## Introduction

Truss bridges are all around us. They are among the simplest yet most elegant structural designs that we have in our world. From the San Francisco Bay Bridge to the Garden Bridge in Shanghai, you can hardly travel anywhere without finding a truss bridge. These bridges can withstand thousands and thousands of pounds without batting an eye. They can do this by distributing and balancing the load across multiple trusses. Some of these trusses are in compression while others are in tension creating a balance that adds strength to the structure. In this lab, you will design, build, test and calculate the forces in a truss bridge to learn how forces are distributed throughout each truss.

## Materials

[NI myDAQ](http://www.ni.com/mydaq/)

[2 Flexiforce Pressure Sensors -25 lbs](http://www.sparkfun.com/products/8712)

6 – Resistors 1KΩ-100KΩ (All resistors need to be the same)

[2 circuit breadboards](http://www.radioshack.com/product/index.jsp?productId=2734155&filterName=Type&filterValue=Breadboards&camp=PPC%3AGoogle)

Extra Wire

Building Materials for the bridges (i.e. balsa wood, popsicle sticks, glue)

## Procedure

**Design and Calculate**

Design a truss bridge that is no bigger than 18”x6”x6” (or whatever your instructor specifies). Make a 2D drawing of the side of the bridge. Make sure to include all lengths and angles for the trusses that you are using. Have your instructor approve the drawing before continuing.

Using the 2D drawing and the position of the forces placed on the bridge, calculate the generic forces in each truss. It is recommended to use Statics to calculate the forces. However either the Method of Sections or the Method of Joints will be sufficient. Predict which truss will fail first.

For more ideas on popular truss designs visit: <http://en.wikipedia.org/wiki/Truss_bridge>

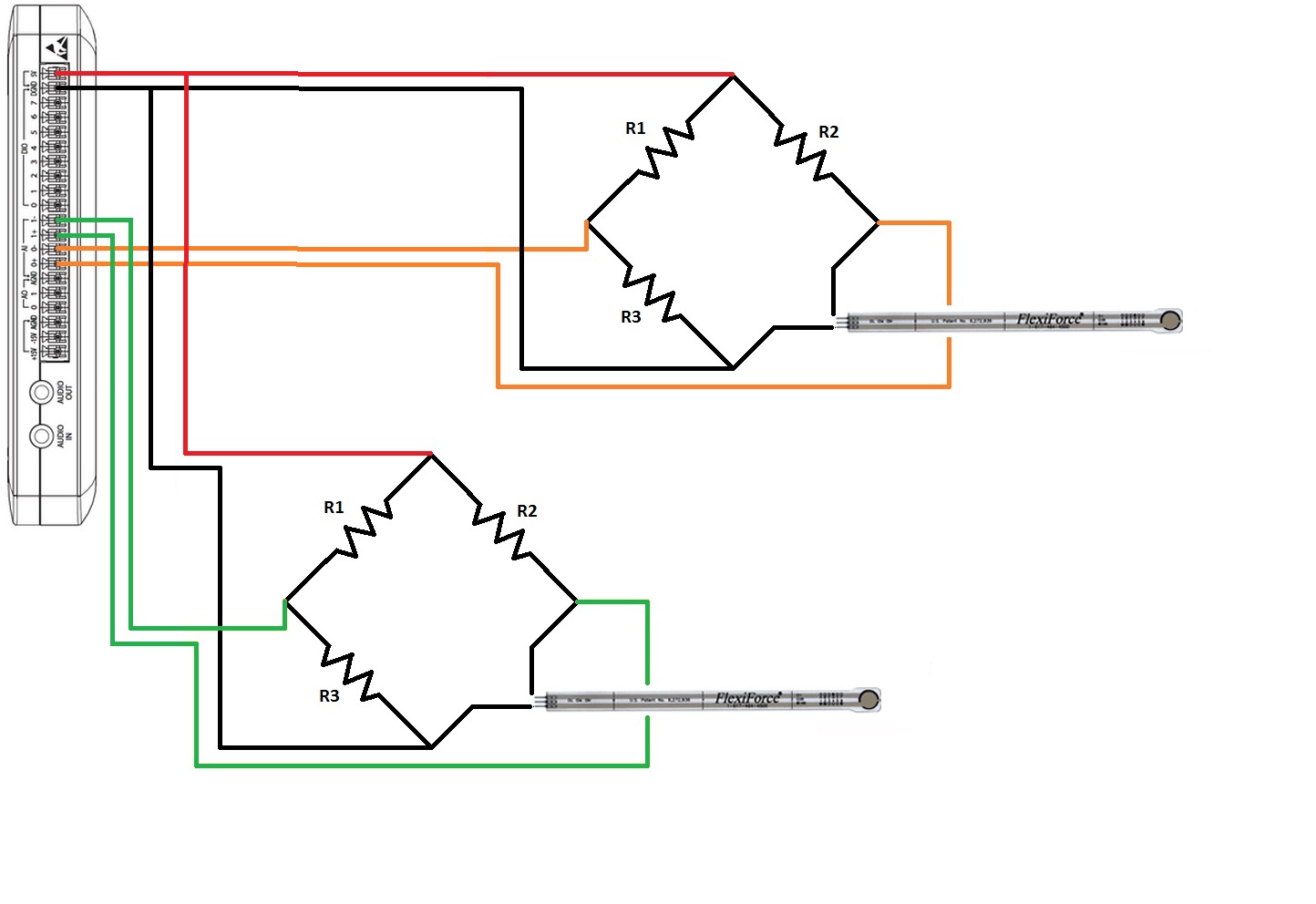
**Build**

The purpose of building the truss bridge is to find the forces in the trusses at failure and then compare those forces to the compressive or tensile strength of the material that you are using. Using building materials (wood, paper, plastic and glue) construct your bridge according to the drawings that you have made. It is important that while building your bridge, the joints are reinforced so that the bridge doesn’t fail at the joints. When gluing the trusses together, make sure that the joints are clamped down while drying to ensure the strongest hold.

**Test and Competition**

To test your bridge you will need to use the 2 Flexiforce sensors, a NI myDAQ, the 6 resistors, the circuit breadboards and the wire.

1. Build the circuit shown below; make sure to allow yourself enough wire to reach both sides of the bridge.



1. Place a .375” dia. piece of wood between the sensor and the bridge. This will ensure that all the weight will be distributed evenly across the sensor, in order to get the most accurate reading possible. Also ensure that the wooden disk only touches the silver center, and not the black trim.
2. Run **myBridge.vi**.
3. Follow the instructions to calibrate the sensors to read weight.
4. Click **Test** which will take you to a new window.
5. Click **Start Test** to start getting data.
6. Start loading the bridge with weight. The bridge can be loaded with the weights in different places, but make sure to load the bridge with the same proportions of forces that are shown in the drawing to make your prediction the most accurate.

**Calculate**

Take the maximum weight each sensor used and the forces that were put on the bridge, and calculate the forces in each member. Then compare that to the tensile and compressive strength of the material that you used.

Did the bridge fail where you thought it would?

Is the compressive and tensile strength of the failure point of the bridge the same as the actual compressive and tensile strength?