Safety for Mechanical Work 105

Ladder safety is addressed several times within the ToolingU lessons. The attached image comes from Safety – Walking and Working Surfaces 180. It illustrates that a metal rung ladder must be placed 1/4 of the ladder length away from the base of the wall. In addition, this lesson states that if the ladder is used to reach a walkway or roof, it must extend 3 feet past the walkway or roof.

1/4 Ladder Length

A ladder that leans against a vertical structure (wall), will form a right triangle with the wall and the ground distance from the wall to the base of the ladder. Because of this right triangle relationship, if two of the distances are known, the third distance can be calculated using the Pythagorean Theorem.

Simply stated, the Pythagorean Theorem says: $a^2 + b^2 = c^2$

The lengths a and b are the lengths of the sides that form the 90° right angle. In a ladder situation, these lengths are the height of the wall (or the vertical height the ladder reaches) and the distance on the ground between the wall and the base of the ladder.

The length c is called the hypotenuse and would represent the length of the ladder, or that part of the ladder that reaches to the roof or walkway if it extends past.
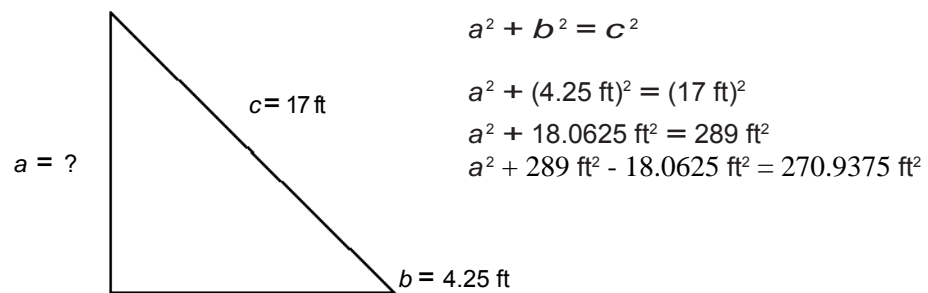
A 20 ft. metal rung extension ladder is being used to reach the roof of a building. To be safe, what is the maximum height the 20 ft. ladder can reach?

SOLUTION:

Because the worker must step off the ladder onto the roof, the worker must use 3 ft of the ladder for overhang.

20 ft. - 3 ft. overhang = 17 ft. of ladder available

1/4 of the 17 ft. = 1/4(17) = 17/4 = 4.25 ft. distance from the wall to base of ladder

$$a^2 + b^2 = c^2$$

$c = 17$ ft

$a = ?$

$b = 4.25$ ft

$$a^2 + (4.25 \text{ ft})^2 = (17 \text{ ft})^2$$
$$a^2 + 18.0625 \text{ ft}^2 = 289 \text{ ft}^2$$
$$a^2 + 289 \text{ ft}^2 - 18.0625 \text{ ft}^2 = 270.9375 \text{ ft}^2$$

Because the height is a and not a^2, the value of a^2 must be square rooted.

$$a = \sqrt{270.9375 \text{ ft}^2} \approx 16.5 \text{ ft}$$

The maximum height reached by the 20 ft ladder is just under 16.5 ft.

EXERCISES:

1. A 15 ft. ladder is used to reach an overhead walkway. How high is the walkway?

2 a. The top of a ladder reaches a 10 ft. height when leaned against a wall. If the base of the ladder is 2 ft. from the wall, how long is the ladder?

   b. Is this ladder being used safely? Why or why not?