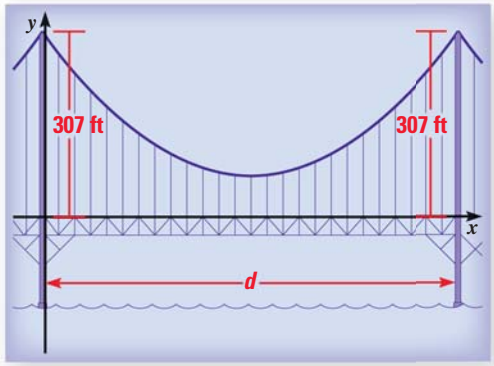
EXAMPLE 2 Use a quadratic model in vertex form

CIVIL ENGINEERING The Tacoma Narrows Bridge in Washington has two towers that each rise 307 feet above the roadway and are connected by suspension cables as shown. Each cable can be modeled by the function

$$y = \frac{1}{7000}(x - 1400)^2 + 27$$

where x and y are measured in feet. What is the distance d between the two towers?



Not drawn to scale

Solution

The vertex of the parabola is (1400, 27). So, a cable's lowest point is 1400 feet from the left tower shown above. Because the heights of the two towers are the same, the symmetry of the parabola implies that the vertex is also 1400 feet from the right tower. So, the distance between the two towers is $d = 2(1400) = 2800$ feet.

GUIDED PRACTICE for Examples 1 and 2

Graph the function. Label the vertex and axis of symmetry.

1. $y = (x + 2)^2 - 3$ **2.** $y = -(x - 1)^2 + 5$ **3.** $f(x) = \frac{1}{2}(x - 3)^2 - 4$

4. WHAT IF? Suppose an architect designs a bridge with cables that can be modeled by $y = \frac{1}{6500}(x - 1400)^2 + 27$ where x and y are measured in feet. Compare this function's graph to the graph of the function in Example 2.

INTERCEPT FORM If the graph of a quadratic function has at least one x-intercept, then the function can be represented in **intercept form**, $y = a(x - p)(x - q)$.

KEY CONCEPT *For Your Notebook*

Graph of Intercept Form $y = a(x - p)(x - q)$

Characteristics of the graph of $y = a(x - p)(x - q)$:

- The x-intercepts are p and q.
- The axis of symmetry is halfway between $(p, 0)$ and $(q, 0)$. It has equation $x = \frac{p + q}{2}$.
- The graph opens up if $a > 0$ and opens down if $a < 0$.