

## FA 4 The joys and frustrations of bridge construction

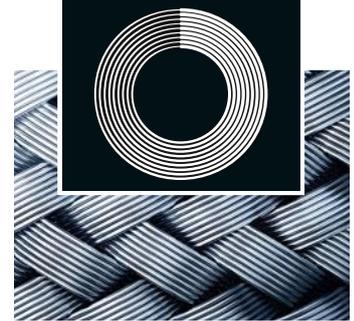
New bridges are needed everywhere! Germany's bridges have been getting a bit ancient recently and need to undergo major repairs or must even be replaced. Motorists are of course rather frustrated about so much congestion due to roadworks. However, bridges can also give a lot of pleasure, as numerous suspension bridges are being built in European countries and are giving a boost to the tourist industry. This is of course great news for wire and cable manufacturers, as it helps them increase their revenues.

In Germany, in particular, quite a few bridges are in rather a sorry state now. Both government and industry are alarmed at the current crisis and are worried about those dilapidated structures. "Traffic congestions are a daily pain in the neck for thousands of commuters," says Klaus Engel, chairman of the industry association Initiativkreis Ruhr and CEO of the chemical group Evonik Industries – a statement which genuinely reflects sentiments among motorists. Lanes are often closed on motorways, and heavy goods traffic is banned from entering rickety bridges. This is apparently also an obstacle to local development and is causing "considerable economic damage" to the region. Evonik's CEO therefore pleads that "traffic in the Ruhr area, the industrial heartland of Europe, must be allowed to roll on without hindrances." Engel gives two striking examples: "The dilapidated motorway bridges in Leverkusen and Duisburg illustrate how urgent it is to invest sustainably in the traffic infrastructure."

Dieter Rosenthal, board member of the machinery and plant manufacturers Siemag, adds: "We have problems taking our large components to their destinations. As more and more bridges are closed to heavy goods vehicles, we are forced to accept long detours for our 100-tonne components. This causes substantial delays in delivery, and yet our customers would expect the exact opposite from us."

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### **Action required**

The need for action is reflected in facts and figures. Germany's network of motorways and main roads currently includes some 39,000 bridges or approx. 51,000 parts of bridges, amounting to 30 million square metres in all. Of these 51,000 bridge sections in Germany's main road network "2,200 have been identified as high priority in terms of urgency and are very much in need of new surveys and, if necessary, reinforcement," according to the German Ministry of Traffic and Transport.

So there is a lot to do and invest, and this is also a challenge to wire and cable manufacturers who need to produce reliable, state-of-the-art products that will make Germany fit for the future. The Ministry has, in fact, set aside a considerable amount of money for this purpose. From the fiscal year 2015 onwards, measures are being taken to reinforce numerous bridges under a special government scheme and at a total cost of over EUR 5 billion. "Between 2015 and 2017," says the Ministry, "more than EUR 1 billion will be provided under this scheme for the modernisation of bridges."

### **Special scheme**

The federal state of North Rhine-Westphalia is suffering particularly hard. The Sauerland Route alone has 32 major bridges, of which many will need to be rebuilt.

Any money that is spent on constructing new bridges and on repairing existing ones under this special scheme is a good investment, as so many bridge cables are seriously in need of major repairs. Damage is particularly common in the coating. "Cables can easily corrode underneath the coating and may even break here and there," says Nicole de Witt, Bridge expert at North Rhine-Westphalia's road construction institution Strassen.NRW.

Practice has shown that "suspension cables can easily be replaced, but not usually the bearing cables of a suspension bridge," says de Witt. With cable-stayed bridges it is possible to replace individual parts. In individual cases cable sheaves on cable-stayed bridges have already had their load angles modified to increase corrosion resistance in the future. In such cases it always depends on the specific design.

## **Higher requirements**

Considerable demands are made on today's bridge cables. Fundamental requirements include the bearing capacity, a long life, testability and the design.

But the cables are not the only "sore points". There are numerous others, including parts which are subject to wear and tear, such as banisters, surfaces, copings, protection devices, bearings, expansion joints and corrosion protection. All of these "need to be repaired at least once, or even several times, and may even need to be replaced" whenever the need arises. Repairs focus, in particular, on damaged concrete, both on substructures and superstructures.

What kind of bridge type should be built as a replacement can often only be decided from case to case. It depends, for instance, on the traffic load and the location. Cable bridges such as suspension bridges and cable-stayed bridges are particularly in demand "in cases where considerable lengths are required", says bridge expert de Witt.

"It's certainly true to say that some designs are more risk-prone than others," she continues. "Nevertheless, every bridge needs to be considered separately."

## **Opening of Europe**

But why is there such a great need to rebuild and repair bridges? "All bridges," says de Witt, "are currently subject to increasing loads, a situation that will continue over the next few years, and this would have been impossible to predict when the bridges were first designed and built 50 years ago." It includes, for instance, the total permitted weight of a heavy goods vehicle and also the Fall of the Wall and thus the opening of Europe, which has led to more traffic on the roads. Also, there has been an increase in heavy duty transport.

The years after the Second World War cannot be compared with today. "There was a shortage of material, and it would have been impossible to go any further," says Witt. "Nowadays we can benefit from those experiences. Better materials and models are available, so that we can now build better bridges." The theoretical usage period of a bridge, incidentally, is assumed to be 70 to 100 years.

## **2,000 projects throughout Europe**

Take, for instance, the bridge across the Rhine at Leverkusen. Strassen.NRW reminds us that this 1960s bridge with its two lanes and hard shoulders was considered to be a pioneering infrastructural achievement at the time. Since then, however, it has been overtaken by the passage of time. Designed originally for 40,000 vehicles per day, it has now reached its limits, as it has to cope with over 120,000 each day. “It certainly won’t be strong enough for the growing traffic of the future, with 160,000 vehicles forecast for 2025 each day.” Bridge specialists have acknowledged since 2012 that this bridge has reached a critical point, with cracks in its support structure. The repair work of the Leverkusen Rhine Bridge has now started. Having removed the coating, the work has focused primarily on the welded joints in the eight cable enclosures. Ultimately, however, the bridge – now almost 50 years old – will be replaced by a new one.

However, Germany is not the only country with a bottleneck. The Rhine Bridge in Leverkusen is only one among approx. 2,000 projects throughout Europe that are classified as urgent, creating enough potential for major investments of approx. EUR 1.3 billion.

## **Suspension bridges as tourist attractions**

The transport and logistics of entire national economies depend on bridges. Yet not all bridges have been designed to take products to their destinations or to enable important services. Bridges are good tourism boosters, as they can be highly popular among visitors to an area. Over the last few years, there has been a general trend to put up numerous suspension bridges for pedestrians. These are very much in demand among tourists and often provide great views. They are particularly appreciated by hikers and ramblers.

Take, for instance, the Stubnerkogel Bridge – the highest suspension bridge and indeed one that causes quite a thrill among tourists. 140 m (459 ft.) in length and situated at a height of 2,300 metres (7,546 ft.) on Mt. Stubnerkogel in Bad Gastein, Austria, the bridge is accessible all through the year, offering stunning views of snow-clad mountains. It is the highest suspension bridge in Europe. As it is only a metre wide and tends to swing to and fro, anyone using it should be free from giddiness –

especially as adventure-seeking mountaineers are separated from the 28-metre abyss (92 ft.) by no more than a wire mesh fence. The walkway, too, allows a view of the world below. The amount of swinging is limited by support and wind cables.

### **Spanning a width of 340 metres (1,115 ft.)**

One suspension bridge that has established itself as a tourist attraction in Switzerland is the bridge across the Aletsch Glacier. It takes the visitor across the Massa Gorge and a valley to Belalp. The bridge has a support cable with a diameter of 40 mm. The minimum breaking load of the cable is 1,536 kN. Being 124 metres (407 ft.) long, the bridge alone weighs 8,080 kg and has a 1-metre walkway.

One of the longest suspension bridges – spanning 340 metres (1,115 ft.) – is the Sigriswill Panorama Bridge in Switzerland. It nicely compliments the panoramic walk around Lake Thunersee, adding good value to this region as a tourist destination. Erected 180 metres (591 ft.) above the ground, it has two support cables, each 65 mm in thickness. Their breaking strength is 2 x 420 tonnes, and the net weight of the cables is 80 kg per metre, totalling 27 tonnes,.

### **Longest suspension bridge north of the Alps**

An initiative is currently active up in Mörsdorf in Germany's Hunsrück area, with the aim of setting a new record. The plan is to build a suspension bridge on a hill, the Mückenberg, across a valley and a small river, the Mörsdorfer Bach, at a height of 100 metres (328 ft.). The bridge will be 360 metres (1,181 ft.) long, and once it is completed this autumn, will be the longest suspension bridge north of the Alps, making it a great tourist attraction. The initiators, an organisation called Hängeseilbrücke (Suspension Bridge), can provide suitable figures: "The bridge," says Mörsdorf's mayor, Marcus Kirchoff, "will create some 50,000 additional overnight stays in the region" – apparently an increase of about two per cent. "If we assume that the average tourist will spend EUR 40 on accommodation and breakfast, then this should generate an additional sales potential of some EUR 2 million in the hospitality industry." The total cost will be EUR 1 million, but the local Hunsrück initiative will receive 55 per cent of the net costs as additional sponsorship money for the project.

### **Six load-bearing cables**

The Mörsdorf-Sosberg Suspension Bridge will be erected as a non-reinforced structure, following the example of a so-called Nepalese suspension bridge. In all, it will be suspended from six load-bearing cables. Running in parallel with the load-bearing cables, there will also be parabolically suspended wind-load cables where the wind-cross cables of the bridge will be attached. This will serve to reduce any swinging movements of the structure as a whole. "This arrangement will give the bridge the necessary stability," says the mayor. The wind-load cables will be anchored firmly among the rocks, using flexible anchoring systems.

The support structure consists of two upper suspension cables, which also serve as handrails, and four lower suspension cables. Each of the steel cables is 40 mm in diameter.

Any structure that is exposed to extreme wind and weather, must of course be highly weather-proof. This is why all load-bearing steel cables will be executed as fully encapsulated cables and will have a hot-dip galvanised coating, providing corrosion protection under EN 1461.

### **Safety as a priority**

The highest priority in all planning is the safety of pedestrians. To provide fall protection, four horizontal steel cables, each with a diameter of 10 mm, will be mounted on both sides in parallel with the walkway, between the upper and lower support cables, between the cross frames. Outside the steel cables fall safety will be provided by a full-coverage wire mesh fence, 1.2 metres (4 ft.) in height. The upper support cables will serve as handrails. Also, pylons will be set up at both ends of the bridge. Their purpose will be to direct the deflection forces of the support cables towards the foundation.

The Mörsdorf (Hunsrück) region is very pleased with this new structure. And if everything runs as planned – as it has been so far – the bridge will be a major tourist attraction and generate a steep rise in local revenues. Thanks to numerous initiatives and helped by sponsorship money, many further suspension bridges will be built over the next few years. The wire and cable industry can therefore look forward to some lucrative profits.

### **Round of applause for the industry**

The industry can also expect to see revenues from bridges for cars and HGVs, as there will be an enormous need for repairs and new

construction over the coming years. Cable and wire suppliers can help to reduce the frustration of motorists with their products. There can be no question that the industry is moving full steam ahead – and that it is getting a good round of applause for its work.

The latest techniques and technologies from the cable and wire sector will feature prominently at this number-one event of the industry, wire Düsseldorf, which will be held at the Düsseldorf Exhibition Centre from 4 to 8 April 2016.

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