

Timber and Technology

Timber bridges

Timbatec
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Dear partners, customers and timber enthusiasts

Peter Ustinov once said that we would have to build bridges to one another if we wanted to have any chance of salvation in this insane world – a statement that is truer than ever before in these times dominated by the coronavirus pandemic. We need bridges. They connect two riverbanks, create physical and cultural links between people – and enable animals to cross motorways.

The Wildlife Overpass Rynetel is Switzerland's first wildlife overpass built with wood. More than 1,000 tons of CO₂ could be saved in comparison to using a conventional construction method. The environmentally friendly wooden construction thus fits in perfectly with the basic ecological idea of the structure, which connects habitats across motorways. Read more about it in our article on pages 4–5.

Planning bridges is the pinnacle of an engineer's craft. For a long time, it was considered the preserve of concrete engineers, as large bridge projects were usually built of steel and concrete. But that has changed: today, bridges are built of timber. This renewable building material has left its niche existence. And not without reason: if the goals of the Paris Agreement are to be reached, nobody should build bridges with concrete any more. Vast amounts of CO₂ are emitted during the manufacture of steel and concrete.

Timber, on the other hand, grows in Swiss forests, binds CO₂ as it grows and permanently stores the greenhouse gas in its built-up state.

When used in construction correctly, wood is incredibly durable. The Spreuer Bridge in Lucerne, dating back to 1408, is proof of that. Thanks to a newly developed load-bearing system with packages of small bar cross-sections, we can now build bridges exposed to the weather using beech wood. In this issue, we will be taking a look at the Tüfisteg bridge, Switzerland's first purely beech wood bridge.

As a member of the Qualitätsgemeinschaft Holzbrückenbau (an association promoting the construction of timber bridges) and as an ISO 9001 certified timber construction engineering company, top quality is our key asset. We are committed on various levels to having more timber bridges. This is our and our customers' contribution to achieving the goals of the Paris Agreement. And that is something that both you and we can be proud of.



Armin Schawalder
Deputy Head of Bern Office
Timbatec Holzbauingenieure Schweiz AG

Timbatec offers the all-round package

A building is more efficient and economical if it is understood as a whole. This also applies to bridges. When it comes to planning timber constructions, the best idea is to consult a timber construction engineer who has skills that go beyond mere structural design. We offer an all-round package in the planning and supervision of timber construction projects. We will also gladly develop solutions for you where there aren't any just yet. Our core competencies:



Timber Engineering



Fire Protection



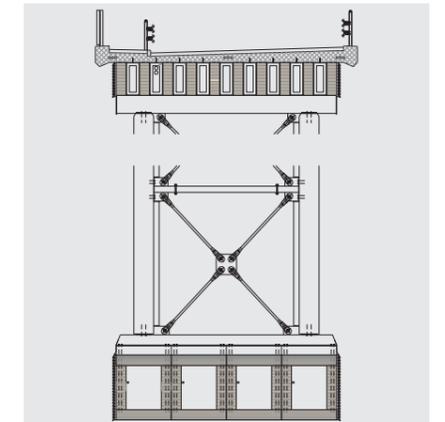
Building Physics



Product Development

Where are the limits for timber bridges?

Basically, the limits are in the mind. Today, timber can do just about anything steel and concrete can do. Timber bridges are particularly efficient for spans of up to 30 metres, which is exactly the distance covered by most Swiss bridges.



The 240-metre-long Vulpera wooden bridge with an arch span of 120 metres and a height of 70 metres.

In Switzerland, a lot of bridges over roads and motorways are soon going to need renovating or replacing. The natural building material timber is in fact perfect for construction projects of this kind: its low weight, good load distribution and cost-effective repairs by replacing individual parts are major advantages. Timber is the right building material for all kinds of bridges. This home-grown building material is the only way in which infrastructure constructions can become temporary CO₂ sinks – due to the fact that CO₂ is stored as the trees grow. Moreover, because elements can be prefabricated without any difficulty, timber bridges are often completed faster than steel and concrete structures.

Over the Inn on wood

In fact, timber can be used for bridges that have an above-average span. In 2005, Timbatec teamed up with Kissling und Zbinden AG, Bauart Architekten and the Graz University of Technology to draft a plan based on timber for the 240-metre-long Vulpera bridge over the Inn in the Lower Engadine for a competition. The concept involved four hollow box arches next to each other. Unfortunately, the project could not curry favour with the jury.

The need for foresight

Naturally the plans for the bridge over the Inn fulfilled all the criteria. But the jury felt the limits of a material-appropriate design had been

exceeded – a disappointment for our team. All the technical prerequisites for large-scale projects, such as the Vulpera bridge, are met today. The only thing lacking is general acceptance and foresight on the part of the decision-makers. It sometimes takes a long time for new ideas to be implemented. That was also the case for the wooden wildlife overpass, which, some 20 years ago, was a daring idea from Timbatec and has now been realised (see the next double page). Gradually, experience will build trust in the new possibilities. The inauguration of the first major timber bridge is just a question of time.

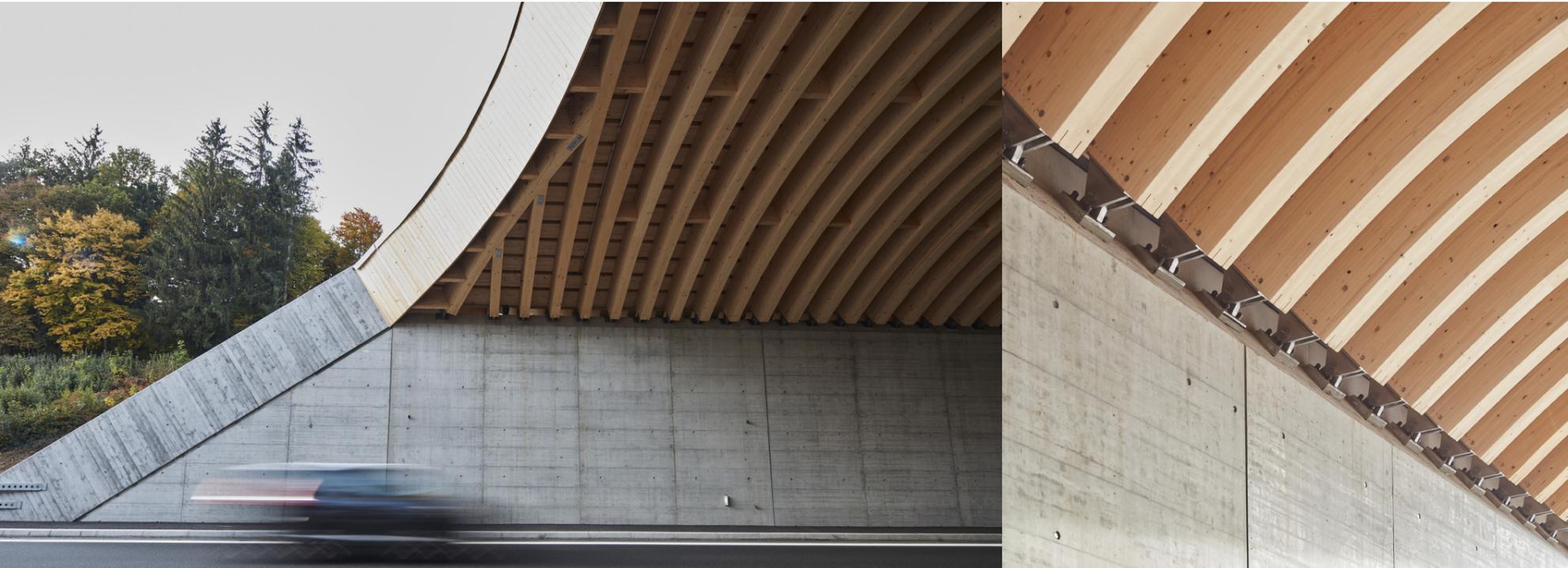


“It's just a question of time until major projects like the bridge over the Inn are realised in timber.”

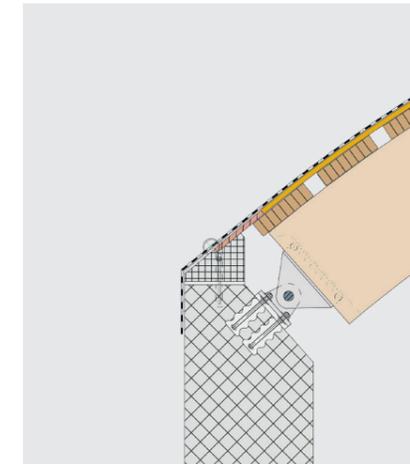
Dr.-Ing. Karl Kleinhanss
Managing Director, Qualitätsgemeinschaft Holzbrückenbau e.V. (QHB)

First wooden wildlife overpass

It took a long time to convince people: more than 20 years ago, Stefan Zöllig demonstrated that wood is the right choice of construction material for wildlife overpasses. Today, the Rynetel wooden bridge over the A1 motorway is impressive – and more will follow.



The wood required for the wildlife overpass grew back in Swiss forests in just 3 hours and 26 minutes.



Building owner
Federal Roads Office FEDRO

Planning
Ingenieurgesellschaft WUEF
Bänziger Partner AG and Timbatec Holzbau-ingenieure Schweiz AG

Execution
ARGE FERA with Aarvia Bau AG and Häring AG

Glulam supplier
Hüsser Holzleimbau AG

Facts and figures
Spans: 2x 17.4 metres
Length: 35.6 metres
Width: 54 metres
Bridge area: 1,922m²
Total costs: CHF 13.4 million
Construction timber: 850m³ spruce, origin Switzerland



“Together, Timbatec and Bänziger Partner AG developed the necessary technical details. We can build on this expertise in future projects.”

Harry Fehlmann
Chairman of the Executive Board, Bänziger Partner AG

When the deer cross the A1 motorway to mate this summer, they won't notice that they are walking across Switzerland's first wooden wildlife overpass. For them, it is important that they can reach their areas on the other side of the motorway again. Because traffic routes cut through the habitats of wild animals, the Federal Office for the Environment has defined wildlife corridors of supraregional importance. Conventional wildlife overpasses are reinforced concrete constructions. They are useful for the animals but are certainly not climate-friendly. However, the two environmental aspects can actually be combined: The "AG6" corridor connects the Jura region with the Central Plateau, crossing the A1 motorway between Gränichen and Suhr. The new 50-metre-wide wooden structure enables wildlife to cross the motorway safely.

in 1998, a fundamental report by Stefan Zöllig demonstrated that timber, as a domestic raw material, is a cost-effective and ecological alternative for green bridges. More than 20 years later, in the pre-project phase of the Wildlife Overpass Rynetel, the client, together with the planning team, compared the designs in concrete and wood. In addition to being economical, the construction had to be low-maintenance and durable, and last for 100 years. It would also have to accommodate a

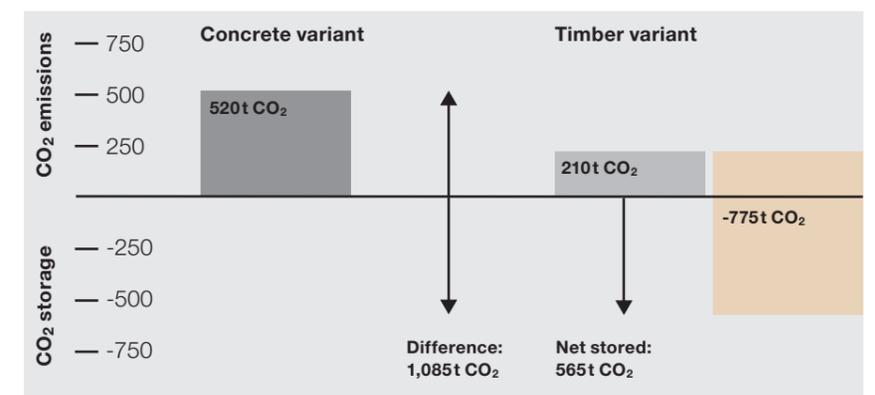
later expansion of the motorway from two to three lanes, and the flow of traffic on the motorway would have to be guaranteed at all times. These requirements are no problem for timber.

Swiss timber
To make the 156 arch girders, Hüsser Holzleimbau AG in Bremgarten processed around 850 cubic metres of construction timber. A large glue press brought the spruce boards

into the desired shape, and after the RF adhesive had hardened, they were dimensionally stable. To assemble the girders, two lanes of the motorway were closed for just 15 nights from 9 pm to 5 am. Because the timber girders were prefabricated, the bridge could be built in record time without traffic ever having to be stopped completely.

More than 1,000 tons of CO₂ saved
One cubic metre of wood relieves the atmosphere of around one ton of CO₂ because trees convert CO₂ into oxygen and carbon in the photosynthesis process as they grow. Making a cubic metre of reinforced concrete, on the other hand, results in around 500 kg of CO₂. If the wildlife overpass had been made of concrete, the manufacture, assembly and transport would have caused the emission of 520 tons of CO₂. With the wood variant, only 210 tons of CO₂ were emitted during the production of the glulam beams and the manufacture of the steel joints. At the same time, the built-

Comparison of the CO₂ balance of the timber and concrete variants for the bridge superstructure



up wood stores 775 tons of CO₂ due to the photosynthesis process. In net terms, 565 tons of CO₂ are stored in the Wildlife Overpass Rynetel. The difference between the timber and concrete variants is thus 1,085 tons of CO₂. That is equivalent to the emissions of more than three million car kilometres. Timber

is thus very much to be preferred in terms of the climate. If the goals of the Paris Agreement are to be reached, we will have to stop using steel and concrete. The wildlife overpass with its timber superstructure is a first step in this direction.

Timber is the better solution
Timbatec has been dedicated to wooden wildlife overpasses for more than 20 years. Back



“Timber is the best building material for bridges. We are proud to be the first to make a wildlife overpass out of wood.”

Jürgen Felber
Managing Director, Häring AG

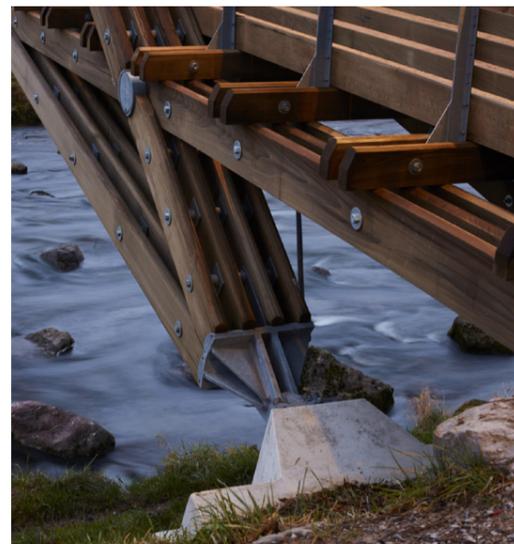
Beech wood – a good material for bridges

The Tüfisteg is the first bridge to be made completely of beech wood. With a sophisticated design and salt-based impregnation, beech wood is perfectly suitable for outdoor use – something that was long considered impossible.



A flagship project: the 45-metre-long Tüfisteg bridge made of Swiss beech wood

Solid beech wood has lots of advantages: it is inexpensive, available in large quantities and easy to impregnate.



The Tüfisteg pedestrian and bicycle bridge in Adliswil was getting on in years. Renovating the lattice bridge would have cost almost as much as replacing it. It was obvious, therefore, that the bridge should be rebuilt. Beech wood from the region was used.

reasonable in price and the nearby forests are full of it. The problem to date: natural beech wood is not durable when exposed to the weather. Pressure impregnation eliminates this problem as it transforms beech wood into a genuine alternative for outdoor use.

The solution: small bar cross-sections

Large timber sections are prone to cracking. Moisture then penetrates into the cracks, ultimately leading to structural damage. For the Tüfisteg bridge, Timbatec developed a new supporting structure with small bar cross-sections. The air-streamed wooden bars dry quickly and thus have a smaller moisture gradient within a cross-section. That reduces the risk of cracks. Small cross-sections require high strength – i.e. hardwood. Oak would be ideal because it is naturally durable thanks to its protective constituents. But it is often too expensive. Beech wood, on the other hand, is

New design procedure developed

When does a bar or a bar package buckle under the load? This is a crucial question. In the standards, however, not much attention is paid to the buckling of compression bars. Timbatec developed a suitable procedure for the static dimensioning of the bar packages used. In lab tests with the Bern University of Applied Sciences, we verified the new design approach and the dependency between the bending strength and the moment of inertia. The findings helped us to safely dimension the load-bearing components.

Architecture and timber construction engineers

Timbatec Holzbauingenieure Schweiz AG

Building owner

Town of Adliswil, 8134 Adliswil

Timber construction

Holzbautechnik Burch AG, 6060 Sarnen

Impregnating plant

Imprägnierwerk AG, 6130 Willisau

Timber cutting

Konrad Keller AG, 8476 Unterstammheim



“The Tüfisteg bridge is a good example of innovative construction with beech wood.”

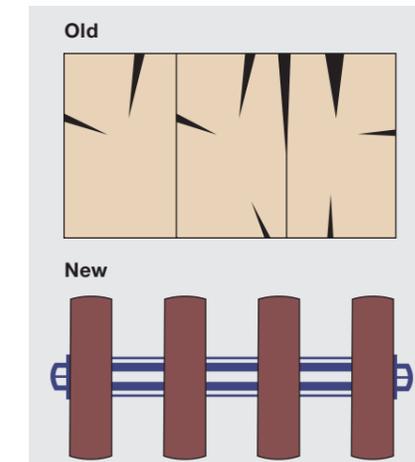
Guido Thalmann
Owner, Imprägnierwerk AG, Willisau

Due to the steel parts in the nodes, the bridge can be prefabricated to a great extent, ensuring quick assembly on site.



“The beech wood construction is compelling. It makes building bridges twice as much fun.”

Roger Burch
Managing Director, Holzbautechnik Burch AG, Sarnen

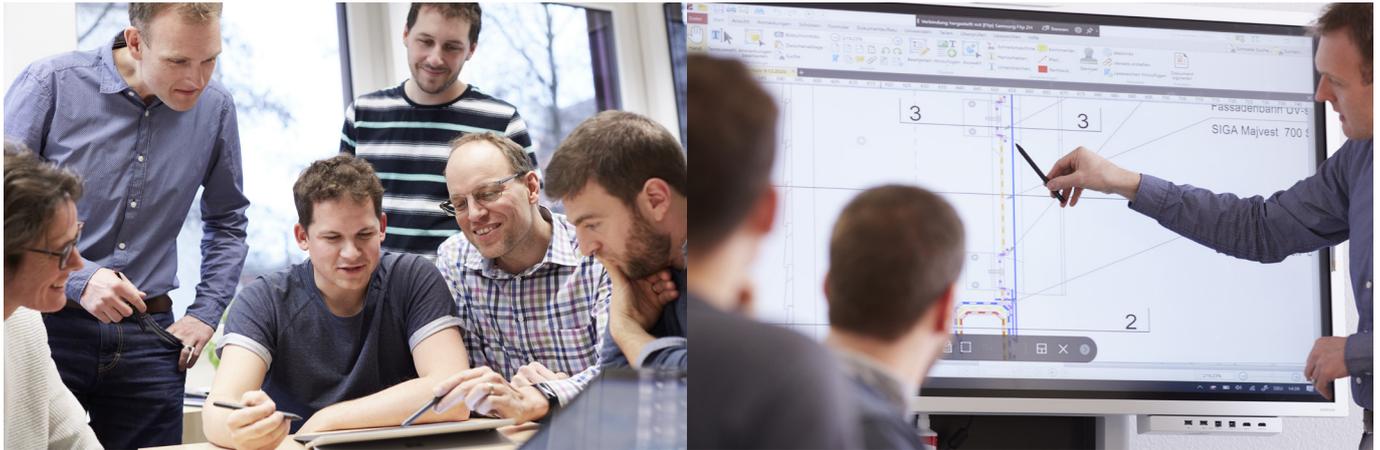


Above: Large cracked cross-sections of spruce wood.
Below: Small cross-sections of beech wood avoid cracks.

Career at Timbatec

Your career will take off at Timbatec

We offer our employees three career paths: management career, professional career and project career. That is widely appreciated. Which is why we are constantly growing.



Timber construction is booming. Timber is the building material of the future – for bridges or for other construction projects. That is why more and more clients are choosing this sustainable material. For us, this means an increase in enquiries for competitions and construction projects. We can only manage the many thrilling projects with a committed and well-trained team. That is why all our employees are entitled to 100 hours of personal further training per year. As a result, we are always up to date – whether in fire protection, building physics or earthquake resistance.



“Do you want to join our team? Just contact us: we would love to get to know you.”

Andreas Burgherr

Head of the Executive Board, Timbatec Holzbauingenieure Schweiz AG



www.timbatec.com

Timbatec
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Switzerland:

Thun branch

Timbatec Holzbauingenieure
Schweiz AG
Niesenstrasse 1
3600 Thun
+41 58 255 15 10
thun@timbatec.ch

Zurich branch

Timbatec Holzbauingenieure
Schweiz AG
Ausstellungsstrasse 36
8005 Zurich
+41 58 255 15 20
zuerich@timbatec.ch

Bern branch

Timbatec Holzbauingenieure
Schweiz AG
Falkenplatz 1
3012 Bern
+41 58 255 15 30
bern@timbatec.ch

Delémont branch

Timbatec Holzbauingenieure
Schweiz AG
Avenue de la Gare 49
2800 Delémont
+41 58 255 15 40
delémont@timbatec.ch

Austria:

Vienna branch

Timbatec Holzbauingenieure
GmbH
Im Werd 6/31a
1020 Vienna
+43 720 2733 01
wien@timbatec.at