

## Volume of Holes Left by a Tree Spade

Problem: “I have sold some large cedar trees to be used for landscaping. The contractor promised to fill in the holes he's dug after he's taken the trees out. He used a 90-inch hydraulic tree-digging spade, so the base of the cone is 90-inches across at its widest, and approximately 60-inches deep. How much back-fill will be required to fill each individual hole, or how much fill would be required to do the entire job, assuming he removes 150 trees. Fill is supplied in cubic yards, that I'm sure you know is 27-cubic feet/cubic yard.”

Solution:

- a) I would calculate the volume in cubic yard. Initially, it is easier to find volume in cubic inches since the measurements are given in inches. However, for the later part of the questions, we need units in cubic yards. For example, we need to calculate how many truck loads of fill we need to cover those holes and fill is supplied in cubic yards. It is much easier to convert inches to yards and it takes minimal calculation with conversion unit that are very standard in school level mathematics. Converting cubic inches to cubic yards, however, will require either complex calculation or memorizing complex conversion factors and both may require use of calculators.

$$\text{Since } 1 \text{ yard} = 36 \text{ inches} \Rightarrow 45 \text{ inch (half of diameter of the hole)} = \frac{45}{36} \text{ yard} = \frac{5}{4} \text{ yard}$$

$$\text{And } 60 \text{ inch} = \frac{60}{36} \text{ yard} = \frac{5}{3} \text{ yard}$$

$$\text{So, Volume of each hole} = \frac{\pi r^2 h}{3} = \frac{\pi}{3} \cdot \frac{5}{4} \cdot \frac{5}{4} \cdot \frac{5}{3} = \frac{125\pi}{144} \text{ cubic yards}$$

$$\text{Now, Total Volume for 150 holes} = 150 \cdot \frac{125\pi}{144} = \frac{25 \cdot 125\pi}{24} = \frac{3125\pi}{24} \text{ cubic yards}$$

- b) We can avoid complex calculations, for example converting cubic inches and cubic feet to cubic yards, by initially converting all measurements to yards.
- c) # of truck loads of fill dirt needed =  $\frac{3125\pi}{24} \div 6 = \frac{3125\pi}{24} \cdot \frac{1}{6} \approx 68.18 \approx 69 \text{ truck loads}$ .  
(answer is rounded up since with 68 truck loads of dirt there will still be part of hole not completely filled).