The inflatable bridge

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The concrete dome, which is then cut on both ends, creating a bridge. Credit: Vienna University of Technology

A wildlife crossing over the upcoming Koralm railway is being built using a new construction technique developed by TU Wien. Traditional

support structures are replaced by an air cushion.

The shell construction methods which are usually used to build bridges and domes generally rely on expensive support structures. However, a team of engineers from TU Wien have now developed a new technique that is not only cheaper, but also makes more much efficient use of resources. Instead of using a support structure, an air cushion is inserted underneath the concrete and gradually inflated during the construction process.

The first major tests were carried out three years ago at a TU Wien test site, but now the new method has been used in a real-life project for the very first time by the Austrian Federal Railways (ÖBB-Infrastruktur AG). With the help of TU Wien, the Austrian railway network operator has successfully used the technique to build a wildlife crossing over a new section of track on the Koralm railway.

From panel to dome to bridge

The basic idea is simple: If you make regular incisions in a piece of orange peel, you can spread it flat on a table. The 'Pneumatic Forming of Hardened Concrete' technique developed by TU Wien applies precisely this principle but in reverse, starting with a flat sheet of concrete with wedge-shaped incisions and transforming it into a curved dome. An enormous plastic air cushion is placed underneath the concrete panel and then slowly inflated once the concrete has hardened. Hydraulic-tensioned steel cables ensure that the concrete retains the correct shape during this process.

It starts with a flat sheet of concrete. Credit: Vienna University of Technology

"It took around five hours to inflate the cushion and create an elongated concrete dome with an internal height of 7.60 m," says Benjamin Kromoser from the Institute of Structural Engineering at TU Wien, who developed the technique as part of his dissertation with Prof. Johann Kollegger and worked closely with ÖBB on the project. Each end of the concrete dome was then removed and archways installed to create a bridge. The new Koralm railway will run under the bridge and the outside of the concrete structure will be backfilled with earth so that animals can use the bridge to cross the railway safely.

Energy-saving, cost-effective and resource-efficient

The method offers some major advantages over traditional bridge building techniques. According to Benjamin Kromoser: "The process requires a little more concrete but 40% less steel." The TU Wien method is also more energy-efficient, reduces equivalent CO2 emissions by 40% and is significantly cheaper. "The costs are expected to fall even further once construction firms have gained more experience of using the new technique. We estimate that it could ultimately reduce costs by 15–30%," Kromoser explains.

It is many years since Prof. Johann Kollegger first developed the idea of constructing a concrete structure using continuous forming rather than support structures. Since then he and his team have worked hard to overcome each of the technical hurdles encountered on the road to developing a practical solution.

It is rare for an academic development to be put into practice in a real-life construction project in such a short period of time. "We're delighted that ÖBB had the courage to test out such an innovative idea. If the method is to become more widespread in future, it is essential to have a real-life prototype construction," explains Johann Kollegger. "We're especially pleased that our calculations about the resource efficiency of the technique proved accurate. Sometimes, you work through these ideas in an academic context, but when you actually put them into practice you find there are still lots of details that need improving. That's why it was so exciting for us to be involved with the project right through to completion," says Benjamin Kromoser.

The innovative wildlife crossing is located on the Carinthia section of the new Koralm railway, one of ÖBB-Infrastruktur AG's major infrastructure projects in southern Austria. Following the completion of the construction and terrain modelling work, the earthwork is now

continuing before the infrastructure for the high-speed electrified railway can be installed.

Provided by Vienna University of Technology

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