



More than a BOX

by Dave Armstrong

When the Wellington City Council held a competition for designing a new indoor sports centre, they wanted much more than a box. The building had to contain twelve indoor sports courts, including a netball court suitable for international matches. And it had to be something the people of Wellington could be proud of.

A challenging idea

The winning architects came up with a design based on a shell shape, or oval. While the architects were walking on a beach and discussing how the sports centre might look, one picked up a mussel shell. That shape became the idea for the centre. But creating a building with an unusual shape is a challenge for architects and structural engineers. (Structural engineers make sure that a new building is strong so that it won't collapse.)



Another big challenge for the architects and engineers was how to hold up the roof. They could use big pillars, but the building was going to be a sports centre. Imagine playing indoor soccer or basketball and having to dribble around a pillar every few metres! The architects and engineers had to come up with a design that had no columns or pillars in the way.

Their solution was to create two rows of columns in the centre of the building. Big steel trusses act like rafters. They connect the central columns to the single row of columns at each side.



The central columns and the trusses

These trusses hold up the roof, removing the need for any other columns. The distance between the side columns and central row of columns is the length of an indoor court.

Using models to help

Kids love building models, and so do most engineers! They create both real and computer models when they are designing a big structure like this sports centre. Each type of model is used to test a different design idea.

The engineers had to consider all the forces that might act on the sports centre. The mass of the building would push downwards on the foundations, and the mass of the roof would also push down on the trusses and columns. Hazards such as earthquakes and high winds might also push, pull, and twist the building. The models helped the engineers get an idea of what the building would look like and how it might behave in different conditions.

Wind is a big problem in Wellington. To test whether the structure would survive heavy wind, a model of the indoor sports centre was put in a wind tunnel. A wind tunnel creates the wind conditions of a very severe storm. A model of the building, exposed to the wind in the wind tunnel, lets the architects and engineers see which parts of the building are likely to be damaged in strong winds.

model of the indoor sports centre



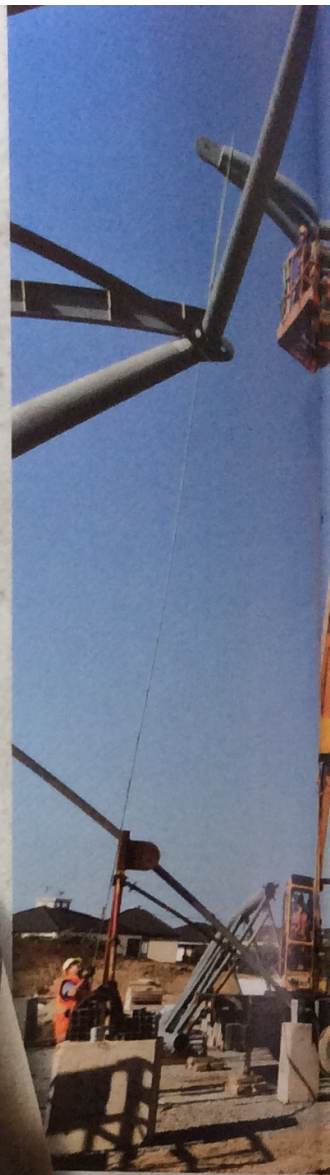


What about earthquakes?

In an earthquake, the ground moves up and down as well as sideways. Earthquakes can result in the ground moving incredibly quickly, often causing massive damage to buildings. The indoor sports centre is built on soft, reclaimed land (land that has been created by filling in an area that was once sea). This type of land can be very unstable. So the building was designed with large, deep, concrete foundations that would help to protect it during an earthquake. The foundations would also help to keep the building stable in a strong wind.

Building the skeleton

Once the concrete foundations were in place, the steel framework was put together. The framework is like the skeleton of the building, with the walls and the roof being the muscles and skin. Building the framework was like putting together a giant construction set. The columns, which were built away from the site, were brought in and set in concrete in the ground. Then each truss was brought to the site in two halves and welded together. Each truss has smaller diagonal steel rods between the upper and lower halves to make it stronger. The trusses were then lifted by a big crane and locked in with very strong bolts. It only took about thirty minutes to raise and “lock in” each truss.



Welding the trusses



Lifting the trusses



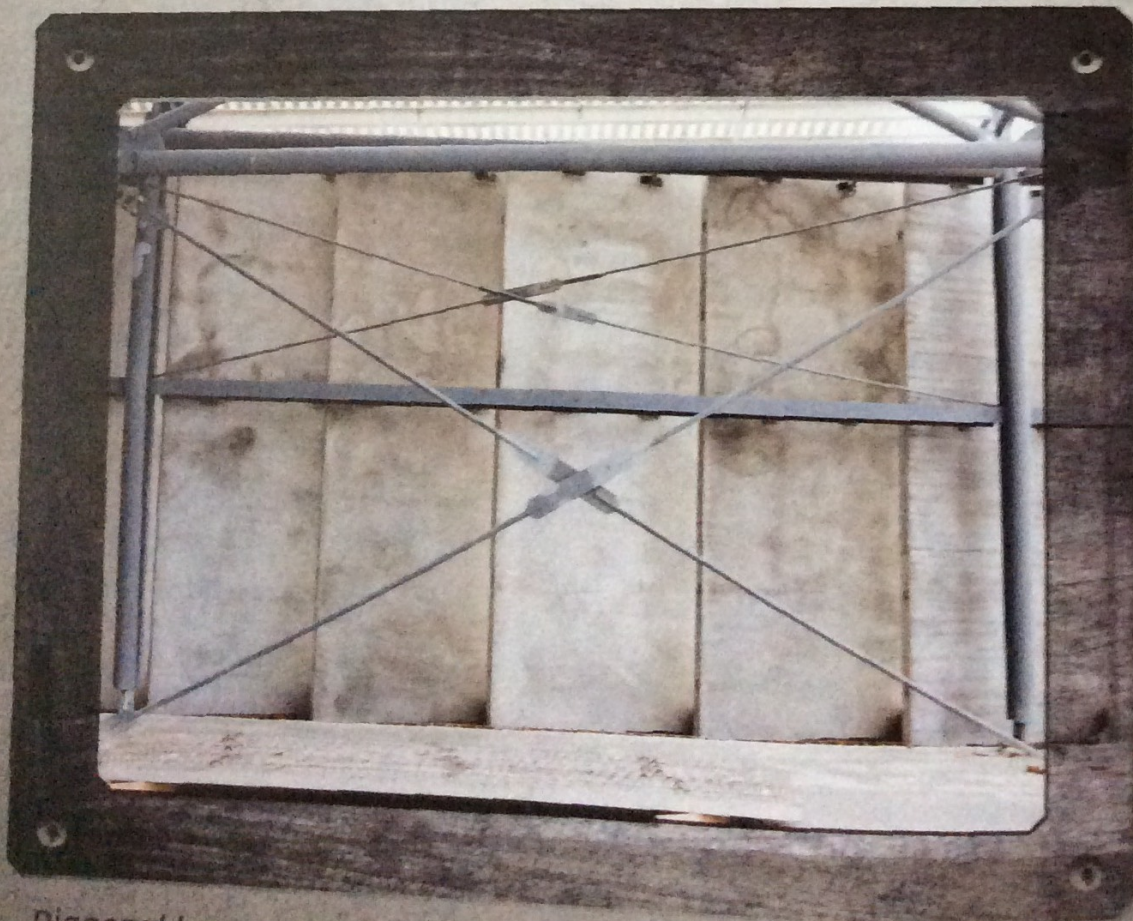
Locking in the trusses



Adding the walls and the roof

When the steelwork was complete, the concrete walls were put in place. Because the building is curved, the concrete panels are all slightly different lengths. (To make the panels, the rectangular box used to cast the concrete had a moveable side. This allowed the builders to change the size of the box as needed.) Diagonal metal rods called braces were placed across the concrete walls to help make the building stronger.

After the walls were built, the roof was attached. It is made of aluminium and steel. Aluminium is a good metal to use on a roof because it is light and strong. Using materials that have the right performance qualities is very important when structures are being built. Lightness and strength are performance qualities of aluminium.



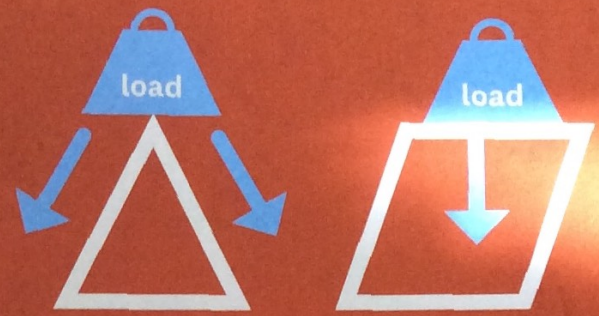
Diagonal braces add strength.



THE STRENGTH OF A TRIANGLE

Triangles are often used to strengthen a structure. This is because a triangle is the polygon that best keeps its shape under pressure. If you put a heavy load on a rectangle, for example, it will soon become a parallelogram.

But you can give a rectangle strength by adding a diagonal brace between two opposite vertices (corners) – and turning it into two triangles!



How many triangles can you find in the picture below?



A brand new sports centre

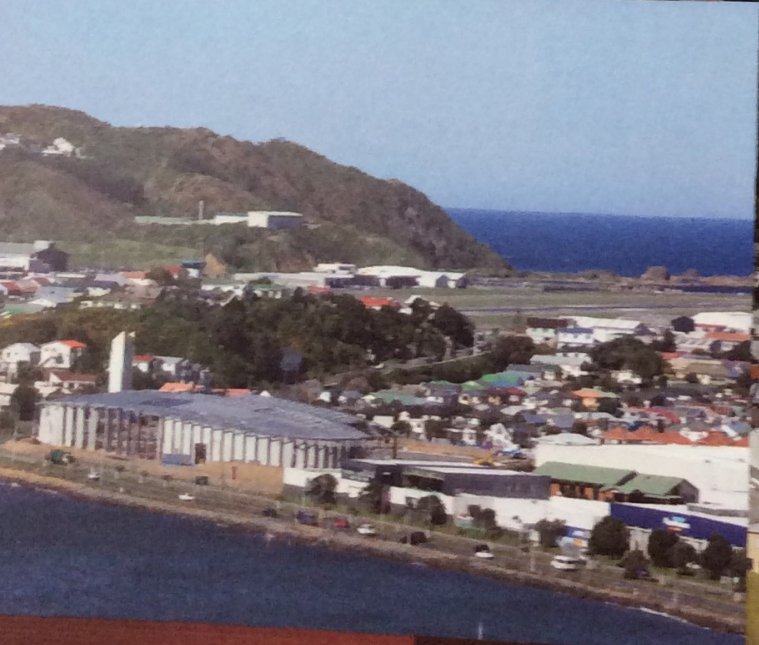
Thanks to a team of architects, engineers, and builders, Wellington has a brand new indoor sports centre. It can be used for a whole variety of sports, such as netball, volleyball, basketball, korfbal, and handball. With its shapely curves and unusual structure, it's definitely much more than a box. Wellington's outdoor stadium is nicknamed the Cake Tin. With its unique shape and structure, what nickname do you think people will give to this new indoor sports centre?



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May 2010



September 2010

Artist's rendering of the finished sports centre