## Module 3 - Scales and Dimensions

# Table of Contents



# List of Figures



# Introductory Information



**Plans or drawings represent full-sized buildings or structures. Obviously, a building cannot be drawn full size, so the drawing must be made a fraction of its original size. The dimensional relationship of the full-sized structure to the drawing is based upon a "scale."**

**The scale will vary from job to job and from drawing to drawing. The scale for a plot plan, for example, may be drawn to the scale of 1/16"=1'; a floor plan may be drawn to the scale of ¼" = 1', while certain details may be drawn on larger scales such as 3"=1'.**

**The scale used for each drawing will be noted on either the label (or title block) on the individual drawings. Dimensions and measurements make up an essential part of construction work. In order to correctly read a print, or when sketching a detail to scale, a worker needs to understand the various dimensioning techniques.**

**In most instances, you will be using the given dimensions on a print or drawing to complete a job. If there is a question, you may need to check a given measurement by scaling. It is important to note that scaled dimensions are only approximations. If there is a discrepancy between the scale and the written dimension, in most cases, the written dimension will take precedence.**

**The most reliable tool for calculating a measurement is the architect's scale. If it is not available, the fractional tape rule may, in some cases, be used to calculate measurements.**

## Learning Objectives

**After completing this module, students should be able to:**

1. **Define the meaning of "scale."**
2. **Use fractional rule to calculate measurements.**
3. **Explain how an architect's scale is used to measure lines.**
4. **Use the architect's scale to determine the actual length of a scaled line.**
5. **Identify the difference between engineer and architect scales.**
6. **Recognize, locate, and determine missing dimensions**

### Reading the Fractional Rule

Measurements in the construction industry are seldom closer than an eighth of an inch. Therefore, the fractional rule usually is divided into 8ths or 16ths. On the rule shown in Figure 1, the inch is divided into 16 parts, and each small division is 1/16th of an inch in size. To read the fractional rule, start with the edge divided into 16ths and follow these steps:

1. Study the major divisions of the inch numbered 4, 8, and 12. These numbers represent 4/16, 8/16, and on to 16/16, or 1 inch. There are four of these major divisions in an inch; therefore, each one is equal to 4/16, or ¼ of an inch.

2. Note that there are four small divisions in each major division of ¼ inch. Each small division represents 1/16th of an inch. Two of these divisions equal 2/16, or 1/8.

3. Further study and application of fractional parts will enable you to locate any common fraction that is a multiple of 16ths, for example:

4/16 = ¼; 8/16 = ½; and 10/16 = 5/8

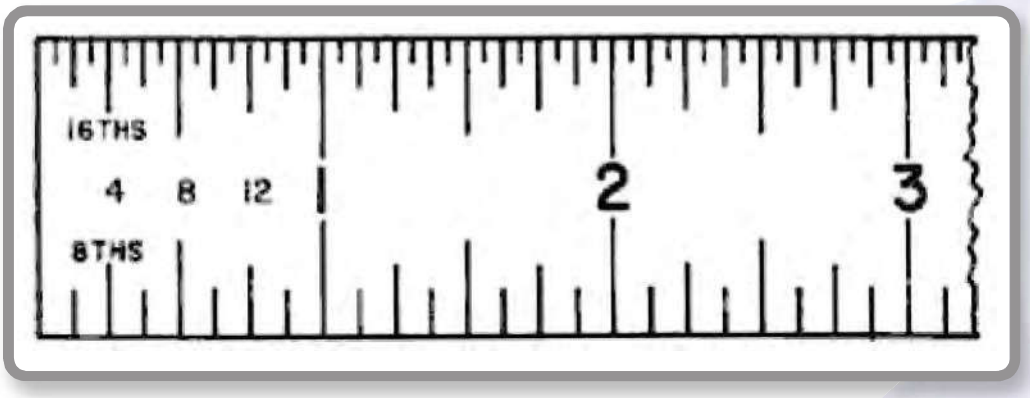
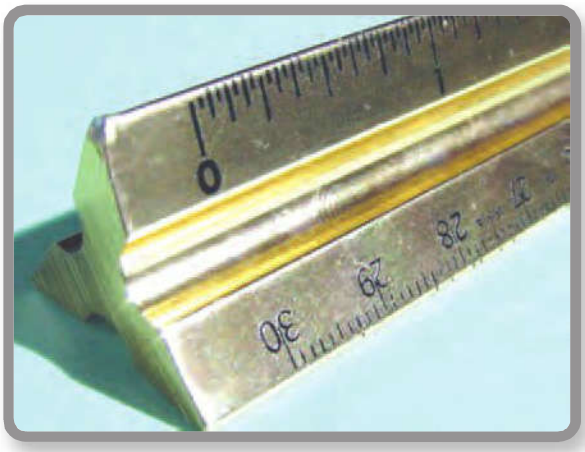



**Figure 1: Typical Divisions of a Fractional Rule**

## Reading the Architect's Scale

Construction drawings are drawn to scale. This means that they are not drawn full size but to a specified scale, such as one inch equals 1 foot. The architect's scale is most commonly used where the divisions of the scale equal 1 foot or 1 inch. On an architect's scale, the inch part of the scale is always the first part of the scale with the closest lines. The foot part of the scale is always the major part of the scale with lines that are further apart.

Since buildings are very large, most major architectural drawings use a scale that relates the parts of the scale to a foot. Architect scales are 12" long. The 16 or full scale is broken into 12 inches. Each inch is broken down into 16 increments, each 1/16". This scale is the same as what is a commonly known as a ruler. The triangular architect scale has 11 scales in all.



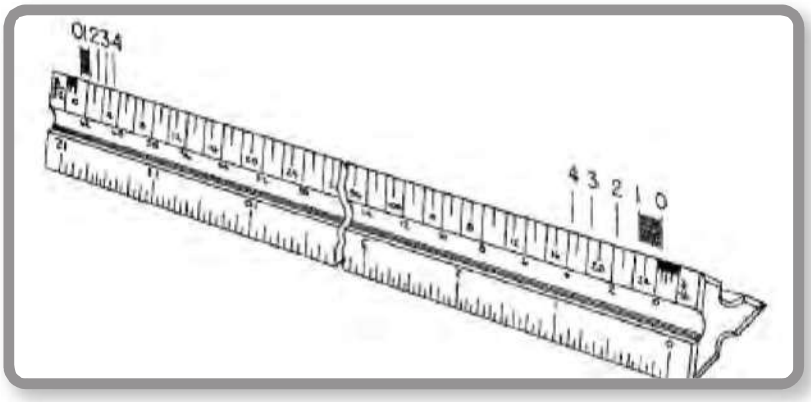



**Figure 2: Triangular Architect's Scales**

Architect's scales are either the bevel type or the triangular type shown in Figure 2. The triangular scale has 6 sides and 11 different scales: a full scale of 12 inches graduated into 16 parts to an inch and 10 open divided scales with ratios of 3/32, 3/16, 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1 ½, and 3 as illustrated below.

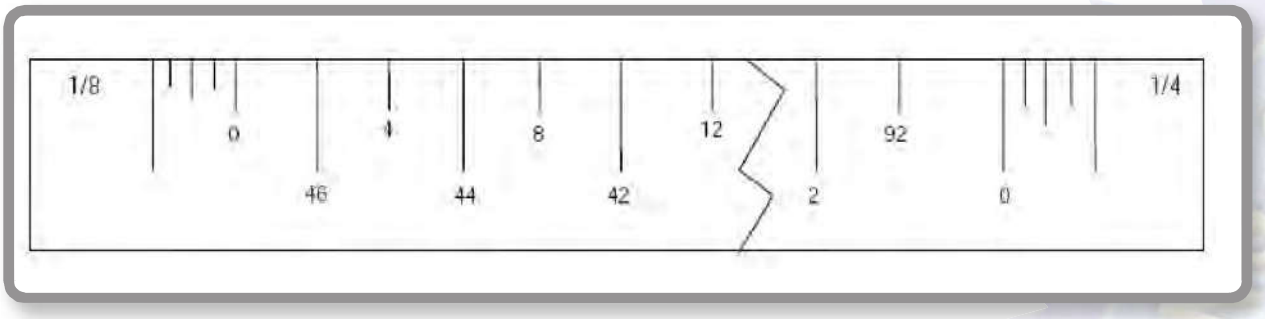
| | | |
|---|---|---|
| 3/32" | = | 1'-0" |
| 3/16" | = | 1'-0" |
| 1/8" | = | 1'-0" |
| 1/4" | = | 1'-0" |
| 3/8" | = | 1'-0" |
| 1/2" | = | 1'-0" |
| 3/4" | = | 1'-0" |
| 1" | = | 1'-0" |
| 1 ½ " | = | 1'-0" |
| 3" | = | 1'-0" |

The scale of 1/8" = 1'-0" is commonly used for construction drawings.

Bevel scales are graduated in the same way with one, two, or four scaled edges. Two scales are located on each face. One scale reads from left to right. The other scale, which is twice as large, reads from right to left. This is so all eleven scales can fit on the six edges of the triangular scale. For example, the ¼ scale and the 1/8 scale are placed on the same face. Similarly, the ¾ scale and the 3/8 scale are placed on the same face but are read from different directions. If the scale is read from the wrong direction, the measurement could be wrong, since the second row of numbers read from the opposite side of the scale is at half-scale, or twice the value.

Note in the example below, the numbers on the 1/8-inch scale increase from *left to right*. The numbers on the 1/4-inch scale increase from *right to left*. • Note that the "0" point on an architect scale is not at the extreme end of the measuring line. The numbers "below" the "0" represent fractions of one foot.






To determine the actual length of a scaled line, follow these steps:

**1.** Select the correct scale.

**2.** Place the scale so that the largest number of feet possible is at one end of the line.

**3.** Determine how far the line extends into the inches scale below the zero.

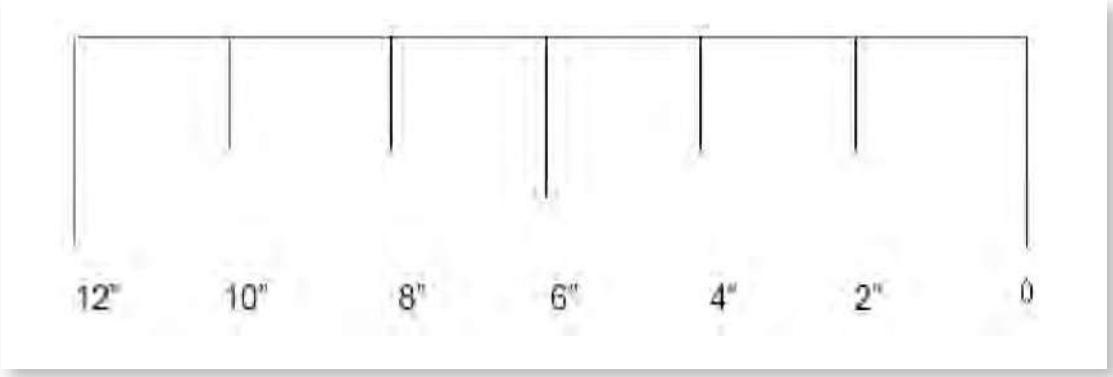
**4.** Add the feet and inches together to find the actual length represented by the scaled line.

## Module 3 - Scales and Dimensions

The following examples are not actual scale dimensions:

**3/32 Scale:** When you are scaling 3/32, each line in the inch part of the scale represents 2 inches.

Examples:

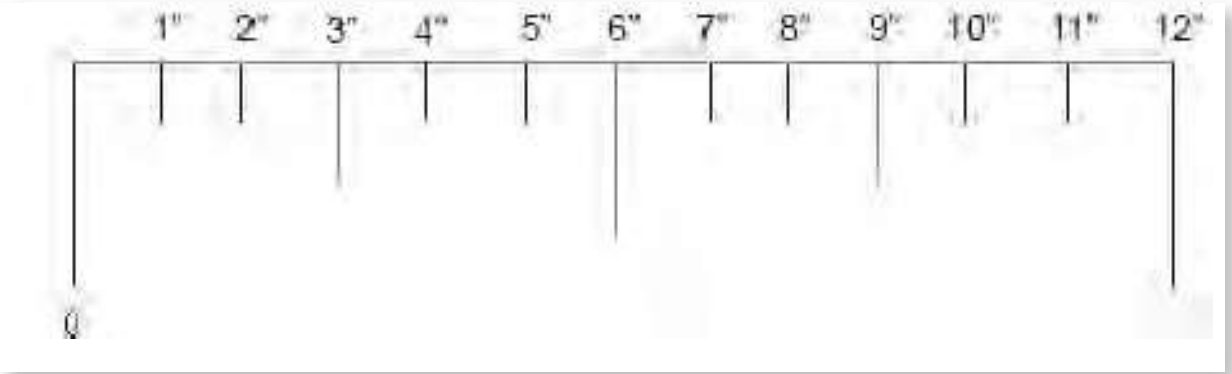



This would equal 12 inches

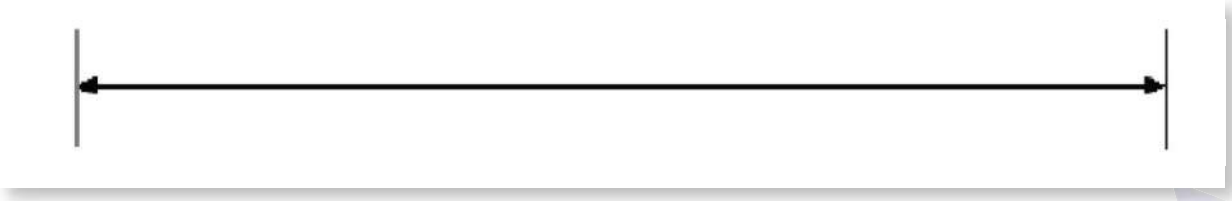
This would equal 6 inches

**3/16 Scale:** When you are scaling 3/16, each line represents 1 inch.

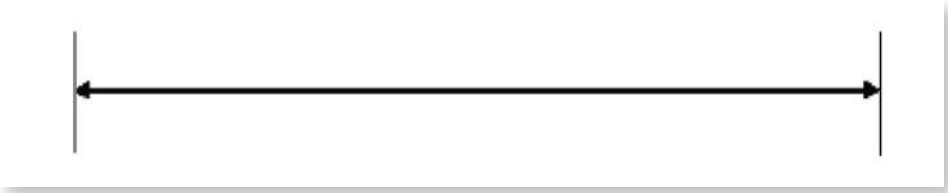
Examples:




This would equal 12 inches



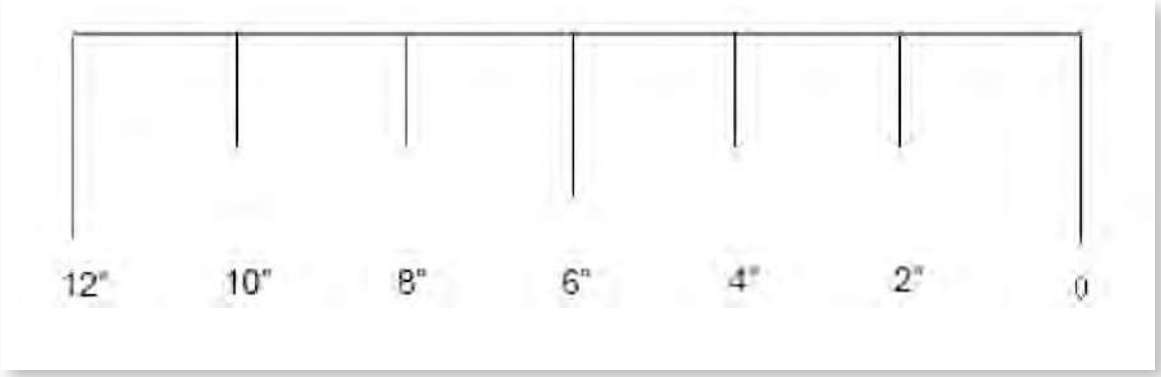
This would equal 9 inches



This would equal 6 inches

**1/8 Scale:** When you are scaling 1/8, each line represents 2 inches.

Examples:




This would equal 12 inches

This would equal 6 inches

**1/4 Scale:** When you are scaling ¼, each line represents 1 inch.

Examples:


This would equal 12 inches

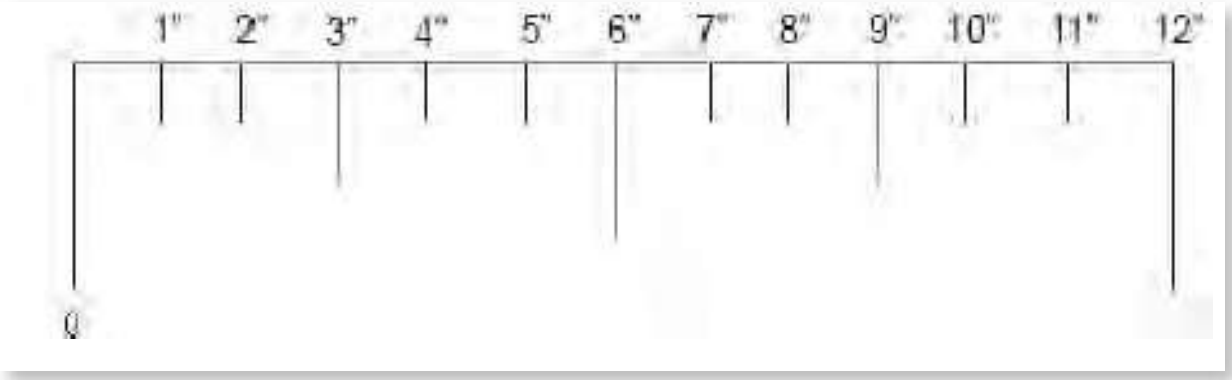
This would equal 9 inches

This would equal 6 inches

## Module 3 - Scales and Dimensions

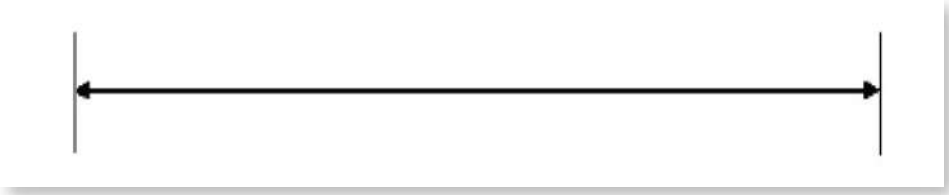
**3/8 Scale:** When you are scaling 3/8, each line represents 1 inch.

Examples:




This would equal 12 inches

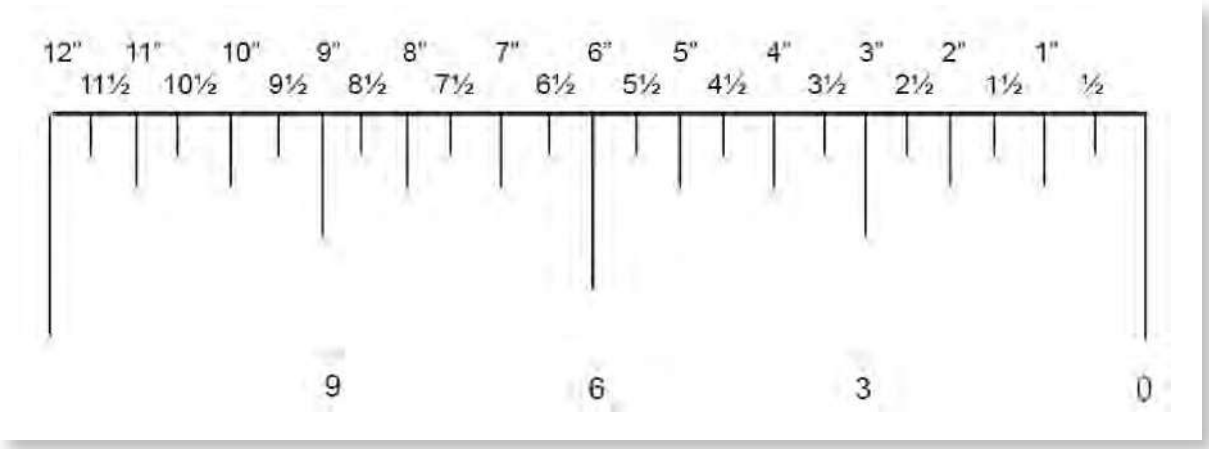
This would equal 9 inches



This would equal 6 inches

**3/4 Scale:** When you are scaling 3/4, each line represents ½ inch.

Examples:



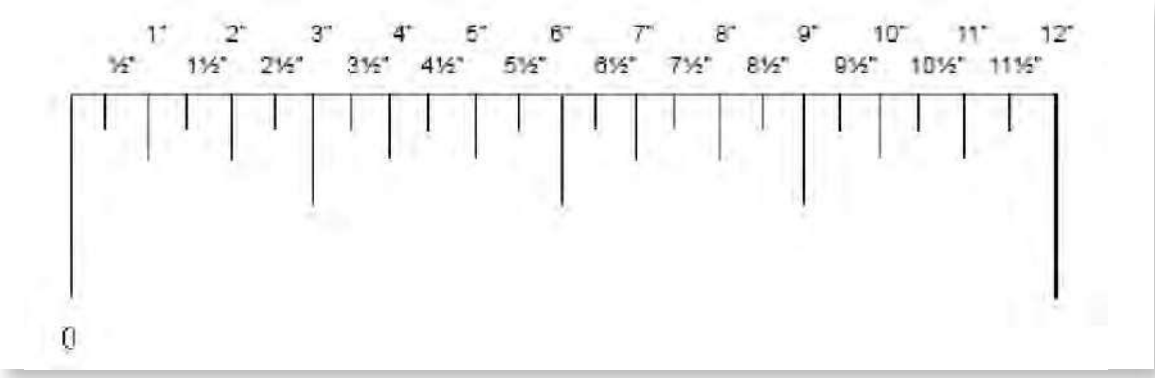

This would equal 12 inches

This would equal 6 inches

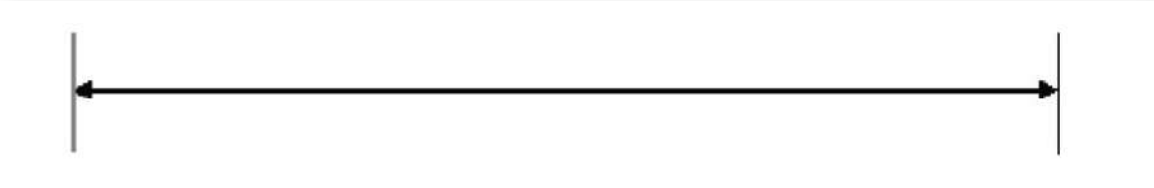
## Module 3 - Scales and Dimensions

**½ Scale:** When you are scaling ½, each line represents ½ inch.

Examples:

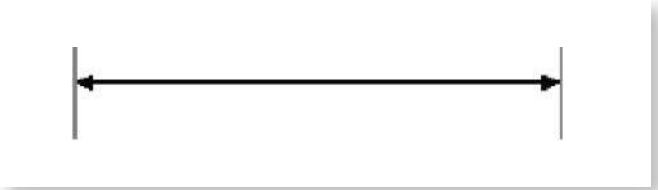



This would equal 12 inches



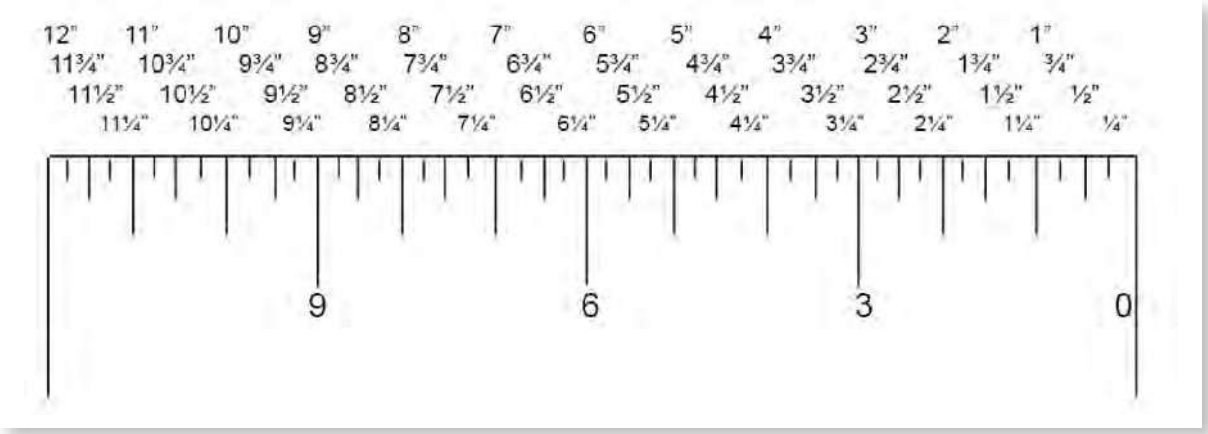
This would equal 9 inches

This would equal 6 inches



**1 Inch Scale:** When you are scaling 1 inch, each line represents ¼ inch.

Examples:




This would equal 12 inches

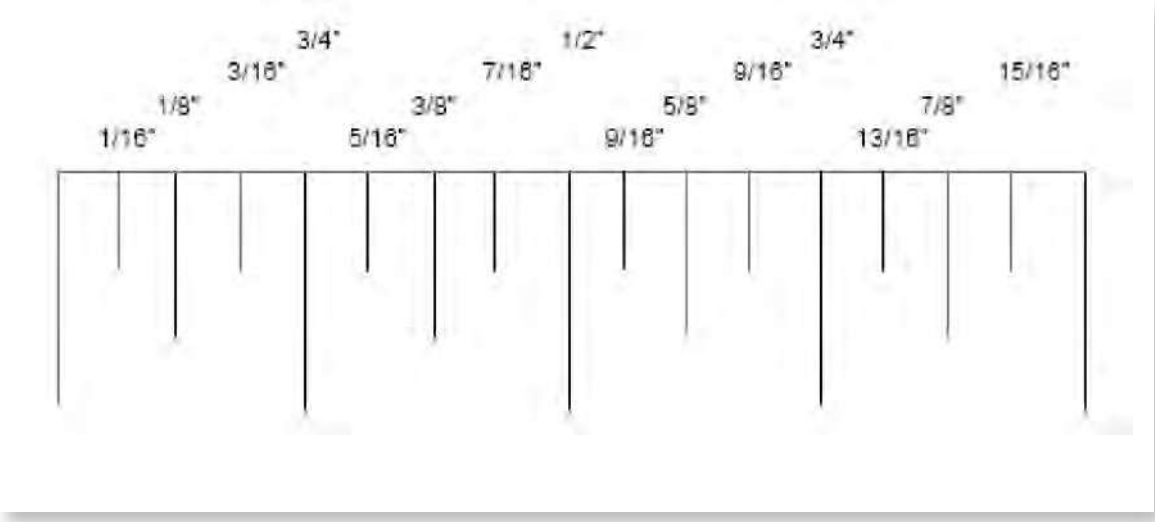
This would equal 9 inches

This would equal 6 inches

## Module 3 - Scales and Dimensions

**Full Scale Ruler:** When using the full scale ruler, each line represents 1/16”

Examples:



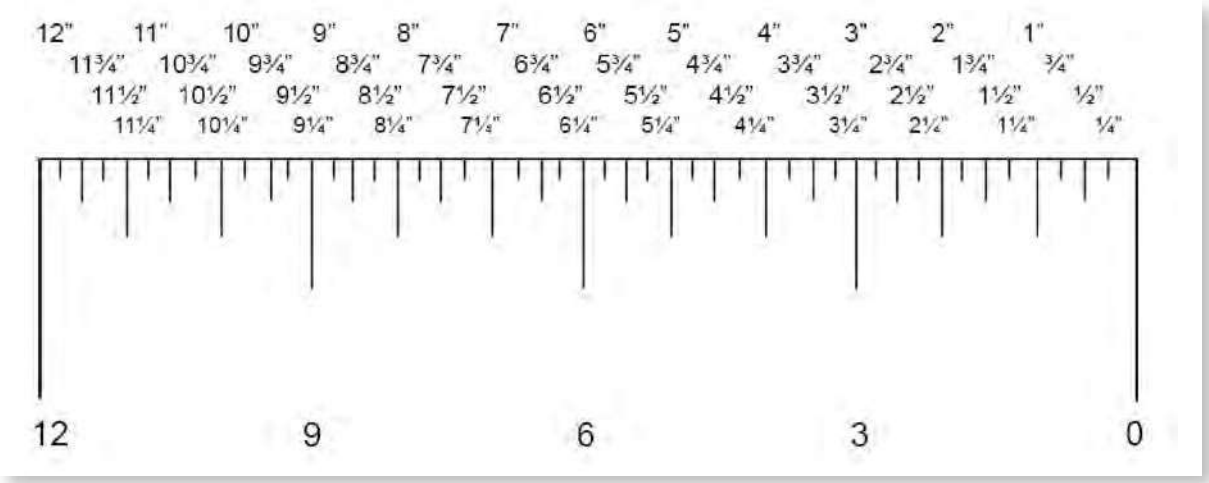



This would equal ½ of an inch.

This would equal ¾ of an inch.

**1½" Scale:** When you are scaling 1½", each line represents ¼".

Examples:



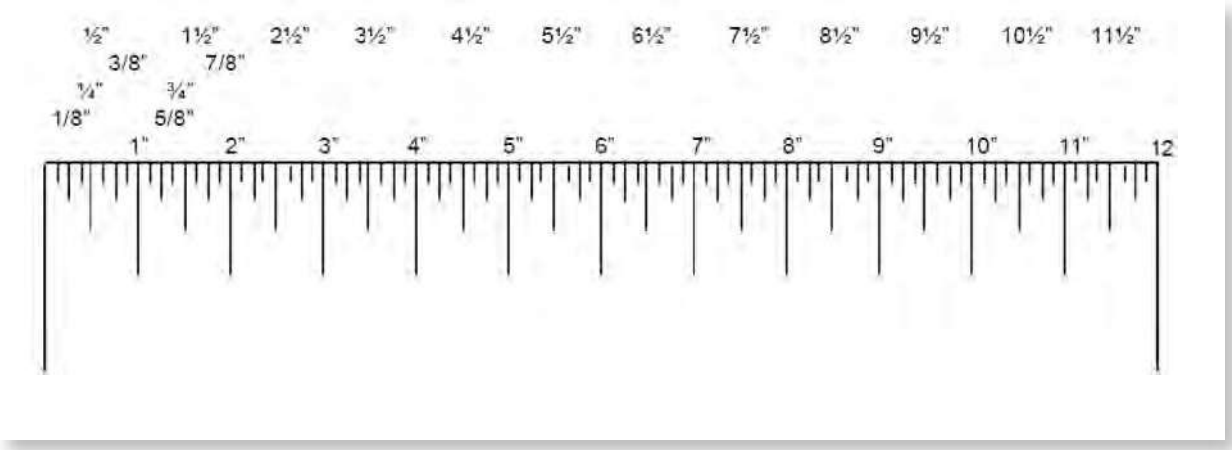

This would equal 12 inches

This would equal 9 inches

This would equal 6 inches

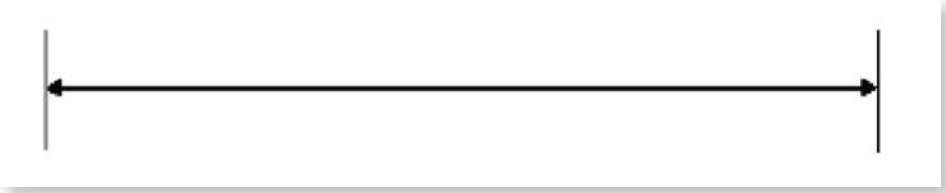
**3" Scale:** When you are scaling 3", each line represents 1/8".

Examples:




This would equal 12 inches

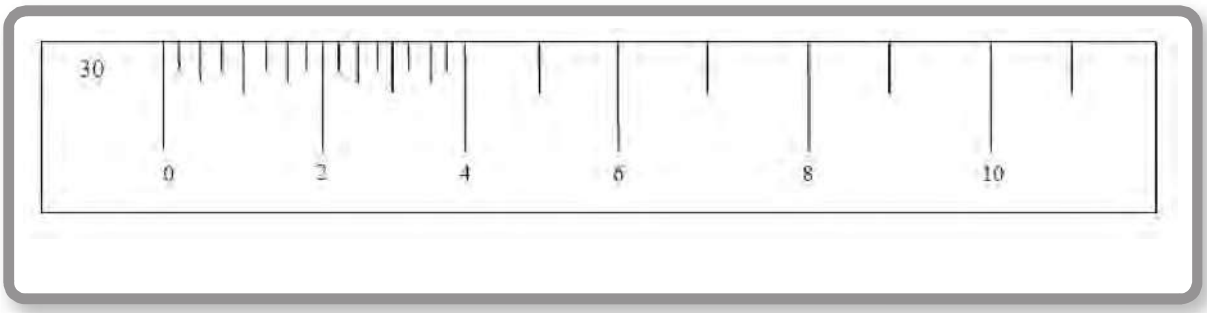
This would equal 9 inches



This would equal 6 inches

## Engineer's Scales

Sometimes plot plans or the sites for building development projects are drawn at very small scale, such as 1" = 40', or 1" = 100', etc. The distance relationships also may be shown as 1:10 or 1:50. Scales such as these are usually used by engineers for very large construction projects and for measuring roads, water mains, and topographical features. Rulers calibrated for these scales are called "Engineers' Scales". Engineer scales have numbers that run incrementally from *left to right*. The whole number to the left of the number line indicates the scale those numbers represent.




When using the engineer scale, you must multiply the value you identify by 10. The small lines between the whole numbers represent individual feet, so a point that falls two marks to the right of the whole number 4 is interpreted as 42 feet.

Engineer scales are 12" long. The 10 or full scale is broken into 12 inches. Each inch is broken down into 10 increments, each 1/10 of an inch. Notice that the engineer scales are always read left to right. The six scales are the 10, 20, 30, 40, 50 and 60 as outlined in Figure 3.

| | |
|---|---|
| 1 inch = 10 feet | 1 inch = 40 feet |
| 1 inch = 20 feet | 1 inch = 50 feet |
| 1 inch = 30 feet | 1 inch = 60 feet |

**Figure 3: Engineer Scales' Dimensional Relationships**

Manufactured parts are often drawn with the engineering scale. In addition, larger items such as bridges and towers are also drawn with this scale. Again, the choice of scale depends on the amount of detail required and the overall size of the object.

## Determining Plan Dimensions

Plan dimensions are written in feet and inches. Feet are always whole numbers.

A typical scale for a floor plan may be ¼" =1'0". For a detail view a larger scale of 1½"=1'0" might be used. The value on the LEFT of the equal sign shows the measurement on the drawing. The value on the RIGHT of the equal sign shows the measurement as it will be on the finished object.

For example, if the scale is ¼"=1'0", each ¼" length on the drawing represents an actual length of one foot. A line that is one inch long will represent four feet. Using the same scale, a line 1-5/8" long will represent 6½ feet (6'6") because it contains six and a half ¼" lengths.

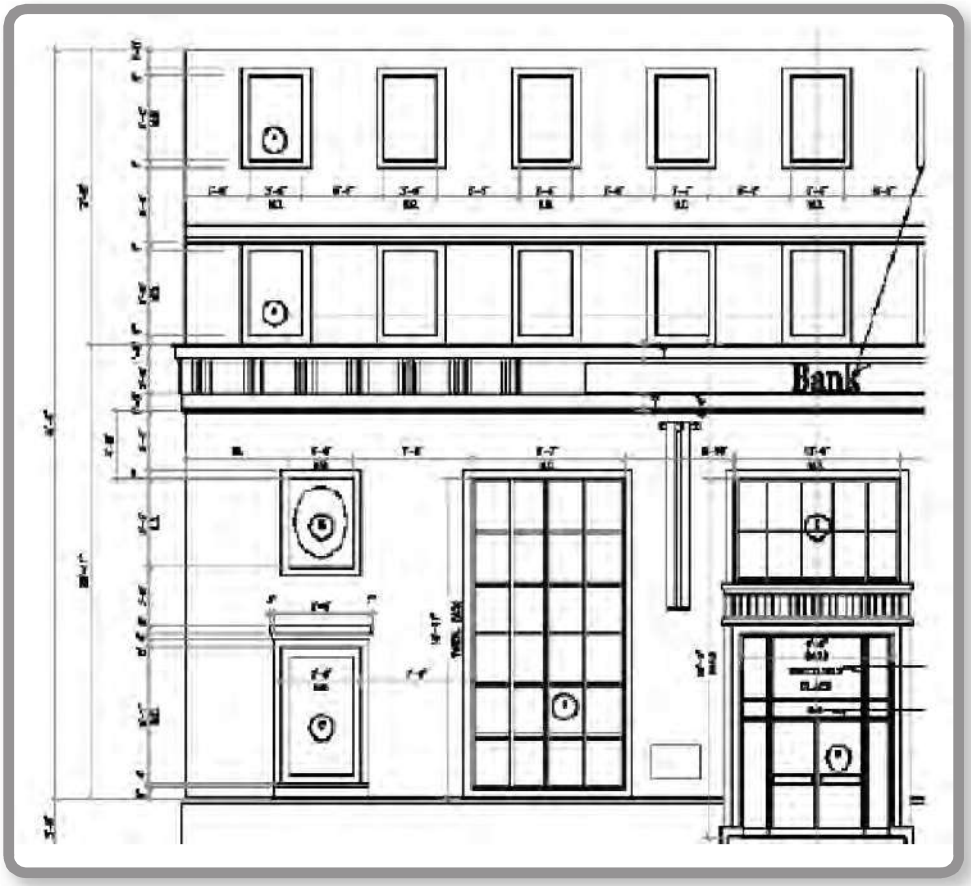



**Figure 4: Finding Missing Dimensions (Bank Building Architectural A07)**

A careful study of the plans should provide all needed dimensions. If a dimension seems to be missing, always check the other drawings. Often the same part of a building will appear on several drawings. Check all possible views for a missing dimension. In addition, all notes on the plan should be checked. Sometimes a printed note will give the needed information.

If a dimension cannot be found, you may have to calculate it from other dimensions by adding or subtracting. Always check the dimensions against each other. No matter how it is dimensioned, equal distance should always be the same.

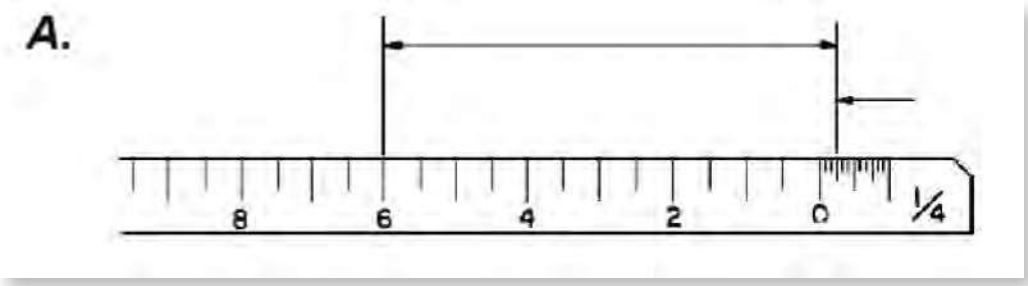
## Practice Exercise

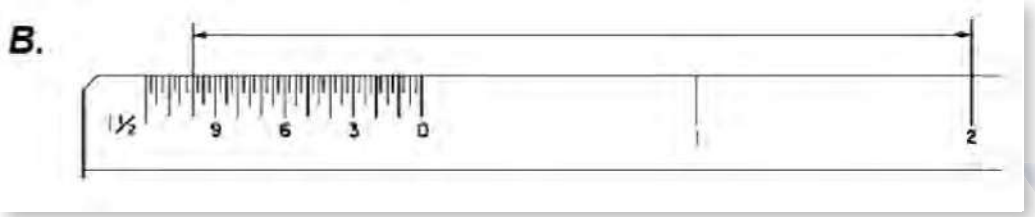
Name: _____ Date: _____

**1.** Commonly, the scale for a set of plans can be found on the individual drawings or on the title block (or label).

A. True B. False

**2.** What is the most reliable tool for determining or calculating a measurement for a set of plans?




**3.** Determine the following measurements: A. B.

## Homework Exercise

Name: _____ Date: _____

**1.** The term of a dimensional relationship of a full-sized structure to a drawing?

A. Fractional
B. Scale
C. Dimensional
D. Representative

**2.** If there is a discrepancy between a scaled dimension and a written dimension, generally, which takes precedence?

A. Written dimension
B. Scaled dimension
C. Calculated dimension
D. Fractional dimension



**3.** Using a 3/32 scale an actual measurement of a 3 3/16" would equal how many feet and inches?

A. 17' 0"
B. 51/16"
C. 3' 6/32"
D. 34' 0"

**4.** Plan dimensions can be written in fractions of feet.

A. True B. False

**5.** If a dimension is missing you should use a "scale" to find the dimensions.

A. True B. False