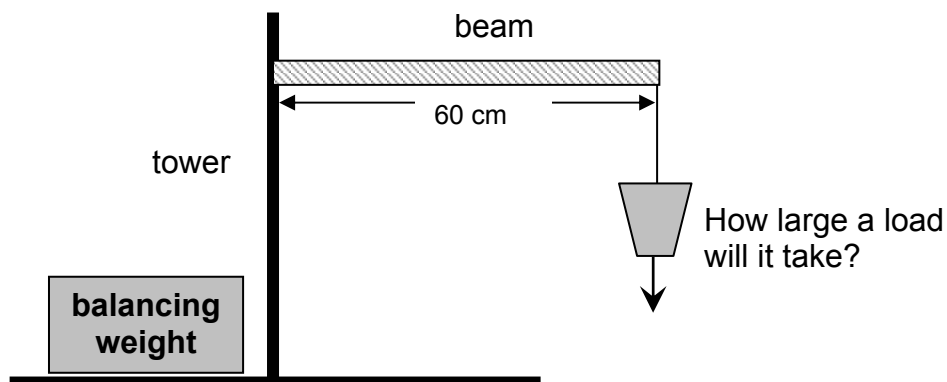




# Crane Construction Challenge



Using the kit provided design and make a beam for a crane. Your beam must be at least 60 cm long.



## KIT LIST

- A4 paper
- hole punch
- masking tape (only to be used to make tubes)
- 2 standard hooks or string – these are to connect the structure to the crane tower and to attach the load.
- tube roller
- nuts and bolts

## CONSTRUCTION

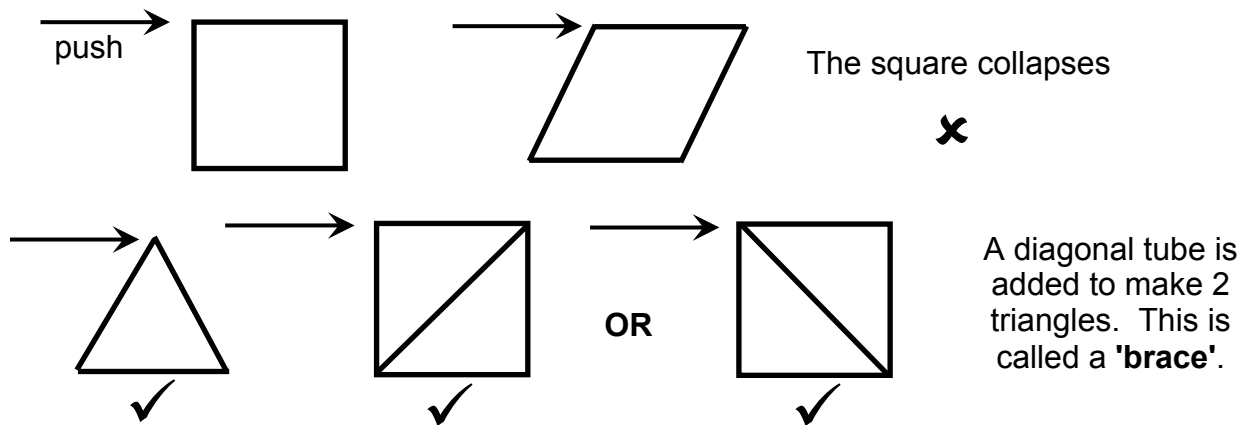
1. Practise making strong paper tubes. You will need to organise your team to make a **tube production line**.
2. Join the tubes together using the nuts and bolts. Only use one nut on each bolt.
3. Design the strongest beam possible. Use the Engineering **top tips** overleaf to help you.
4. **Test!** – can your beam take the maximum load?
5. Improve your design. Are all the tubes in your structure necessary? Try to reduce the materials used so that your design will still take the maximum load but cost less to manufacture. Your engineering company will now make a profit!

**If you need any advice please ask one of the engineering volunteers.**

Sponsors:



## STRONG STRUCTURES USE TRIANGLES



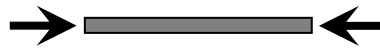
😊 **Top Tip:** You can still use squares – just add a diagonal or **'brace'**

😊 **Top Tip:** A sheet of A4 paper will make a long or short tube depending on how you roll it. Make your basic structure using short tubes (length of the short side of the paper). You can then use the long tubes for any diagonals.

## STRETCHING AND SQUASHING



stretching or **'in tension'**  
stronger

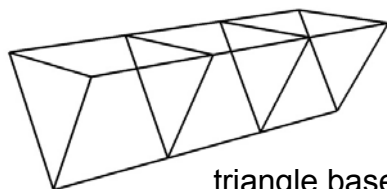


squashing or **'in compression'**  
buckles easily

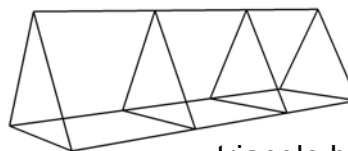
😊 **Top Tip:** Spot which tubes are in **'tension'** or in **'compression'** in your design. If you have a choice use tubes which will be in tension.

😊 **Top Tip:** Try to strengthen any tubes which are in compression.

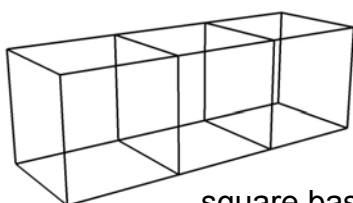
## SUGGESTED STARTING POINTS



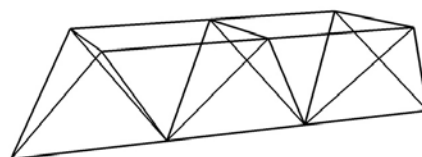
triangle based



triangle based



square based

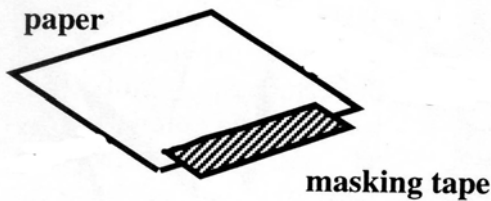


tetrahedron  
(very tricky!)

😊 **Top Tip:** Think about where the beam will fail. Where should you **brace** the structure?

# HOW TO MAKE A STRONG TUBE

☺ **Top Tip: ORGANISE YOUR TEAM TO FORM A PRODUCTION LINE WITH 4 JOBS TO MAKE THE TUBES QUICKLY**



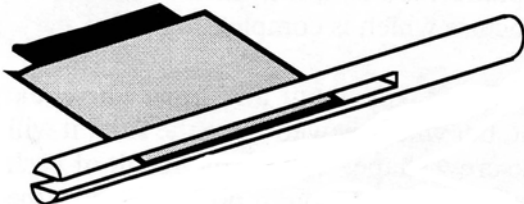
## Job 1. The sticker

Take a piece of masking tape which is slightly shorter than the side of the paper.

Stick the masking tape along the edge of the paper, half overlapping the paper, half hanging off.

Flip the paper over so the sticky side of the tape is facing up.

masking tape  
sticky side up



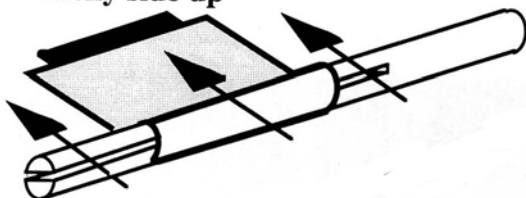
## Job 2. The roller

Slide the opposite edge of the paper into the tube roller. Line up the edge of the paper with the edge of the roller.

Grip the tube roller and roll it carefully across the paper while leaning on the table. The masking tape will automatically fasten the tube together.

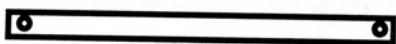
Slide the tube off the roller.

masking tape  
sticky side up



## Job 3. The hole puncher

Place the paper tube on the table and flatten the two ends using your finger. Use the hole punch to make a hole in each end.



## Job 4. The chief engineer

Join the tubes together using the nuts and bolts. Only cut the tubes to different lengths if you have a plan!



**Teamwork is essential for success**

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Harry Marsh 1994.