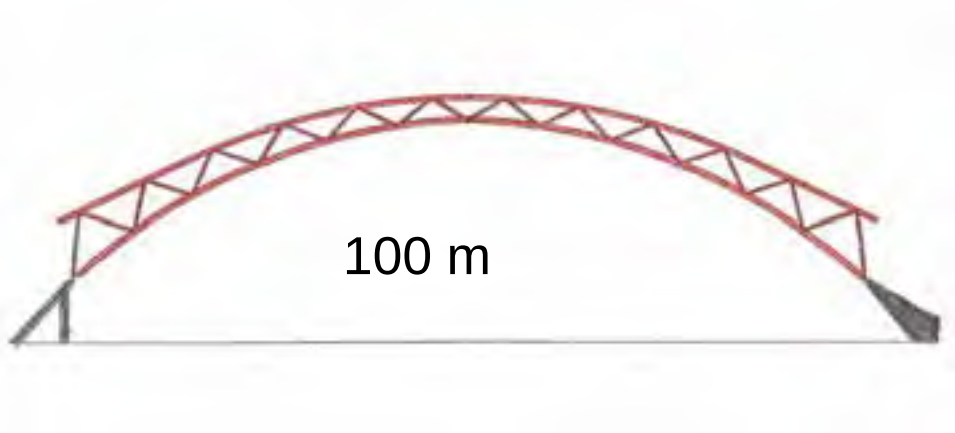
Innovative glulam structures in Norway

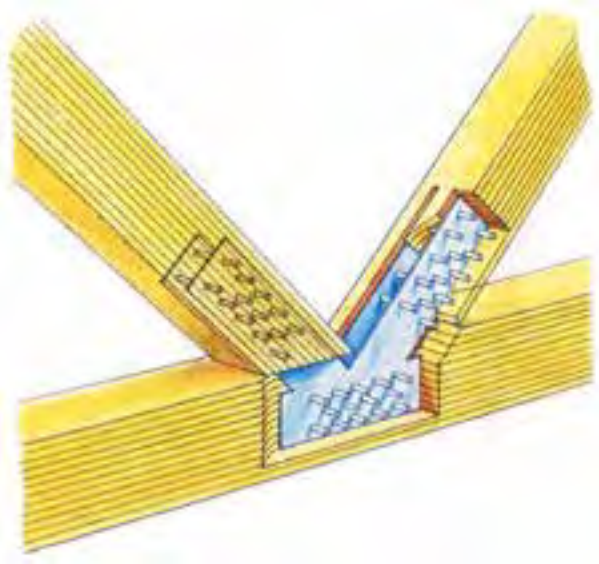
- Olympic stadiums
- Timber bridges
- The Norwegian pavillion at Expo 2010
- Vennesla Library
- Tidal power plant

Moelven Limtre AS
Åge Holmestad

Olympic stadiums

- Arches
- Trusses
- Slotted in-steel plates
- Steel dowells





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Olympic stadiums

- **Maximum span width: 96.4 m**
- **Length: 260 m**

Architects:

Niels Torp / Biong Architects.

Olympic stadiums

Maximum span width: 85,8 m

Length: 127 m

Architects:

Østgård arkitekter AS

Oslo Airport Gardermoen

- **Total lengde 136 m**

Architects:
Aviaplan AS

Oslo Airport Gardermoen

Oslo Airport Gardermoen

The lower chord has an elliptic form

The NordicTimber Bridge Project

- A seminar in Norway
- Study tour to USA and Switzerland

The NordicTimber Bridge Project

- The objective was to increase the competitive power of timber in bridges compared to other structural materials
- The project have been running in the period 1994 – 2001

- **Participation: Finland, Sweden, Denmark and Norway**
  Industry, Research Institute., University and Road authorities

Evenstad Bridge

Total length	**180 m**
Carriageway width	**6.5 m**
Span length	**36 m**
Construction year	**1996**

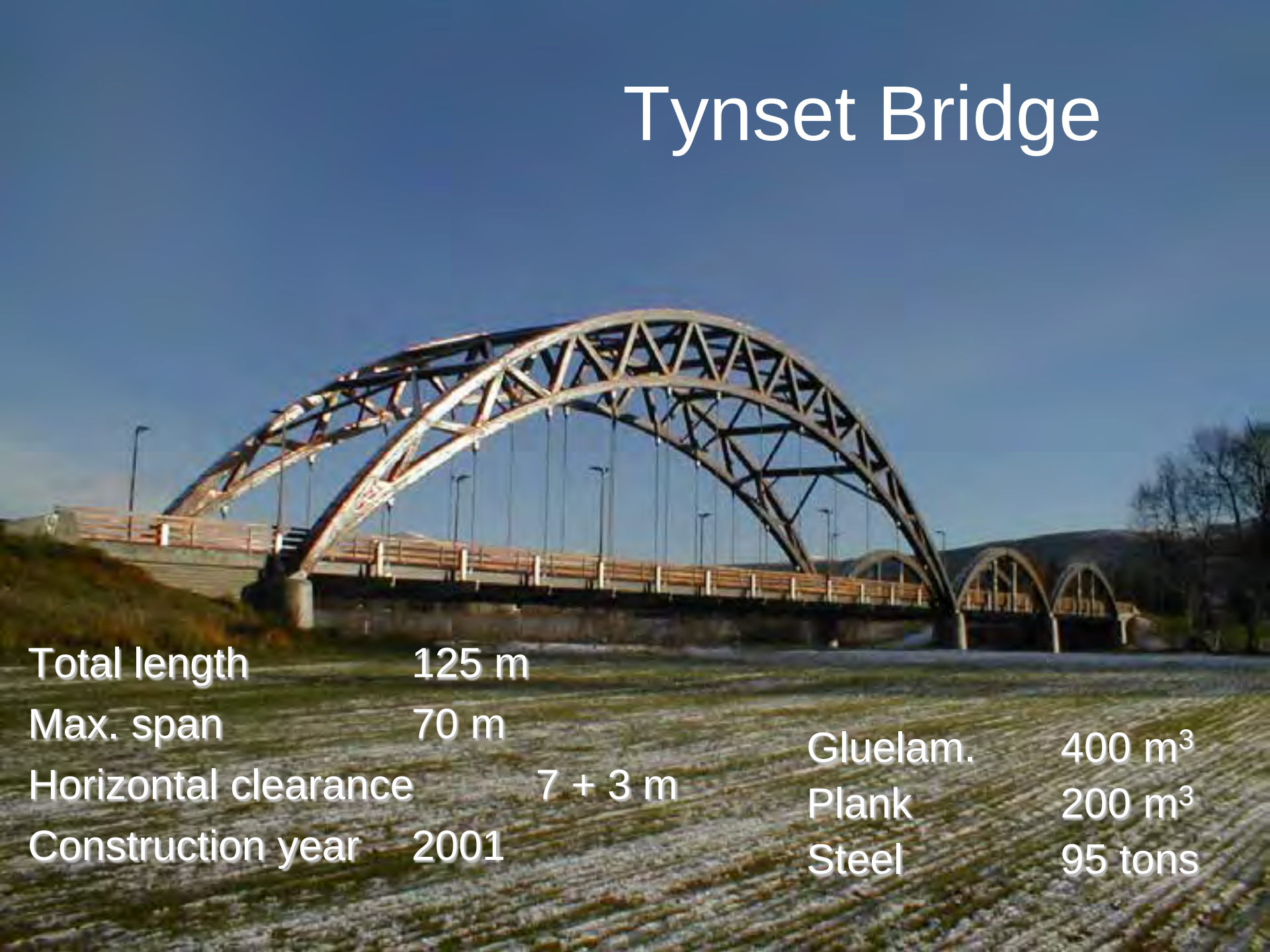
Skubbergsenga Bridge

- Total length 40 m
- Main span 32 m
- Horisontal clearance 4 m
- Construction year 1997

Fønhus Bridge

Total length	35.5 m
Carriageway width	7.5 m
Max. span length	28 m
Construction year	1998

Tynset Bridge



Total length	125 m
Max. span	70 m
Horizontal clearance	7 + 3 m
Construction year	2001

Gluelam.	400 m^3
Plank	200 m^3
Steel	95 tons

Tynset Bridge

Main span 70 m

Construction year 2001

Flisa Bridge

Expo 2010 – Norway pavilion

Norway Powered By Nature:

- Better city, Better life is the theme of the Expo 2010 in Shanghai.

Designed by the norwegian architect firm Helen & Hard

Expo 2010 – Norway pavilion

The pavilion is made up of 15 trees, each of them a functional part of the whole pavilion – like a forest.

The pavilion was awarded the Silver Medal at the Expo for Best Design.

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Expo 2010 – Norway pavilion

Expo 2010 – Norway pavilion

One tree:

- 9 glulam pieces

Expo 2010 – Norway pavilion

Expo 2010 – Norway pavilion

Norway pavilion - transportation

Norway pavilion - erection

Norway pavilion - erection

Norway pavilion - erection

Norway pavilion - erection

Expo 2010 – Norway pavilion

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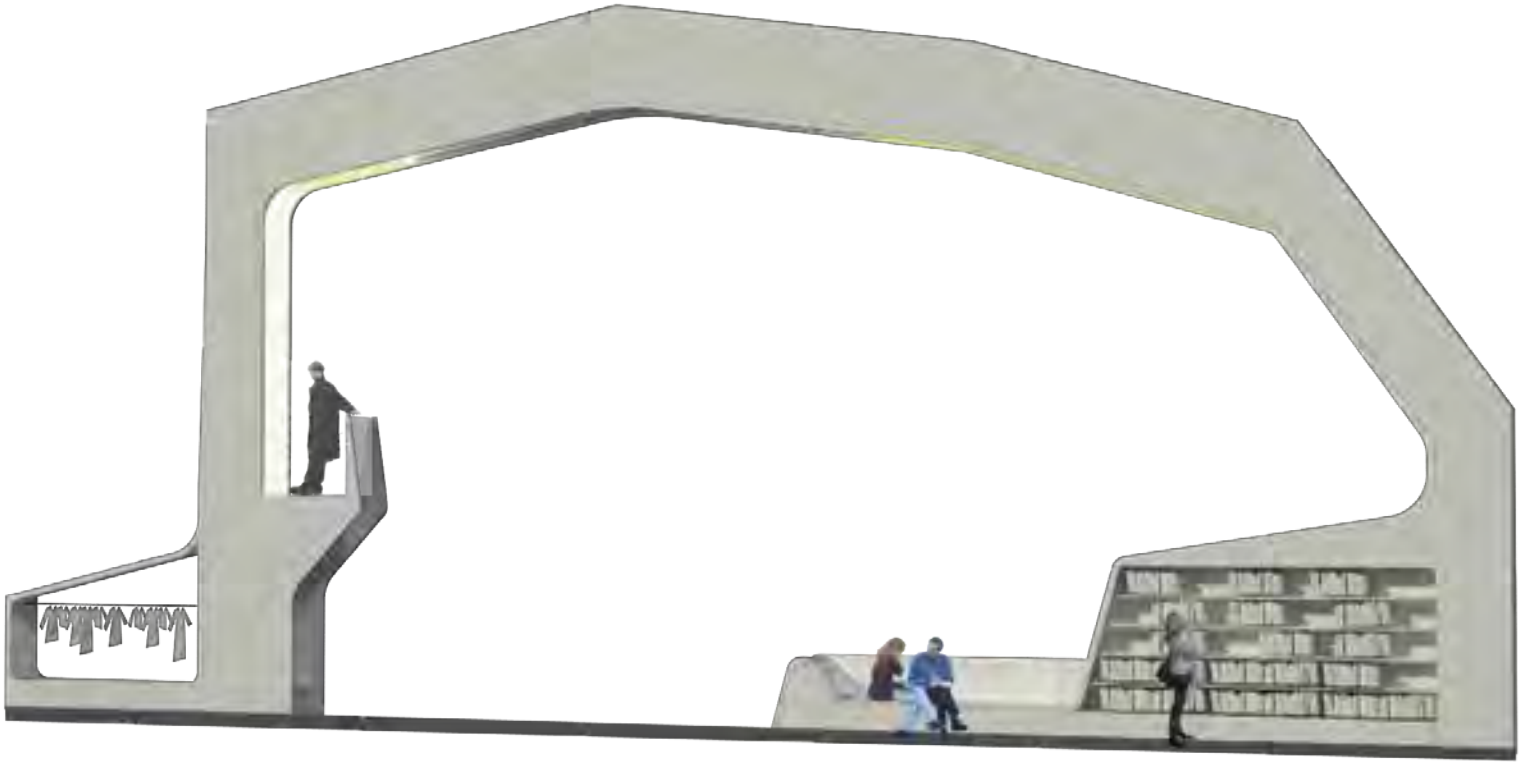
Vennesla Library

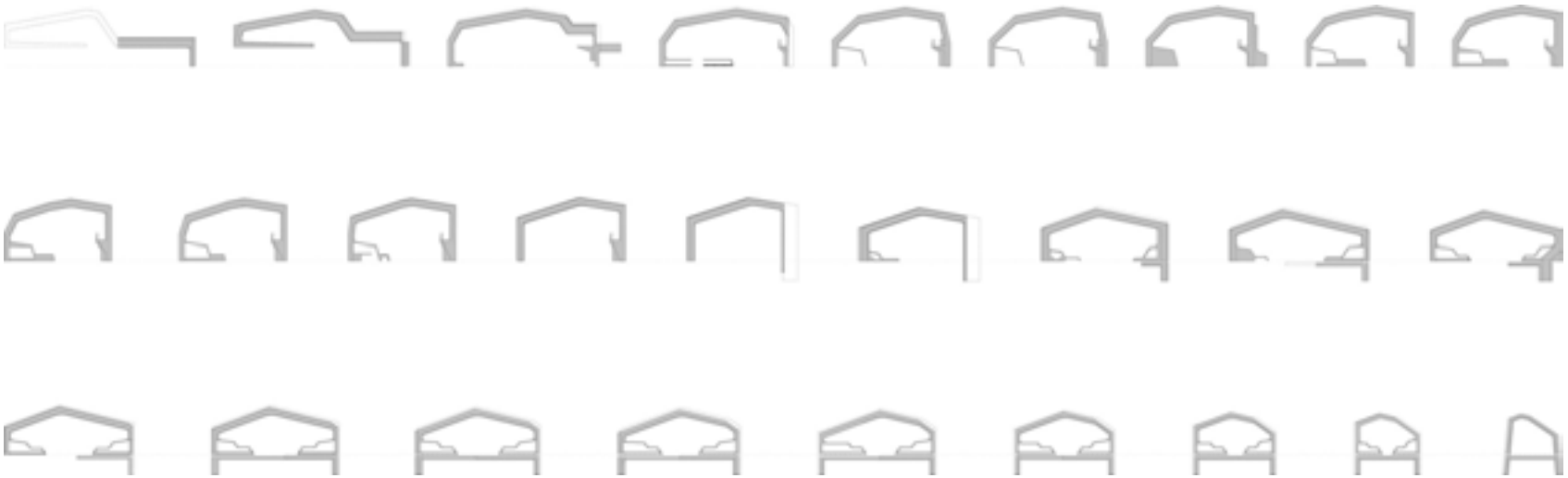
Architect:
HELEN & HARD AS

Vennesla Library



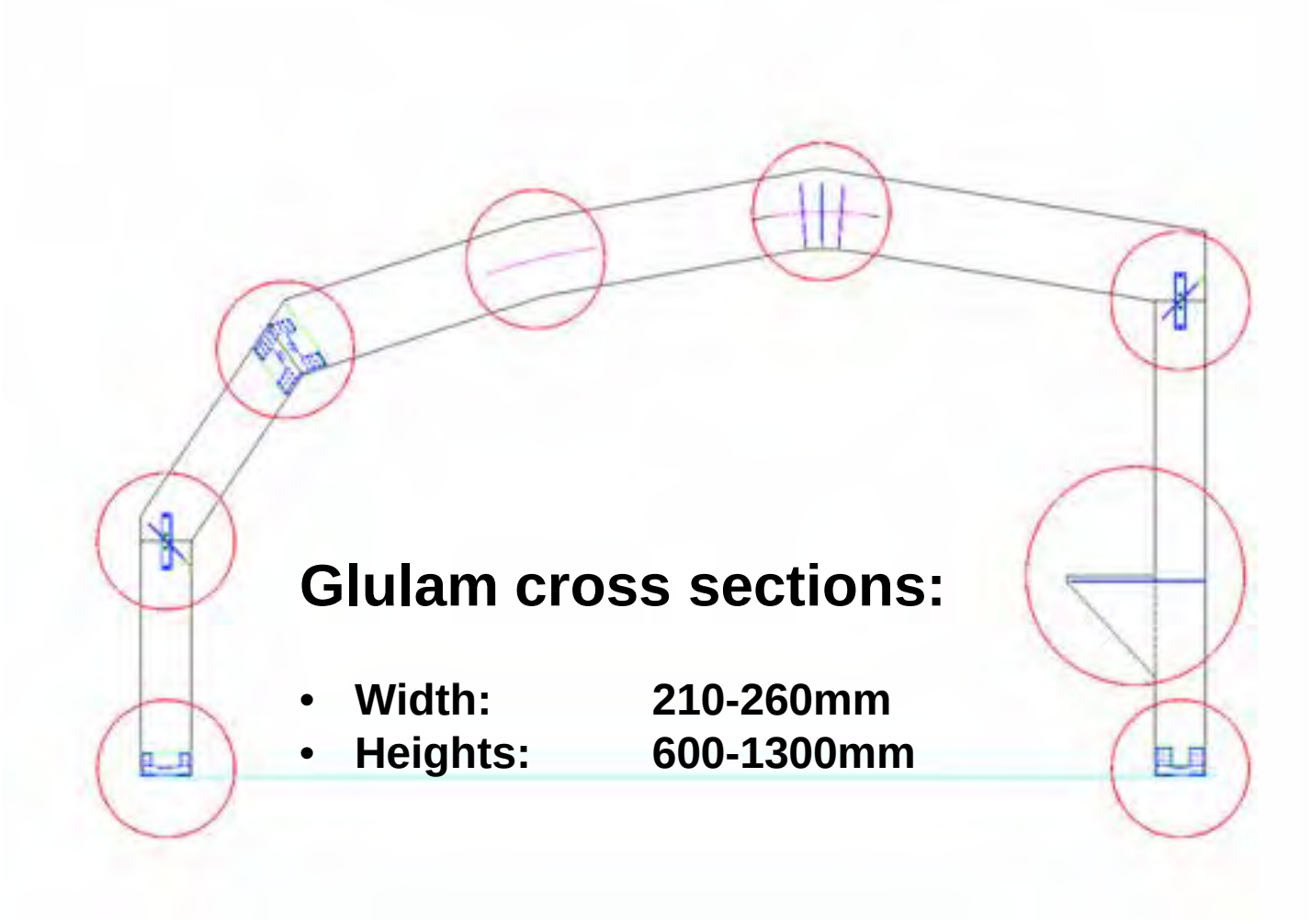
Typical glulam frame

Vennesla Library



27 different glulam frames !

Vennesla Library – solutions for joints



Glulam cross sections:

- **Width:** **210-260mm**
- **Heights:** **600-1300mm**

Vennesla Library – from building site

Vennesla Library

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Tidal power plant

- with wooden turbine blades

SCHWEIGHOFER PRIZE
2011

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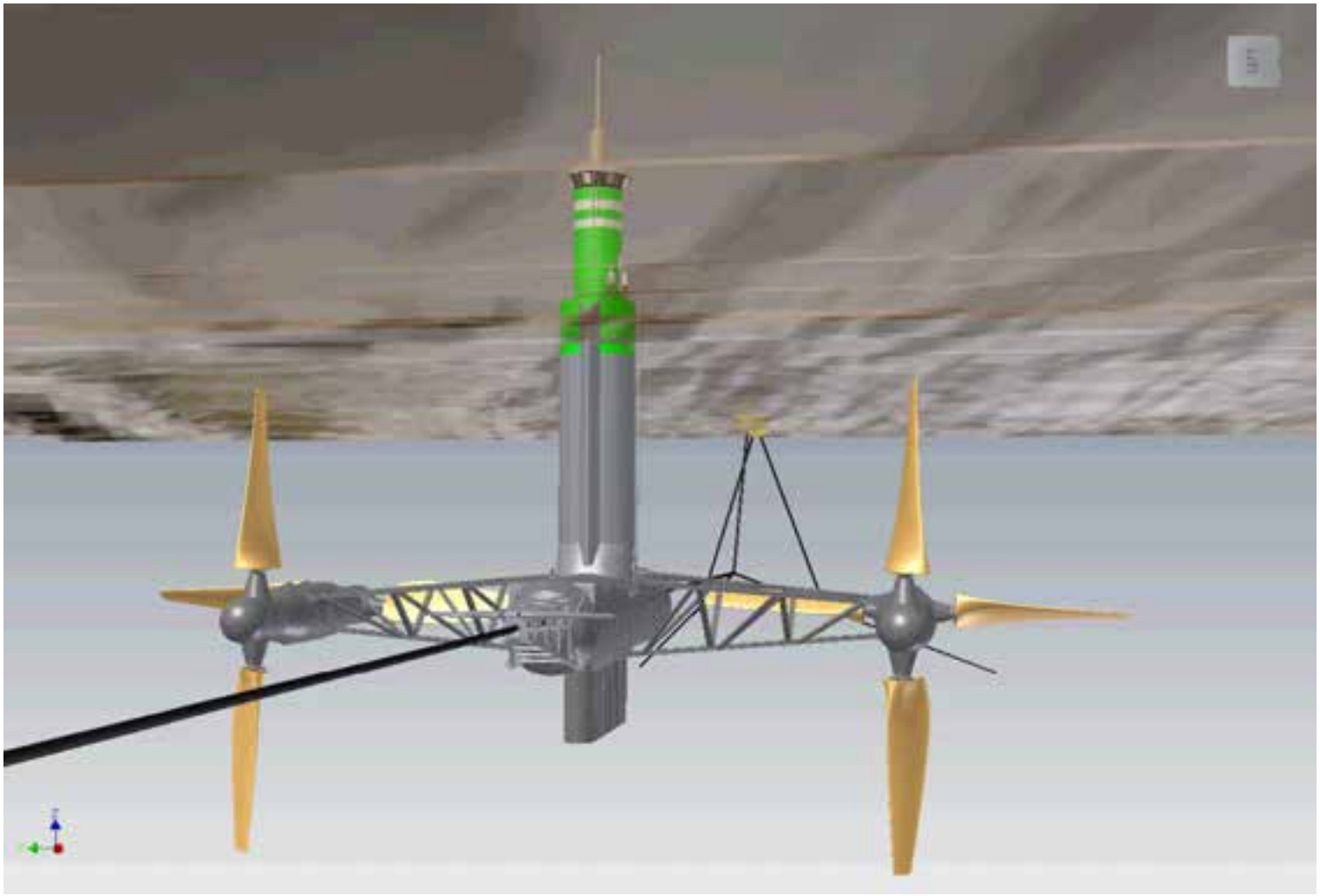
Tidal power plant



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Tidal power plant

The foundation and the business basics:

Ocean currents are formed by a complex interaction of temperature, osmotic pressure and winds. The Sun and the Moon´s gravitational pull on the Earth creates tidal currents.

The goal is to harness these massive and perpetual sources of energy with our unique floating power plant Morild II, and transform it into electricity.

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MORILD II: Tidal power plant

Since Hydra Tidal was founded in northern Norway in 2001, the design and technology of the MORILD tidal power plant has been re-engineered, developed and fine-tuned to meet any foreseeable challenge from the brutal forces of nature.

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MORILD II: Tidal power plant

In autumn 2010 the MORILD II tidal power plant, the first of its kind in the world, was successfully launched at sea and towed into location in the Gimsoy stream in Lofoten, Norway. In December 2010 the plant was thoroughly prepared, anchored and submerged into operational position.

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Tidal power plant

Hydra Tidal´s Morild II tidal power plant at-a-glance:

- **A unique and patented floating tidal power plant**
- **Prototype has an installed effect of 1,5 MW**
- **Annual production 5 GWh (the consumption of 300 households)**
- **Turbine diameter of 23 meters**
- **Each turbine pitch-controllable**
- **4 turbines with a total of 8 turbine blades**
- **Unique wooden turbine blades**
- **The MORILD II can be anchored at different depths, thus it can be positioned in spots with ideal tidal stream conditions**

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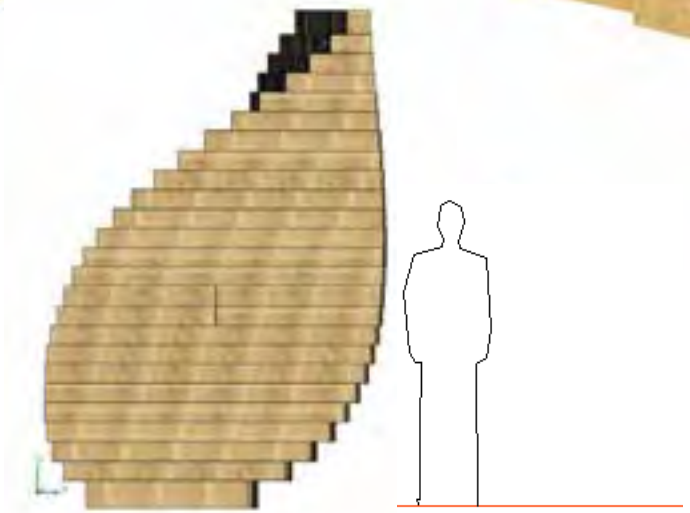
Turbine blades in laminated timber

Length: 10 m
Height: 3,0 m
Width: 1,8 m



Turbine blades in laminated timber

Benefits of wood:

- Wood submerged in salt water is a very durable material.
- Wood is an environmentally friendly material (renewable, binds CO_2), and will therefore help to further enhance the environmental profile of the project.
- The use of wood avoids fatigue, which is a major challenge when using composite, steel or other metals.
- Milling pine gives a smooth surface with little friction.
- Its saturated weight is approximately equal to the weight of water.
- At end-of-life, or if a blade should be permanently damaged, the remaining material can be used for heating the production plant, thus avoiding difficult or costly disposal.

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Production

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Tidal power plant

-anchored in Gimsøystraumen

Tidal power plant
- the future

The pilot tidal power plant will have an annual power output of 5 GWh, which is the equivalent of the annual electricity consumption of about 300 households. The total output potential for tidal power plants along the Norwegian coast is enormous, estimated at 30 TWh. Development of one-third of this translates into a consumption of about 240 000 m3 of glulam. This amounts to 1% of the potential international market.

A test group of six power plants is expected to be built during 2012. If these are successful, production will subsequently increase and could reach up to 200 power plants annually.

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Tidal power plant

Consequences for the European Forest Based Sector

- **Volume of glulam**
  1 % of the international market
- **Marketing of wood**
  New application for glulam
- **Contributions to clean energy**
  Wood are not only suitable for bioenergy but may be an integral part in other area of renewable energy

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Innovative glulam structures in Norway

Thank you for your attention !

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