Flume Demo: Rapidly Varied Flow

SPEAKER Rick Huizinga: Welcome to the flume demonstration for Lesson 16. In Lesson 16, we started to discuss that this is the beginning of the practical applications from all the things that we've learned so far. In Lesson 16, we introduced the idea of using the energy equation to compute discharge through a contracted opening.

So we've set the flume up with a contracted opening. Now we've talked about contracted openings before, particularly Lesson 14, but I'd like to show you a few characteristics of contracted openings and how we use these to compute discharge. In the lesson, you will notice that we talked about four points, the first one being a point upstream of the bridge. And this is our approach. This is generally taking one bridge length upstream of the bridge or the contraction. The second point is right here at the inlet. There's a third point right at the downstream end of the contraction right before it expands. And then there's a fourth point in the downstream expansion area.

Now, I'd like to take a closer look at the downstream expansion and point out a few things about it that make it difficult for the energy equation. You can see here that in the downstream section we have a great deal of turbulence, there's a lot of energy loss here because of the expansion of flow as that turbulence transforms from eddies into heat loss in the water. We're now going to inject a little bit of dye into the flow so that you can see how this looks. And you'll notice that as the dye is injected, it very rapidly disperses. You can see how there are some air bubbles that are entrained in the flow that actually backflow, they flow upstream, and this just indicates that there's a tremendous amount of energy loss here from these eddies and this turbulence. So, in general, this is not a good idea or this is not a good place to write the energy equation to. So when we write the energy equation for contracted openings, we write it between the approach and the downstream end of the contracted opening.

Once again, as was pointed out in Lesson 14, this area here at the inlet is difficult to work with as well because of the turbulence there and the contraction of flow. So the energy equation is written between the approach section, one bridge length upstream, and the exit section.

And the equation takes into account the friction losses between the approach and the inlet, and the inlet losses and the friction losses in the contracted opening itself. These are accounted for in the C term. The C term also takes into account the shape of the inlet and any potential rounding that's there or slope or those sorts of things. And these are all found in your textbook as well as other references that are referred to in the resources section of the class. And this basically concludes the flume demonstration for contracted openings.