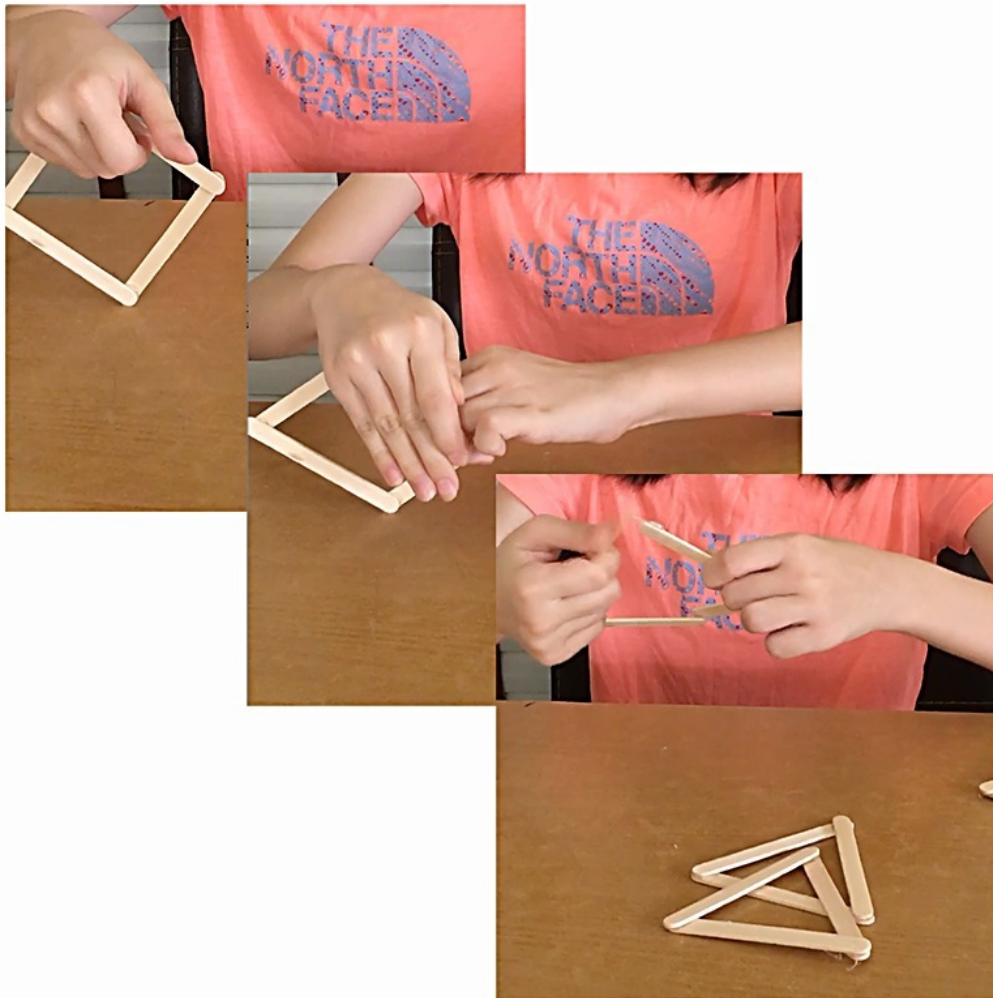


# A Timber Bridge

*Shannon and Ian Jacobs*

Modern bridges are works of art with soaring columns of steel reinforced concrete strung with kilometres of steel cable, but there was a time when bridges were made of heavy pit-sawn timber. How does one make a bridge extra strong with no modern materials? The answer is triangles.

To see why triangles are so useful we made squares and triangles with hot glue and popsicle sticks. Dad gave me two squares and two triangles and one minute to break them apart in my hands.



The squares could be dismantled quickly and easily by pushing them out of shape to wrench and weaken the glue but to my surprise the triangles couldn't be taken apart without breaking the sticks.

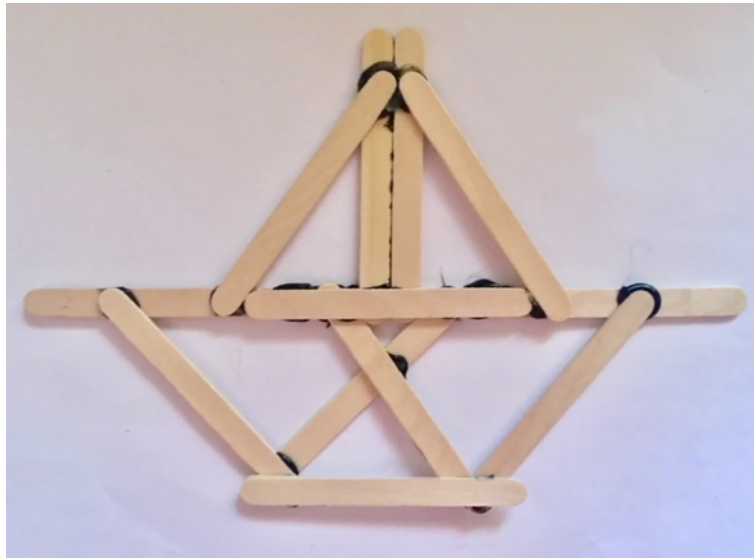
Given that: and the challenge we were given: to make a bridge with a hundred or so popsicle sticks that looks pretty, spans a 20 cm gap and holds five kilograms, we designed a bridge that looked a bit like the two examples below.



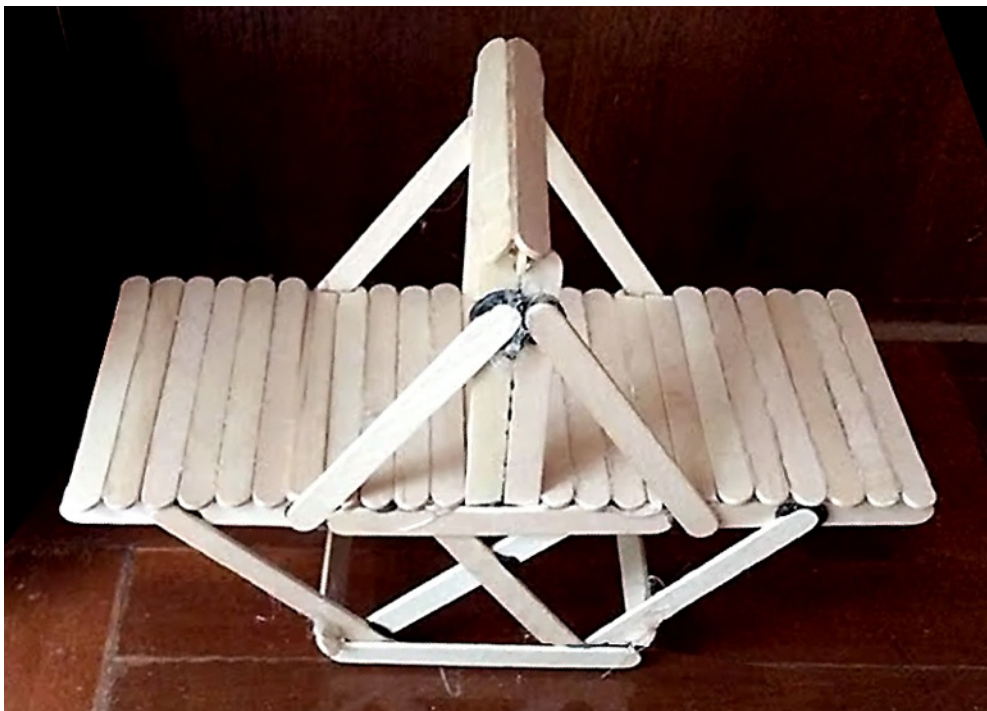
A thousand years of floods and the decay that comes with age has destroyed most ancient timber bridges. There are lots of repaired medieval stone bridges in Europe and some in Asia but few timber ones. We did find two images which provide clues.

Engineers built both these bridges with triangular bracing. The Firth of Fourth rail bridge (upper left) is in Scotland. It was built in 1882 with steel girders and has as more structure below the rail deck that above. The wooden bridge on the lower right looks authentic but it's probably a reconstruction of an ancient timber bridge with much bracing below the deck and no superstructure.

## Triangular bracing



The frame is made with 9 cm popsicle sticks. It has a laminated horizontal girder 22 cm in length with two triangles on top and four below. We made two of these: one on each side of the decking.



The deck is 8 cm wide and rests on the two girders. Cross ties have been added above and below to keep the side frames in line as weight is added to the deck.



## Extra bracing



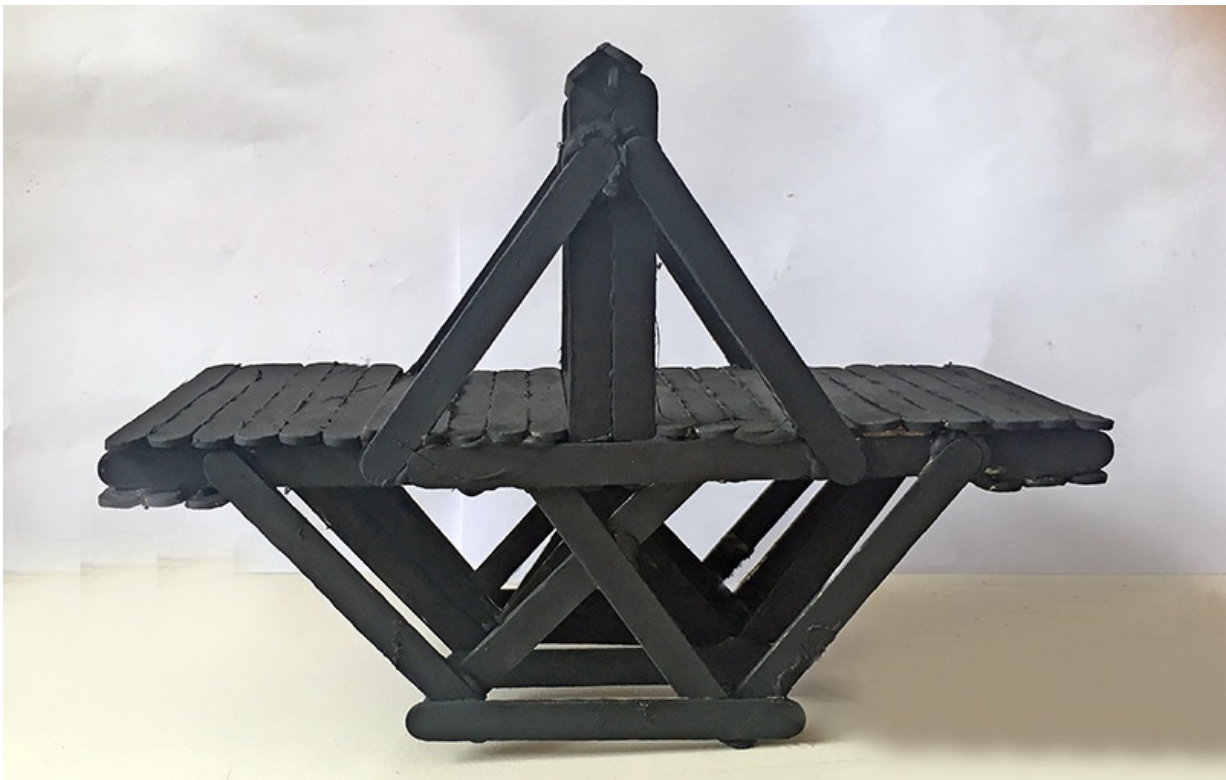
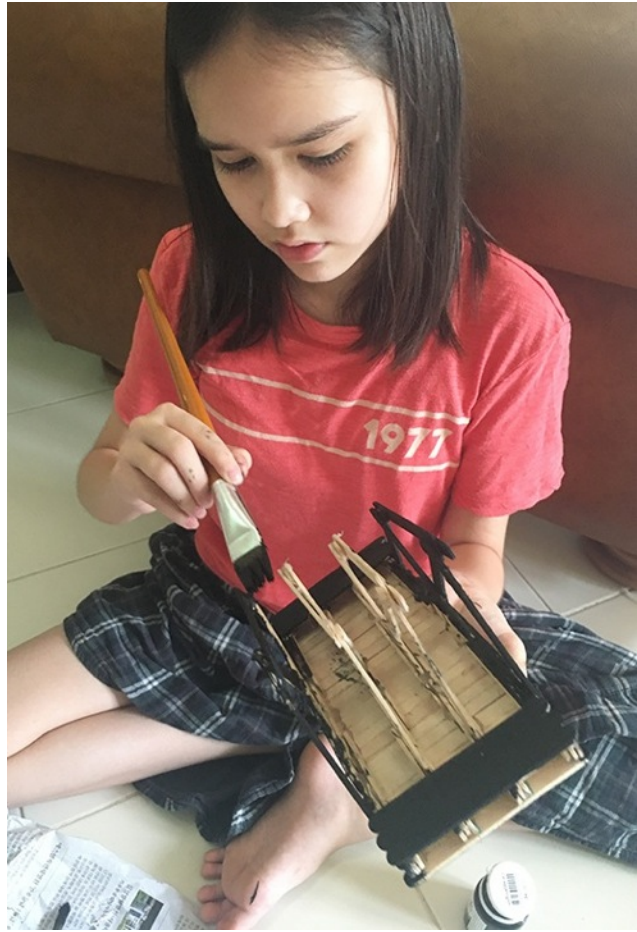
We made two additional frames on the same pattern to provide extra bracing.



The two new frames were fixed with hot glue to the decking and additional decking was added at both ends to provide a firm support at the sides of the 20 cm gap.

Medieval bridges were painted with tar to preserve the timbers and the joints strengthened with pitch. We painted our bridge black for that reason and to make it look more sinister. It is wide to allow battering rams on wheels, war elephants and three horses abreast to pass. We imagine this bridge to be on the road to the gates of Mordor at the end of the Third Age in Middle Earth.

The finished structure is below.





To decorate the bridge and make it pretty we asked a friend to design a banner. She came up with a magical theme that did not fit well on a flag so we added a panel above the deck with her banner, like the signs mounted over the main roads in the City of Bangkok.

A party of huge orcs in full battle dress pound over the bridge at right and the Knights of Rohan cross in more leisure fashion below.





## The strength test



The bridge was placed between two chairs. The pot of 100 gram stones had a measured mass of 5.4 kg. A bag was hung on the bridge as shown below and stones were added one at a time.



The bridge showed no visible bending with 5.4 kg hung on the deck.