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Timber bridges – revive of old and new bridges built in Switzerland

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Abstract*: Timber bridges – revive of old and new bridges built in Switzerland.* This paper is to present timber bridges in Switzerland visited by authors during a COST FP1101 and FP 1004 workshop and conference. Timber bridges can be built of glulam and of other wooden materials, such as LVL. Old and new constructions are presented. Aim of the authors was to prove, that wood can be regarded as a material of the XXI – st century even in the scope of bridge construction. Proper design is however essential, considering all properties of wood during design, building and usage of the structures.

Keywords: structural timber, strength class, timber bridges

This paper is a short report from the technical tour during the cost FP1101 and FP 1402 conference meeting. The report presents Swiss bridges and the basics of their constructions. Despite the world famous wealth, the Swiss are not afraid of such solutions, which in our country are considered temporary, dangerous, or at least unstable. Timber bridges are used there both as footbridges for pedestrians and bicycles, as well as carrying a full load of automobile traffic. A lot of bridges are covered. The roadway is mostly designed as asphalt. Visited region of Emmen and Oberaargau valley is well known as an area of historical timber bridges. It is worth to note that 220 of 1500 historical timber bridges of the world, described in World Guide to Covered Bridges (USA, 1990), are in Switzerland. 29 of them are in the area of Emmen valley. The oldest timber bridge in the upper part of Emmen valley is Ramseren Bridge, built in 1793, renovated 1936 and 1984. Its length is 30 m and it is designed for vehicle traffic up to 4t.

In Switzerland, there is a rule that if a timber bridge must be removed, it can only be replaced by other bridge made of wood or wooden products. This also applies when the previous bridge was burned down. One of the examples is Aare Bridge (Fig. 1). The first one was built in 1821, but burned down in 1989. The present bridge dates 1991 and was built according to the old solutions, but using modern materials, such as glulam and asphalt. The bridge has length of 107m, span from 15,8 to 20,3m and is designed for vehicle traffic up to 18t. Two gangways are on both sides of the road.

Figure 1. Aare Bridge – general view and support construction

Present Baubenei Bridge (Emmen) was built of modern materials but basing partially on the model of the old bridge, coming from 1837. The old bridge has been moved in 1988 to Brunnmatt. In the construction of the new bridge 335 m^3 (Fig. 2) of timber was used, mostly glulam. Deck is also made of glulam. The new object is more massive than the old one, among other things due to the use of two-way roadway. Today bridge has width of 8,7 m and span 43,4 m and is covered with full gauge of 4,5 m.

Figure 2. Baubenei Bridge – general view and roof construction

Next visited bridge was built in 1846 and renovated in 1982 (Fig. 3).Total length of the bridge is 62 m with a span of about 20,2 m. The usable width is 5,6 m. When the task of the bridge was to carry load up to 6000 vehicles per day (until the year 2000) – the construction was extra reinforced. Currently, the bridge has been restored to its original condition and strengthening have been removed.

Figure 3. Gohlhaus Bridge – general view and deck construction

Next two presented bridges were built recently.

Neumatte Bridge (Fig. 4) is the bridge with the largest span in Switzerland. Its length and at the same time span is 59m, the bridge is designed for pedestrian and bicycle traffic with usable width of 3.8 meters. It was built in 2013.The bridge was supplied in the form of 6 prefabricated trusses and many individual elements. All of them were assembled on the river side and as a finished bridge placed on supports. The mass of the bridge is 140 tons. Unlike the other mentioned bridges, the road of this bridge is made of wood, there is no asphalt coating.

Figure 4. Neumatt Bridge – general view and connection

Very interesting solution was used in the Obermatt Bridge (Fig. 5), built in 2007. The bridge has a length and a span of 32 m. It is designed for full-load vehicle traffic, there are also two gangways separated on the sides. Innovative solution of the construction is the use of hydraulic cylinders. In case of increased water level, bridge can be fully raised to a height of 70 cm in 5 minutes. The bridge is made of glulam and LVL.

Figure 5. Obermatt Bridge – bridge during raising anddeck construction

Timber bridges, as can be observed basing on the examples described above, may be used through the centuries. They can carry the load of traffic, inclusive trucks. The appropriate design, execution and maintenance of the structure, as well as knowledge of the properties of wood, is the condition of the proper work. Monitoring the moisture level and general condition of construction as well as placing of reinforcements is required, if needed.

In conclusion, it is worth to mention the old rule that dictated the designer/builder to sit under the bridge during the first full load. Old Masters did not have concerns and quietly sat on the beam, often located in the middle of the span of the bridge. Would today Polish designers sit also without fear under the first time loaded bridge, built according to their project? Are today's projects properly designed? In a situation of tender rules that only the lowest price guarantee the contract, may designer believe in the proper execution of all design requirements? And the owner of building company, who won the tender by lowering the bid price below the limits of reason – would they sit under the bridge built by their company?

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Streszczenie: *Mosty drewniane – stare i nowe mosty w Szwajcarii*. Artykuł prezentuje rozwiązania stosowane w szwajcarskich mostach, wizytowanych przez autorów podczas warsztatów i konferencji w ramach akcji COST FP1101. Pokazane zostały przykłady wciąż funkcjonujących mostów historycznych oraz współcześnie wzniesionych. Zamierzeniem autorów było pokazanie, że również w kontekście budownictwa mostowego, drewno można nazwać materiałem XXI wieku. Warunkiem jest właściwe zaprojektowanie i uwzględnienie wszystkich właściwości drewna podczas zarówno procesu projektowego, wykonawstwa, jak i użytkowania.

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