

e-mosty

ISSUE 02/2025

JUNE

GERMAN BRIDGES



MM1018 – THE LIQUID-SHIM[®] SECURES LONG-TERM INTEGRITY OF GERMANY'S HIGHEST STEEL RAILWAY BRIDGE

*Carsten Vogels, Key-Account Manager
DIAMANT Polymer GmbH*



Figure 1: The Müngsten Bridge is the highest steel railway bridge in Germany with a height of 107 m

1. INTRODUCTION

Historic bridge structures are not only engineering marvels but also vital components of transportation infrastructure, often exposed to extreme mechanical and environmental stress.

Their sustainable refurbishment demands the seamless integration of traditional engineering expertise with modern materials.

A prime example of such a fusion is the Müngsten Bridge - Germany's highest steel railway bridge. This structure has faced growing operational demands, necessitating a technically sophisticated refurbishment. A central challenge involved achieving a precise, load-bearing, and full-surface connection between newly designed bearings and reinforcement profiles and the over 100-year-old steel structure.

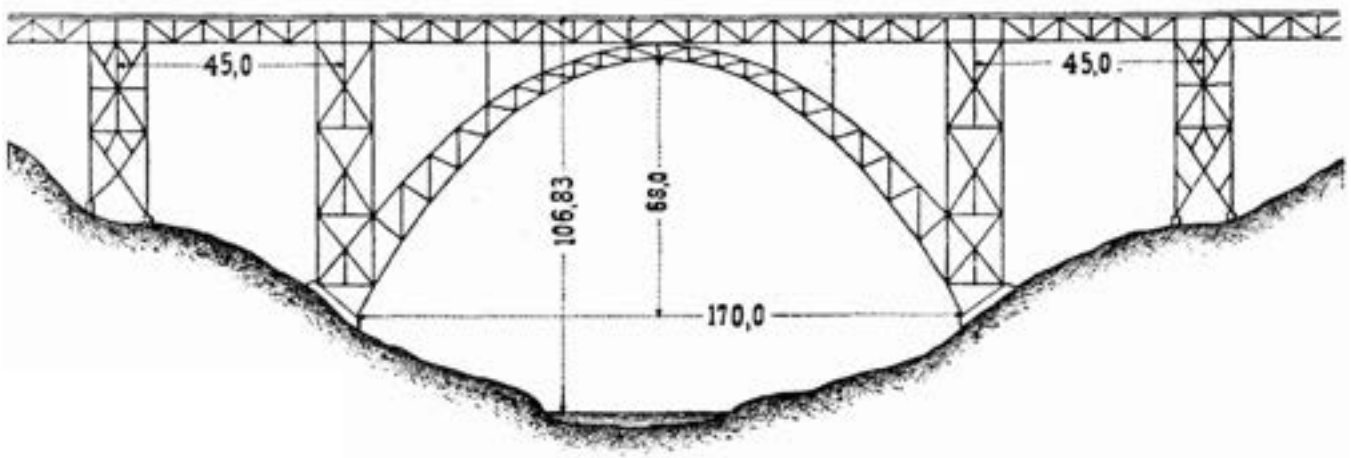


Figure 2: Sketch of the Müngsten Bridge with its dimensions

The use of MM1018, a metal polymer developed by DIAMANT Polymer, provided a safe and simple solution. This innovative material proved to be a critical enabler for the successful long-term rehabilitation of the bridge.

2. THE MÜNGSTEN BRIDGE: A CENTURY-OLD ICON OF GERMAN ENGINEERING

Opened on 15 July 1897, as the “Kaiser Wilhelm Bridge,” the Müngsten Bridge spans 465 m across the Wupper Valley between Solingen and Remscheid, rising 107 m above the ground. Composed of 4,978 tons of steel and joined by over 934,000 rivets, its structure includes six lattice piers and a central arch with a main span of 170 m.

This steel bridge has been an essential part of the Deutsche Bahn railway network for more than a century, reducing once the rail distance between the two cities from 44 to just 8 km - a milestone for regional development.

Preserving this landmark is of both logistical and cultural significance, as it is now a candidate for UNESCO World Heritage status.

In the course of its refurbishment, the bridge was completely refurbished for long-term use in route class CM2, whereby historical substance, structural safety and modern requirements had to be reconciled.

3. REFURBISHMENT REQUIREMENTS AFTER MORE THAN 100 YEARS OF USAGE

After more than 113 years of continuous use by trains and environmental exposure, a 2010 structural inspection revealed fatigue-related damage and increased structural deterioration.

Corrosion, stress-related wear, and material fatigue particularly affected critical components such as gusset plates and the original roller bearings, which required complete replacement.

The gusset plates connect load-bearing steel girders and are essential for the supporting structure. Their partial corrosive and structural weakening posed a long-term threat to operational safety.

Furthermore, all 28 original roller bearings and the 126 deck bearings mounted on gusset plates needed replacement.

The replacement of these bearings posed a particular challenge, as they had to be precisely adapted to the partially distorted and corroded historical structures of the gusset plates, which had been subjected to decades of stress, and required a force- and form-fit connection to the existing structure.

**THE SOLUTION: MM1018 – THE LIQUID-SHIM®
AS FLEXIBLE GAP COMPENSATION**

To guarantee operational safety, the rigid and seamless connection of the new bearings to both the upper and lower bridge structure was an essential prerequisite for the operational safety of the Müngsten Bridge.

A complete, full-surface and form-fit gap compensation was essential for even load transmission - an extremely demanding requirement given the state of the historical components.

Considering these findings, the MM1018 metal polymer was identified as the optimal solution.

The composite material, which contains metallic fillers, was specially engineered for structural gap compensation in steel and bridge construction.

It is the only product of its kind with official German building authority approval for such applications.

MM1018 can be applied directly on site - whether injected in liquid form or applied as a putty version - allowing it to fully adapt to irregular geometries while ensuring durable and stable connections between structural elements.

Its outstanding compressive strength, creep resistance, and chemical durability make it a superior alternative to conventional shims, lining and wedge plate - particularly for heritage structures with individually shaped geometries.

Unlike mechanically machined plates, MM1018 does not require prefabrication and conforms precisely to the actual surface geometry - without the need for extensive rework.



Figure 3: The refurbishment work began in 2013

MM1018 IN ACTION: APPLICATION ON THE MÜNGSTEN BRIDGE

A major advantage of the metal polymer MM1018 during the Müngsten Bridge refurbishment was its versatile application: the material could be processed both as a paste and as a liquid, allowing it to be optimally adapted to the structural requirements.

For the gusset plate connections to the supporting structure and for gap compensation when installing a total of 28 new roller bearings, the liquid variant of MM1018 was used.

Thanks to its superior flow behaviour, the material could be injected into the cavity through designated injection points, displacing air through ventilation ports to ensure complete, void-free gap filling. The result was a full-surface and force-fit connection across the entire contact area.

In contrast, the putty variant of the metal polymer was used to connect the base plates of the 126 new deck bearings to the gusset plates.

Applied with a trowel onto the contact area, the paste provided precise gap compensation, even on uneven or inclined surfaces.

Both variants cure within 24 hours, are resistant to chemicals, non-conductive and corrosion-resistant.

The time component also posed a considerable challenge during the renovation of the Müngsten Bridge. The replacement of all roller bearings had to be completed within a tight 21-day window - an enormous logistical challenge.

Without the rapid and efficient application of MM1018, this ambitious schedule would have been almost impossible to meet.

The smooth processing on site, the high material safety and the immediate load-bearing capacity after curing made the material a real success factor in this historic refurbishing project.

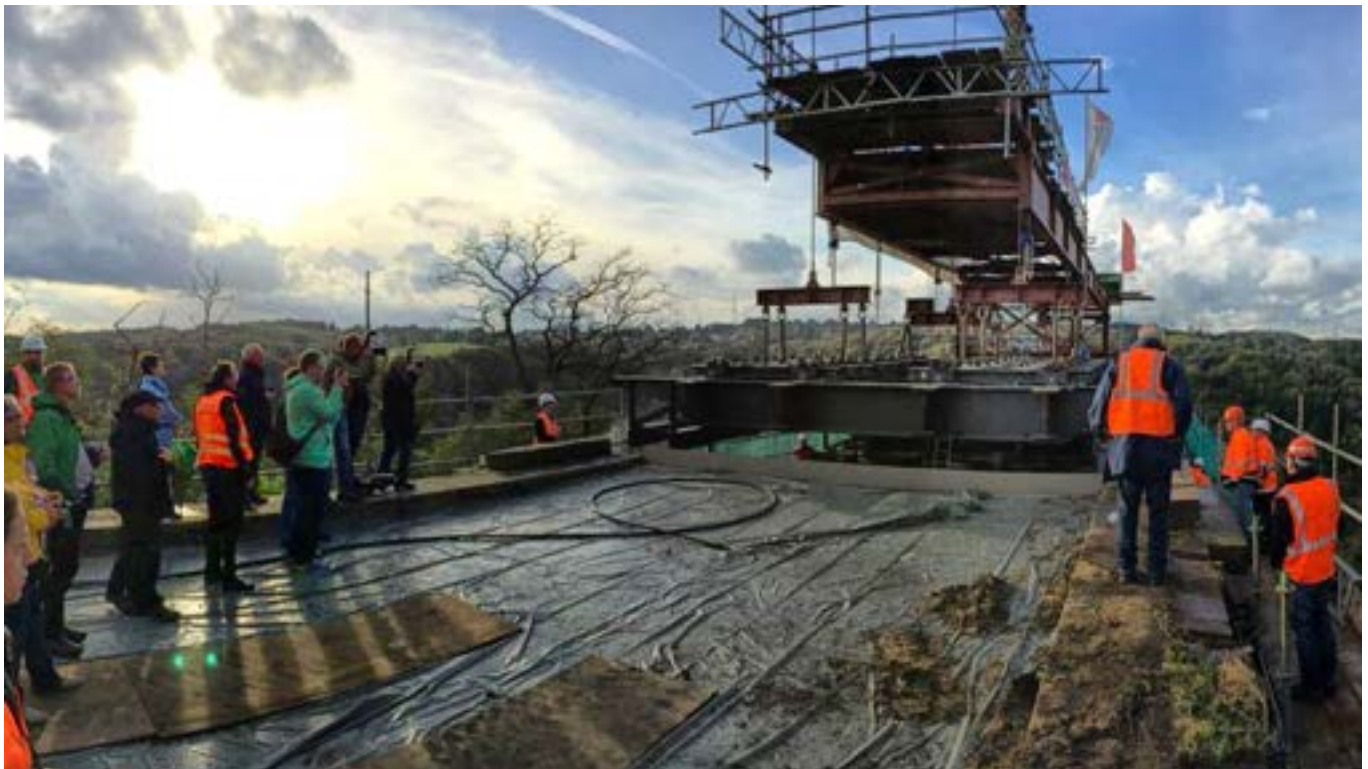


Figure 4: MM1018 was used for the connection and installation of newly designed bearings and reinforcement profiles

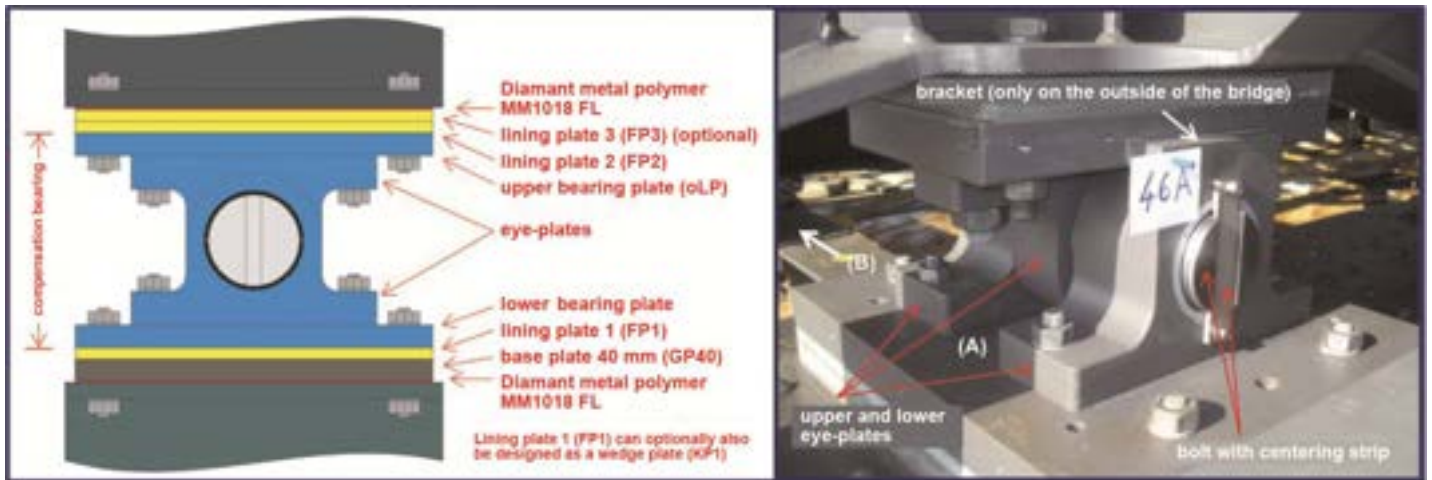


Figure 5: Schematic diagram of a typical connection of the newly designed compensation bearing [1]

4. TECHNICAL EXCURSION: ENGINEERING A NEW BEARING TYPE

The Müngsten Bridge refurbishment required not just replacing existing bearings but developing an entirely new compensation bearing type tailored to the bridge's unique load and movement dynamics.

Due to the complex movement and load conditions, particularly the cyclical forces from railroad operations, conventional elastomer or spherical bearings were out of the question.

Instead, a new type of compensation bearing was developed that was able to meet the high requirements, even in view of the limited space available, while at the same time ensuring the necessary mobility and absorption of tensile forces [1].

A crucial prerequisite for this design's success was a precise and even connection between bearing components and the irregular mounting surfaces of the bridge.

Again, MM1018 played a vital role by enabling complete flatness and inclination compensation. Figure 5 schematically highlights the typical installation process of this custom bearing system.

5. CONCLUSION: MM1018 AS A KEY MATERIAL IN BRIDGE CONSTRUCTION

The use of MM1018 in the refurbishment of the Müngsten Bridge impressively demonstrates the advantages of innovative polymer composite materials in traditional steel construction, especially in the refurbishment of historic engineering structures.

Its ability to deliver full-surface, load-transferring and form-fitting gap compensation - even in complex irregular gap geometries - ensures long-term structural integrity. Combined with its ease of handling, rapid curing time, and resistance to environmental stressors, MM1018 offers clear time and cost advantages over conventional solutions and makes it a key material for bridge renovations where absolute precision is required.

This case of the Müngsten Bridge exemplifies how traditional engineering expertise and modern materials engineering can work hand-in-hand to create future-proof solutions even for historic structures.

[1] Bewersdorff, S., Kina, J., Liebelt, M., Porsch, M., & Schackenberg, R. (2019). Entwicklung eines neuen Lagertyps für den Eisenbahnbrückenbau. *Stahlbau*, 88(2), 105-127



To provide you with the best service possible, our team is ready to apply our products directly on site. Just like we successfully did for projects like the Chenab Bridge (India) and the Yavuz-Sultan-Selim Bridge (Turkey).

100% GAP AND TOLERANCE COMPENSATION

WITH MM1018 – THE LIQUID SHIM



In a single step. Without mechanical processing. More quickly and less expensive than conventional lining plates or wedge plates.

Introducing our globally trusted solution **MM1018** for [gap and tolerance compensation](#) in bridge construction! Applied in countless construction sites worldwide, our innovative product ensures unparalleled structural integrity and safety for your bridges. Save time and money with our advanced technology, allowing for precise fitting and alignment of bridge components in a single step, without costly delays. Join our satisfied customers and experience the proven effectiveness of our **MM1018**.



Advice & sales:

www.diamant-polymer.de/en

info@diamant-polymer.de

or call **+49 2166-98360**



DIAMANT
POLYMER SOLUTIONS