Fluid Mechanics

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Lecture - 24
Fluid Flow Applications Part - III

Good morning, I welcome you all to the session of fluid mechanics. Now, last class, we were discussing a problem, which we could not complete. So, today first we should complete the problem, the later part of the problem, and then we will proceed to a new topic of the section. So, if you look to the problem, which we was discussing, which we were discussing last class. Please see.

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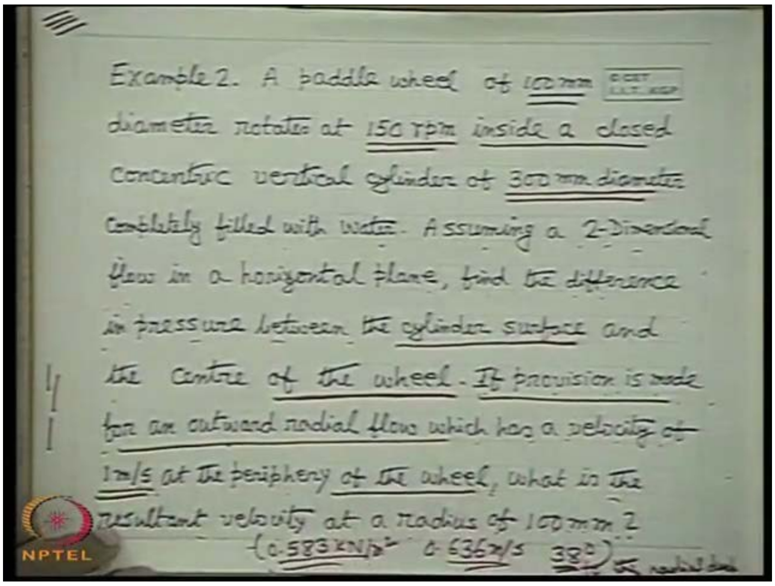

A paddle wheel of 100 millimeter diameter rotates at 150 rpm, I think this problem was taken well in last class just I am repeating it again, inside a closed concentric vertical cylinder of 300 millimeter diameter completely filled with water. Assuming a two-dimensional flow in a horizontal plane, find the difference in pressure between the cylinder surface and the centre of the field. If provision is made for an outward radial flow which has a velocity of 1 meter per second, that the periphery of the wheel, what is the resultant velocity at a radius of 100 millimeters?

So, the last part we could not complete; if the provision is made for an outward radial flow, this one which has a velocity of 1 meter per second at the periphery of the wheel, what is the resultant velocity at a radius of 100 millimeters? This is the question.

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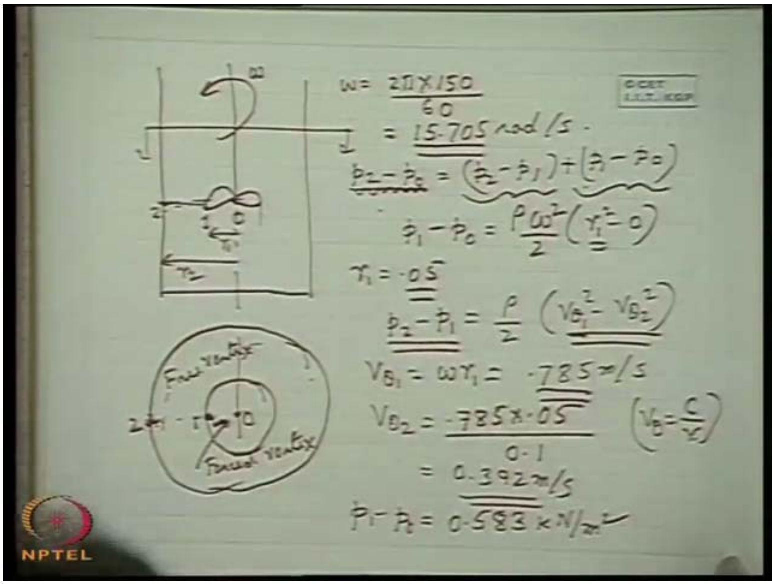

So, first part we did if we recall the first part was very simple, it is like this which we did first part that like this, this is the cylinder and this is the paddle wheel and this is the axis. So, we recall that there are two in a plane, in a horizontal plane if we see, let this point is centre 0, this is 1 and at the same radial location we take another point 2, that is at the surface, and this one we define to be radius r 1 and this is the radius r 2, that is the radius of the cylinder. That means if we see the plan view we will get this type of thing; that means this one with this paddle wheel this is like this. So, this is the centre one, this is the radius a radial location.

So, what we did we assumed from 0 to 1, that means within this domain the flow is force vertex, and from 1 to 2 flow is free vertex. So, we found out the rotational speed omega, omega is 150 rpm that means 2 phi into 150 by 60, which was found yesterday. This comes out to be well, these value comes out to be something 15.705 Radian per second. So, we can find out this repeating again p2 minus p o by rho or p2 minus p o first you write this one is nothing but p2 minus p 1 plus p1 minus p o.

So, this part is found from the free vertex pressure distribution equation because this part is free vertex zone and this part is forced vertex zone, core forced vertex. This is the forced vertex zone, this is the free vertex zone, and this is the forced vertex zone. So, this part is found out from the forced vertex zone. So, this we solved p 1 is equal to p1 minus p 0, from the forced vertex equation omega square by 2 into rho into r 1 square minus 0, that means simply r 1 square, and value of r 1 is given as 0.05, if you put it we will get the value of p 1 minus p 0.

Similarly, p 2 minus p 1 we will get from the Bernoulli's equation at rho by 2 V Theta 1 square minus V theta 2 square. V theta 1 is omega into r 1, r 1 with 0.05 and omega with this, if you calculate V theta 1 that means, at this radius this will be in a point well V theta will be 0.785 meter per second. So, you can very well find out V theta 2 considering the free vertex motion from 1 to 2, you know that for free vertex motion V theta is C by r, that means V theta into r is constant. Therefore, V theta 2 is 0.785 into it is radius 0.05, that means this one divided by at this point, do you want the velocity so this radius, which is 0.1 that means simply it is half of this which becomes is equal to 0.392 meter per second.

So, with this value of V theta 2 and this value of V theta 1, we can find out p 2 minus p 1. So, if you find out p 2 minus p 1 and then they define out the difference in pressure which becomes equal to p 1 minus p 0 becomes equal to 0.0583 kilo Newton per meter square there is no problem.

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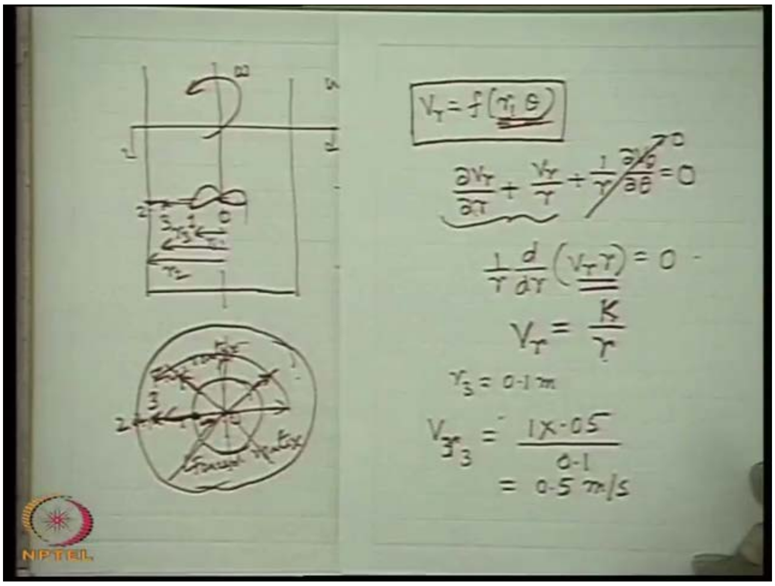

Now, next part is the pressure, now how to find out pressure, sorry how to find out the velocity, next part is the radial velocity. Now, if there is a radial velocity; that means if there is a radial velocity it is; that means you draw the radius that means, if there is a radial velocity coming out, if there is a radial velocity along with the tangential velocity. Tangential velocity is at there in this direction, so along with the tangential velocity there is the radial velocity. Now, radial velocity if it is there, now we will have to find out that what is the functional relationship of radial velocity, whether it is a function of r only or Theta only or general function of r theta. So, we will have to first find out the explicit form of the radial velocity with the independent variable, that is special coordinate r theta.

So, to do this we will have to explore the continuity equation. Now, for a 2 dimensional steady flow the continuity equation del V r, for an incompressible flow del V r del r, for an incompressible flow, 2 dimensional incompressible flow the continuity equation V r by r. If you recall 1 by r del V theta, del theta is equal to 0. Therefore, we see that V del V theta, del theta is 0 because already we have found that V theta is a function of r only. So, V theta is not a function of theta so this is 0. Therefore, continuity equation tells us del V r del r plus V r by r is 0, which can be written as… Now, del I write in terms of d.

So, if you take 1 by r d d r of, because V r is a function of r only from here we see d d r of V r into r is equal to 0. So, which tells that V r, alright? So, which tells that V r is equal to some constant let K by r that V r into r is equal to constant. So, from the continuity we see that the dependence of V r is let V r is equal to some constant divided by r, all right? Therefore, from here from the equation of continuity we find out that V r is equal to constant by r. Therefore, now next job is very simple it is given that the outward radial flow velocity is 1 meter per second at the periphery of the wheel, that means this point the radial velocity is 1 meter per second that is this point.

So, we can find out the K rather we can straightway find out the radial velocity at a point here which is 100 millimeter in diameter, let this point is the 100 millimeter in diameter point in question. Let this is 3 point and this r 3, that means this 1 r 3 is equal to 100 millimeter that means 0.01 meter. Therefore, V 3 that means at this point 3, V r 3 rather V r 3 is equal to it is inversely proportional to r that means it will be the radial velocity 1 meter per second corresponding radius which is 0.05 divided by the r 3, r 3 is 0.1. So, what is the value of V r 3? V r 3 value is 0.5 very good meter per second.

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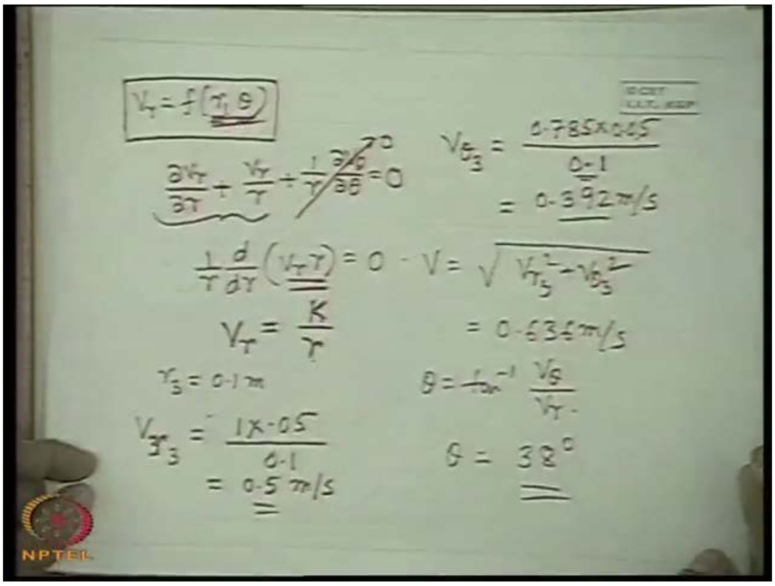

In the similar way we can find out the value of V theta; that means if I write this V theta 3 is equal to what I can write. Now, again you see that V theta 3 we can equate with one V theta 1 is known so V theta 1, so V theta 1 what is the value of v theta 1? V theta value we have found out, V theta 1 is 0.785 which is the velocity here, well so 0.785 into the radius it is also inversely proportional to radius that means 0.05 divided by the radius of the point 3. That means 0.1; that means this is also V theta 3 it is alright, the radius is 0.1, so this is also half 0.392 meter per second, alright 0.05 a 0.1 so 0.392. But here probably I have done a mistake so it is not 0.1, this is V theta 2 this diameter is well 300 millimeter 0.15.

Well so, this value is you please cut 5.0, what is this value 2 no I am sorry I am very sorry, what will be this value 0.26 to calculate it? It is wrong because it will be 0.5 because here the radius is 0.5; well here the radius is 0.5. So, 0.5 radius is 0.15, 300 millimeter diameter so radius is 0.15, so that is why this is 0.392 now the radius is 0.1. So therefore, we know V r 3 we know V theta 3 so the resultant velocity V is root over of V r 3 square plus V theta 3 square. If we want; that means this value becomes 0.636 meter very simple; that means here this point, this is the radial velocity. Let this be the direction of rotation as it is shown this is the direction of, so that means this is the tangential direction, that is perpendicular toward, so this is the V.

So, it is inclination with radial direction if it is theta then tan theta will be what? Tan theta will be V theta by V r, so with the radial location if theta is the angle then Theta is tan inverse V theta by V r, V theta by V r and you find out theta to be 38 degree if you find out (( )) V theta by V r. So, this is the problem which we could not complete in the last class because of time. Now, today I will start another topic of the section is a hydraulics siphon. So, before I start the hydraulics siphon it is a very simple thing which is a practical device and which can be analyzed simply by the application of Bernoulli's equation. But before that I like to tell you a few words which is very important in this context that whenever the fluid flows in case of an ideal flow.

Now, if we consider this like this that in any fluid circuit or flowing device if we exclude the energy interactions from outside; that means no energy is added from outside to the flow of fluid or no energy is taken from the flow of fluid. It is not the case for flow of fluid through a turbine where the flow takes place through the turbine, if you consider turbine as a device work is taking out because work is developed by the turbine or in case of a compressor or pump when the fluid flows through the device like pump and compressor work is given in.

So, if we exclude this type of devices only we consider the flow of fluid in certain device or in certain equipment or in a pipe or whatever may be, that means if the fluid flow situations exclude this circumstances where the work interactions from the outside source. Then we can tell like that if the fluid is in viscid then the total mechanical energy remain constant in the flow during the flow; obviously total mechanical energy is constant in the entire flow it comes no equation nothing comes from very simple concept of conservation of energy. Total mechanical energy why remains constant because if the fluid is in viscid mechanical energy cannot be dissipated into other form of energy.

Because it is the viscosity or the fluid friction which causes the conversion of mechanical energy a part of the mechanical energy, which we call as dissipation of energy; that means conversion of a part of mechanical energy into intermolecular energy or heat. So, that part is absent therefore, total mechanical energy remains constant. So, there may be a conversion from one form to other form that pressure energy to kinetic energy, kinetic energy to pressure energy, potential energy to kinetic energy, pressure energy to potential energy, but sum of these three components of energy remain constant it is number 1.

Number 2 now, in practice fluid is not ideal or in viscid, all fluid has got viscosity. Therefore, practically all fluids which we can think of in practice are viscous fluids and they are known as real fluids. Therefore, real fluid is a synonymous term of the viscous fluid. Now, in practice the mechanical energy changes, why this is because there is a dissipation of mechanical energy, due to friction into intermolecular energy. Now, just consider this that whenever there is a flow of ideal fluid from one point to other point the mechanical energy remains constant. Therefore, the flow is equally possible in both the directions and flow is maintained by virtue of its inertia.

Now, or it may be by virtue of its inertia or may be some external forces acting on the fluid. Now, in case of a real fluid flow you have to understand this whenever there is a flow of fluid. So, energy at the upstream section or upstream point is more than that at the downstream point, which means that fluid flow by virtue of the energy gradient. So, energy is the potential which causes the fluid to flow if you compare with other phenomenological facts like flow of heat. Heat flows from a higher temperature to lower temperature, electricity flows from higher potential to lower potential. Therefore, fluid flows from higher energy to lower energy.

Now, in reality for real fluid, the fluid flows from higher energy to lower energy and this difference of energy is consumed by the fluid friction or the viscosity. That means this is the energy mechanical energy which we call as a loss you have seen that in Bernoulli's equation. We call this difference of energy is the loss of energy loss of energy from the view point of mechanical energy, because energy can never be lost, that means this difference; that means upstream is higher mechanical energy, downstream is lower mechanical energy. So, this difference of mechanical energy is dissipated or converted into the form of intermolecular energy; that is loss from the view point of mechanical energy.

That is the loss in mechanical energy that is why we call it in terms of loss in fluid mechanic. So, this loss of energy is consumed by the friction that is due to friction. Now, in this context we will see that sometime we see that in upstream part of the fluid, the pressure may be low, downstream part the pressure may be high. So, apparently it keeps a confusion the fluid is flowing from a low pressure to high pressure, does not matter fluid is obviously flowing from high energy to low energy. That means upstream though the pressure is low you may see the kinetic energy, the velocity is such.

The data made is such that the sum of the kinetic and potential energy can counterweigh or counterweighs the difference in pressure energy and makes the sum of the three components definitely more than that of the downstream. Sometimes, we may be conducive that water spontaneously goes from a lower elevation head to higher elevation head, how it is going from a lower potential energy to higher potential? It is not the potential energy, total mechanical energy, that means at the lower potential energy probably the velocity energy, that is the kinetic energy or the pressure energy are such that the sum of the three components the total mechanical energy is more than that of the downstream part.

Therefore, fluid always flows from higher mechanical to lower. It is a very simple thing, but still you should have mind so that you should not have any confusion apparently as you see. So, it is a pressure fluid can flow from a low pressure to high pressure from a low head to high head provided the energy at the upstream portion is higher than that of the downstream portion it always flows from a higher to a lower energy level.

Now, we come to the hydraulic siphon, hydraulic siphon is a device which raises the liquid from a level where it is pressure is atmospheric by a tube and it does. So, provided a negative pressure or a vacuum pressure in the tube is caused, otherwise fluid from an atmospheric pressure cannot go up, how it will go up? From the energy conservation it is pressure has to be lower than the atmospheric pressure, so creating a vacuum pressure raising the fluid from a level, where the pressure is atmospheric pressure is known as the siphonic action is known as a siphonic action. The tube or instrument or the device whatever you call does it is known as a hydraulic siphon. So, let us now concentrate to a hydraulic siphon; how does it work.

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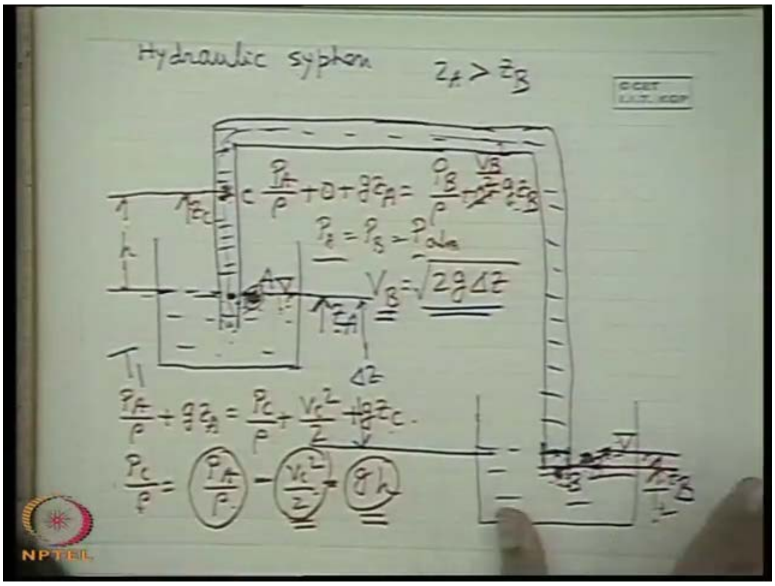

Now, let us hydraulic siphon, very simple you have read it probably at your school level, but still again brushing up let us consider the two tanks, oh sorry, this will be difficult. Now, hydraulic siphon, hydraulic siphon let us consider tube like this, well let us consider this one, let us well, let us consider a situation like this, this is a hydraulic siphon. Let us consider two tanks one is T 1 another is T 2; so T 1 tank the water is at a higher elevation than the level water level than the tank T 2. Let this point is B, let this point is B, where this is discharging. So, this is discharging that at this point B, right? At this point B and let this point is a free surface it has elevation at Z A B has a elevation as Z B.

Well, Z A is greater than Z B; obviously it is shown from the figure. Now, what happens definitely the liquid level here is at a higher energy than the liquid level here because pressure energy and kinetic is as 0. So, the elevation energy or the potential energy is higher than this, so if we fill up a tube like this AU tube inverted U tube with the same liquid and dip this tube into this tank then water will automatically flow. Because what you are doing practically we are connecting this water of the two tanks by a water circuit. That means full of water in a pipe and you just connect it, so what will happen since there is an energy difference between A to B the water will go on flowing like this from A to B.

So therefore, if we consider the point A and B very simple because I am telling you, if you can understand it in physically then equations are very simple. So, A to B there is every possibility water should come from A to B, but while we consider the flow in this part we may be apparently confused, that how the liquid is going from this tube at this point at a lower potential energy to higher potential energy. That then means definitely the pressure created is lower at this point, such a way that the sum of the three components of the energy at any point must be lower than the sum of the three components of energy at this point.

On this point that is why the flow in this part is possible, so as a whole if you consider the flow with the entire circuit flow from this point to this point is very much possible. Now, this is the siphonic action, so if you consider the phenomena the action that liquid is flowing out of this tube and of you continue it the entire liquid will be coming out. That means this tank will be emptied, so that the all liquid in the tank can go to the tank T 2 from T 1 to T 2. It is a so physically there is no bar or it is totally possible from the physical point of view.

Now, let us write the Bernoulli's equation between point A and point B. So, Bernoulli's equation between point A is if I write P A by rho plus what is the velocity here? Velocity here is 0 at the free surface. The velocity here is 0 though the surface is going down, but it is very slow or we can maintain a constant head by supplying. We can start here and analyze this with a maintaining a constant. So, there is no movement of the surface, so velocity energy is 0 or even if there is a movement is velocity is very small because of the large cross sectional area of the tank.

So, the most important is the elevation at this Z A, it is elevation referred to any vertical referred to any reference datum from which these elevation head is Z B. Let us then very important is that we consider this as delta Z that means this difference between the elevation head of this 2 delta Z. Now therefore, this can we write P A by rho plus 0 plus G Z A is equal to P B by rho plus 0 plus G Z B. So, P A is equal to P B is equal to P atmospheric, P atmospheric, so this is the two atmospheric pressure. So, it is very simple that if we now, if we write this B point not here, so otherwise it will give you a confusion.

So, G Z A minus Z B, what is happening, so I am sorry this, because you can argue that if I write this, this is a confusion this I will explain it afterwards. There is a loss exit loss, so exactly at the exit plane if you consider which is the atmospheric pressure, that means the exit is taking place just at the surface. I have drawn like this, so there is no pressure difference between this point and this point that means, you can consider exit just at the free surface or just below the free surface. So, the pressure is same as the free surface atmospheric pressure, so I am sorry, so here there will be V B square by 2 V B square by 2.

So, if you take P A and P B as the same as the atmospheric pressure they cancels out. So, simple deduction is that V B is equal to 2 G delta Z, I will explain this afterwards. If one is interested to know if exactly at the free surface after the liquid comes to rest, if I write then P A P B cancels out, how the difference of this Z A Z B energy goes that comes out to the exit loss. That means the velocity energy which is discharged here, that is being dissipated through the friction into intermolecular energy that is known as the exit loss. So, a loss term will come that I will consider afterward.

Now, for in viscid flow if there is no loss, if we do not count any loss, so through this path of flow if you write the energy equation at the point A at the free surface and the discharge plane point B. Then I get that V B is equal to root over 2 G delta Z, which is very simple. That means, the kinetic energy created here by virtue of the elevation difference delta that mean, as the elevation head of A above B is utilized in creating this velocity V B. Now, we see that how the flow is taking place in this vertical section of the pipe.

Let us consider a point C whose elevation is Z C and let this height is H Z C is the elevation measured from the same datum, from which the elevation of A is Z A, elevation of B rather B point is here elevation of B is Z B, like this. Now, if we write the Bernoulli’s equation from point, this point A which is at free surface and point C this point A and point C. What we can write please tell me we can write that P A by rho. Here, the velocity is 0 plus G Z A is equal to P C by rho plus the velocity at the point C V C square.

I have to write in the same page that is why this is superimposed, otherwise I cannot get the figure V C square by 2 plus, you tell me Z C, G Z C. Therefore, P C by rho is P A by rho very simple minus V C square by 2 minus G Z C minus Z A that means H, which means the pressure at C has to be lower from the pressure at A by the amount of V C square by 2 and G H which physically signifies. Now, this is for an incompressible, sorry this is for an ideal flow, flow is incompressible and ideal that means the total energy at this point and this point remain same. So, what happens is part of the pressure energy at P A is being utilized to create the kinetic energy and the datum energy or the potential energy.

So, that the pressure energy at C has to be lower than that of A by this 2 amount kinetic energy and the potential energy. So, if pressure at A is atmospheric that means P A is atmospheric pressure, as we have already written therefore, the point P C, the pressure at P C is lower than the atmospheric by this amount V C square by 2 plus G H minus, so therefore, the pressure is vacuum pressure.

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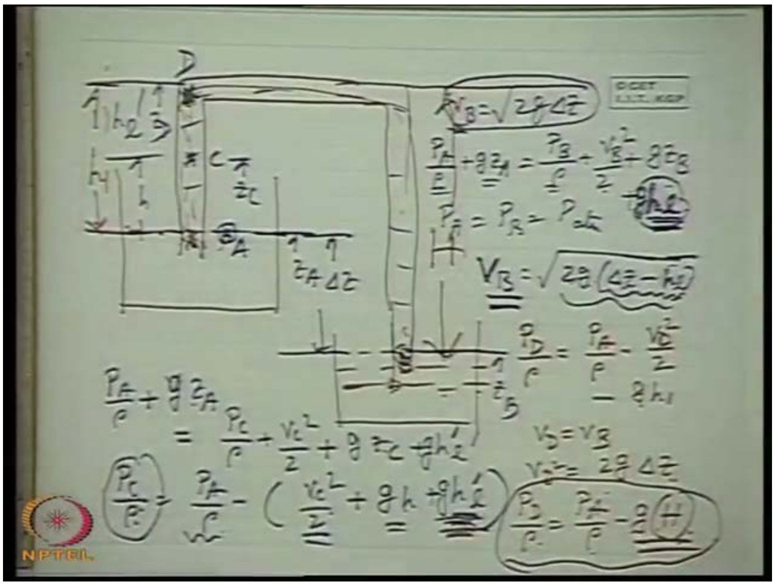

Now, you see if we consider the losses, if we consider the losses what will happen, now if I consider the losses if I consider the losses again, better we draw this figure. If we consider the losses now what will happen, if we consider the losses that means in a short I am drawing this again, the siphon this is not like this, let this goes like this, this is the discharge plane, this is the discharge plane B, let us do like this, this is the point A. Now, this as the point C, so this was the point A this is the point B, so this is Z B, again this is

Z A, so this is delta Z, this is delta Z and this is H and this is Z C. Now, we have found out that V B is root over 2 G delta Z very simple.

That means this potential head is utilized to create the kinetic energy writing the Bernoulli's equation between this two points. Now, if we considered a loss frictional loss that if we consider a real fluid, we have discussed earlier the Bernoulli's equation can be used for a real fluid with a modification term as loss. That means, if we write the Bernoulli's equation between A to B through this fluid path, that is, the fluid path taking care of the frictional loss of energy. Then we can write the total energy at the upstream point that means P A by rho plus G Z A is the total energy at the downstream point.

I have told that the upstream point energy will be more than the downstream point by the loss term, therefore, total energy from at the downstream point V B square by 2 plus G Z B plus a loss term H l, that is, the loss of energy due to friction per unit mass. Because these are the energy quantities per unit mass, this is known as the frictional head loss. So, frictional energy loss H l, so in that case if you cancel P A and P B to be equal to be atmospheric pressure, then you get simply the V B is equal to root over 2 G delta Z.

So, this will be the head loss term, so if this is the energy loss, usually energy loss is written in terms of the per unit weight this is the Nomenclature. We write G H l that means H l is the frictional head loss that is the energy loss due to friction per unit weight that is why I multiplied with the G, so that G H l becomes the energy loss per unit mass due to friction. Because H is usually used is usually used to express the frictional loss per unit weight that is a head whose dimension is meter. Therefore, it is G H l that means 2 G delta Z minus H l it is very simple it comes from this.

So, V B is equal to G Z A minus Z B minus G H l that means, the velocity created is less than 2 G delta Z, but that means the potential head is effectively reduced by the amount H l. That means the velocity which will be generated in this case will be less than this one which is generated because of the ideal fluid. So, therefore, due to the friction some part of the mechanical energy is dissipated or converted into intermolecular energy, which is taken care of by this loss term. So, that the velocity head is generated at the discharge plane is less than that could have been generated by the ideal flow.

Now, if you write the equation here and here considering the loss term and if you consider the loss frictional energy loss per unit weight or loss of head due to friction per unit weight is H l dash that is between A to C. Then I can write again the same equation which we wrote earlier P A by rho plus here V B, V A square that is 0, G Z A is equal too. Here if we write P C by rho plus V C square by 2 plus G Z C, so this energy is to be more than this by the loss H l dash. That means now I see that P C by rho has to be less than P A by rho by which amount V C square by 2 plus P A by rho is V C square by 2 plus G into H because Z C minus Z A is H plus H l.

So, you see P C by rho has to be lower than the P A by rho that means the pressure here is lower by this by this three amount, which means a part of the pressure energy here is responsible for creating the kinetic energy, here increasing the potential energy here plus to overcome the friction. That means this pressure has to be sufficiently low as compared to this point because to take care of this.

It is very simple alright, H l dash sorry, here I have considered G sorry sorry sorry sorry sorry sorry sorry G H l dash this is the question of consistency with the unit. So, concept is clear therefore, we can justify that the flow of fluid in the liquid through the siphonic tube or the siphon, that this part the pressure is minimum and then gradually it becomes increases and becomes again atmospheric. So, which point the pressure will be the minimum one. So, topmost point because the pressure will go on decreasing now V C square by 2, now this V C and this B V B is same if we consider the pipe to be of uniform diameter.

Let us consider a point D, at the topmost point here D. Let us consider where the datum head is Z D, you write the Bernoulli's equation. Now, you write the Bernoulli's equation between this point and this point taking care of the losses, first of all you neglect the loss because usually the losses are just I have explained what is the role of the losses. But frictional losses are low because the velocities are very low, therefore we can neglect the losses neglecting the losses if you find out this pressure. So, what will be this pressure P D by rho is equal to tell me P A by rho minus V C square by 2 minus G. Let this height is, this height is H 1, any height you take, so V B D square, V C and V D is same, V D square very good minus G H 1.

Now, if we consider the pipe to be uniform, so V D is V C and V B, so we can write V D is equal to V B, so V D square is 2 G delta Z. Alright, very simple so P D by rho is equal to P A by rho minus what is that 2 G delta Z. So V D square is 2 G delta Z, so V D square by 2 is G delta Z and P A by rho minus G. So, minus G H1 plus delta Z that means, it is the total height, let this height is big H in the same, the pace is so limited space, so it is very difficult all the superimposed G into H that means minus GH. So, just bracket is not needed minus G H that means the pressure here is the P A by rho that means atmospheric pressure minus G H.

The same equation you can derive, if you write the Bernoulli's equation between this point and this point you can find out the same equation, therefore this is the minimum pressure obviously the minimum pressure will occur here. That is at the topmost part of the tube where the vertical height will be maximum. So, this pressure P D is equal to P A by rho minus the total height from this level of liquid H to the uppermost point minus G H neglecting the losses. If you make the loss then this pressure will be this minus G H minus the loss which has taken place during this part of the flow frictional losses properly take into account minus G H L r or H L 2 whatever you define so.

It is very simple, now in this context I like to tell you one very important information of fluid flow which is very important for designing any practical equipment. Now, first you see that in this type of situation, if this is open to atmosphere this surface, so this point are having pressure below the atmospheric pressure. As you go up you see pressure is becoming lower and lower, that is lower and lower than the atmospheric then vacuum pressure is increasing obviously. Now, if you go on increasing the height the vacuum pressure will be increasing, that is pressure is still going to be lower and lower what is the restriction of the minimum pressure. Can you tell me what the restriction is?

So physically it is alright, we can make a very high tube and we can make the flow possible theoretically the pressure at any point here, if you go up will be lower than the atmospheric pressure by this potential head and the kinetic energy created if we take a very small tube so kinetic energy will be very high. So, under all situations the physical definition is alright, but is there any limitation of the minimum pressure? The minimum pressure in the circuit is at here what is that limitation can you tell me, what is the limitations? This limitation is that, that pressure vacuum pressure or the pressure created should not fall to below a pressure which is the vapor pressure of the liquid at the existing temperature.

What will happen then the liquid will boil up? So, vapor will be generated, therefore the limit to this pressure, the minimum pressure is the vapor pressure of the liquid at the existing temperature. So, liquid will starts boil up, boiling up and the phenomena is known as Cavitation.

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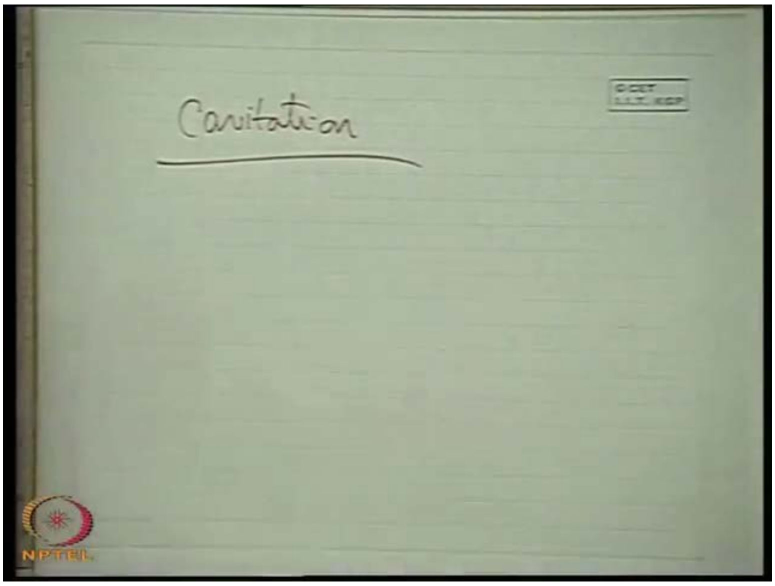

Now, I define you the Cavitation, in general this phenomena is known as Cavitation. So, liquid will boil up and the hydraulic circuit is closed, sorry hydraulic circuit is detached. So, fluid flow stop; this phenomena is known as Cavitaion. Now, I define you in general what is Cavitation? Cavitation is like that if in any hydraulic circuit the liquid circuit at any point if the pressure is below the atmospheric pressure. So, when one has to be very careful that this pressure should not go below the vapor pressure of the liquid at the existing temperature where the liquid will start boiling up. So, liquid will change it is face and the flow will be stopped.

You know that for all liquid there is a pair of pressure and temperature at which it changes it is phase from liquid to gas. Let us consider the water we know at ambient pressure, the water boils up at 100 degree Celsius, but at the ambient temperature also water boils up for consider today's ambient temperature as 20 degree Celsius. At 20 degree Celsius water is boiled, water also boils up we do not have to heat the water, if we reduce the pressure to a sub atmospheric pressure which is equal to the saturation pressure corresponding to that temperature, that you have read in the physics.

For example, it may be 0.3 Atmospheric pressure where 20 degree Celsius is the boiling point of water. That means, that is the saturation pressure corresponding to that temperature that pressure is known as the Vapor pressure of water at it is existing temperature, where the water will boil up. So, by chance the room temperature water has a pressure of that value then water will start boiling up. So therefore, one has to take care of that, this vapor pressure at the existing temperature should be the minimum pressure such that the pressure at any point in the hydraulic circuit should be above that to avoid the phenomena of boiling of the liquid. What happens in practice when this pressure is approached?

The boil liquid starts boiling and the vapor pockets are generated and therefore what happens, this vapor pockets ultimately is generated and it is carried away by the liquid and then immediately collapsed. When it reaches a higher pressure region of high pressure and liquid particles from surrounding rushes to fill up the cavities, the cavities are formed and this causes a serious damage to the surface of the dark, through which the liquid is flowing or the surface of the body passed, which the liquid flows and causes a serious damage and immediately the flow is stopped because of the vapor locking, so this phenomena is known as the Cavitation.

So therefore, in any hydraulic circuit design of hydraulic circuit where there is a chance of having a pressure lower than the atmospheric pressure. One has to take care in designing the circuit that that pressure should be much above with some allowances above than the vapor pressure of the work of the liquid at the working temperature.

Thank you.

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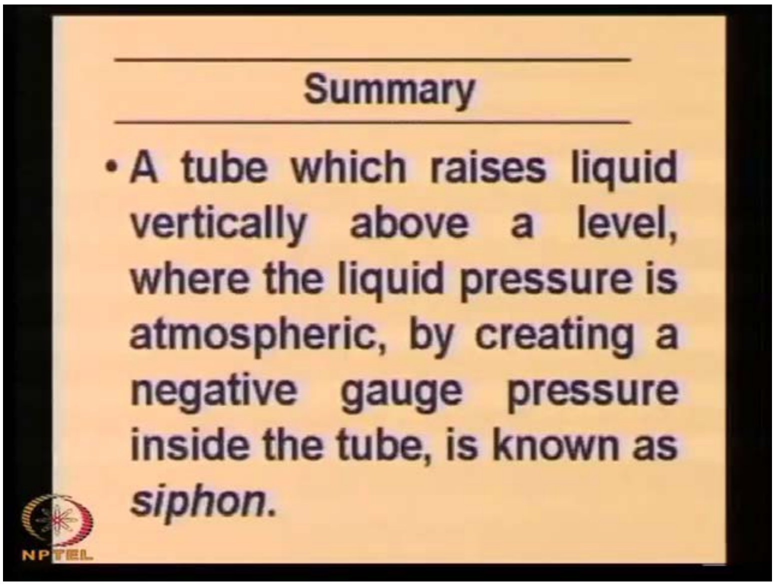

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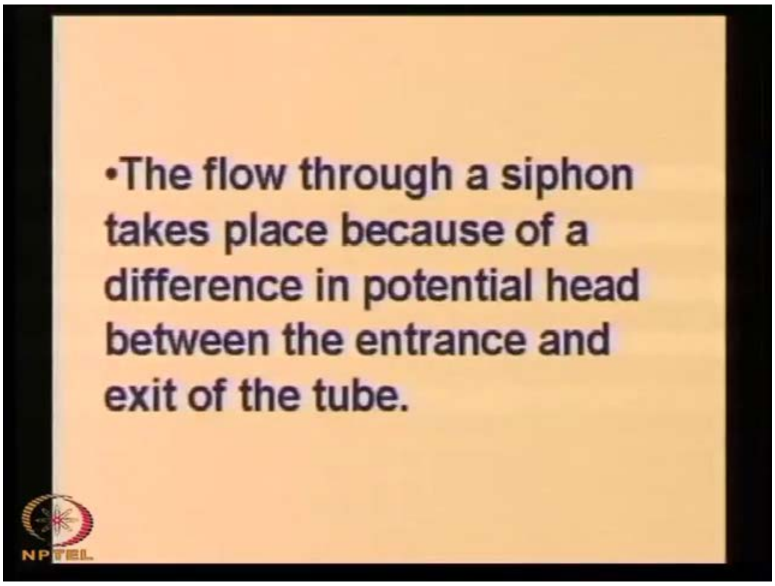

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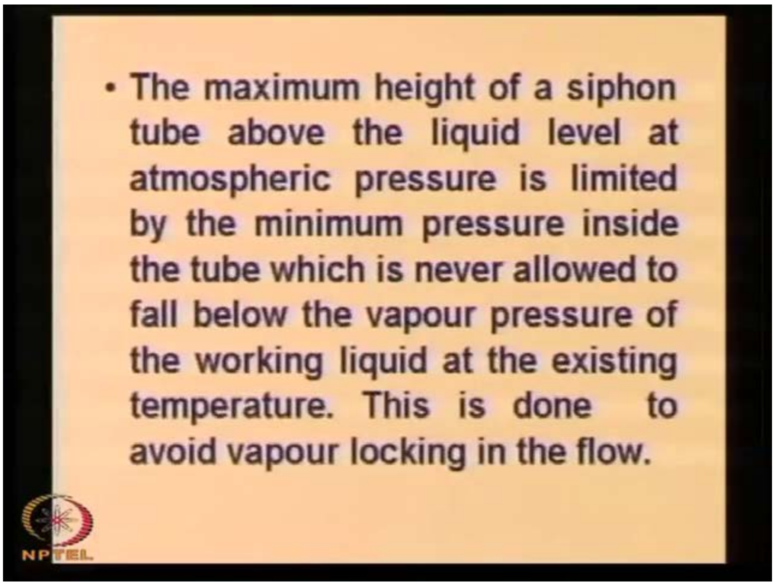

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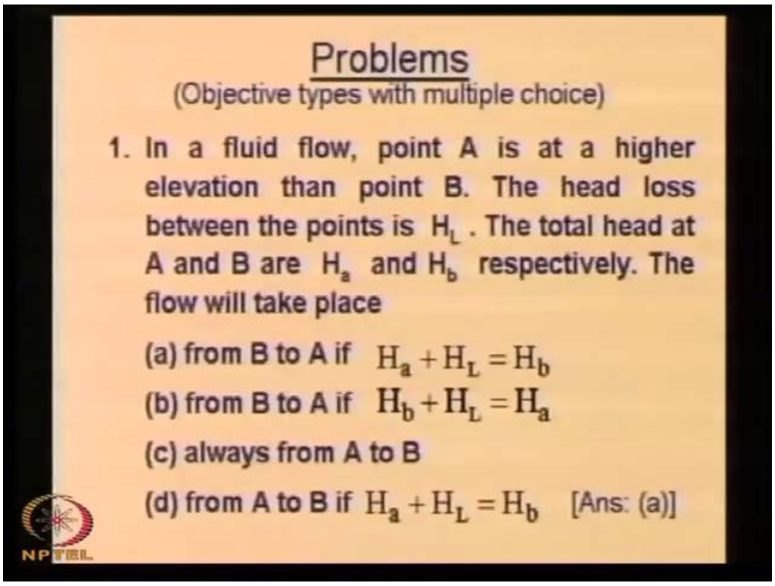

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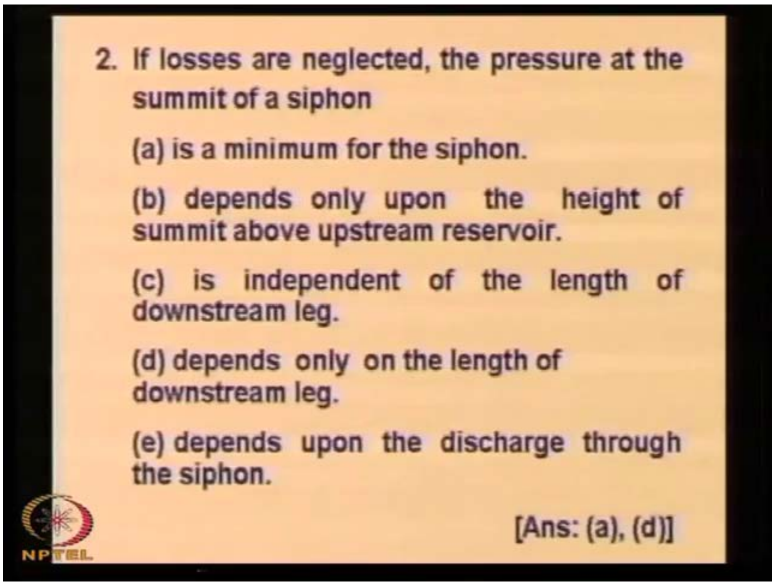

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