Resilience for aged bridges
An increasing number of steel bridges need to be replaced or repaired due to signs of fatigue. Researchers from Empa fortify the load-bearing elements with pre-stressed, fiber-reinforced plastic plates – a cost-effective alternative to building a new bridge. The recently patented method was now used on the 120-year-old Münchstein Bridge.
The cast-iron predecessor to today's Münchenstein Bridge collapsed in 1891 as a steam train was crossing it with ten wagons. 71 people lost their lives. Empa, which had just been founded a few years earlier, conducted the investigation into why the metal bridge constructed by Gustav Eiffel in 1875 came tumbling down after only 16 years. Empa’s first CEO, Ludwig von Tetmajer, discovered that Euler’s Column Formula, which had been used to calculate such structures thus far, needed correcting for compact girders (as used in Münchenstein).

The PUR system now provides bridge operators with a swift, cost-effective alternative to bridge replacements. Wear and tear can be reduced to such an extent that, in theory, fatigue can be deferred indefinitely. While project head Masoud Motavalli is more realistic when it comes to practice, he remains confident: “A bridge reinforced entirely using this method will certainly last for the next 50 years, by which time we’re bound to have devised new methods to repair ageing bridges.”

### Diagonal cracks and a flat PUR system
There are already two follow-up projects, one of which just got underway in Switzerland. It is backed by the Swiss National Science Foundation (SNSF), with EPF Lausanne as project partner. The aim is to examine diagonal and combined cracks with a view to improving our understanding of how we can prevent them from growing or even forming in the first place.

The second study recently began in Australia: the project headed by Xiao-Ling Zhao from Monash University and funded by the Australian Research Council focuses on the reinforcement of riveted metal bridges. The project partners are Swinbourne University, S&P Clever Reinforcement AG and VicRoads (the transport authority of the Australian State of Victoria). The aim is to develop a flat PUR system that can also be used on girders where there is not enough room for the patented trapezoid PUR system. At the end of the project, in 2017, Melbourne’s Chandler Bridge is to be reinforced with the new system developed by Empa.

### Fortifying old bridges with CFRP plates. How does it work?

First of all, the CFRP plates are clamped to both sides of the bridge with special brackets, then stressed with a special tool. Finally, two V-shaped brackets secure the plates and keep them stressed. If greater stresses are expected for the bridge later on, the system can be re-stressed by reapplying the tool and fitting larger V-wedges.

The system reduces wear and tear on bridges, which can extend their lifespan by 50 years and renders a quick rebuild redundant.

The Münchenstein Bridge: Empa’s faithful old friend

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