Energy Equation Introduction

SPEAKER Bob Holmes: In this lesson, we're going to now apply the energy equation to real fluids. You'll recall in Lesson 4 we talked about an ideal fluid, and I wanna discuss with you in this introduction where we're going, kind of give you a give you a roadmap of exactly the main points we want to hit. We will do some derivations, and sometimes it's a little easy to get lost until you see the end goal, the big picture if you will. So I'm going to give you the big picture, where we wanna be by the end of this lesson, and hopefully you'll be able to track as we go through the derivations.

One of our main points is going to be that we're going to derive something called the kinetic energy coefficient also named in some fluid mechanics textbooks as the Coriolis coefficient. And so we'll give you that equation. That's basically a correction factor, if you will, to be applied to the mean velocity when we get to kinetic energy. We also will provide you a new form for the energy equation that we'll encounter or will include the Coriolis coefficient in there, that's the Greek letter alpha. And then also, at the end of this lecture, we will put in the concept of energy loss or head loss. As you noted earlier in Lesson 4, we talked about an ideal fluid where there were no friction losses, the particles of the water as they moved against each other were frictionless, so it was an ideal fluid. We had no energy loss. Now we're gonna apply the energy equation, in a form that will be applicable to the real world, the real fluids that you encounter out there in the riverine environment. You will note that in these equations that Y and D is sometimes interchangeable, not necessarily in this lecture, but you'll see that in some fluid mechanics textbooks and basic hydraulics manuals.

I want to just review very quickly, and you'll see on your slide, that we have three forms of energy. Our first form is potential energy, and that is the elevation above a common datum. The common datum we typically use is a horizontal plane well below the riverbed.. The pressure potential is the second kind of energy, and that's abbreviated either Y or D, as we've said, and that goes from the riverbed up to the water surface. And then our last form of energy is the kinetic energy. That's the V squared over 2 times g.

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And in this particular case, when we're dealing with the real fluid, we're going to insert that value of alpha, which is the energy Coriolis coefficient.

On your screen, you'll see a graph that essentially lays out a side view of the river as it's going downstream, and you'll see that the energy loss or the head loss is now going to be included, where before we had the total head, it did not change from upstream to downstream. You'll see that the potential energy is there, that's the value for Z. So you'll see Z1 and Z2 on the downstream. You have the pressure potential energy, which is the depth of flow in this case. That's D1 and D2. Again, Section 1 is upstream, and Section 2 is downstream. And then if you add those two together, that becomes something we call the piezometric head or the hydraulic head, and that's the sum of the potential energy and the pressure energy or the pressure potential energy. Our last term is the V squared over two G, which is again the kinetic energy or the velocity head.

That concludes our introduction to this. Now we'll get into more details as we deal with a real fluid and the application of the energy equation in that real fluid.