Appendix B. Volume Calculations

There are several important factors to consider when preparing for a fumigation. One of the most important is calculating the volume of the space you plan to treat.

Calculating the Volume of Rectangular Structures

In simple terms, to determine the cubic content of a rectangular structure multiply the length by the width and then multiply the result by the height. Use this calculation for truck trailers, boxcars and other simple structures. Measure the inside of these structures if the structure will be sealed and treated on the inside. Measure the outside of the structure if the structure will be tarped. The entire area enclosed by the tarp must be calculated.

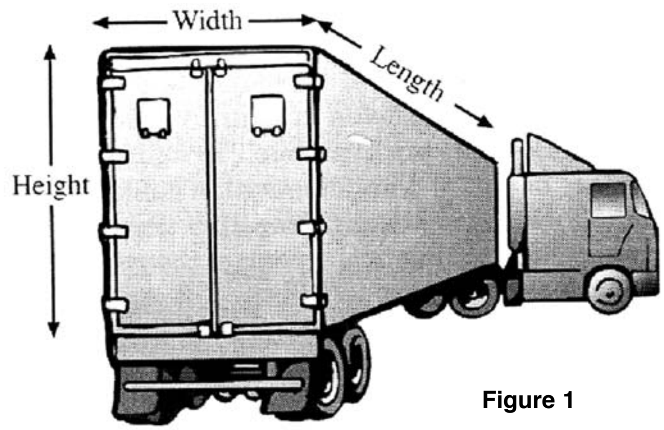

Figure 1

Calculating the Volume of Buildings

Calculating the volume of a tobacco warehouse, flat grain storage building or similar structure is usually more involved. Most buildings are irregular in shape. They also may have peaked or gable roofs. To calculate the cubic content of such structures, first determine the area (square feet) of the space you plan to treat. Then multiply the area by the average height (feet).

Example 1: The rectangular building shown in Figure 2 is 80 feet long and 20 feet wide, with an average height of 25 feet. Calculate the volume (cubic content) of the building.

Area	=	length x width
	=	80 ft x 20 ft
	=	1,600 sq ft
Volume	=	area x average height
	=	1,600 sq ft x 25 ft
	=	40,000 cu ft

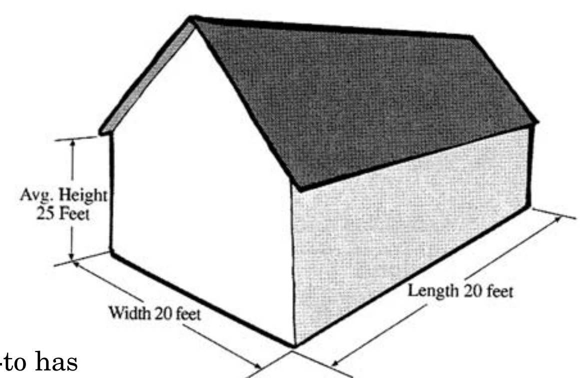

Figure 2

This is a very basic example. A fumigator must be able to calculate the cubic content of buildings much more complicated than this. He or she also must understand how to determine average height. The building in Figure 3 is still simple, but a little more complicated than Figure 2. A lean-to has been added to the main structure, and there is a crawl space, or “subarea.”

Example 2: To figure the volume in Figure 3, (cubic content) of this structure, use the same procedure outlined in Example 1, but calculate the volume of each section separately. Section 1 is the main section, not including the loft and subarea. Section 2 is the lean-to, not including the loft and subarea of that section. Section 3 is the loft area of the main structure. Section 4 is the loft area of the lean-to, and section 5 is the combined subareas below the main structure and the lean-to.

Volume of Section 1:

40 ft x 30 ft	=	1,200 sq ft
1,200 sq ft x 8 ft	=	**9,600 cu ft**

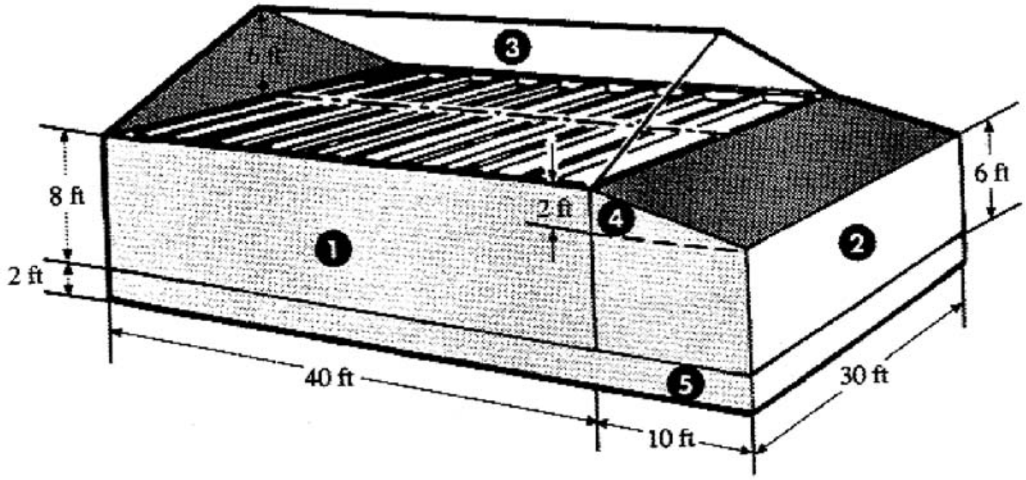

Figure 3

Volume of Section 2:		
30 ft x 10 ft	=	300 sq ft
300 sq ft x 6 ft	=	**1,800 cu ft**
Volume of Section 3:		
40 ft x 30 ft	=	1,200 sq ft
1,200 sq ft x 3 ft (1/2 of loft height)	=	**3,600 cu ft**
Volume of Section 4:		
30 ft x 10 ft	=	300 sq ft
300 sq ft x 1 ft (1/2 of loft height)	=	**300 cu ft**
Volume of Section 5:		
40 ft x 30 ft	=	1,200 sq ft
30 ft x 10 ft	=	300 sq ft
1,200 sq ft + 300 sq ft	=	1,500 sq ft
1,500 sq ft x 2 ft (height of subarea)	=	**3,000 cu ft**

Total volume would be the sum of all area volumes:

9,600
1,800
3,600
300
3,000

Total square feet = 18,300

Calculating Average Height

Calculating the average height of a building is a critical step in figuring volume. Several methods are available. To figure the average height of a building with a gable roof, multiply one-half the distance from the ground-floor ceiling to the peak of the roof by the number of square feet in the loft Another method is to multiply the maximum height at the peak by the number of square feet and divide the result by two.

If the building has a simple roof, without dormer or extra gables, as in Figure 4, you can calculate the average height of the total building by adding the wall height and one-half of the loft height.

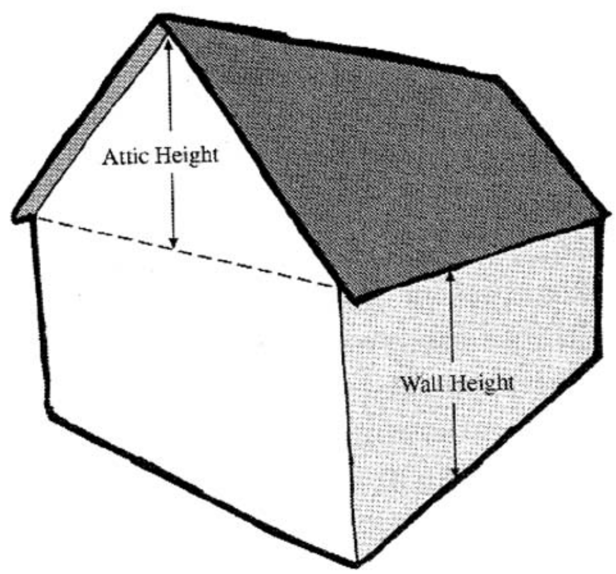

Figure 4

To measure the average height of the building in Figure 5, find the midway point between roof peak and eave. From there, measure to the ground. If the terrain is sloping or access to the outside is difficult, it is useful to measure the roof from inside while making the inspection.

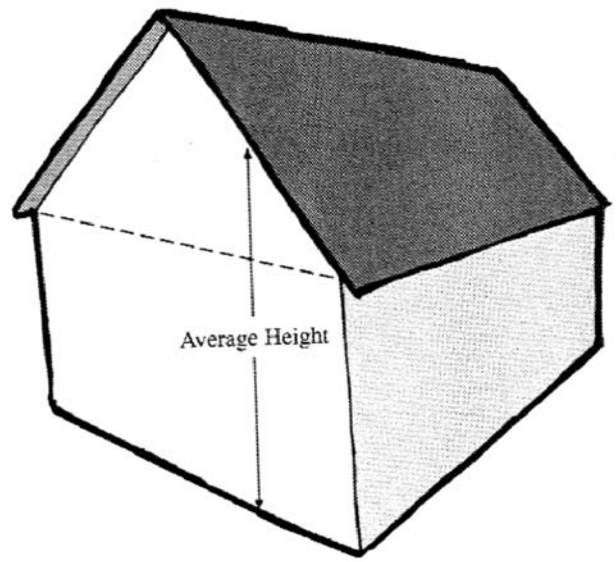

Figure 5

Calculating the Volume of Grain Bins

Grain bins are usually cylindrical, with cone-shaped caps. To calculate the volume (cubic content) of a grain bin, you must know how to figure the volume of a cylinder and a cone:

Volume of a cylinder = $3.14 \times r^2 \times h$

Volume of a cone = $\frac{3.14 \times r^2 \times h}{3}$

r = radius (1/2 of the diameter of the circular base of the bin)
h = height of the cylindrical part of the bin

3.14 is a constant often called "pi" and represented as π

Example 1: Figure 6 shows a basic grain bin. The height of the cylindrical part of the bin is 25 feet. The diameter of the circular base of the bin is 20 feet. The height of the cone-shaped cap is 5 feet. With these dimensions, calculate the total volume (cubic content) inside the bin.

Volume of the cylindrical portion
of the bin = $3.14 \times (10 \text{ feet})^2 \times 25$ feet
= 7,850 cubic feet

Volume of the cone-shaped cap = $3.14 \times (10 \text{ ft})^2 \times 5$ feet

= $\frac{1{,}570 \text{ cubic feet}}{3}$

Total volume

523.3 cubic feet

7,850.0 cubic feet

\+ 523.3 cubic feet

8,373.3 cubic feet

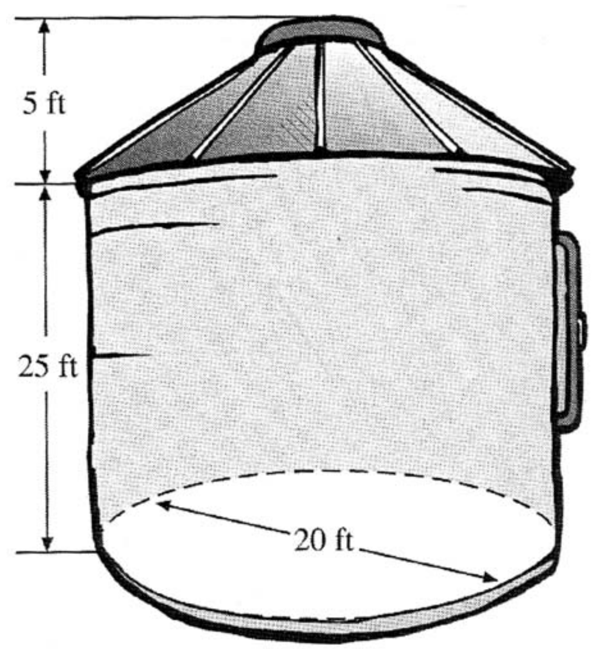

Figure 6