

Prestressed

Granite Bridges

Slender structural elements made of Prestressed Granite



Nature in Tirschenreuth 2013 Garden Festival

geskes.hack Landschaftsarchitekten bdla

Length of bridge: 7.9 m (25' 11")

Slab thickness: 15 cm (5 7/8")

2011



The nearly 8 m (26 ft) long and 15 cm (5 7/8") thick prestressed granite bridge over the millstream leads to the grounds of the *Nature in Tirschenreuth 2013* Garden Festival.



Bridge over a stream in Löbau

ibe Ingenieurbüro Edelmann
Length of bridge: 11.5 m (37' 9")
Slab thickness: 26 cm (10 1/4")
2012



Prestressed granite bridges are prefabricated at the factory and tested according to their designed load capacity. They can be installed at the construction site in just a few hours.



Ruhrvorland urban district in Herdecke

brandenfels landscape + environment

Length of bridge: 16 m and 12 m (52' 6" and 39' 4 1/2")

Slab thickness: 38 cm and 26 cm (14 15/16" and 10 1/4")

2014



The transition between the city, river, and wetlands defines the character of the new Ruhrvorland Herdecke urban district, about 10 ha in size. Low-maintenance, near-natural meadows provide a counterweight to the intensive designs of the recreational areas and public walkways. For improved safety, the high-traffic Ruhrtal bicycle path was separated from the pedestrian path when the Ruhr wetlands were reconfigured. The two paths cross the Herdecker stream on separate prestressed granite bridges.



Heavy traffic bridge in Cochem

Cochem municipal administration

Length of bridge: 9.4 m (30' 10")

Slab thickness: 40 cm (15 3/4")

2011



In order to withstand the load of heavy traffic, the 40 cm (15 3/4") thick granite bridge is prestressed to 1000 tonnes. It can bear loads of 30 tonnes, although the weight of the bridge itself is only about 40 tonnes.

The prestressed granite bridge is part of the Mosel bicycle path between Trier and Koblenz.



Townhouse in Chicago, IL, USA

Linnig Architecture

Length of bridge: 5.5 m (18' 1/2") and 4 m (13' 1 1/2") m

Slab thickness: 17 cm (6 11/16")

2011



When a well-preserved townhouse, built in Chicago around 1886, was renovated, the garage was reconstructed and a new story added to gain an additional "open-air room" that is connected to the building via a prestressed granite bridge. The second prestressed granite slab was installed as a balcony.



Town Centre Gardens in Stevenage, Hertfordshire, UK

HTA Landscape Design, London
Length of bridge: 14.35 m (47' 1")
Slab thickness: 28 cm (11")
2010



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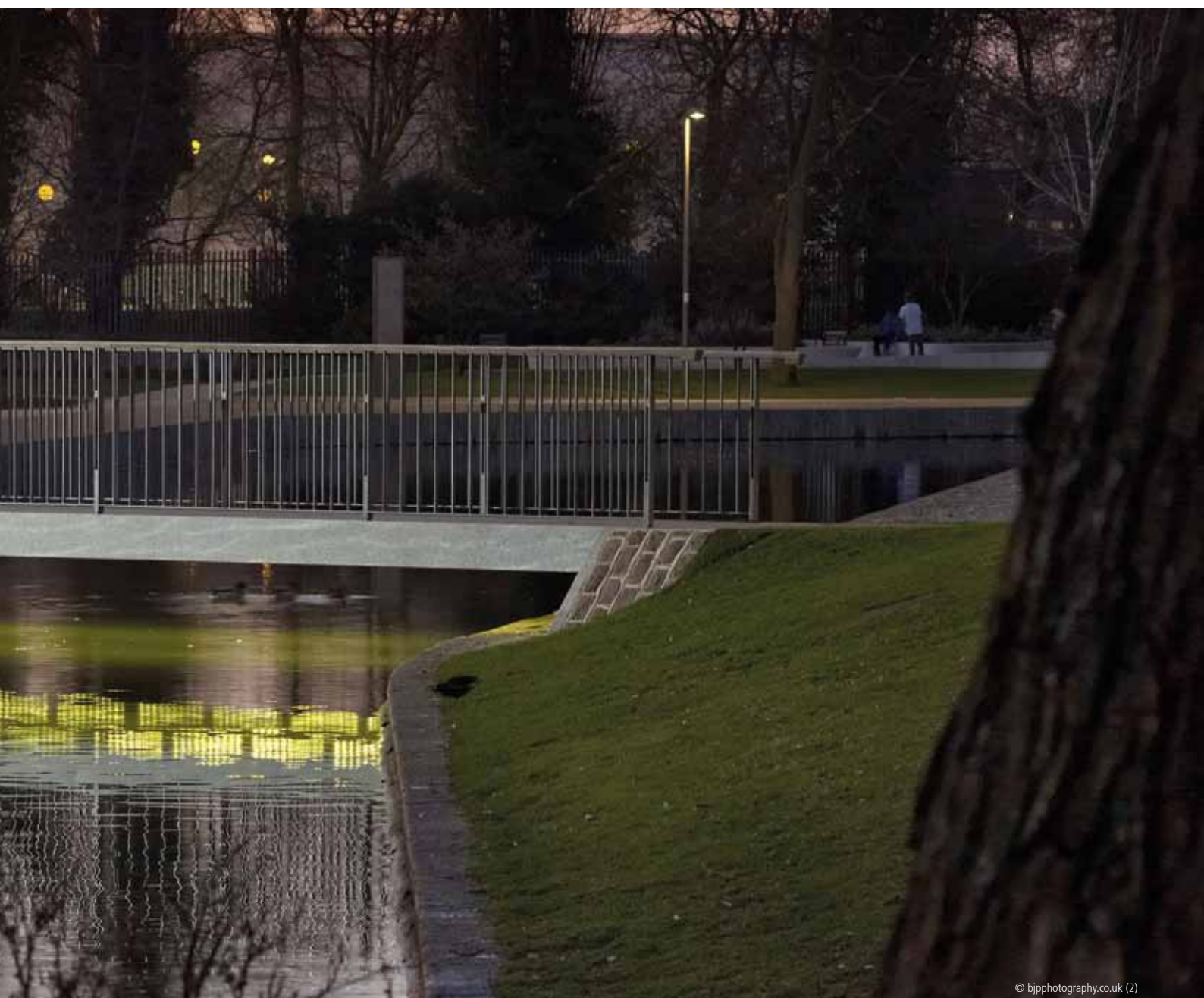
The first prestressed granite bridge in England was built as part of the restoration and reconfiguration of the four-hectare Town Centre Gardens, located in Stevenage, about 40 km north of London. The project also plays a pioneering role, as it is the first modernist, New Town landscape to receive subsidies from the Heritage Lottery Fund. In 2011, it received the *Landscape Award* in the category of *Heritage and Conservation*.



“The Stevenage Town Centre Gardens has been an exciting and fulfilling scheme to work on and we are proud of the two UK firsts that have been achieved as well as the recognition of heritage status for this modernism landscape. New Towns are coming of age and the Gardens are a significant asset that deserves to be looked after; they are the Capability Brown landscapes of the future.”

James Lord, partner and director of HTA Landscape Design, London





© bjpphotography.co.uk (2)

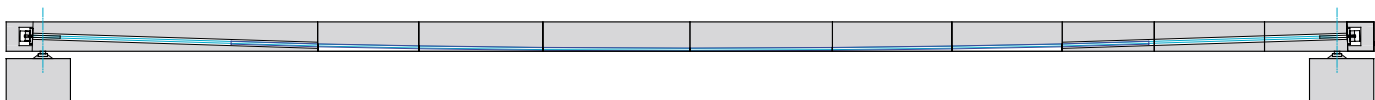
Construction principle

Prestressed granite bridges

Granite

Density	2.66 to/ m ³ (166 lb/ ft ³)	Granite is about as light as aluminum and one-third the weight of steel.
Compressive strength	203 N/ mm ² (29,443 psi)	Granite has many times the compressive strength of C35/45 concrete.
Compressive strength per 56F-T-W with 2% NaCl	217 N/ mm ² (31,473 psi)	Granite is very resistant to frost and corrosion.
Flexural strength	17.5 N/ mm ² (2,538 psi)	The flexural strength of granite is many times greater than that of concrete.

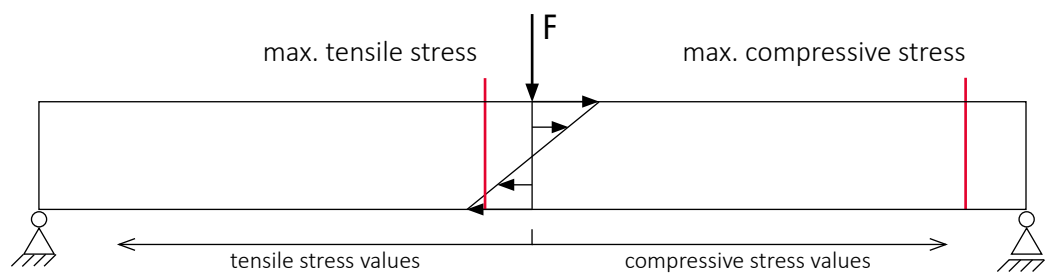
When granite is prestressed, steel strands are fed into holes or grooves that run through the element along its length and tensioned with a force to meet the expected design load in order to compress the component. To protect against corrosion, grease-injected plastic tubes surround the prestressing tendons, which are also protected against UV radiation and mechanical effects by a sturdy PE tube. The dense microstructure of the granite, in addition to the two PE sheathings and the grease injection, provides a fourth layer of safety that protects the tendons against corrosion. Unlike concrete, Tittling Fine Grain, the light grey, fine-grained granite that is used to make the prestressed bridges, does not shrink or creep. Therefore even after decades it does not form cracks where water could penetrate into the prestressed granite bridge. It is quarried by Kusser in the Bavarian forest and processed in their factory. All bridges are individually designed and meet stringent criteria for serviceability and load-bearing capacity. The structural design method required was developed in cooperation with the engineering office of Zilch + Müller and the Institute for Materials and Construction (Chair of Concrete and Masonry Structures, Munich Technical University).



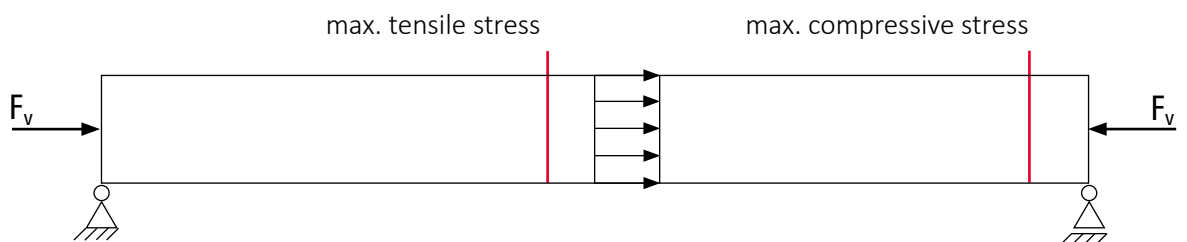
Longitudinal section

Stress distribution in a granite slab supported at both ends

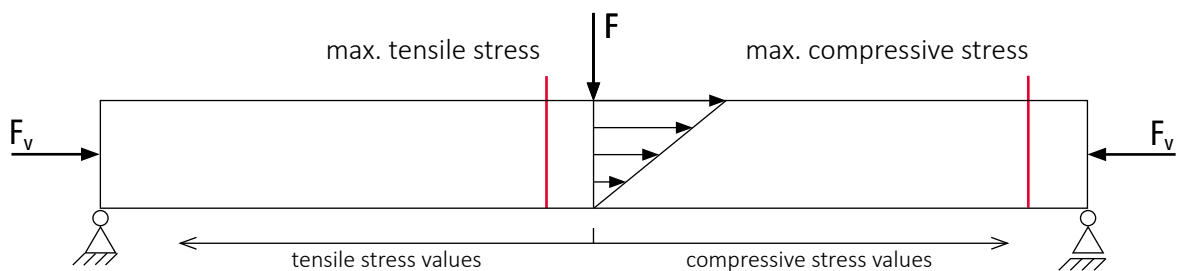
1 Granite slab with centric load.
Component failure.



2 Prestressed granite slab, no load.



3 Prestressed granite slab with centric load



When a load is applied to the center of a granite slab (1), the component breaks as soon as the maximum tensile stress is reached. The high potential compressive stress remains unused. Centric prestressing (2) builds up compressive stress across the entire section. The slender component can withstand very high loads without reaching maximum tensile stress (3).

Mombach bridge in Stuttgart

Capital city of Stuttgart, Office of Public Works

Length of bridge: 9 m (29' 6 3/8")

Slab thickness: 19 cm (7 1/2")

2010



© Landeshauptstadt Stuttgart, Tiefbauamt

Tittling Fine Grain has a very high compressive strength, many times that of C35/45 concrete, making it very well suited for prestressing. It is so resistant to de-icing salt, weathering, and wear that it does not require any corrosion protection. A prestressed granite bridge is therefore very slender not only because it is prestressed, but also because the additional height of a surface course is eliminated. The sandblasted granite provides good surface texture and is suitable for pedestrians, bicyclists, and vehicles.

Pedestrian bridge in Augsburg

City of Augsburg, Office of Public Works

Length of bridge: 6 m (19' 8")

Slab thickness: 15 cm (5 7/8")

2010



Kai Dölzer

Bridge over the Lindach in Jesingen, Kirchheim u. Teck

Eurich · Gula Landschaftsarchitektur

Length of bridge: 15 m (49' 2 1/2")

Slab thickness: 35 cm (13 3/4")

2011





As part of the renovation of the town center of Jesingen, the traffic zones of the L 1200 state road were significantly reduced in order to improve the residential environment. Also the retaining walls and nearly 90 m (295') long culverts on the banks of the Lindach were removed as much as possible. A newly laid riverside path and landscape staircases now open up the expanded and naturally designed river space, which is a public recreation area that pushes the previously dominant state road into the background. Because the cross sectional area of the waterway was increased when the river landscape was redesigned, slowing down the flow of water, the flooding situation in downstream municipalities has also been improved. The 15 m long pedestrian bridge made of prestressed granite won over the client not only for esthetic reasons, but also due to its good price-to-performance ratio. It provides both a necessary means for crossing the river, and views of the newly designed natural space of the Lindach.

The project was recognized by the architectural chamber of Baden-Württemberg as "Exemplary construction in the district of Esslingen 2006-2012".

Expansion of a bridge in Neuhausen a. d. Fildern

Cheret Bozic Architekten, Stuttgart

Length of bridge: 7.9 m (25' 11")

Slab thickness: 20 cm (7 7/8")

2010



The Nepomuk bridge in Neuhausen auf den Fildern is no wider than a two-lane road, and is bordered on both sides by massive natural stone parapets. A prestressed granite bridge was therefore erected for the new walking path, directly adjacent to the historical arch bridge. Due to its slender design and glass railing, it blocks as little as possible the view of the protected historical natural stone bridge.



Bridge on the Ennepebogen in Gevelsberg

rha- reicher haase assoziierte gmbh, Planungsgruppe Scheller, Niederkrüchten (execution)

Length of bridge: 19.4 m (63' 8")

Slab thickness: 45 cm (17 3/4")

2010



Prestressed granite bridges up to about 20 m (66') in length provide a comprehensive solution that is ready to be handed off, including structural analysis, production, and assembly.

In 2010, as part of the "Stadtumbau West" urban renovation project, a 19.4 m (63' 8") long prestressed granite bridge was built in order to connect the city center of Gevelsberg directly to the new Ennepe Park. The design of the bridge was to be light and slim, without additional structural features, in order to reinforce the existing scale of the Ennepe Park. At the same time, the bridge had to meet the requirements of the civic client with respect to cost and sustainability (maintenance, service, durability).

In 2014 the project "Ennepebogen in Gevelsberg" was awarded the prize in the category of "Centers" by the urban construction subsidy program "10 Years of Urban Renovation in NRW".



Patrick Kirschhofer (2)

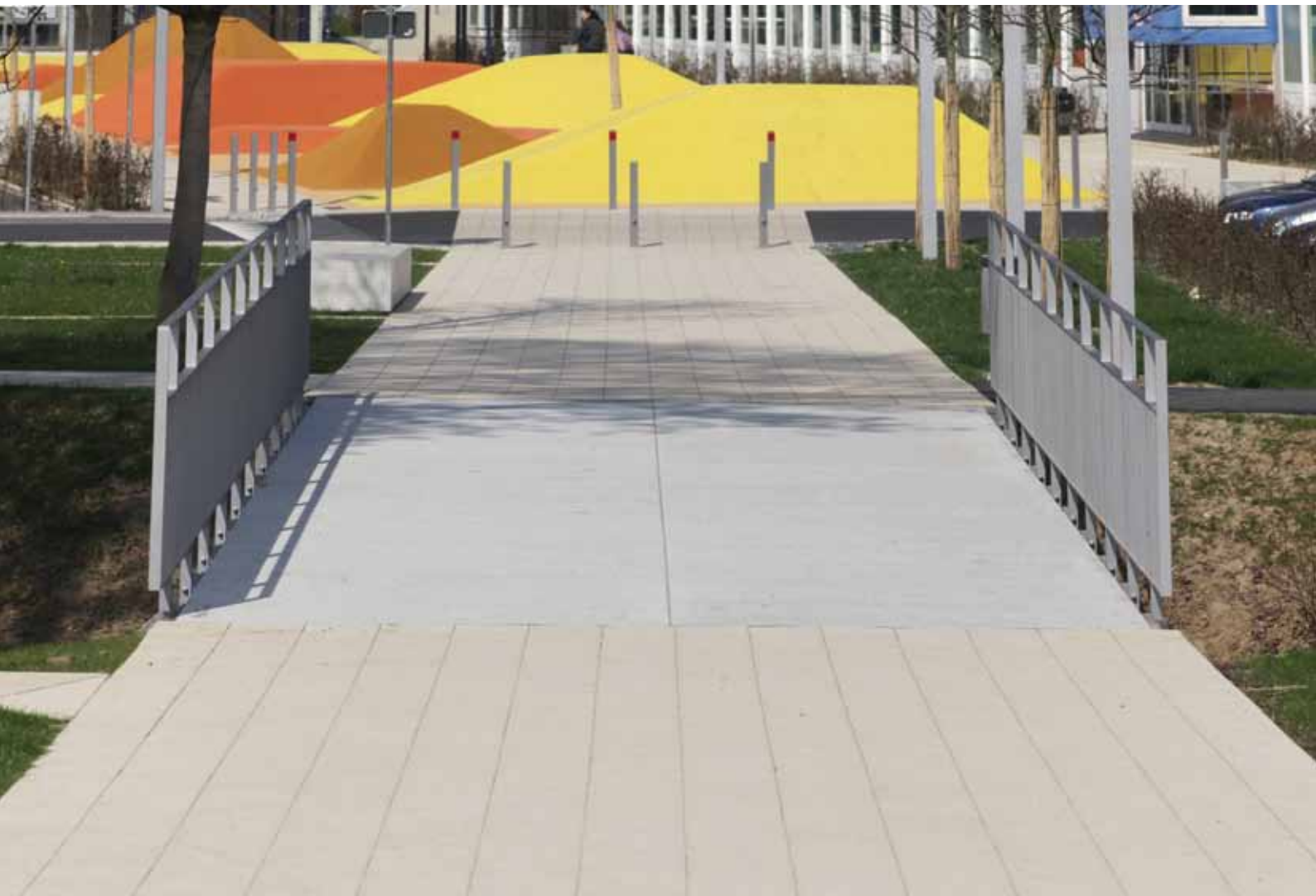
Two-part bridge over the Eipbach in Eitorf

rha- reicher haase assoziierte gmbh

Length of bridge: 15.1 m (49' 6 1/2")

Slab thickness: 35 cm (13 3/4")

2012



The 4 m (13' 1 1/2") wide pedestrian bridge consists of two 15.1 m (49' 6 1/2") long prestressed granite bridges, each 2 m wide. It won out over the wooden design variant because it naturally and unobtrusively blends into the landscape, and because the associated maintenance and follow-up costs are much lower. The waterway and the riverbanks of the Eipbach are a protected natural area whose tree population is considered a heritage.

The overall plan "Eitorf—Leap to the Sieg" was developed on the basis of a competition from the time of the Regionale 2010 planning convention. Among other things it provides for improving the connection between the inner city of Eitorf and the landscape area on the Sieg river.

The bridge, which spans the Eipbach from north to south, is part of a continuous axis of paths that leads through newly created or designed spaces from the Sieg riverside area north of the train station, across the forecourt of the school, to the balcony of the Sieg. It also provides direct access to the train station for students at the secondary school and visitors to the outdoor swimming pool.



Hans Peter Barrig (2)

Bridges over the Wolfach in Ortenburg

Wagmann Ingenieure (site & structural planning)

Length of bridge: 14 m (45' 11 ³/₁₆")

Slab thickness: 30 cm (11 ¹³/₁₆")

2013



Larger flow cross sections due to lower superstructure height

The low component height of the prestressed granite bridges is the feature that made it possible to provide a barrier-free path across the Wolfach in Ortenburg. Other construction methods, such as the steel, wood, or reinforced concrete designs that were investigated as alternatives, would have required stairways at the ends of the bridge in order to achieve the outflow cross section required by the Water Management Office. Because the two 14 m (45' 11 ³/₁₆") long bridges are identical in terms of span, static effects, and soil conditions, the planning and implementation costs were reduced.



Bridge over the Elsenz in Bammental

Ing.-Büro Wolf GmbH, Gaiberg

Length of bridge: 15.3 m (50' 2 ³/₈"")

Slab thickness: 35 cm (13 ³/₄"")

2013



Barrier-free, seamless surface with good texture

The 15.3 m (50' 11") long pedestrian bridge at the edge of the water dam leads to the Bammental senior park, where more than 100 senior residences are maintained in addition to the care facilities in the Anna-Scherer-Haus. Because their residents want to be able to reach the surrounding businesses, pharmacies, and doctors on foot, the flat, sand-blasted surface of the prestressed granite bridge is ideal. Unlike planked surfaces, even seniors who use rolling walkers can cross them without a problem.



Bridge in Hildesheim

Hildesheim Office of Public Works

Length of bridge: 15 m (49' 2 1/2")

Slab thickness: 30 cm (11 13/16")

2010



Kirstin Kaufmann

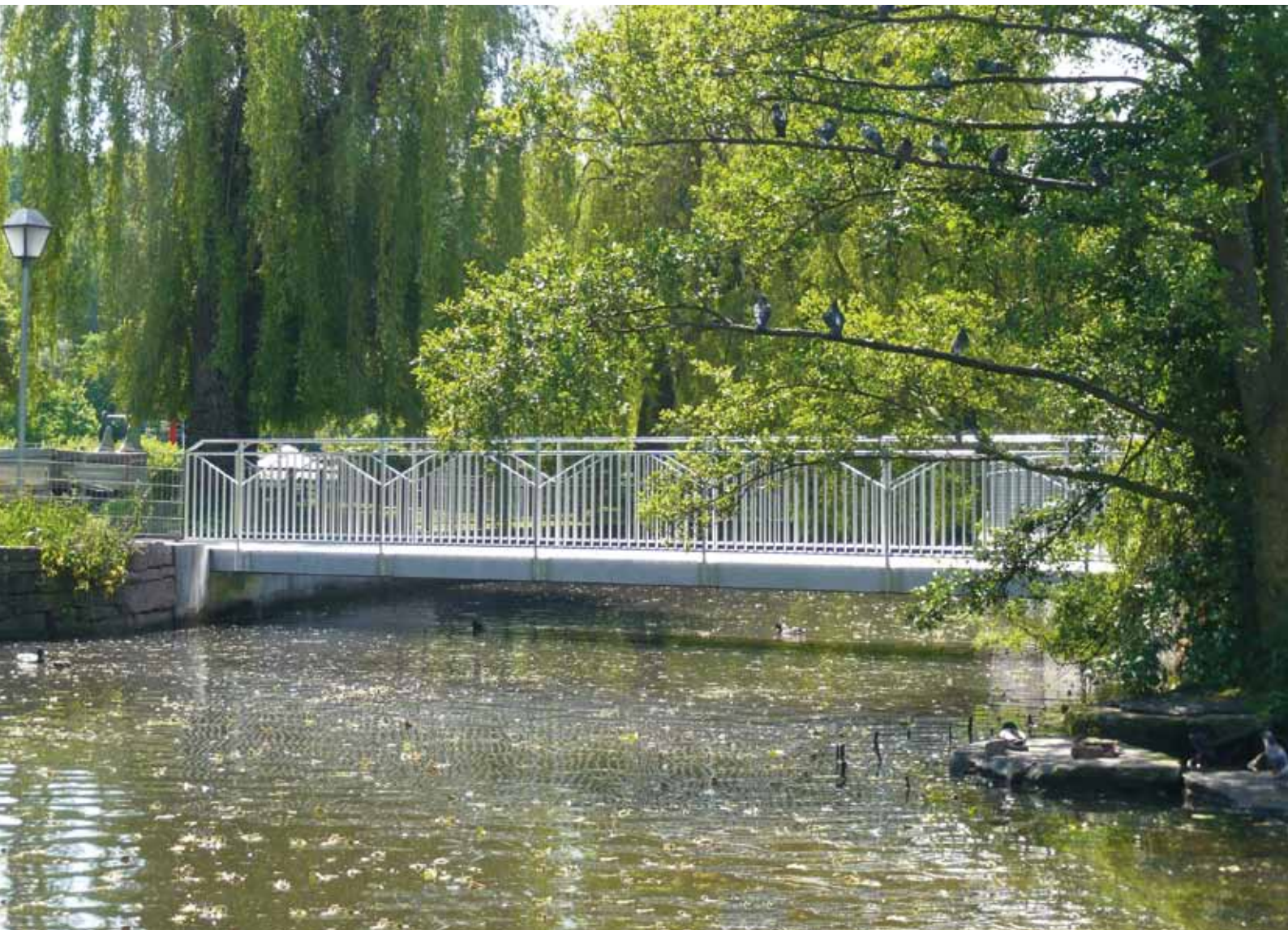
Park bridge in Pforzheim

City of Pforzheim, Office of Public Works

Length of bridge: 13.3 m (43' 7 1/2")

Slab thickness: 28 cm (11")

2013



Bridge in the Elfenau landscape park in Bern, CH

Hager Partner AG, Zürich

Length of bridge: 2.7 m (8' 10 5/16")

Slab thickness: 15 cm (5 7/8")

2014



The Bern real estate administration, represented by the Parks & Open Space Department *Stadtgrün Bern*, commissioned a footbridge in the Elfenau landscape park that can be driven on by service vehicles weighing up to 5 tonnes.

Granite crossing in a private park, CH

Hager Partner AG, Zürich
Length of bridge: 3 m (9' 10")
Slab thickness: 5 cm (2")
2014



Pond bridge in Konstanz

Planstatt Senner, Überlingen

Length of bridge: 8.2 m (26' 11")

Slab thickness: 15 cm (5 7/8")

2010



The 8.2 m (26' 11") long, 15 cm (5 7/8") thick prestressed granite bridge is part of the loop trail through the media park of SCHWARZ-Außenwerbung GmbH. It leads around two central water areas that serve as rainwater catch basins for the green roof areas.



Garden bridge over a koi pond

Wendland, Pötter, Kriebelt Landschaftsarchitekten

Length of bridge: 3.1 m (10' 2")

Slab thickness: 5 cm (2")

2012



Granite crossing in Tagmersheim

Kattinger + Kattinger Landschaftsarchitekten

Length of bridge: 7.1 m (23' 3 1/2")

Slab thickness: 15 cm (5 7/8")

2011



More Prestressed Granite Bridges

www.kusser.com



1



2



3



4



5



6



7



8

1, 2 Vaihingen/Enz, 2012
Ingenieurbüro Lachenmann
Length: 10.8 m (35' 5 ³/₁₆")
Slab thickness: 23 cm (9")
and
Length of bridge: 6.7 m (22')
Slab thickness: 15 cm (5 ⁷/₈")

3 Abtsteinach, 2012
Length: 6 m (19' 8 ¹/₄")
Slab thickness: 15 cm (5 ⁷/₈")
MVV Enamic Regioplan
GmbH

4 Rosenheim, 2007
Length: 9.4 m (30' 10")
Slab thickness: 25 cm (9 ⁷/₈")
SEP Baur & Deby Architekten
+ Stadtplaner, München

5 Kappelrodeck, 2009
RS Ingenieure, Achern
Length: 14.9 m (48' 10 ¹/₂")
Slab thickness: 32 cm (12 ⁵/₈")

6 Verden, 2013
Fritz-Dieter Tollé Architekt BDB
Length of bridge: 11 m (36' 1")
Slab thickness: 23 cm (9 ¹/₁₆")

7, 8 Schloss Neuhaus a. Inn
Wagmann Ingenieure
Lengths of bridges:
8.7 m, 12 m and 8.3 m
(28' 6 ¹/₂", 39' 4 ¹/₂" and 27' 3")
Slab thickness: 30 cm (11 ¹³/₁₆")

ohne Abb.: Oberndorf a. Lech, 2014
Ing.-Büro Marcus Kammer
Length of bridge: 6 m (19' 8 ¹/₂")
Slab thickness: 15 cm (5 ⁷/₈")

Jettenbach a. Inn, 2014
Length of bridge: 7,2 m (23' 7 ⁷/₁₆")
Slab thickness: 15 cm (5 ⁷/₈")
Ingenieurbüro Behringer & Partner

Ober-Ramstadt, 2014
Ingenieurgesellschaft Fahlbusch mbH
Length of bridge: 5 m (16' 4 ³/₈")
Slab thickness: 8 cm (3 ¹/₈")

- solid
- corrosion-resistant
- high-strength
- slender
- elastic
- lightweight
- prefabricated
- quickly installable designs

Prestressed Granite



8



9

8 Prestressed granite steps
Bau 2013, Munich

9 Prestressed granite stairs,
PlusCity Shopping Center, Linz,
Austria, 2004

10 Axis of the Earth, Scale.
1:1.000.000, Magdeburg,
station forecourt
artist: Timm Ulrichs, 1999
(weighing 10 tons and 12
m (40') long, the axis in
prestressed Nero Assoluto is
the main component of an
accurate time clock)

12 Flag poles, Ø 13-17 cm
(5 – 7"), h: 9 m (30'), 2004

13 Office center, Suhl
artist: Manfred Mayerle,
Munich, 2006



10



11

Additional projects with Prestressed granite:

Column in the Michaelibad, a Munich public bath,
Artist: Manfred Mayerle, Munich, 2001

Granite stairs and gallery, public capital and building
department Ludwigsburg, Germany, 2004

Gallery, Moosinning City Hall,
Germany, 2003

Gallery and diving board in a private garden in
Wiesbaden, Büro für Freiraumplanung, landscape
architect Ulrike Stryck-Hartmann, Wiesbaden,
Germany, 2008

Granite steps, Antiesenhofen, 2008
AW Architekten TZ GmbH

11 'Lichtblicke', Waldkirchen regional garden
festival 2007, Landscape Architect: Barbara Rainer,
Bernhard Dingler



12



13





Kusser Granitwerke is a family company with almost 100 years of history in the extraction and processing of natural stone, which currently employs approx. 100 staff in Germany and the USA. Thanks to traditional craftsmanship, a high-tech machine park and our own specialists, as well as internal planning teams of technicians, engineers and architects, the firm has been able to establish itself as a world leader in the natural stone industry.

Brochures:

- Interior Works in Natural Stone
- Exterior Works in Natural Stone
- Prestressed granite
- Kusser Fountain SYSTEM (1+2)
- Floating spheres/ objects, Tumbling objects



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