Parabolic Bridge

There are conic sections used everywhere in our world. This activity involves the students taking measurements of a parabola found in our community and finding the equation that would represent that parabola.

I start the unit on the conic sections by defining the conics and then having students bring in pictures of the different conics. Usually there are lots bridges for parabolas, which helps when we get to this activity.

I break the students into groups of two or three for the activity. They are responsible for measuring and recording the data for the bridge. The students are graded on if they find the correct equation, the evidence of the work they did to find the equation, and the use of their time. We spend one class period taking measurements, and they are required to do the calculations and any remeasuring outside of class. The students take measurements in groups, but are each required to turn in a final equation and evidence of their work to get it.

A cable or chain hung from two supports pulled down by gravity is called a Catenary curve which is not a parabola but a hyperbolic cosine function. When the main (curved) cables are attached to the deck by vertical cables the weight will pull the curve into the shape of a special parabola. Our town has such a bridge at one of our local parks. The student’s task is to find the equation of the parabola of the bridge and to graph it. The bridge has planks on it with people’s names that donated money to have the bridge built. Each group is given a different persons name that will act as the origin for their equation. Essentially, this just changes the horizontal translation of the individual equations.

The students are required to find the vertex and four other points of the parabola with respect to their origin. (One of which is the y-intercept.) Then they have to find the equation of the parabola using points and the vertex by hand and then compare it to the results they get by using quadratic regression on the calculator.

The students generally do a good job with this activity; however, I have had some erroneous results as well. Although I have them measure in groups, I have them do the calculations individually which can lead to a lot more variations on the resulting equation. We do spend a little time in class for each group to compare and see if they got the same equation as the others in their group and try to find the errors if they did not. Then we discuss as a class whether or not the equations that everyone has should be similar. We discuss the parts that are similar and the parts that are different within the equations. Usually I get this conversation started by writing up four or five of the equations on the board for them to look at. Invariably one of the students will notice that the vertex form the equations are very similar equations except for the horizontal translation. this typically leads to good discussion about what each part of the parabolic equations does to the graph and how it changes the shape, location, and direction of the parabola.