

Unit 26 VOLUME MEASUREMENT— CUBES AND RECTANGULAR SOLIDS

BASIC PRINCIPLES OF VOLUME MEASUREMENT

Volume is measured in *cubic inches*, *cubic feet*, *cubic yards*, and so forth. It is never measured in inches, feet, yards, and so forth. One inch times one inch times one inch equals one *cubic inch*.

To find the volume of a rectangular solid, first express all dimensions in the same unit of measurement, then multiply width by length by height.

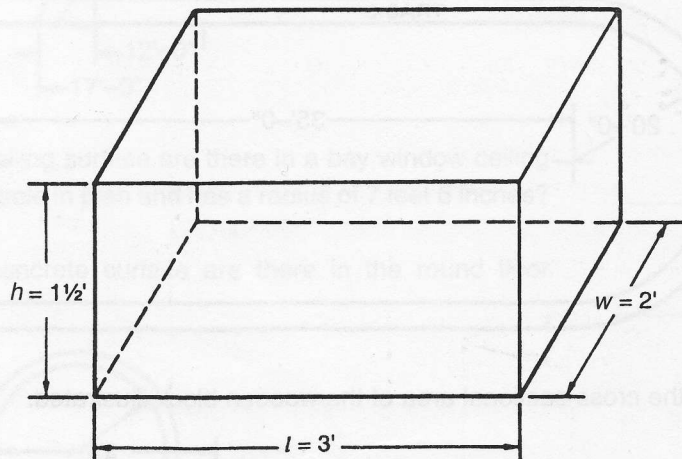
Example: Find the volume of a rectangular solid that is 2 feet wide, 1 yard long, and 18 inches high.

First change the problem to read 2 feet wide, 3 feet long, and $1\frac{1}{2}$ feet high. The answer will be in cubic feet.

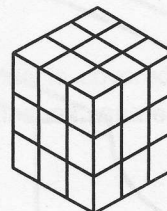
$$V = w \times l \times h$$

$$V = 2' \times 3' \times 1\frac{1}{2}'$$

$$V = 9 \text{ cu ft}$$



Note: A cubic yard is 27 cubic feet (3 feet $\times$ 3 feet $\times$ 3 feet)



PRACTICAL PROBLEMS

Find the volume of the following cubes:

1. Side = 9' _____

2. Side = 5 cm _____

3. Side = 8' 11" _____

Find the volume of each of the following rectangular solids:

4. Length = 6", Width = 5", Height = 4" _____

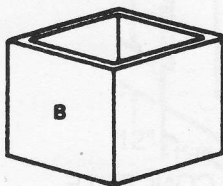
5. Length = 8 m, Width = 5 m, Height = 3 m _____

6. Length = 10', Width = 8', Height = 2½' _____

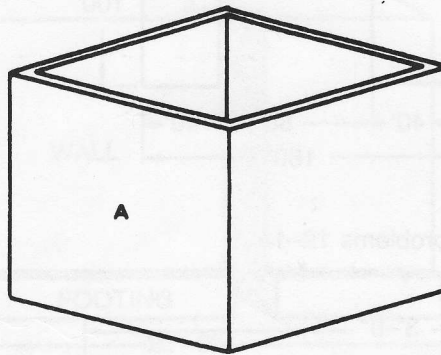
7. Length = 3', Width = 2', Height = 6" _____

8. How many more cubic feet are there in container A than in container B? _____

**INSIDE
DIMENSION = 2' X 2' X 2'**

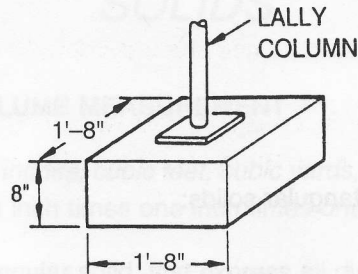


**INSIDE
DIMENSION =
4' X 4' X 4'**



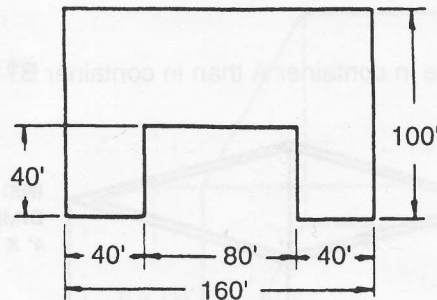
9. How many cubic feet of space are there in a storage area 8 feet wide, 16 feet long, and 7 feet high? _____

10. How many cubic yards of concrete are needed to pour eight footings, 1 foot 8 inches by 1 foot 8 inches by 1 foot 8 inches? (See Appendix Section II, Table I Cubic Measure for conversion from cubic feet to cubic yards.)

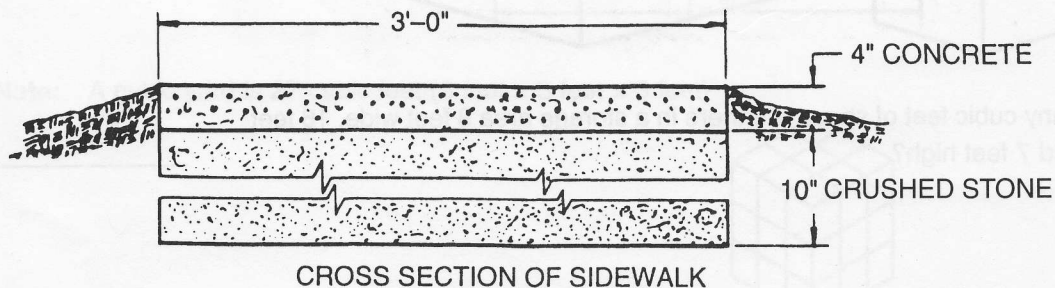


11. How many cubic yards of earth must be removed for the excavation shown if the depth is 8 feet?

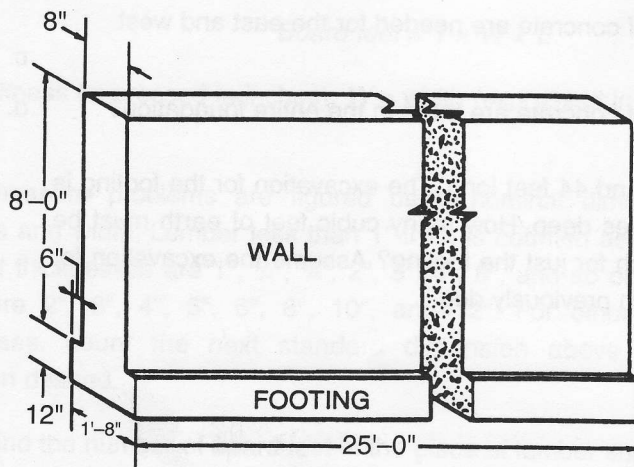
Note: Excavations are usually computed in terms of cubic yards.



Note: Use this illustration for problems 12-14.



12. The illustration shows a cross section of a concrete sidewalk. How many cubic yards of earth does it displace if the sidewalk is 40 feet long? _____
13. How many cubic yards of concrete are there in the sidewalk shown? _____
14. How many cubic yards of crushed stone are required for the sidewalk shown? _____
15. A large building requires a basement 9 feet deep, 78 feet wide, and 96 feet long. How many cubic yards of earth must be removed if an additional 15% must be removed for the foundation and floor? _____
16. A storage space in a basement is 8 feet 6 inches by 6 feet 8 inches by 8 feet 8 inches. What is the number of cubic feet of storage space? _____
17. The illustration shows a section of a concrete foundation wall and footing. How many cubic yards of concrete does it contain? Round answer to the nearest tenth of a yard. _____

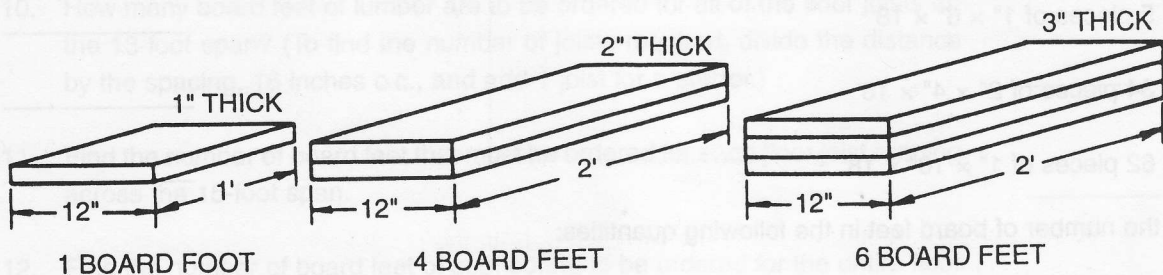




Unit 27 BOARD MEASURE

BASIC PRINCIPLES OF BOARD MEASURE

A *board foot* (bd ft) is defined as the equivalent of a piece of wood measuring one foot wide, one foot long, and one inch thick. In each of the sketches, the number of board feet is shown.



To calculate the board measure in any quantity or piece of lumber, use the formula

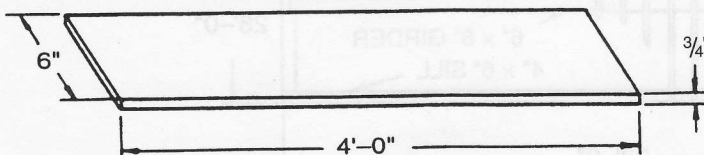
$$\text{Board feet} = T \times W \times L$$

in which T = thickness (expressed in inches), W = width (expressed in feet), and L = length (expressed in feet).

Note: Board measure problems are figured using nominal dimensions for thickness and width. Lumber less than 1" thick is counted as a full inch. Standard thicknesses are 1", $\frac{5}{4}$ ", $\frac{6}{4}$ ", 2", 3", 4", 6", and so on. Standard widths are 2", 3", 4", 5", 6", 8", 10", and 12". For other widths or thicknesses, count the next standard dimension above the exact dimension desired.

Example: To find the number of board feet in the piece of lumber shown, use $T = 1$ inch, $W = \frac{6}{12}$ foot, and $L = 4$ feet.

$$\text{Board feet} = T \times W \times L = 1 \times \frac{6}{12} \times 4 = 2 \text{ bd ft}$$



Notice that the dimension for width must be converted to feet, while thickness remains in inches.

In the board feet problems in this text, nominal dimensions are used. The nominal dimensions of lumber are the approximate dimensions before the lumber is dried or planed. *Dressed stock* is lumber that has been surfaced. In planing a board, the width and thickness can be reduced by as much as $\frac{1}{2}$ inch. For example, a 2×4 will measure $1\frac{1}{2}$ inches by $3\frac{1}{2}$ inches when planed and dried.

PRACTICAL PROBLEMS

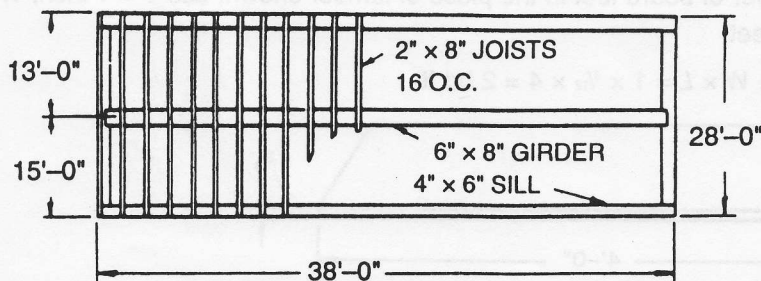
Find the number of board feet in the following quantities:

1. 5 pieces of $1" \times 6" \times 18'$ _____
2. 34 pieces of $2" \times 4" \times 16'$ _____
3. 62 pieces of $1" \times 10" \times 18'$ _____

Find the number of board feet in the following quantities:

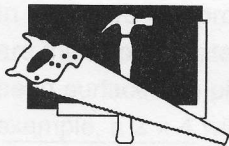
4. 18 pieces of $\frac{1}{2}" \times 4" \times 16'$ _____
5. 8 boards, $1\frac{1}{2}"$ thick, 22" wide, 16' long _____
6. 25 pieces, $\frac{3}{4}" \times 3" \times 12'$ _____
7. Determine the total number of board feet of select sugar pine in the following list:
 10 pieces of $\frac{5}{4}" \times 4" \times 16'$
 6 pieces of $\frac{5}{4}" \times 10" \times 18'$
 1 piece of $\frac{5}{4}" \times 12" \times 12'$ _____

Note: Use this illustration for problems 8–13.



8. The building shown requires two 4×6 -inch sills, each 38 feet long. They are constructed from four pieces of 4×6 -inch timber, each 20 feet long. This allows for a splice 2 feet long in the center of each sill. How many board feet of lumber must be ordered?
9. Determine the board feet of lumber to be ordered for each floor joist running across the 13-foot span. (Floor joists are sold in multiples of 2 feet in length.)
10. How many board feet of lumber are to be ordered for all of the floor joists for the 13-foot span? (To find the number of joists required, divide the distance by the spacing, 16 inches o.c., and add 1 joist for a starter.)
11. Find the number of board feet that must be ordered for each floor joist running across the 15-foot span.
12. Find the number of board feet of subflooring to be ordered for the entire floor surface if 1×6 -inch matched boards are to be used. (The number of board feet to be ordered is found by determining the area and adding 20% for matching and waste.) $88.6' \times 1.2$
13. How many board feet of 1×3 -inch oak flooring must be ordered for the entire floor, as shown, if an allowance of 38% is made for waste and matching?

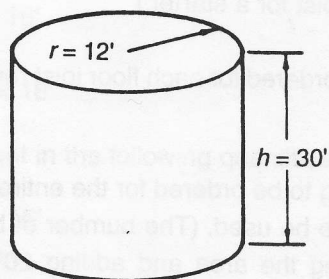




Unit 28 VOLUME MEASUREMENT—CYLINDERS

BASIC PRINCIPLES OF VOLUME MEASUREMENT

The procedure for finding the volume of a cylinder calls for the use of the formula: $V = \pi r^2 h$, where r = radius of the circular end, $\pi = 3.1416$, and h = the height of the cylinder when viewed with the circular surface as the base. All measurements must be in the same units before proceeding to multiply.



Example: Find the volume of a circular cylinder with a radius of 12 feet and height of 30 feet.

$$V = \pi r^2 h$$

$$V = 3.1416 \times 12 \text{ ft} \times 12 \text{ ft} \times 30 \text{ ft}$$

$$V = 3.1416 \times 144 \text{ sq ft} \times 30 \text{ ft}$$

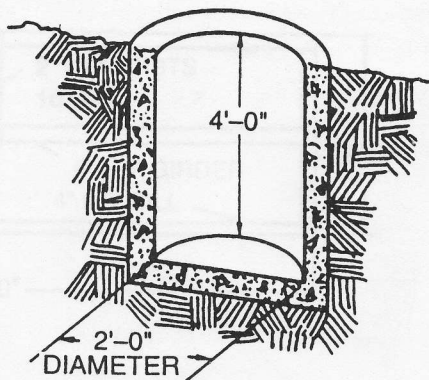
$$V = 3.1416 \times 4,320 \text{ cu ft}$$

$$V = 13,571.712 \text{ cu ft}$$

PRACTICAL PROBLEMS

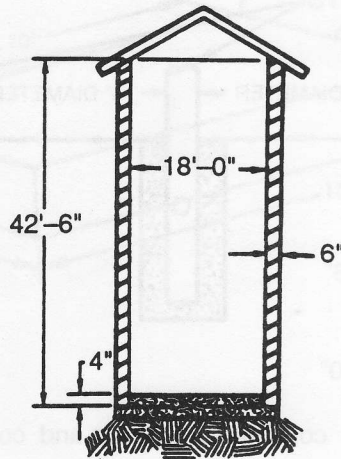
Note: Let $\pi = 3.1416$. Express all answers correct to the nearest hundredth.

1. A cross section of a cylindrical cistern is shown. What is the volume of the cistern?



2. What is the capacity in gallons of a wooden storage tank that has an inside diameter of 16 feet and an inside height of 18 feet 9 inches? One cubic foot contains 7.481 gallons.

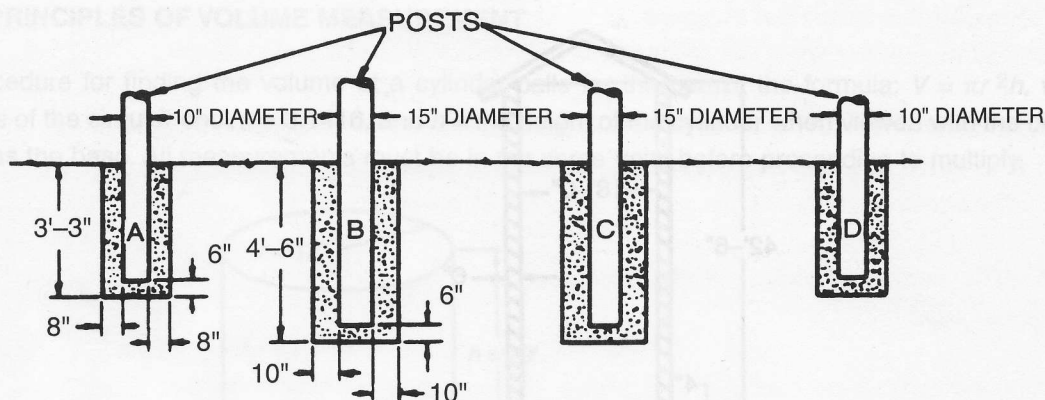
Note: Use this illustration for problems 3 and 4.



3. What is the capacity in cubic feet of the circular silo shown?
4. How many cubic yards of concrete are needed for the wall of this silo?
5. A loading dock is supported by two solid concrete piers. The piers are each 2 feet in diameter and 10 feet high. How many cubic yards of concrete do the two piers contain?
6. Sections of steel tube, having an inside diameter of 4 inches, are filled with concrete and used for posts to support the main floor girder in a building. If these posts are 8 feet long and there are 6 in all, how many cubic yards of concrete are required for the job?

7. How many cubic yards of concrete are needed for a foundation that is 14 feet 6 inches in diameter and 2 feet 6 inches deep? _____

Note: Use this illustration for problems 8–12.



8. The posts in the illustration are set in concrete. All posts and concrete casings are cylindrical. How many cubic feet of earth are excavated for setting both identical posts A and D? _____
9. How many cubic feet of concrete are needed to pour around both posts A and D? _____
10. The two posts B and C are alike. How many cubic feet of earth are removed for setting both posts B and C? _____
11. How many cubic feet of concrete are needed to pour around post B? _____
12. Determine the number of cubic feet of concrete needed to set the four posts shown if posts A and D are changed to 8 inches in diameter and posts B and C are changed to 12 inches in diameter. All other dimensions remain unchanged. _____