Conveyance

SPEAKER Rick Huizinga: In this lecture, we're going to be talking about computations in steady uniform flow. In Lecture 7, we were introduced to the topic of the Manning's equation. And in this lecture, I'm going to show a couple of characteristics about the Manning's Equation that are useful to us for making computations in steady uniform flow. As in previous lectures, I'm going to show you where we're going so that you have a road map of where we're going to get to by the end of this lecture. We're going to talk about the idea of conveyance and the idea of a section factor, both of which are contained within the Manning's equation. And then as part of this section on section factors, we're going to talk about the normal depth, which states that for a given Manning's roughness and discharge Q and friction slope, there is only one depth at which steady uniform flow can be maintained.

In steady uniform flow, you might recall from earlier lectures, we make some assumptions, and these assumptions are that the hydrostatic forces on the upstream and downstream ends are equal, that the acceleration of the body of water is zero, and that the bed slope is equal to the slope of the energy grade line or the friction slope. Well, in natural channels, this is seldom the case. Natural channels are seldom uniform. They have change in cross-sectional area. They have change in slope from one section to another. However, we can still work with the assumption that steady uniform flow with some minor modifications. Here again is the Manning's equation at the top of your screen. And if you look at the first portion of the Manning's equation, the portion of 1.49 over N, A times R to the two-thirds, we call this the conveyance. We indicate that with a capital letter K. And, again, K is equal to 1.49 over N times the area times the hydraulic radius to the two-thirds power.

Well, Manning's equation for discharge can be written: Q is equal to the conveyance times the friction slope, and this is the slope conveyance version of the equation. Conveyance is a useful tool. It has the same unit as discharge, cubic feet per second, and it's also a measure of the carrying capacity of the channel, as is discharge. However, it's a function of only the cross-sectional properties of the channel and it's independent of the slope. Therefore, it can be used

from one cross-section to another if those cross-sections are similar to one another without having to worry about the slope.

Now let me revisit slope for just a moment. In the Manning's equation, slope is taken as the slope of the energy grade line and the friction slope, S sub-f. For uniform flow, we assume that the friction slope is equal to the bed slope is equal to just the slope. And now this is assumed, and an additional assumption that we make is that flow is steady at or near the peak of a flood event as the floodwave moves down through the channel. To try to demonstrate this, one needs to look at a long reach of river during a flood and one that has minimal inflow from tributaries. At base flow, the bed and the water surface as well as the friction slope are parallel to one another, but during the rising limb, there’s usually additional head on the upstream end that causes the water slope and the friction slope to be unequal to the bed slope. Then at the peak, they are again parallel, and then on the falling limb, they are unequal to each other the other direction. And to show this in sort of an animation, as the floodwave comes down, the water surface does this. And at the peak, we assume that the friction slope, the bed slope and the water surface slope are all equal to one another.

This is the end of the first section of Lesson 8.