Problem of the Day
2015.Aug.08

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A 14-inch diameter force main flows full. What is the area, in ft^2, through which the flow is passing?

Introduction
This is a very straightforward area-of-a-circle calculation. Calculating the area of a circle is done over and over again in wastewater math problems. Finding the area of a circle, no matter what size, should be automatic for operators.

Solution
All that is given in this problem is the diameter of the pipe and the fact it is flowing full (since force mains, by definition, flow under pressure, they will always be flowing full):

1. Pipe diameter, d = 14 in

The question specifically asks to find the area in ft^2 so these units are put between heavy vertical lines, as always, followed by an equals sign and the blank solution bridge.

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$$\left| \ ft^2 \ \right| = \overline{}$$

The formula for calculating the area, A, of a circle that WWTT uses is:

A = 0.785 x d^2 = 0.785 x d x d

where d is diameter. This equation, then, is used to populate the solution bridge.

ft^2 =	0.785	14 in	14 in	

The problem is that the question asks for the area in ft^2 not in^2, which it is now. Converting one of the in to ft,

ft^2 =	0.785	14 ~~in~~	14 in	**ft**	
				12 ~~in~~	

then the other,

ft^2 =	0.785	14 ~~in~~	14 ~~in~~	**ft**	**ft**
				12 ~~in~~	12 ~~in~~

Since all the unwanted units have now canceled and only the units needed in the answer remain (ft^2, in bold), we know the solution bridge is complete. The arithmetic gives the answer.

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ft^2 =	0.785	14 ~~in~~	14 ~~in~~	**ft**	**ft**
				12 ~~in~~	12 ~~in~~

0.785 x 14 x 14 ÷ 12 ÷ 12 = **1.068 ft^2**.

Discussion

When of the most powerful aspects of the solution bridge approach to doing math problems is you don't have to figure out whether to divide or multiply by a conversion factor, even as simple as 12 inches/foot, because the units tell you what to do.

Happy calculating! Let us know, by leaving a comment, if you want us to do a specific problem, if you see a mistake, or if you have a question on any of the Problems of the Day you are looking at.