Fluid and Particle Mechanics
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Lecture - 62
Pressure Drop in Pipes Connected in Series

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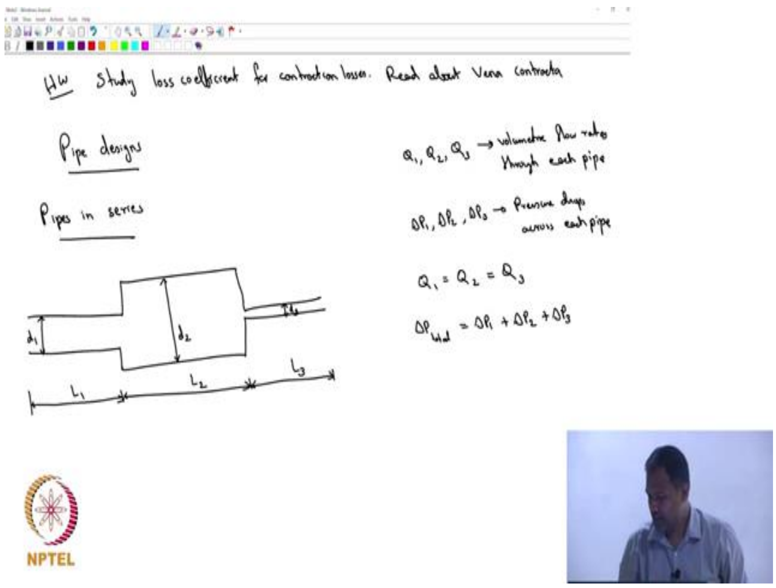

Pipes in series; let us say you have a system in which you have three pipes, of three different diameters connected together ok. Of course, L 1 is much larger just for convenience that we have drawn it this way and you have connected three of them together. Let us say Q 1, Q 2, Q 3 are the volumetric flow rates through each pipe.

And delta P 1, delta P 2, delta P 3 are the pressure drops across each pipe ok. So, we have been dealing with a single pipes so far; now I have connected three of them together. What do we know about Q 1, Q 2, Q 3? They are same. So, Q 1 is equal to Q 2 is equal to Q 3; what do we know about delta P 1, delta P 2 delta P 3? There will be individual contributions that will add up to the total pressure draw and therefore, we can say delta P total is equal to delta P 1 plus delta P 2 plus delta P 3 hm. So, what does it like; Q is like?

Current and delta P is like your? Voltage and the friction losses would have been your really a resistance ok.

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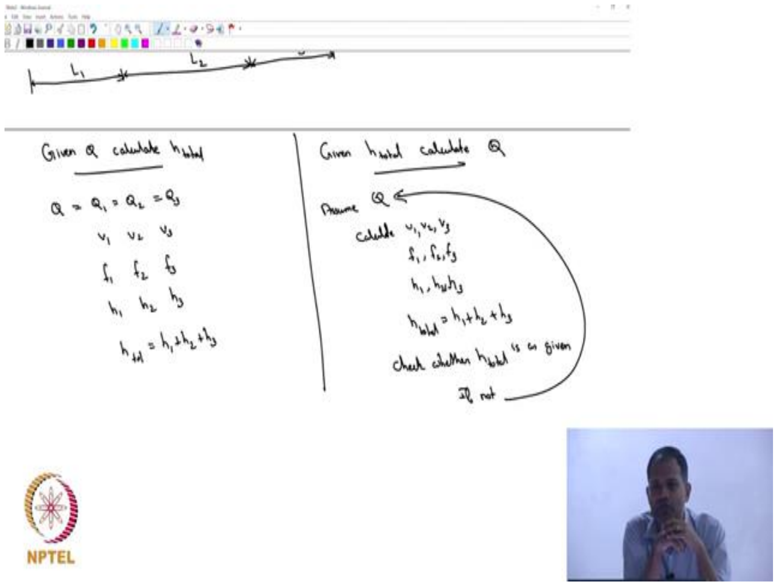

Question is Q calculate h total, how would you proceed? So, you know let us say you have this system ok; you know this is the flow rate that you want to get through the system, what is the pump that you have to select? What will you do?.

Q is given; that means, Q is equal to Q 1 equal to Q 2 equal to Q 3; you know flow rate through each pipe; that means, you know v 1, v 2, v 3 velocity through each pipe. You know f 1, f 2, f 3 friction factor in each pipe you know h 1, h 2, h 3 head loss in each pipe and h total will be simply h 1 plus h 2 plus h 3 right. So, if you have a complex system like that you could do it for individual pipes and then add up and then find out the total pressure loss ok.

Of course, I have neglected the expansion and the contraction losses if you had that you should have added that also; simple. Given h total calculate Q ok; you have this pipes in series you also have got a pump; you want to know how much you can pump, how will you do? Can you tell? So, I will take Q as a variable and then I do not know Q I need to solve for Q. So, so I assume Q calculate v 1, v 2, v 3 ; that means, I can calculate f 1, f 2, f 3 for some assumed value of Q.

And therefore, I can calculate h 1, h 2, h 3 and calculate and h total as h 1 plus h 2 plus h 3; check whether h total is as given; if not go back and correct your Q and you are right that is the only way to do it at least that is the one way to do it ok. So, it has to be an iterative procedure ok; the equations involved are non-linear you do know you will not be able to really do anything especially because if you do not know v 1, v 2, v 3; you will not know what Reynolds number you are going to operate.

So, you might be probably using laminar you know the 64 by Re as the correlation or you have to use anything that will come from Moody's chart or any of the other things. So, a priori you would not even know whether you should worry about your roughness factor or not because of that complication it becomes hard. So, one way to do it would be to start with a Q ok, calculate and then find out if a total matches; if not go back and check it and you know how to do this loops and so on. You know how to solve a set of non-linear equations right, how would you solve a set of non-linear equations numerically; unless you want to use a mat lab routine.

Of course, you can use the MATLAB routine and do it much simpler; so, either way ok. So, it is basically solving a set of non-linear equations for a given system that is what it turns out to be hm. We will see two more examples tomorrow and then, then we will get into boundary layer theory ok. Any questions?

I do not know. So, if it was all laminar; maybe you can write down an expression and try to simplify and get an expression for Q, but a priori; I do not think there is any other way.