Bridges in Austria often exceed expectations

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Patrick Huber and Tobias Huber, performing experiments. Credit: Technische Universität Wien

Assessing old bridges using modern standards is no mean feat. Studies conducted by TU Wien show that many bridges are actually significantly more stable than might be expected, often rendering costly restoration work unnecessary.

Deciding which bridges need to be restored in the near future and which are still in good condition can have extremely expensive repercussions. Many of the prestressed concrete bridges in Central Europe were constructed in the 1950s and 60s – a time when bridge building technology and indeed the corresponding standards were very different. However, this doesn't necessarily mean that these bridges are unsafe.

At TU Wien, in-depth research has been conducted into the load-bearing capacity of prestressed concrete bridges on the basis of large-scale experiments and model calculations. The results of this work have shown that modern standards often grossly underestimate the load-bearing capacity of bridges, which are more robust than might be expected. This means that costly restoration work is completely unnecessary in many cases.

With these latest findings to be incorporated into new Austrian standards, Patrick Huber's dissertation on the load-bearing capacity of prestressed concrete bridges, written under the supervision of Prof. Johann Kollegger from the Institute of Structural Engineering at TU Wien, has now been recognised with an award by the International Federation for Structural Concrete (fib, Fédération internationale du béton).

Experiments for improved calculation models

"Standards have to cover a wide range of different load scenarios as well as being firmly on the safe side for all conceivable situations," explains Patrick Huber. "The standards themselves do also change over time, however. We have to bear in mind that the amount of traffic on the roads has increased and loads have become heavier. Plus, a number of experiments have furthered our understanding of load-bearing characteristics considerably. Unfortunately, the fact that there is still a dearth of experiments relating to prestressed concrete bridges means that

the load-bearing capacity of these structures can sometimes be hugely underestimated by the standards."

With this in mind, the TU Wien team decided to conduct some complex experiments. Prestressed concrete girders measuring 14 m in length and 75 cm in height were subjected to specific loads using hydraulic presses until large cracks formed and the test girders ultimately failed. Using the results of these experiments, Patrick Huber developed a calculation model that allows the load capacity of bridges to be assessed in a much more realistic way than before.

"The models used in the current standards are based on the assumption that the steel reinforcement in the concrete has to bear the entire load," says Tobias Huber, who is currently working together with Patrick Huber to progress with the research project. "But what we have seen is that the concrete itself still has a considerable load-bearing capacity, even after a crack has already formed." Once this property of the concrete has been factored in, the overall load-bearing capacity of the bridge is boosted by some margin. This finding will be key in deciding which bridges are to be reinforced in future.

Credit: Technische Universität Wien

The results of this research are already generating a great deal of interest in Austria, as the new calculation models have been used to decide against expensive reinforcement work on a bridge support structure on the Tauern motorway. This TU Wien research is also attracting attention on an international level, with Patrick Huber having been awarded the 'Achievement Award for Young Engineers' at the Fédération internationale du béton (fib) Symposium in Maastricht on 12 June 2017. An outstanding young researcher from the field of structural engineering is honoured with this prize only once every two years.

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