Speaker Bob Holmes: Okay, this is an abbreviated version of Lesson 3. Because of some of the course time constraints in our physical class that we teach at the training center and the limited use of similitude dimensional analysis in this course, we offer this abbreviated version in order to introduce the important concepts in Chapter 3 that you're required to know or that are required for later parts of this course which are not too detailed. We encourage you, if you have the time, to go into the more detailed sections of this course. You'll see--as part of this course material, you'll see an example of where you would apply dimensional analysis and similitude with an example from the Marmot Dam on the Big Sandy River in Oregon. It's a fascinating video. I encourage you to watch the very segments that we have as part of this lecture material.

There are two important equations that we're going to introduce as part of this lecture, and that's the Reynolds number, which is the ratio of the inertial to viscous forces, and this Reynolds number is one of the basic dimensionless parameters that we use in fluid mechanics. The Froude number is the other important equation, and it's the ratio of the inertial forces to the gravity forces, also a very crucial number that we use in fluid mechanics especially in open channel hydraulics.

The Reynolds number is abbreviated R sub-E. Sometimes, you'll see it as R with some sort of a fancy script to it, sometimes R sub-E as we have it in this particular course. That is basically the characteristic velocity times the characteristic length divided by the kinematic viscosity. You also see it in other forms where it's the characteristic velocity times the characteristic length times the density of the fluid divided by the dynamic viscosity.

Now, the characteristic velocity is typically the mean velocity of the channel or the pipe and the characteristic length in open channel flows is the depth of the open channel flow where the characteristic velocity is, again, the mean velocity. The Froude number is abbreviated capital F sub-R. Sometimes you'll see it just as capital F in some fluid mechanics textbooks. It is the characteristic velocity divided by the square root of the acceleration in gravity, abbreviated with a small "g," times capital D, which is, again, your characteristic length, depth, of the flow in an open channel hydraulic situation or the pipe diameter, in the case of a situation where you might be

considering flow in a pipe. The rho is, again, the density of the fluid, and U is the dynamic viscosity, and the Greek letter “nu” is the kinematic viscosity.

Now, if we look at dimensional analysis, variables in fluid mechanics can be expressed in the following dimensional properties: mass, symbolized by a small letter “m”; time, either small letter “t” or capital T, depending on the textbook or reference you’re using; and the length which is abbreviated by the small letter “l.”

Now, force is another type of dimension but is a combination of the above three dimensions. It is the mass times the length divided by the time dimension squared. Now, physically-based equations, which simply means those equations derived from physics, must be dimensionally consistent on both sides of the equation. It’s going to be crucial as you move through these problem sets because it’s very easy to leave out some of the equations. So you should always carry your units to make sure you’re dimensionally consistent throughout working your problem.

That concludes our abbreviated version. The required components, again, are that you understand the concept of the Reynolds number, which is computed, as we’ve given in the equation, and the Froude number. Now, the Reynolds number, as we will talk later, we will use it as a computation to tell us the difference between turbulent flow and laminar flow. The Froude number, on the other hand, we’ll use that as a computation to tell us the difference between subcritical and supercritical flow, which you’ll understand more about in later lectures.