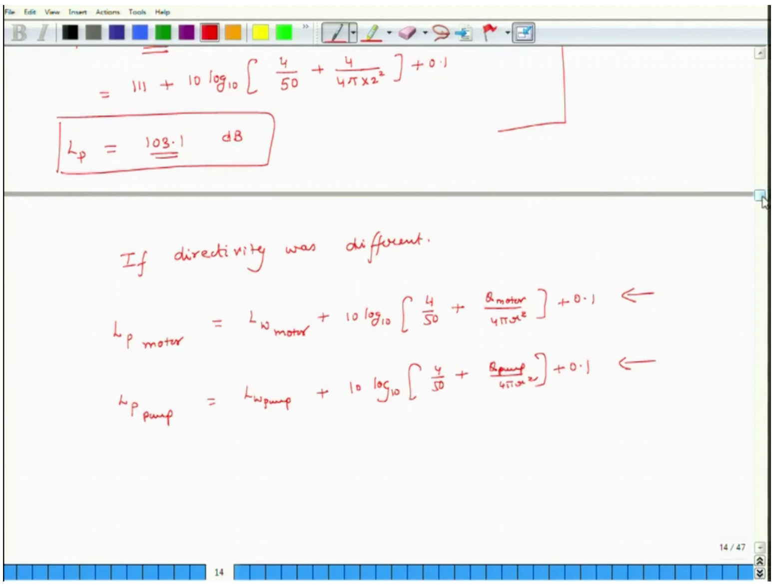

But if the directivity was different, then what did we do? First we will calculate LP due to motor, and when we are doing LP motor we will put LW for what? Only motor, plus what is the thing? 10 log 10 4 over 50 plus Q of motor by 4 pi r square plus 0.1. This is one thing we will do. Then I will do the same thing for LP pump; is equal to LW pump plus 10 log 10 4 by 50 plus Q pump by 4 pi r square. Now, if the pump was not there then this is the sound pressure level which would be there. And if the pump was there, but the motor was not there, then this is the sound pressure level.

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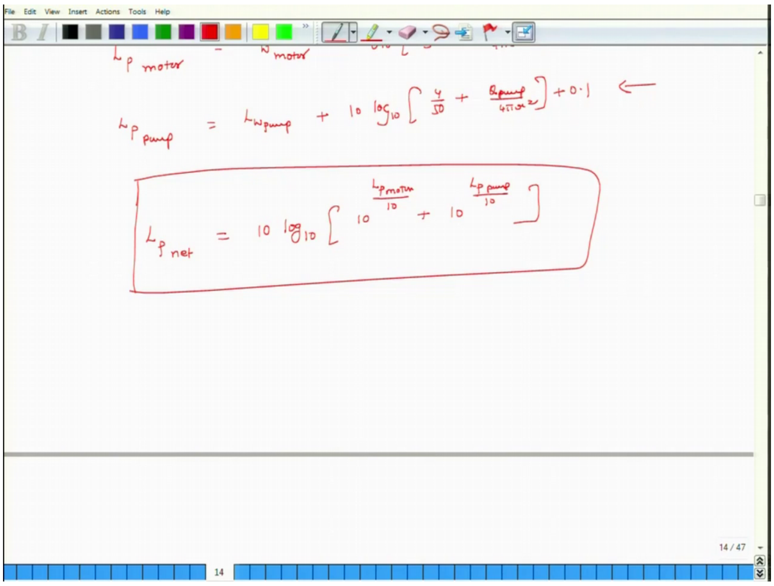

Now, if both the cases are there, then we would compute LP net equals 10 log 10 10 to the power of LP motor by 10 plus 10 to the power of LP pump by 10. And this is how we will get the overall decibel level; if the directivity was different. If the directivities are same I can do this way also. We will get the same answer, but if it was different then I have to use this approach. So, this is how I can do this. If there are 10 different sources with 10 different directivities I can use this exactly the same procedure, and come up with the final answer.

So, this is what I wanted to discuss today. What we will do tomorrow? We will be a discussion on compressors. So, that is what we plan. And, till then have a great day. Bye.