# Instructional Handout: Geometric Shapes Roller Coaster Design

Frank Jamison, National University

**Objective:** To understand and apply geometric shapes and principles in designing roller coasters.

## Basic Geometric Shapes: Definitions and Examples

**Circles:** Defined as shapes where all points are equidistant from the center.  
**Example:** The loops in roller coasters, for instance, the loops in Steel Vengeance at Cedar Point.

**Triangles:** Three-sided polygons.  
**Isosceles:** Two sides of equal length.  
**Equilateral:** All sides and angles are equal.  
**Right-Angled:** One angle is 90 degrees.  
**Example:** The triangular supports of Fury 325 at Carowinds

**Polygons:** Shapes with three or more straight sides.  
**Example:** The multi-sided structures supporting Velocicoaster at Islands of Adventure.

**Importance in Design:** Shapes determine the layout, stability, and aesthetics of the coaster, affecting thrill and safety.

## Understanding Circles in Roller Coaster Design

### Formulas

Radius: Distance from the center to the circumference.  
Diameter: .  
Circumference: .  
Area:

### Application

Circles are crucial for loop designs. The radius influences the loop's size and the force experienced by riders, as seen in Steel Vengeance's intricate loops.

## Application of Triangles in Track Design

### Formulas

**Pythagorean Theorem** (for right triangles):   
**Trigonometric Ratios** for non-right triangles.

### Application

Triangles are used in coaster track design for slopes and structural supports. Fury 325's triangular supports demonstrate how triangles contribute to structural integrity and aesthetics.

## Principles of Symmetry and Balance

### Symmetry in Design

Symmetry contributes to a visually appealing and balanced ride experience.

### Balance in Structure

Balance is key for safety, distributing forces evenly, as seen in the symmetrical design of Velocicoaster's track layout.

## Case Studies: Applying Geometry in Roller Coasters

**Steel Vengeance, Cedar Point:** Features circular loops with carefully calculated radii for optimal thrill and safety.

**Velocicoaster, Islands of Adventure:** Utilizes polygons and symmetry in its track and support structures, ensuring a balanced and visually striking design.

**Fury 325, Carowinds:** Employs triangular supports, demonstrating the application of geometric principles for stability and aesthetic appeal.