Welcome to Engineering Earth. The topic of this video is dimensional homogeneity and conversion using unit ratios.

I'm going to start with a brief overview of dimensions versus units. There are seven fundamental or primary dimensions so these uh would include things like length, time, or mass. All other dimensions are made up of combinations of the fundamental dimensions. So for example, a velocity is made up of a length per unit time. A force would be a mass times length per unit time squared.

Units are used to describe dimensionality, so for example we might use something like centimeters per second to describe velocity in the SI system of units. In US customary units maybe we would use something like miles per hour to describe velocity. All engineering equations have to be consistent dimensionally. This means that every term in an equation has to have the same dimensions.

For example, if I have an equation where I have mass and I add another mass to come up with a total mass, all terms have the same dimension of mass so these are like terms and can be added directly. So further each term needs to have the same units of mass so I can't add unlike terms. For example, I couldn't add 10 kilograms of mass plus 10 pounds of mass. They have the same dimension of mass but they have different units. So, another thing about dimensional homogeneity is that I can't equate unlike terms, right. So, this can be a powerful tool in engineering problem solving. So, for example, if I'm solving for a force in SI units I know that I'm looking for newtons and therefore everything on the other side of my equation has to combine to produce newtons and if they don't that can be a really good clue to me that I need to go back over my work and find my error.

If I encounter a problem with unlike units like the problem we were looking at earlier, 10 kilograms plus 10 pounds of mass. I'm going to have to need to convert these units and the tool that use to do this is called a unit ratio, also sometimes called a conversion factor. So as implied by their name unit ratios are mathematically equivalent to one. I can insert a unit ratio into any equation to change the units without changing the given values. So for example, the unit ratio between pounds of mass and kilogram is that 1 kilogram is equal to 2.2046 pounds of mass. So I can rewrite this equation in terms of a ratio of 1 kilogram divided by 2.2046 pounds of mass is equal to 1, so that this ratio has a value of 1 and I can therefore put this anywhere into any of my equations and it's the same thing as multiplying by 1. So, in this case I'll have my 10 kilograms plus my 10 pounds of mass that I will multiply

by my unit ratio and now my pounds mass units are going to cancel leaving me with kilograms plus kilograms.

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Good job making it to the end of this video please reward yourself with a moment of Zen. I study fluid mechanics because I love water and healthy aquatic ecosystems. Whatever your passion is I hope it motivates you to continue your study of fluid mechanics.