

Imagineering-1

G.K. Ananthasuresh with illustrations done by G. Bharathi

Engineers use imagination to build new things. In this series of articles, we present different types of engineering topics. Each topic requires you to think and to work patiently with your hands. Happy Imagineering!

Tensegrity

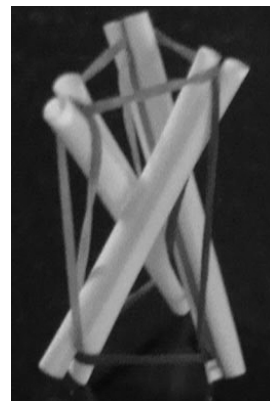
A stretched rubber band is in tension. Tension is a force. The opposite of tension is compression. Take a straw, rest it vertically on a flat surface, and press down upon it. Now, the straw is in compression. Compression is also a force. Can you compress a cut-piece of a rubber band by holding its two ends? Of course, you can, but it relaxes, becomes slack and offers no resistance. So, a rubber band can only take a tension force.

Now, just imagine: can you make a straw stand on one of its ends using only rubber bands? If you want, you may also use more straws but nothing else. And, you may connect rubber bands and straws to each other but not to anything else. Any two straws should not be connected together; they may only be connected to the rubber bands.

Look at picture 1. It shows a structure in which compression members (like straws) appear to be floating but they aren't; they are held in place with almost invisible tension members (like rubber bands). Gravity does not make this structure collapse. How is it possible? Think. If you get some ideas, work on them with a few rubber bands and straws. Then, turn to the next column for Imagineering fun.



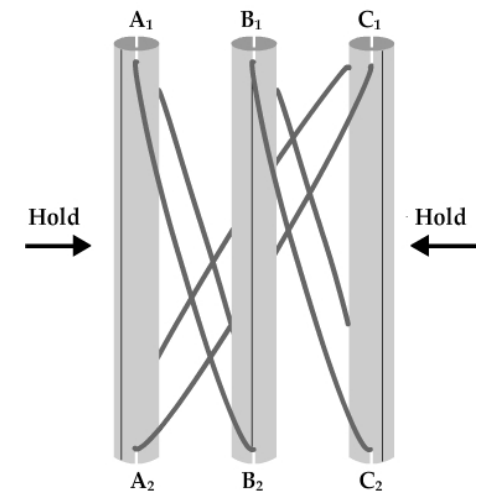
Picture 1



Picture 2



Picture 3



Picture 4

Imagineering is a *portmanteau* word. A portmanteau word is a combination of two words and its meaning is also a combination of their meanings. Here are other examples: breakfast + lunch = brunch; spoon + fork = spork; scientist + engineer = sciengineer. Think of some more. You can make some up yourself!

If you came up with an answer all by yourself, you are an inventor like Richard Buckminster Fuller and Kenneth Snelson. They invented *tensegrity* – a method of getting structural integrity with tension. Look at picture 2. Wonder how the straws are staying put even though only stretched rubber bands are holding them? You can check it out yourself as explained below.

You need: three straws and five rubber bands and patience. The length of the un-stretched rubber bands should be slightly shorter than the straws.

Step 1: Cut a very small (3 mm long) cuts into the two ends of the three straws. See picture 3.

Step 2: Connect three straws and three rubber bands as shown in picture 4. You need to stretch the rubber bands to connect them to the straws. Hold the straws in the middle to prevent the rubber bands from relaxing.

Step 3: Move A₁, B₁, and C₁ ends apart, take the fourth rubber band and pass it through A₁, B₁, and C₁ forming a triangle.

Step 4: Repeat step 3 for ends A₂, B₂, and C₂ with the fifth rubber band. Leave your hands. Lo and behold! All straws stay on giving a shape to your first tensegrity structure. Want to build more? Visit www.kennethsnelson.net.