Solving for Discharge

SPEAKER Charles Berenbrock: Now, we're going to refine the energy equation to compute discharge. As you see here, the energy equation is between sections 1 and 3. I've defined all the variables in the energy equation. For example, alpha-1 times V sub-1 squared divided by 2g is your velocity head at section 1. I'm not going to go through the rest of this equation. As you can see, all the terms have been defined for you. But we're going to use this energy equation between section 1 and we're going to refine it here. We're going to say from continuity that Q is equal to A times V, or really V is equal to Q divided by A. And remember that A is your cross sectional area. Also, if the datums are the same at section 1 and 3, in other words z_1 equals z_3, then we can substitute all of that into the energy equation. And you can see the resulting equation, in other words, alpha sub-1 times Q squared divided by 2 times g times A sub-1 squared plus D sub-1 is equal to alpha sub-3 times discharge or Q squared divided by 2g times A sub-3 squared. And then it's plus your depth at section 3 plus your friction losses between sections 1 and 2 plus your friction losses between two and three plus your entrance loss. And K sub-e, that "quantity" is your entrance loss.

Now, we're going to have "h" represent the depth plus the datum and also "h_e" represents your entrance loss terms. And if we do that and also rearrange the terms, in other words put Q's on one side and everything else on the other side, you'll see the resulting equation.

Now, we're going to further rearrange the equation and we're just going to get only Q on one side of the equation and everything else on the other side of the equation, thus Q squared is equal to-- and you can see everything else on the other side of the equation. Using this equation, we can solve for discharge between sections 1 and 3. We know everything, almost, because we have high watermarks, so thus we can define what Q, I mean h_3 is and h_1, and we can also define what our friction head loss is. There are seven unknowns here, and the unknowns are alpha-1, alpha-2, alpha-3, your friction losses between sections 1 and 2, your friction losses between sections 2 and 3 and your energy loss or your entrance loss. And embedded in that energy loss is K sub-e, also the velocity at 2A and the velocity at 2. Knowing them, we can use this equation

to determine what the discharge is between sections 1 and 3, thus we have refined the equation here.