Flume Demo Weir

SPEAKER Rick Huizinga: Welcome to the flume demonstration for Lesson 18. In Lesson 18, we've introduced the concepts of weirs and how they're useful for computing discharge. And what I'm going to do in this flume demonstration is show you a couple of different kinds of weirs and some various characteristics about them. Now what we have in the flume right now, this is a sharp-crested weir. Now don't be confused by the Styrofoam block here. This is just something to support the weir. The weir plate is right here, and you can see that one of the ways that weirs work is by forcing flow through critical depth. It's very deep and tranquil on the upstream side of the weir and everything is measured in reference to the top of the weir plate. And you can see that it goes through critical and forms a spout. There may be a roller on the downstream end. If you've ever watched any of the rescue things on TV, they talk about how you get these rollers on the downstream side of dams and this is where that occurs. This area here, there's a lot of turbulence occurring and it's re-circulating, and if you get trapped in that area, it can be a very bad thing. But with regard to open channel hydraulics, weirs are very useful because again they force a point of control at the weir plate. Flow goes through critical and this is then a controlling point for flow upstream and discharge can be computed for the flow that's coming from upstream by flowing over the weir.

Now, something that's really interesting about a sharp-crested weir is that you'll notice that the shape of the nappe, as this area here is called, it mimics the shape of the ogee spillway that we introduced earlier. And you can see the ogee spillway there, that shape of the ogee spillway was designed such that it mimics the underside, the aerated--or the underside of the aerated area of the nappe and that is because it creates basically a frictionless surface along the upper side of the ogee spillway. As I said earlier, everything is measured referenced to the top of the weir plate. The height of the weir plate is it's necessary to know that because, of course, you need the area in the upstream channel to be able to compute the discharge. But everything else then is measured in reference to the top of the plate and the water surface. Energy grade line is computed and the C values then that are used, these take into account the losses due to the flow over the top of the weir. Now let's take a look at the second kind of weir in this flume.

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What we have here is a broad-crested weir and many times out in the field where you will see a broad-crested weir, it's not so much as a design as much as it is a natural occurrence. When flood flows get high enough to flow over a road, the road becomes a broad-crested weir. Now once again, the way that broad-crested weirs function is by forcing flow through critical and you can see that flow on the upstream side, again, is flowing fairly deep and tranquil, but as it flows over the broad-crested weir or over the road if this were a road, it dips down and then it goes through critical at the downstream end as it falls off the backside of the roadway and you can see that there's a standing wave then. And in this particular flume case, that standing wave tends to fluctuate a little bit as it moves upstream and downstream and that is completely controlled by the tailwater conditions, downstream of the broad-crested weir.

The difficulty sometimes with broad-crested weirs is that the downstream conditions can cause flow on the weir to be submerged. It then does not go through critical on the downstream side. However, it is still useful for computing discharge because the change in area from upstream to the surface of the weir, knowing that amount of contraction and accounting for radiuses of curvature at the upstream end and those sorts of things which are all accounted for in the C value, you can still compute the discharge even when the broad-crested weir is partly submerged. When it becomes completely submerged, it becomes ineffective and can no longer be used to compute discharge.

But these are two examples of how weirs can be used to compute discharge and this concludes the flume demonstration on weirs.