



bauma Innovation Award 2016: Final round for LEONHARD WEISS

New method for reinforcing steel bridges in need of repair

Germany's bridges are creaking under the load of the constantly increasing traffic volume. Built decades ago, their design means they are no longer fit to cope with today's passenger and heavy-duty traffic. In other words: conventional refurbishment is not sufficient in view of the damage caused. For this reason, there is a risk that thousands of bridges will need to be demolished and replaced at considerable expense. In collaboration with various state sector partners including the German federal government and the state of Baden-Württemberg, the construction company LEONHARD WEISS has now implemented a pioneering pilot project: reinforcement of a steel bridge with an orthotropic deck plate made of high-strength concrete (HSC) in Beimerstetten.

There are 39,000 bridges that provide rapid connections and direct transportation routes as part of Germany's main road network, much of which dates back to the 1970s or earlier. These bridges were designed to cope with a much lower volume of traffic: both the number of vehicles and the proportion of heavy-duty traffic have increased enormously since they were built. At least 6,000 bridges will no longer be able to stand up to this strain in the near future: initially it seemed as if there was no alternative but to demolish them and replace them with new ones.

A step forward into the future based on partnership

In their search for a more economical solution, the Federal Ministry of Transport and Digital Infrastructure (BMVI), the Baden-Württemberg Ministry of Transport and Infrastructure (MVI), the Federal Highway Research Institute (BAST), Karlsruhe Regional Council (RP Karlsruhe) and Tübingen Regional Council (RP Tübingen) have taken a major step forward into the future in collaboration with LEONHARD WEISS and CONTEC International. Together they have tested a method which uses the existing structure rather than replacing it with a new one: Undersized steel bridges are structurally reinforced using high-strength concrete so as to adapt them to the increased traffic load, thereby significantly extending their lifetime.

HSC is mainly used in the Netherlands to build new bridges but has now been discovered as an option for steel bridges with an orthotropic deck plate. On this basis, LEONHARD WEISS and its partners have developed an innovative and efficient method for applying this material to steel



bridge reinforcements, and this has now been put into practice for the first time.

Four stages to refurbishment

The pilot project focused on a steel bridge in need of reinforcement which is located in Beimerstetten near Ulm. The bridge's original structure consisted of an anti-corrosive orthotropic steel plate with steel girder underbeams and an asphalt covering. Up until now, all forces acting on the road surface have been passed on unimpeded to the plate, which was not designed to cope with today's loads. So the aim was to find a way of reinforcing the steel plate. The solution consists of a high-strength concrete layer applied to the plate – with a thickness of just 6 cm in the case of the Beimerstetten steel bridge.

Together with CONTEC International GmbH, who supplied the high-strength concrete, LEONHARD WEISS conducted numerous tests on the material and its processing before applying the method to the Beimerstetten bridge in four stages.

The first stage was to remove the existing road covering and then clean, inspect and repair the steel surface. This was followed by application of epoxy, which was then sprinkled with bauxite chippings. The chippings enable a permanent mechanical connection to be formed between the steel plate and the high-strength concrete applied later. Clamps were first installed along with a dense armouring grid at the precisely required height, and then the high-strength concrete was integrated.

Since high-strength concrete is also suitable for road surfaces, a final coating of asphalt was no longer required.

The final stage was to apply a wear-and-tear coating with sanding as the top road cover. Sensors were installed in the bridge so as to be able to continuously monitor and examine the finished project.

One year after project completion, additional measurements and a number of on-site inspections carried out by the Karlsruhe Institute of Technology confirm that the reinforced bridge is in perfect functioning order. The reinforcement measure has provided long-term stabilization for the bridge, ensuring it is capable of meeting future demands.

Fibre-reinforced concrete with a high level of pressure resistance

If the method used for the pilot project in Beimerstetten continues to prove effective, a solution will have been found for numerous orthotropic steel bridges in Germany. The application of HSC is not merely a tempo-



rary repair solution: this method strengthens the entire bridge structure and makes aged edifices fit for the future. This is due to the particular qualities of the concrete: its special formula with the addition of steel and plastic fibres gives it a very high level of pressure resistance.

While conventional reinforced steel composite structures consist of concrete parts which are 20 to 25 cm thick, a layer thickness of 6 cm is sufficient to reinforce the steel structure when high-strength concrete is used. This slim-line method of concreting therefore saves both weight and material. What is more, HSC is highly impermeable and free of cracks, so it protects the steel structure from damage caused by surface water which might otherwise penetrate the surface. It also makes an ideal road surface because its high stability effectively prevents the formation of track grooves and other distortions on the road.

Fast and efficient process

Other benefits lie in the speed and cost efficiency of the method. By ensuring damaged bridges are reinforced on a lasting basis, it is possible to avoid a huge amount of planning effort, saving both costs and time-consuming new construction phases. Above all, the entire reinforcement process can generally be carried out without blocking off traffic completely but keeping one side of the road open. Traffic can flow over the bridges during the construction phase, thereby largely avoiding complete closure and congestion.

Reinforcement rather than complete reconstruction, shorter construction periods and very limited traffic impairment for several thousand bridges – the success of this pilot project reflects the innovative strength and cost efficiency that LEONHARD WEISS and its partners have developed with the HSC method.

Text: ar/pp

Additional explanation of terms:

REFURBISHMENT:

Tends to apply to the trade crafts – the restoration of something that has been damaged (facade, balcony, window)

MAINTENANCE / PRESERVATION:

Here the aim is to preserve the value of a component. This means restoring the item to its original state, where there is no change in terms of the demands it is subjected to.



REINFORCEMENT:

The existing state is improved, as in the example of the bridge in Beimerstetten. The load-bearing capacity is increased as compared to the bridge's original state. Other examples include raising the height of railings on a building or improving noise protection.

Photos:



Reinforcing steel placed before HSC



Pouring and smoothing HSC



Surface treatment HSC with Epoxy Layer



About LEONHARD WEISS:

„Experience the joy of construction with LEONHARD WEISS“

LEONHARD WEISS was founded in 1900 as a pure railway track construction company. Out of these roots, a modern medium sized family business has emerged with now 4,166 employees. With the two headquarters Göppingen and Satteldorf and 18 branches LEONHARD WEISS is operating in nearly every aspect of construction. The corporate philosophy is largely based on partnership, adherence to schedules, creation of values and integrated construction solutions. An intensive, captive research work establishes the basis for groundbreaking technologies that operate economically and environmentally beneficial. LEONHARD WEISS operates in the multifaceted European market with three divisions: Road and network construction, rail infrastructure, engineering and turnkey construction. The service activities range from single services to integrated solutions from one provider, from small orders to demanding large-scale projects.

The development of young employees and continuous advanced training has a particular significance at LEONHARD WEISS as well as teamwork on site, quality assurance, leadership ability and efficiency. Numerous achievements of the apprentices on a regional and federal level confirm the sophisticated system and assure a solid basis of personnel in the future.

Your contact:

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