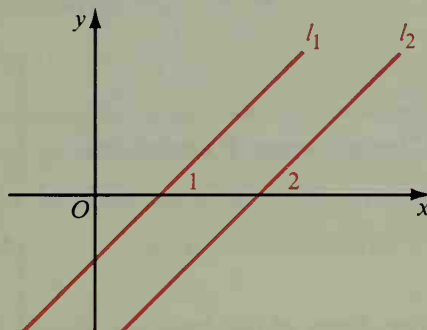# 13-3 *Parallel and Perpendicular Lines*

When you look at two parallel lines, you probably believe that the lines have equal slopes. This idea is illustrated by the photograph below. The parallel beams shown are needed to support a roof with a fixed pitch.

You can use trigonometry and properties of parallel lines to show the following for two nonvertical lines l_1 and l_2 (see the diagram at the right above):

1. $l_1 \parallel l_2$ if and only if $\angle 1 \cong \angle 2$
2. $\angle 1 \cong \angle 2$ if and only if $\tan \angle 1 = \tan \angle 2$
3. $\tan \angle 1 = \tan \angle 2$ if and only if slope of l_1 = slope of l_2

Therefore $l_1 \parallel l_2$ if and only if slope of l_1 = slope of l_2.

Although the diagram shows two lines with positive slope, this result can also be proved for two lines with negative slope. When the lines are parallel to the x-axis, both have slope zero.

Theorem 13-3

Two nonvertical lines are parallel if and only if their slopes are equal.

In Exercises 27–29 of the preceding section, you may have noticed that perpendicular lines, too, have slopes that are related in a special way. See Classroom Exercise 11 and Written Exercise 23 for proofs of the following theorem.

Theorem 13-4

Two nonvertical lines are perpendicular if and only if the product of their slopes is -1.

$$m_1 \cdot m_2 = -1, \text{ or } m_1 = -\frac{1}{m_2}$$