Hydraulic Engineering
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Lecture- 04
Basics of Fluid Mechanics- 1 (Contnd.)

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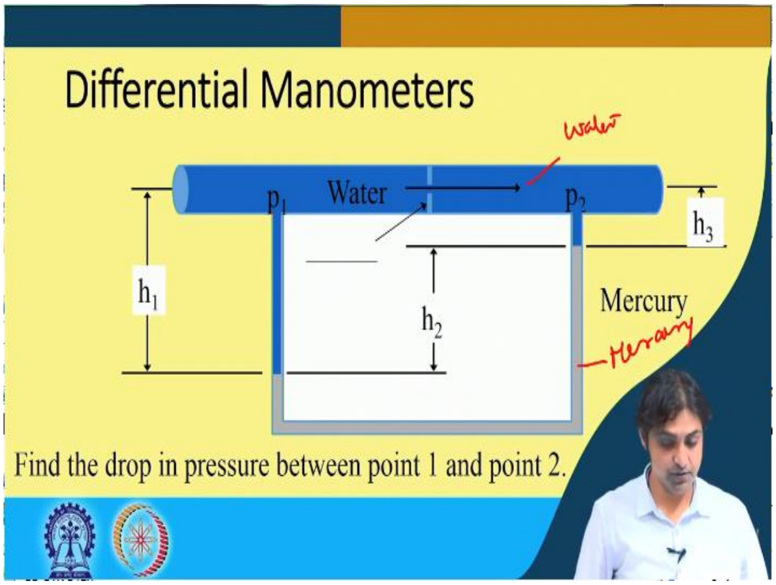

Welcome back to the lecture number 4 of this week. Last week we stopped sorry last lecture we stopped at differential manometers this was the slide that we were going to talk about, we saw some devices that can be used to measure pressures one of them was manometers in which a standard manometer and a differential manometer, so we are actually going to write down an equation or you can call it as a numerical as well, so this is the set up you know the blue one is this liquid here is water. And this is mercury.

So we need to find out the drop in pressure between points 1 and 2. So how are we going to approach this problem, so where if you see this is an orifice.

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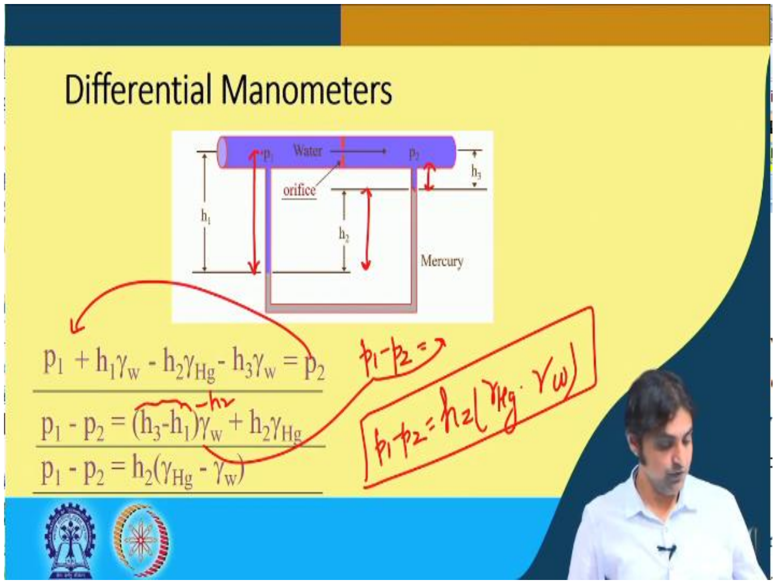

So now we are actually going to keep this figure in a small and just write down start writing down the equations variation with pressure if we go down we are going to add the pressure if we are going up we are going to subtract that pressure. So firstly P 1 this is P 1 here plus h 1 gamma w so what we are we are traversing around this direction okay h 1 gamma w because this is water minus h 2, so if we travels around this direction and reach this point, so, minus h 2 into gamma Hg again we are traversing across the water, so minus h 3 gamma w should be equal to P 2 very very simple equation. Correct? So we can write we can $p_1 - p_2 = h_2(\gamma_{Hg} - g_w)$. Right?

So this can be written as minus h 2 this term here. So it will be h 2 can be taken out and we can write P 1 - P 2 is equal to h 2 gamma Hg - gamma-water and this is the pressure difference. Very very simple question on differential manometers, and this is how it works. Okay? Nice. So, this concludes my first part where the pressure variation with location was their pressure at a point.

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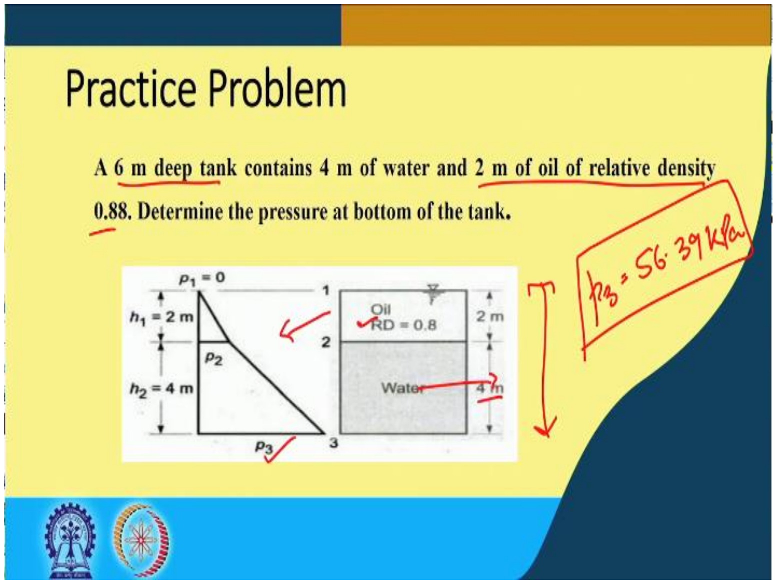

So we are going to solve some questions also, and this is quite important. So, what we say we have a 6 meter deep tank, so this is 6 meter, right? And contains 4 meters of water, so this is as it is written here very clear 4 meter and 2 meter of oil of relative density 0.88. So we have an oil the relative density is 0.88, we have to determine the pressure at the bottom of the tank. Okay? So, for your convenience we have drawn the pressure variation here on this side and this.Okay?

So how are we going to this is a question that generally people do it for before in you know engineering starts or you must also have done it in a fluid mechanics class. So now we are going to approach this and as always what I am going to do is I am going to use a white screen.

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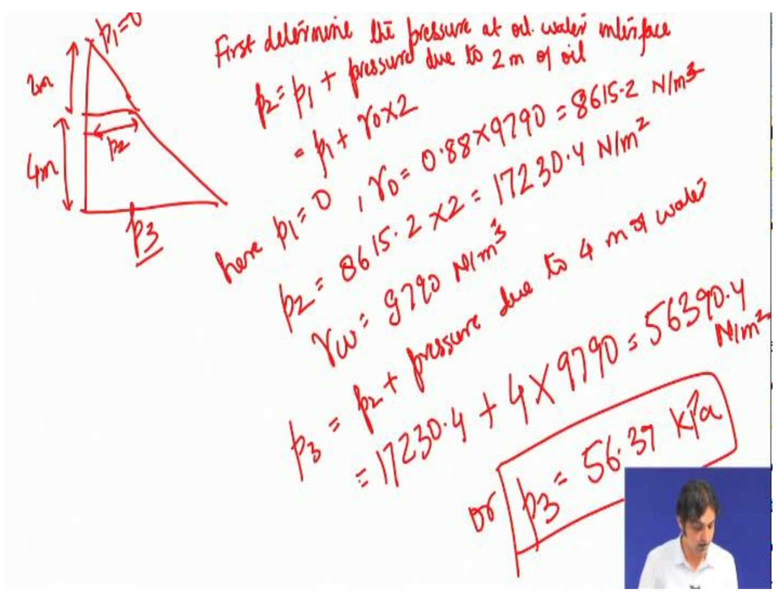

So we have already seen this equation so I will just draw the pressure prism I cannot should not call it pressure prism but yes so this is p 2, right? The entire thing here this is 2 meters, okay, so that, you remember pressure at atmosphere is 0 this is 4 meters, okay, and this is p3 we need to find this correct. So these are all the information that we have. So, first see steps are very important so you must be noting it down.

First, determine the pressure while water interface, that is, p2, so p2 is written as p1 plus pressure due to 2 meter of oil, very nice. So or p1 plus what is the pressure due to 2 meters of oil, gamma 0 into 2. Correct? Here p1 is equal to 0, right? Whereas gamma not which is the pressure of the oil it is 0.88 specific gravity into 9790 that is 8615.2 Newton per meter square and a Newton per meter cube sorry because this here.

So p2 can be written as 8615.2 into 2 that gives us 17230.4 Newton per meter square. So, you do not have to be very specific about 9790 you can also assume 9.8 so 9800 it is just what I have assumed, okay. So, that is the first step now we must also determine P 3, right. gamma w is we have assumed 9790 Newton per meter cube, okay. So p3 will be p2 + pressure due to 4 meters of water, right.

So p2 we already know, correct? So, p2 value, p2 is what we have found out was 17230.4 + pressure due to 4 meters of water is going to be 4 into 9790, okay, that gives us 56390.4 Newton per meter square, or p3 can be written as 56.39 kilo Pascal, okay. So, this was what the question had asked to calculate p2 and p3. If we just go back, you know, so determine the pressure at the bottom of the tank so bottom of the tank was p3 and that is exactly what we have found out. So, the answer was P 3 is equal to 56.39 kilo Pascal, okay. So maybe, so I have one another problem for you.

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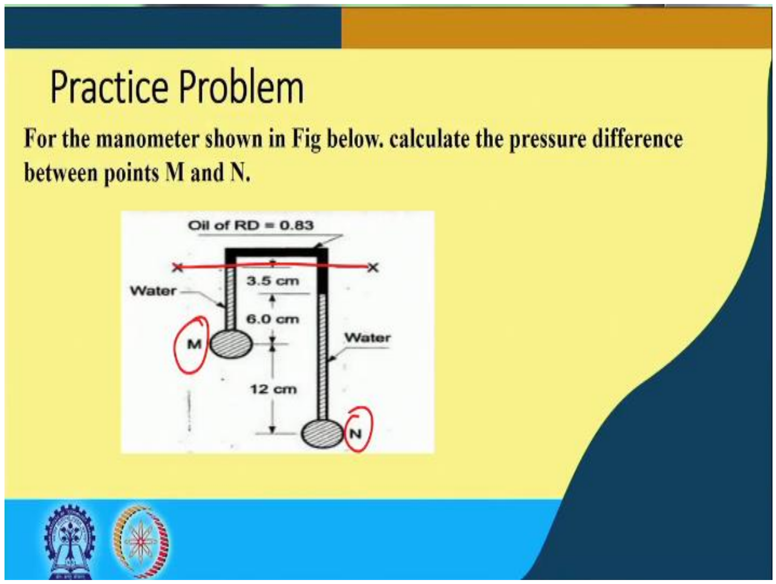

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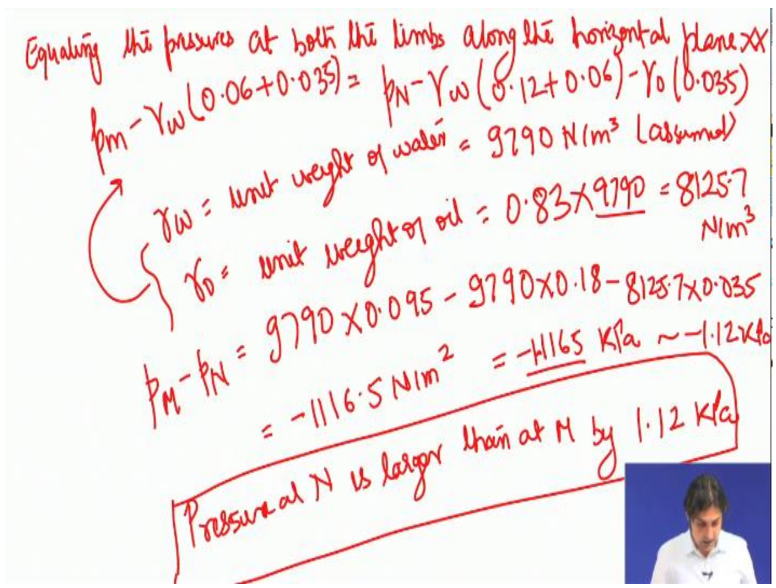

Before we go to the next concept, and that is, we have shown a manometer here in this figure. We have to calculate the pressure difference between points, M and N, this is point M and this is point N. The best way as I told you before, if you want to calculate the pressure difference or pressure at that point you have to start at one point where the pressure is known and traverse to the other point where you have to calculate the pressure.

If you go up you have to subtract that pressure if you go down you have to add that pressure. So, that is the one of the ways. Here, what we are going to do, we are going to equate the pressure at this level. okay. So, I think you must be drawing this figure, because I will not be redrawing it now. So but what I am going to do is, I am going to use that another white sheet to be able to solve this problem. Good. So, as I already told you we have to equate.

So, equating the pressures at both the limps as I told you, while discussing the figure along the horizontal plane, and what is that plan, xx. So, pm - gamma w 0.06 + 0.035 will give us pN – gamma w 0.12 + 0.06 - gamma not into 0.035. So here, gamma w is unit weight of water, which is equal to 9790 Newton per meter cube. And this value has been assumed, okay. This is a standard value. What is gamma not, is unit weight of oil. What is it going to be any guesses? The specific density was 0.83 into 9790, specific gravity when we say it is always our density that is in ratio with water no other fluid, okay.

So, that is why this the density of I mean unit weight of water is what we multiply to the specific gravity to get the unit weight of that oil, so here it comes out to be 8125.7 Newton per meter cube. So if we use these 2 values in equation here what we are going to get pM - pN is equal to 9790 into 0.095 - 9790 into 0.18 – 8125.7 into 0.035 and this is going to give us - 1116.5 Newton per meter square or - 1.1165 kilo Pascal. I mean, we do not have to be very, you know, where we can simply write 1.12 also. - 1.12 kilo Pascal okay.

So, the answer is going to be because it is negative that means pressure at N is larger than at M by 1.12 kilo Pascal, simple. So, the calculation of, you know, the pressure things is not that difficult. If you follow the chain rule, keep writing the pressure while going up and down this is very, very, very, simple, great. So, now we go back and this we have solved this problem now.

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