Dimensions and Units

SPEAKER Bob Holmes: Hello. This is Lesson 1, Section A. We're gonna cover in this section--we're gonna discuss dimensions, units, and fluid characteristics. Now in this particular course, we're gonna be talking about our quantities, our three basic dimension set. Everything will build upon that. We have the dimension of length, which has units of feet or meters, depending on whether you're on the British gravitational system, which is what we use in the federal government for most of all the work that we do in the water area, so we're gonna use feet, or if you're in the SI system we'd use meters. We also have the dimension of time, and that unit is universal. It's in seconds. And then we're gonna have the dimension of mass, which in the British gravitational system is slugs. If you're in the SI system, it's gonna be in grams.

Now, one thing that we're going to talk a lot about in this particular lecture and in subsequent lectures is the concept of force. And that force is a combination of the three basic dimensions of mass, length, and time. Essentially you have mass multiplied by the length divided by the time dimension square. So, for example, your weight, when you basically weigh yourself on a scale that's a force, that's a weight. So you actually have the mass times the acceleration of gravity. We abbreviate the acceleration of gravity with the letter small "g." Now the acceleration of gravity is dependent on where you're at. If you're on the moon, the acceleration of gravity is much different than it is here on Earth. Essentially we have a basic unit of acceleration of gravity of 32.2 feet per second squared in the British gravitational system, and obviously, as we've spoken, that number would be different if you were somewhere else either on the moon or on another planet. One slug weighs 32.2 pounds. So if you take and look at your equation on the screen, the weight is equal to your mass times the acceleration of gravity. So if you have your mass and let's say that it was 10 slugs multiplied by the gravitation--the acceleration of gravity--32.2 feet per second squared, that gives you a total weight of 320.2 pounds.

Now when we talk about fluid characteristics, fluid has no definite form. If you have a solid, let's say a steel I-beam or a book, that has a definite form, and it's irrespective of where it's placed on this table or in the room or anywhere else for that matter. But a fluid is going to take on the shape

of whatever the container that it resides upon. So we talk about things with fluid characteristics such as density. We abbreviate that with the Greek letter rho. We have specific weights, and we'll explain all these concepts. We abbreviate that with the Greek letter gamma. And we have specific gravity, and that's capital S with a subscript "g." Now, the density essentially is the mass of the fluid in slugs divided by the volume of the fluid. So if you take a particular amount of fluid and place it in a gallon jug, that gallon--one gallon--7.48 gallons is one cubic foot. So let's say that we knew exactly how much volume we had, we place the fluid inside the container and we weigh that and we got the mass of that, that density would be the mass of that fluid divided by the volume of that fluid. And so we would express that in slugs per cubic foot. A specific weight is a very similar concept, only here we're not dealing with a mass of the fluid, we're dealing with the weight of the fluid. And if you paid attention to the previous discussion, we know that the weight is the mass times the acceleration of gravity. So if we take the weight of that same fluid, that's in that container, and we weigh it, we know what that is in pounds and we know what the volume of that fluid is, we can express the specific weight, is that weight per volume or weight per unit volume. So we'd have pounds per cubic foot. Now, water has an approximate value. We use 62.4 pounds per cubic foot. And all the problems you're gonna work in this course, you're gonna use the value of 62.4 pounds per cubic foot as the unit weight.

Specific gravity is sort of a reference. If you have water, that has a density of 1.94 slugs per cubic foot. So any other type of fluid, if we're dealing with a specific gravity of fluid or of water, is essentially one because it is the density of that fluid divided by the density of water. So the density of fluid we're talking about is water here. It's 1.94 slugs per cubic foot divided by 1.94 slugs per cubic foot. Where specific gravity comes in handy is when we have a different fluid. So let's say we have an oil, and we know that that particular oil has a density of, let's say, 2.2 slugs per cubic foot and we divide that by 1.94, we know that that number is greater than one. It's a ratio, if you will. That ratio tells us whether that fluid will sink or float on the water. So if we have oil that has a specific gravity greater than one, we know that that oil once it's released onto the water will sink. If the specific gravity is less than one, we know that oil will float. This comes in real

handy whenever you have a spill. If you know that the system, that oil of--oil that spilled out into the ocean or into a riverine environment, it has a specific gravity less than one, you know that absorbent booms deployed upon the surface would contain that oil because the oil is actually gonna float. If you had a specific gravity of a substance in oil that was greater than one, the oil is gonna sink, and a surface containment system will not work. So that's the concept of specific gravity. It's sort of a reference measure of how that density of that particular fluid is related to water. Okay, that concludes our Section A, Lesson 1.