Shopping for Parabolas

Teachers Teaching with Technology™
Professional Development from Texas Instruments

Student Activity

7 8 **9** **10** 11 12

TI-Nspire™ | Investigation | Student | 50 min

Introduction

Some architectural, engineering and advertising curves feature parabolic forms, the arches at Eastlands shopping centre were designed as parabolic. The long atrium is illuminated via glass panels resting on top of this long series of parabolic arches. The arches continue around a corner adding further mathematical beauty.

In this activity, a short passage of these arches will be modelled with appropriate equations.

Set up

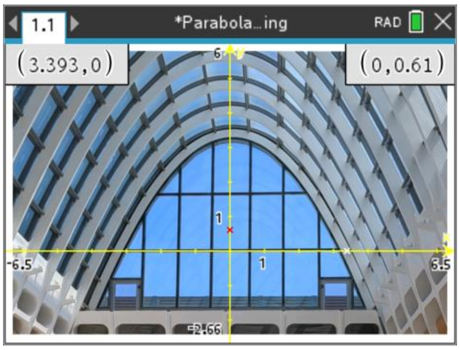
Open the TI-Nspire document: “Parabola Shopping”.

A picture of the atrium in one section of the shopping centre has been inserted in the Graphs Application.

The axes provide a numerical reference frame on which models (equations) will be generated. The scale and location of the cartesian plane have been set.

The x axis is approximately 14m above ground level.

Two points have already been created and the coordinates placed in the top left and right of screen.



> You can change the colour and style of the point to make it easier to see.
> - Changing the attributes of the point allows you change its shape/appearance.
> - Change the colour depending on where the point is located.

Modelling Arch 1:

The atrium consists of a huge family of parabolas. The images shows one section of the atrium. Each parabola in this section is the same size, however, they appear smaller and smaller, this is due to perspective.

Question: 1 Equation 1 – Difference of perfect squares

a) Move the point along the x – axis to locate where the first arch (end of atrium) intersects the axis and record the abscissa (x coordinate) to the left and right.

b) For the purposes of this first equation we assume that the arch is symmetrically oriented around the y – axis. Use the two values from the previous questions to write an appropriate quadratic equation that passes ‘close’ to these two points. The equation should be of the form: $y=-(x-b)(x+b)$

c) Determine the current y intercept for your equation.

Author: P. Fox

d) Use the point on the y axis to locate the required coordinate for where the parabola should cross the y axis.

e) Use your previous two results to finalise the equation for the arch in the form: $y = a(x-m)(x+n)$.

f) Using the current scale the first floor (where the arches terminate) would be represented by the line: y = -10. Determine the width of the arches at the first floor.

Question: 2 Question 2 - Modelling Arches 2 & 3:

a) Use the same technique from Question 1 to determine an equation for the second arch.

b) Comment on how well the graph models the arch.

c) Explain why the width of the arches (at the first floor) is different for the second arch.

d) Use the same technique from Question 1 to determine an equation for the third arch.

e) Comment on how well the graph models the arch.

Question: 3 Question 3 - Modelling Arch 4:

a) Identify the approximate x and y axis intercepts.

b) The dilation factor can still be calculated using the y axis intercept and substitution x = 0.

c) Determine the equation in the form: . $y = a(x-m)(x-n)$

Question: 4 Question 4 - Modelling Arch 5:

A slightly different approach is required for this arch as the top of the arch is not visible.

a) Identify the approximate x axis intercepts.

b) Place a point somewhere on the Cartesian plane (Press P) and then measure it's coordinates. Move the point so that it is on the arch to be modelled. Record the location. (coordinates)

c) Determine the equation in the form: . $y = a(x-m)(x-n)$

Question: 5 Question 5 - Modelling

Explain why the parabolas all have different equations when the physical parabolas (steel structures) are all the same?

Author: P. Fox