

Bridge Modeling Investigation

(Please share one copy with your group and type all answers on that shared file)



You've been hired to design a bridge to replace the current I-5 bridge across the Columbia River and you've decided to go big and recreate this bridge in Zwodzony, Poland. The support structure is the tall parabola. The deck of the bridge is the part that cars drive on and is a shallow parabola.

1. What information do you need to design this bridge for the Columbia River Crossing?

Width of river = 3500      height of structure = 200  
 height of deck = 75

2. Once you obtain this information, use it to model the structural element and deck as two different parabolas. Define your variables.

Use (0,0) to solve for "a"  
 y = height above water.  
 x = distance from riverbank (on left)

Support Structural Parabola:  $S(x) = a(x - 1750)^2 + 200 = \frac{-2}{30625}(x - 1750)^2 + 200$

Deck of Bridge Parabola:  $D(x) = a(x - 1750)^2 + 75 = \frac{-1}{122500}(x - 1750)^2 + 75$

$$0 = a(0 - 1750)^2 + 200$$

$$-200 = a \cdot 3062500$$

$$\frac{-200}{3062500} = a = \frac{-2}{30625}$$

$$0 = a(0 - 1750)^2 + 75$$

$$-75 = a \cdot 3062500$$

$$\frac{-75}{3062500} = a = \frac{-1}{122500}$$

3. Research local regulations about shipping, aircraft, and bridges. Provide any information regarding the height of ships that can fit under the deck and restrictions for aircraft (the bridge is near PDX) altitudes.

Lights on top for airplanes to see  
 Don't worry about shipping regs.

4. Recall that the structural parabola is  $S(x)$  and the deck parabola is  $D(x)$ . Write the equation of each of the following transformations and discuss what effect each transformation would have on the bridge.

a.  $-S(x)$   
 Equation:  $-S(x) = \frac{2}{30625}(x-1750)^2 - 200$

Effect: Structure goes underwater.

b.  $S(x) + 100$   
 Equation:  $S(x) + 100 = \frac{-2}{30625}(x-1750)^2 + 300$

Effect: Structure is floating 100 feet above the deck.

c.  $D(x-5)$   
 Equation:  $D(x-5) = \frac{-1}{122500}(x-1755)^2 + 75$

Effect: Deck is 5 feet to the right, so the bridge doesn't reach both riverbanks

d.  $4D(x)$   
 Equation:  $4D(x) = \frac{-4}{122500}(x-1750)^2 + 75$

Effect: Deck is 4 times as tall (too steep for cars)  
 Deck is skinnier, so it doesn't stretch over  
 (2 times)  
 the whole river