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## **Industrial prefabrication improving competitiveness of wooden bridges**

**Erhöhte Konkurrenzfähigkeit durch  
industrielle Vorfertigung**

**Aumento della competitività grazie a  
una prefabbricazione industriale**

**Document in English**



# Industrial prefabrication improving competitiveness of wooden bridges

## 1 Background

The main way crossing Finland from South to North, the E75, is from Helsinki in south to Heinola in north the busiest in Finland. Although the traffic in Finland never reaches a frequency as on motorways in Central Europe, the queuing has been just intolerable. For better future, a national motorway project was started in 2004. The project was completed on November 15, 2005. This project was unique in Finland and has been handled widely in publicity.

Versowood Oy supplied a wooden bridge that crosses over the motorway just before the Vierumäki junction. Although there are several concrete bridges crossing the way, the Haikula wood bridge, as it is, is a symbol of high wood construction technology, a real landmark. The Finnish Road Enterprise, a domestic organization that is responsible of the road net, construction and maintenance, was the main contractor. Consultants, who were designing the motorway as a whole, the bridge included, had originally proposed a wooden bridge. The bridge design was opened to competition between several architects, designers and students, from whom Versowood was chosen as the partner on the grounds of experience and comprehensive service. The bridge was to be a double truss framed bridge, the design being somewhat similar to a bridge built about five years ago, 50 km north from Haikula.



Illustration 1: Haikula Bridge

## 2 Design

From the start of the project, Versowood was involved in the design of the bridge as expert of technical details and design of heavy duty wood bridges. This contribution was especially important, because the consultants had no experience in wooden bridges in general. Normally Versowood co-operates with experienced designers only, but this project was an exception. As the contractor had released the total design as a complete package to one supplier, no other solutions were possible for the bridge in question; even if the contractor might have saved work and costs through employing a special designer outside the project.

Two bridge experts from Versowood were participating in the design meetings. These two persons had earlier been involved in tens of wood bridge projects, from minor pedestrian to heavy traffic bridges. It was of great importance to design details and components that were suitable for industrial fabrication and necessary impregnation. Also the joints were to resist the Finnish four seasons' climate and, further more, some of them had to be technically advanced to be installed outside, at the site. Versowood's special know-how was also required to calculate the correct cross profiles for glulam support beams. A technically safe and competitive solution was found. Although the bridge as a pedestrian bridge mainly serves light traffic, there is an option allowing heavier traffic, too. Actually, the bearing capacity of the bridge is 60 tons and corresponds with the weight of a full loaded log truck. In spite of that, thanks to professional architect and designer work, the bridge profile is slim and elegant. The design work took about 4 months prior to start of manufacturing.

## 3 Manufacturing

The manufacturing took place at Versowood's Vierumäki factory. Pine was chosen as material, as it tolerates well pressure impregnation and is after processing climate resistant. Spruce is not good enough for this purpose. The redwood lamellas were sawn on the sawline. The lamellas were kiln dried, glue-laminated and planed, the supports were dimensionally precise and corresponding with the technical design. The components were impregnated. Assembly could be started.

In order to speed up and secure the erection at site, as large modules as possible were made at the factory. As the transport distance was short, relatively large modules could be transported to the site for final erection. The number of modules was not higher than six. Each of the six modules was a stable, complete unit, only their rails and hangers were excluded.

The bridge has two truss frames that are standing on three supports. The total length of the bridge amounts to 52 metres, thus the widest span length is 25 metres. The pin connections were tested before transport out of the factory, thus the joints did not cause any delays in erection at site.

The assembly of elements in the factory took about 3 weeks, 2-3 persons were involved.



*Illustration 2: Assembly of elements*



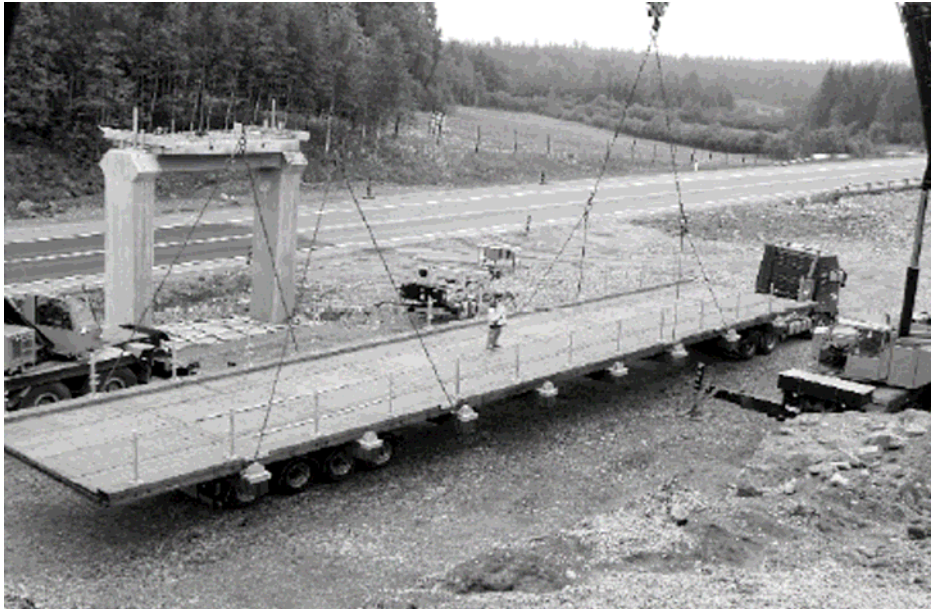
*Illustration 3: Factory*

The metal connection pieces are of hot galvanizes steel. The connection pieces are fixed to the wood components through penetrating joint bolts, a method that is fast, easy and sure. The glulam components and the deck element were mainly dressed. The dressing minimizes the sun shine's effect on bearing structures. It is also easy to redress the deck, if necessary. A ventilation space was left between the bearing structure and the timber dressing.

The industrial premises were ideal for element prefabrication. The quality of components and work were under permanent control, unexpected factors hampering or delaying the process could be easily eliminated.

## 4 Erection

The erection site was carefully checked before transportation. The lifting points and the unloading points for elements were chosen in advance so that there was no need to move machinery or bridge elements during road side landing.



*Illustration 4: Bridge elements during road side landing*

The six elements were lifted on in two phases, because the traffic could not be blocked on two lanes simultaneously. The lifting- and connecting work took 24 hours. The bridge was supported from beneath until the deck elements were laying on the hangers. From the arrival of the first element at site to the last joint finishing, hanger suspension and rail erection, only seven working days per completed half bridge was taken. Six persons were involved in total: 2 crane men, 3 assemblers and the project manager in charge.



*Illustration 5: Construction*

## 5 Costs

The costs are consisting of design, glulam and sawn timber structures, connecting pieces between the members, assembly work, transportation and erection at site. Additional costs are accrued from administration.

The cost distribution was the following:

- Design 15%
- Wood material 27%
- Connecting pieces 17%
- Labour 12%
- Transport 4%
- Erection 15%
- Administration 10%

Worth special attention is the minor share of the wood material price in the total. The design costs were, due to the unique characteristics of this project, higher than standards. In major, demanding projects it is normal that the costs of connections exceed 10% of the total.

## 6 Versowood as bridge constructor

Versowood is the largest, privately owned wood processing enterprise in Finland. The industrial activities include round wood procurement, sawmilling, glulam manufacturing and impregnation.

This is a range of operations that makes cost effective, competitive bridge construction possible.

Annually Versowood manufactures and supplies about 50 – 100 wooden bridges. Most of the bridges are of minor size, with 5-8 m span length, they are simple and fast to erect on forest truck roads. The second main category consists 15-20 m long cross over bridges for pedestrian traffic.

Versowood has 3-4 basic type solutions to offer in each bridge group, straight and arch bridges as well as truss frame bridges, but also special designs meeting specific customer needs are designed.

Versowood has had the honour to supply every one of the largest wood bridges in Finland. The bridges and we have also enjoyed great positive publicity. Bridge Construction is a part of Versowood's INFRA division, the other sectors of which are Noise reduction fences, Protection fences (especially against elks) and Poles for electricity and lightning.

## 7 Wood bridge or Concrete bridge?

Wooden bridges have e.g. the following advantages in comparison with concrete bridges:

- fast and easy erection
- availability of individual and attractive design solutions
- long age, low maintenance costs
- general competitiveness



*Illustration 6: Panorama of the Wood Bridge*





*Illustration 7: Haikula Wood Bridge finish*