Flume Demo Water Surface Profiles

SPEAKER Rick Huizinga: In this flume demonstration, we're going to try to conceptually show you some of the things that we talked about in lesson 13. Of course, lesson 13 is entirely conceptual. We don't do any computations, but there are a couple of key issues that we wanna talk about. Now, what we have in our flume is we have an area--we've set the flume basically so that it is flat right now. And what we have is we have an area of subcritical flow in the upstream reach. Then it passes through a brink here and transitions into a supercritical flow reach here, and you can see that the depth upstream of the brink is quite a bit deeper. The depth here in the middle on the supercritical reach is shallow, and it transitions again into another subcritical reach on the downstream end and you see that it goes through a hydraulic jump. Now, let's take a closer look at what occurs on the upstream side. Here we are in our subcritical flow reach upstream, and you see that flow is deep and that it's tranquil and very little disturbance. You see the water bubbles that are flowing through and they're very moving slowly.

As it transitions closer to this brink, flow begins to approach critical and it goes through critical right there at the brink. This flow surface that we have here then is the M2 profile because it's going from normal depth upstream through to critical at the brink, and that represents the M2 profile. Now, let's take a wider look again at the overall flume, and take a look--now that I've explained what happens on the upstream side, let's take a look at what happens in this central section. In this area, we have supercritical flow and that's because the tilt of the flume is such that the bed is at a supercritical slope. Upstream, we have again our point of critical flow right there at the brink, and downstream, it flows at approximately normal depth, which is very shallow and very rapid.

This transition curve between the point of critical flow and normal depth is the S2 profile, again, because it is between critical and normal. This point of critical depth is very important though because it establishes a point of control. In the upstream reach, gravity waves can propagate upstream from that point but not downstream. And so, that point becomes the point of control for flow measurements or for any sorts of disturbance that will occur in the flow.

Now, let's take a look again at the wider overall flow. Finally, in this downstream area, you see that it transitions from supercritical slope here back to our subcritical slope farthest downstream, and the transition occurs through a hydraulic jump. Now, where this jump occurs depends entirely upon the energy of the system. If this supercritical flow area on the upstream side is powerful enough, it will push that jump further downstream, but where that jumps occurs tends to be controlled as well by the tailwater conditions in the downstream section of the flume. In this particular case, we call this a submerged jump and because the jump has transitioned up here into the supercritical slope area, but you see the amount of turbulence. You see the bubbles that are disturbed. There's a tremendous amount of energy that is lost in a hydraulic jump, and this provides a good transition between super and subcritical flow. That basically concludes this flume demonstration.