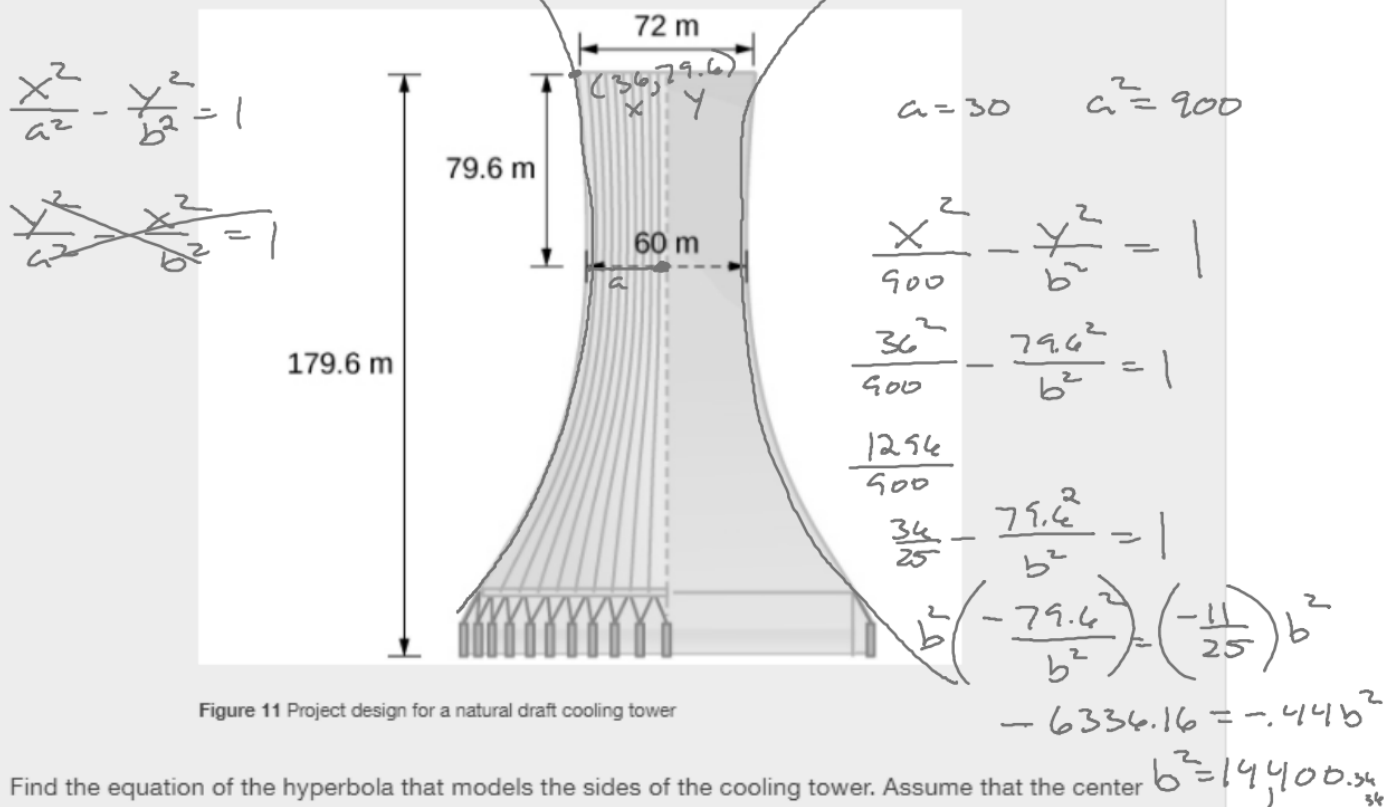## Graphing a Hyperbola Centered at (*h*, *k*) Given an Equation in General Form

Graph the hyperbola given by the equation $9x^2 - 4y^2 - 36x - 40y - 388 = 0$. Identify and label the center, vertices, co-vertices, foci, and asymptotes.

$$9x^2 - 36x \quad - 4y^2 - 40y \quad = 388$$

$$9(x^2 - 4x + 4) - 4(y^2 + 10y + 25) = 388 + 36 - 100$$

$$\frac{9(x-2)^2}{324} - \frac{4(y+5)^2}{324} = \frac{324}{324}$$

$$\frac{(x-2)^2}{36} - \frac{(y+5)^2}{81} = 1$$

$$\begin{array}{r} 1\ 1 \\ 288 \\ \overline{36} \\ \overline{324} \end{array}$$

Solving Applied Problems Involving Hyperbolas

The design layout of a cooling tower is shown in Figure 11. The tower stands 179.6 meters tall. The diameter of the top is 72 meters. At their closest, the sides of the tower are 60 meters apart.

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

$$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$$

Figure 11 Project design for a natural draft cooling tower

$(36, 79.6)$

$a = 30 \qquad a^2 = 900$

$$\frac{x^2}{900} - \frac{y^2}{b^2} = 1$$

$$\frac{36^2}{900} - \frac{79.6^2}{b^2} = 1$$

$$\frac{1296}{900}$$

$$\frac{36}{25} - \frac{79.6^2}{b^2} = 1$$

$$b^2\left(-\frac{79.6^2}{b^2}\right) = \left(-\frac{11}{25}\right) b^2$$

$$-6336.16 = -.44 b^2$$

$$b^2 = 14400.36$$

Find the equation of the hyperbola that models the sides of the cooling tower. Assume that the center of the hyperbola—indicated by the intersection of dashed perpendicular lines in the figure—is the origin of the coordinate plane. Round final values to four decimal places.

$$\frac{x^2}{900} - \frac{y^2}{14,400.3636} = 1$$