Making Strong Structures

Introduction

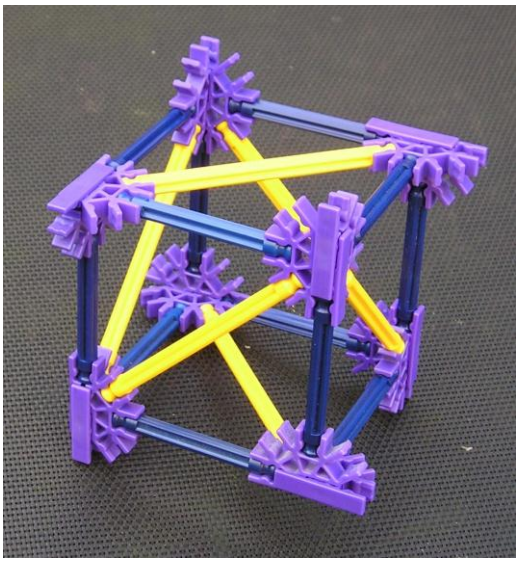
Occasionally when building K'Nex structures some extra strength is required. A simple two-dimensional example is adding a diagonal rod to two equal-sized rods which are at right angles, but what about three-dimensional structures?

What sized rods should be used for the optimum number of pieces/strength combination? Are some pieces stronger than others? Are some pieces particularly weak?

All these questions are answered here.

Building a Strong Cube

If you want to build a strong cube, or a structure which consists of adjoining strong cubes, it goes without saying that each face should have a diagonal rod. The cube is strongest if the diagonal rods on opposite faces are at right angles to each other.



The example on the right shows such a cube, but note that purple connectors have been used so that the nature of the joins can readily be seen. *In practice, the 3-D 4-way purple connectors are nowhere near as strong as the 3-D 7-way blue ones, and blue connectors would be used for large blocks of cubes.*

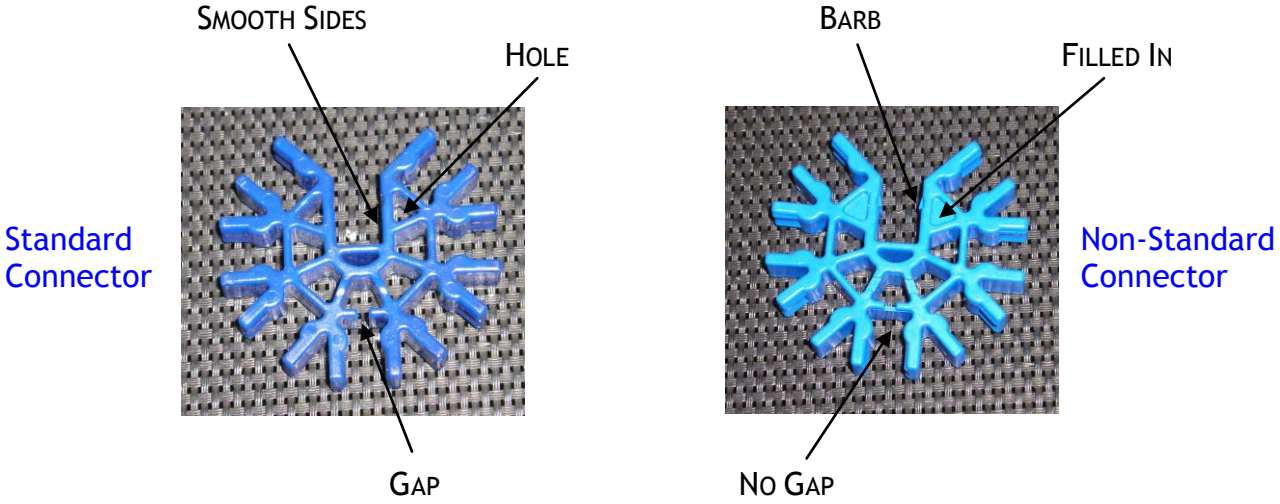
For a large structure consisting of contiguous cubes, using blue rods for the sides gives the highest strength in relation to the number of pieces used, and this is why so many large K'Nex structures are built this way.

Making Really Strong Connections

Ted's 9-year-old step-granddaughter spotted that some of his 3-D 7-way blue connectors had filled-in sections. "Oooh," said Ted, "You're right!"

Ted then spotted two more differences, and it dawned on him that he had some very special pieces — pieces that would make <u>incredibly strong</u> connections.

Have a look at these:



- An ordinary 3-D 7-way connector has smooth sides where another connector slides in, but the special connector has a barb on each side. When a standard connector is slid in to one of these, it is very difficult to separate the two connectors; when *two* special connectors are joined, you wouldn't believe the force required to separate them.
- The filled-in hole of the special connector slightly reduces its flexibility.
- The absence of the gap at the bottom of the special connector is another reason that it is so difficult to separate two connectors — the gap would normally become smaller while two connectors were separated.

Black Rods

A black 192mm rod is much stronger than a grey one — it's made of a different kind of plastic. It is ideal for axles or for holding a pulley, where flexing needs to be minimal.

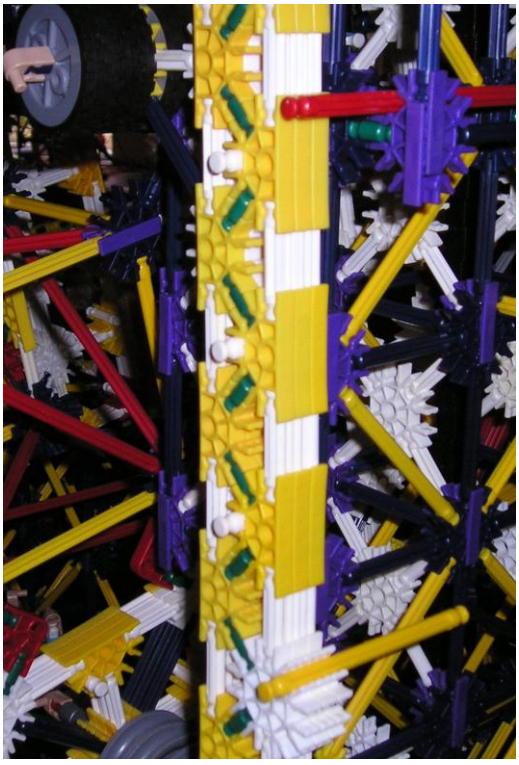
Other Pieces

An orange (or brown) 2-way connector is weak and should not be used if the rods attached to it are being pulled apart with any force.

If the rods do have a force on them, use an 8-way connector and insert a green rod either side of each rod — this will make the 8-way connector rigid, and a very strong force would be required to pull apart the main rods. This is illustrated on the next page.

Making Strong Levers

Some levers, like many of the ones used in Ted's fruit machine, need to be really strong. One way to achieve this is by giving it a thickness of three connectors and using white (33mm) rods to hold them together. Here's an example:



This is part of Ted's fruit machine. The lever down the middle of the picture is three connectors' thick, and the connectors are reinforced with white rods.

A rod like this can be made quite long and yet be difficult to bend or twist.

It is possible to make an even stronger rod, and this is shown on the next page.

Making Strong Structures

In the picture on the right you can see another part of Ted's fruit machine. This lever had to be very strong because it is pulled by the handle and raises a heavy weight which, when released, spins the three reels.

It is 5 connectors' thick, blue rods being used to hold them together. In addition, white rods are used diagonally to give the lever extra strength.

This is a really chunky lever.

Yet another part of Ted's fruit machine is shown here.

On the right you can see a red and black rod separated by an 8-way connector. This is used to pull the lever described above.

If the red and black rods were connected without the green rods, they would snap out of the connector fairly easily, because the connector's jaws would open up. By inserting the green rods, the jaws are much firmer because there is no longer any flexibility in them.