

Large Timber Structures in Norway

Riga 2006-10-17

Tallin 2006-10-18

Erik Aasheim



Long traditions in Norway



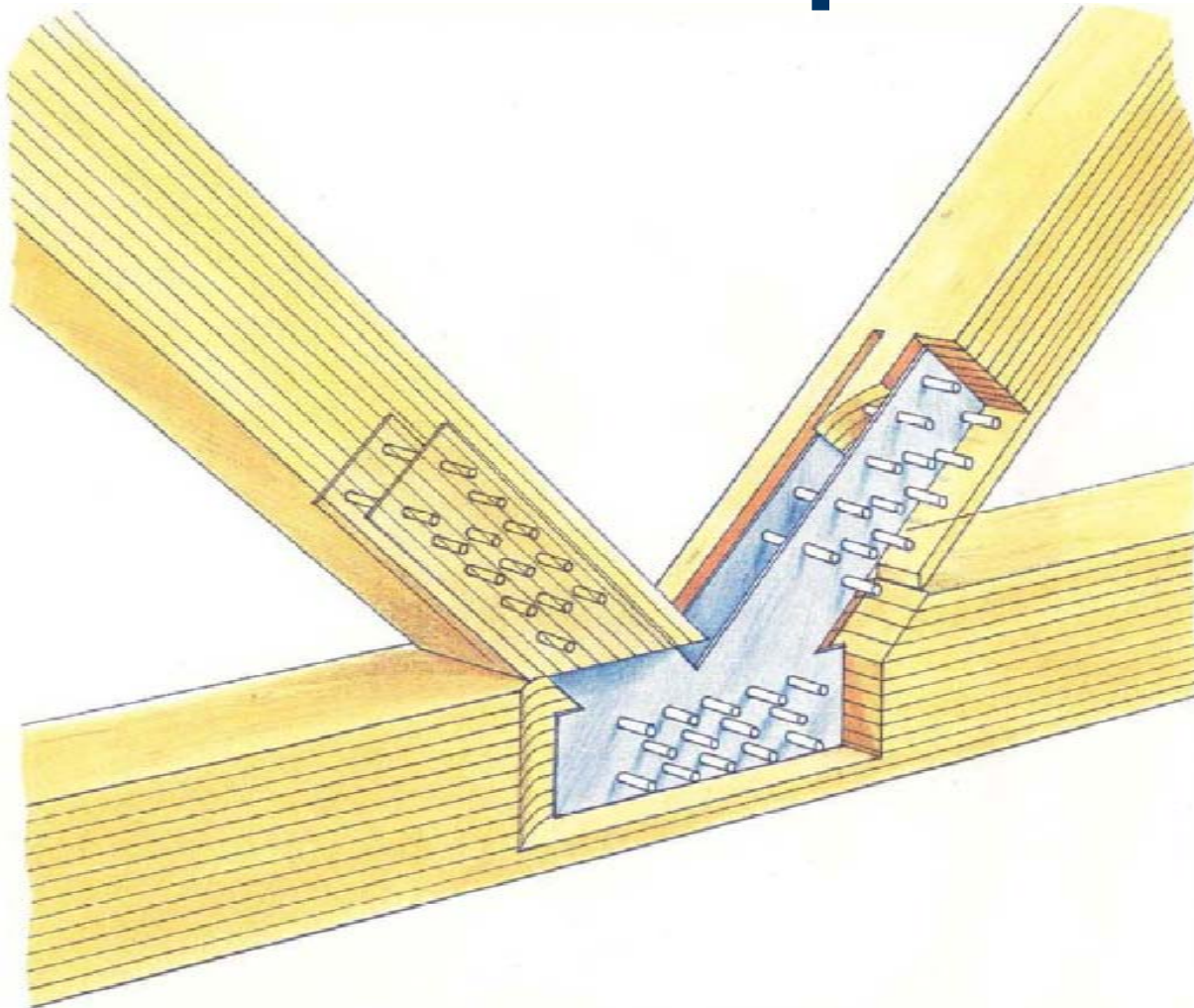
Large Timber Structures in Norway

- 1. Structures for the 1994 Winter Olympics**
- 2. Structures for Oslo Airport Gardermoen**
- 3. Timber Bridges**

1994 Winter Olympics

- Lillehammer February 1994
- Glulam structures up to 100 m
- Effective jointing system
- Fire resistance minimum 60 minutes

Steel dovels and slotted in steel plates

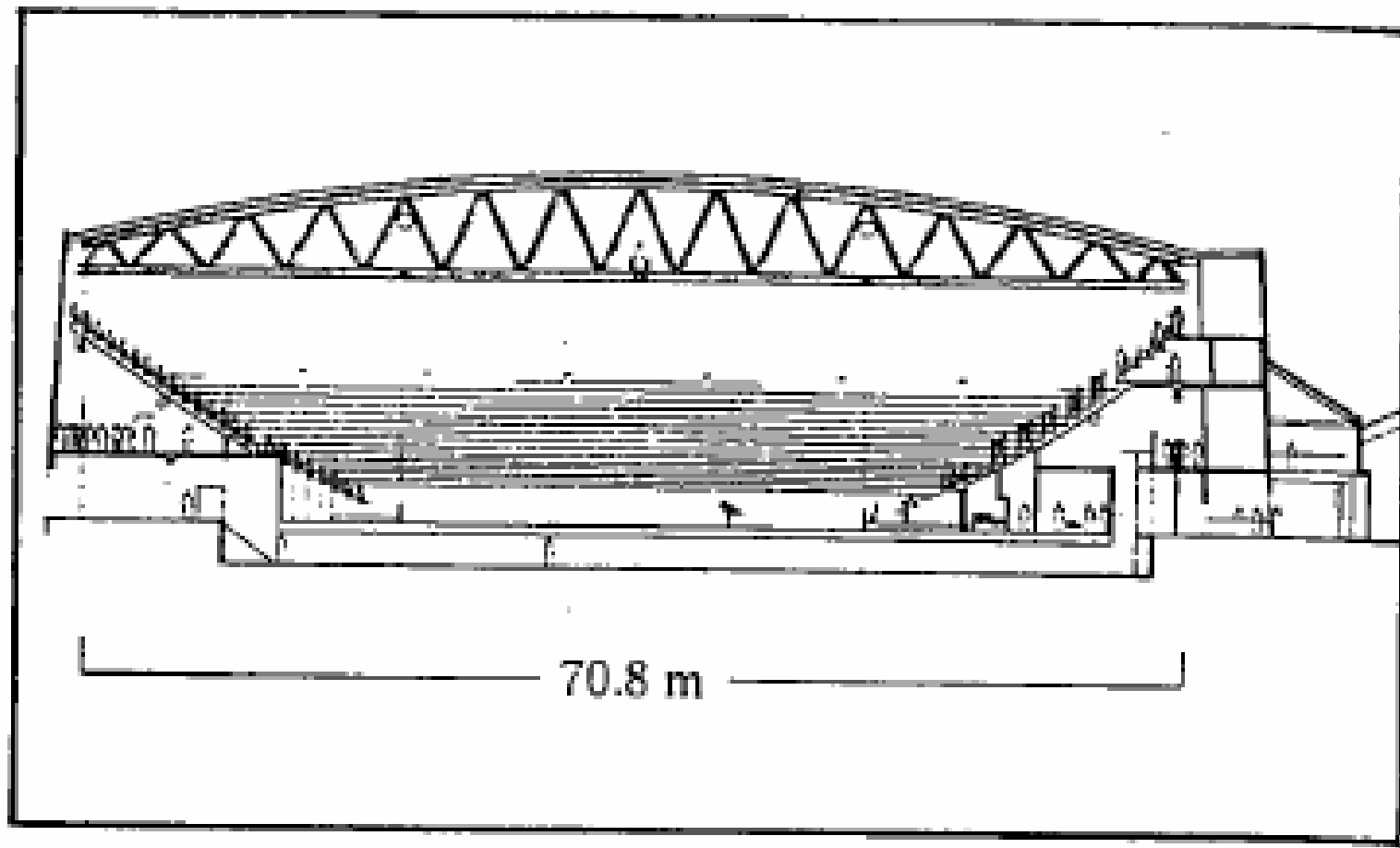




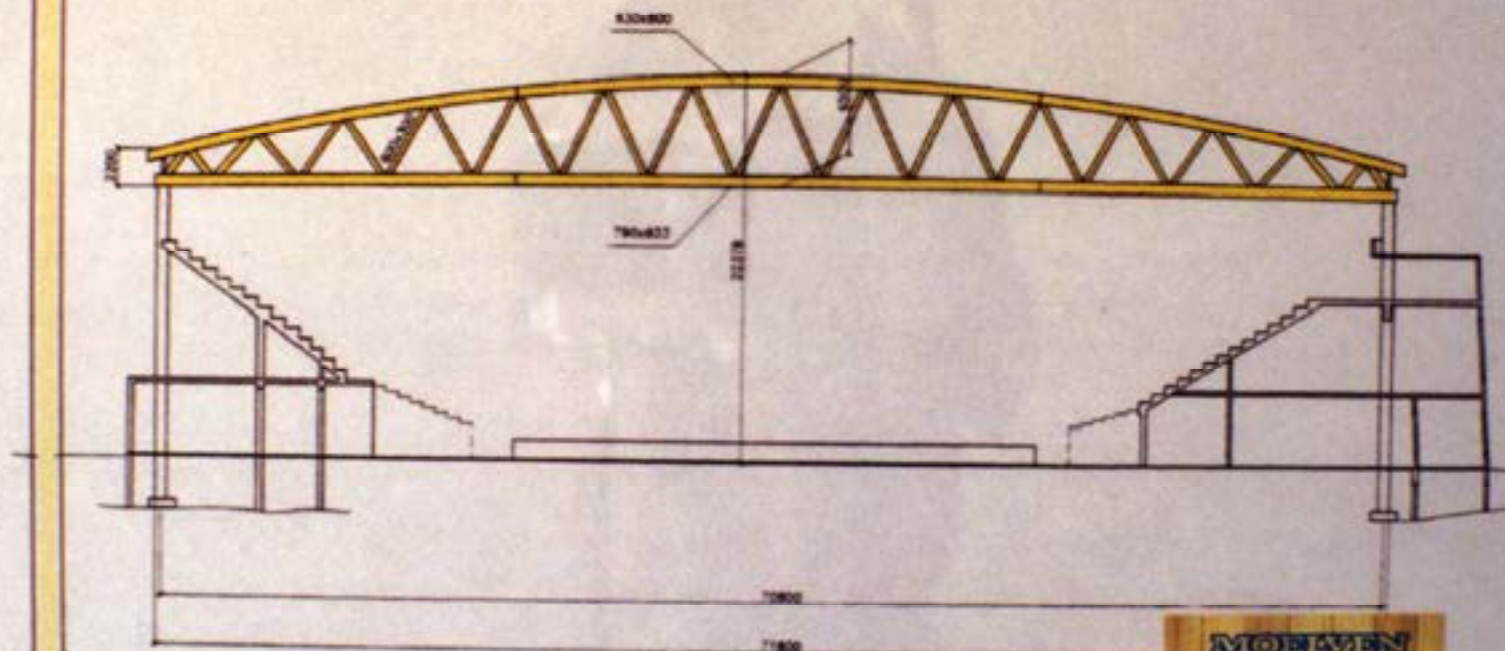
1994 Winter Olympics

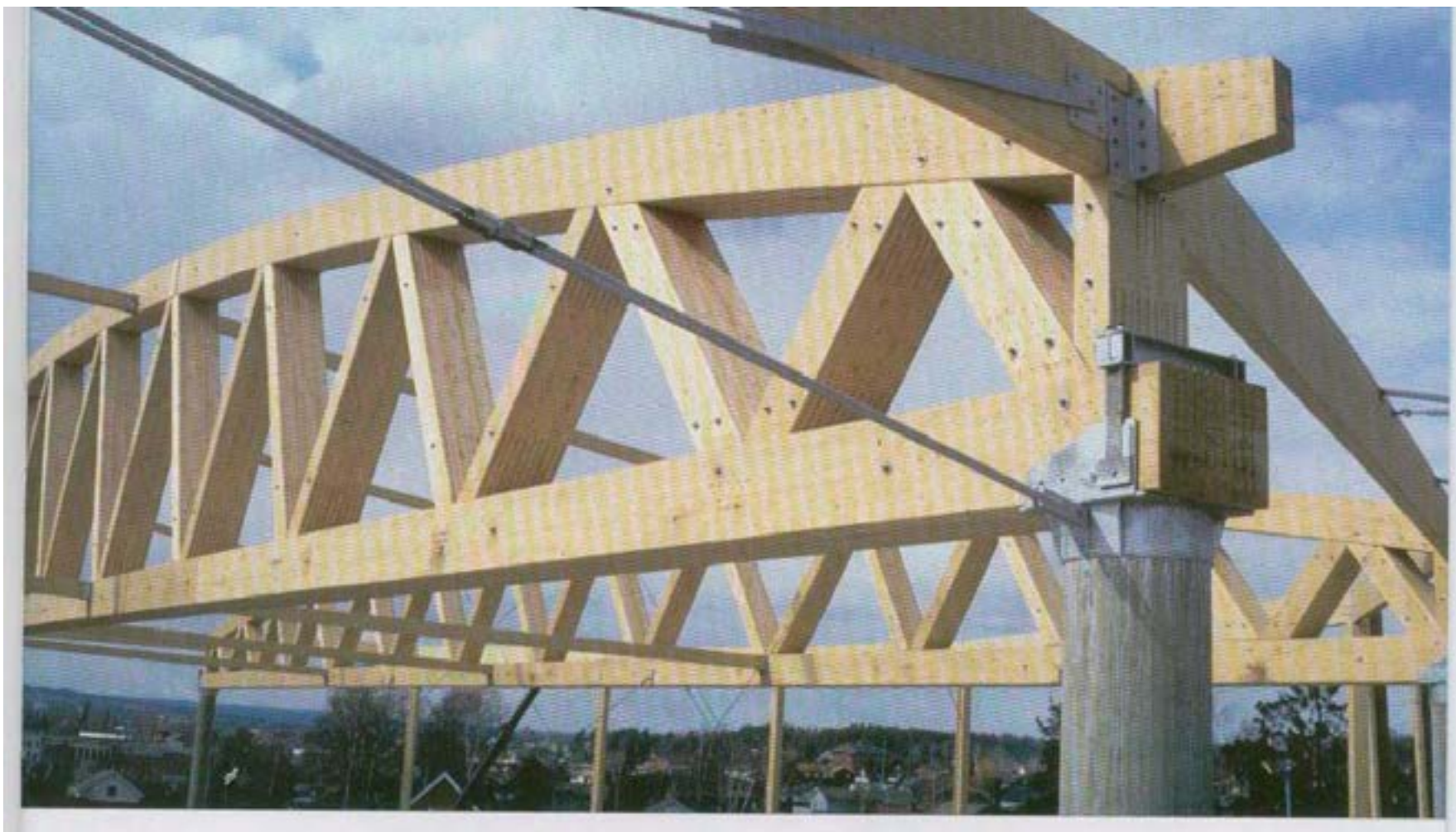
- **Hamar Olympic Amphitheatre**
- **Håkon's Indoor Stadium**
- **Hamar Olympic Stadium (The Viking Ship)**

Hamar Olympic Amphitheatre



Hamar Olympic Amphi



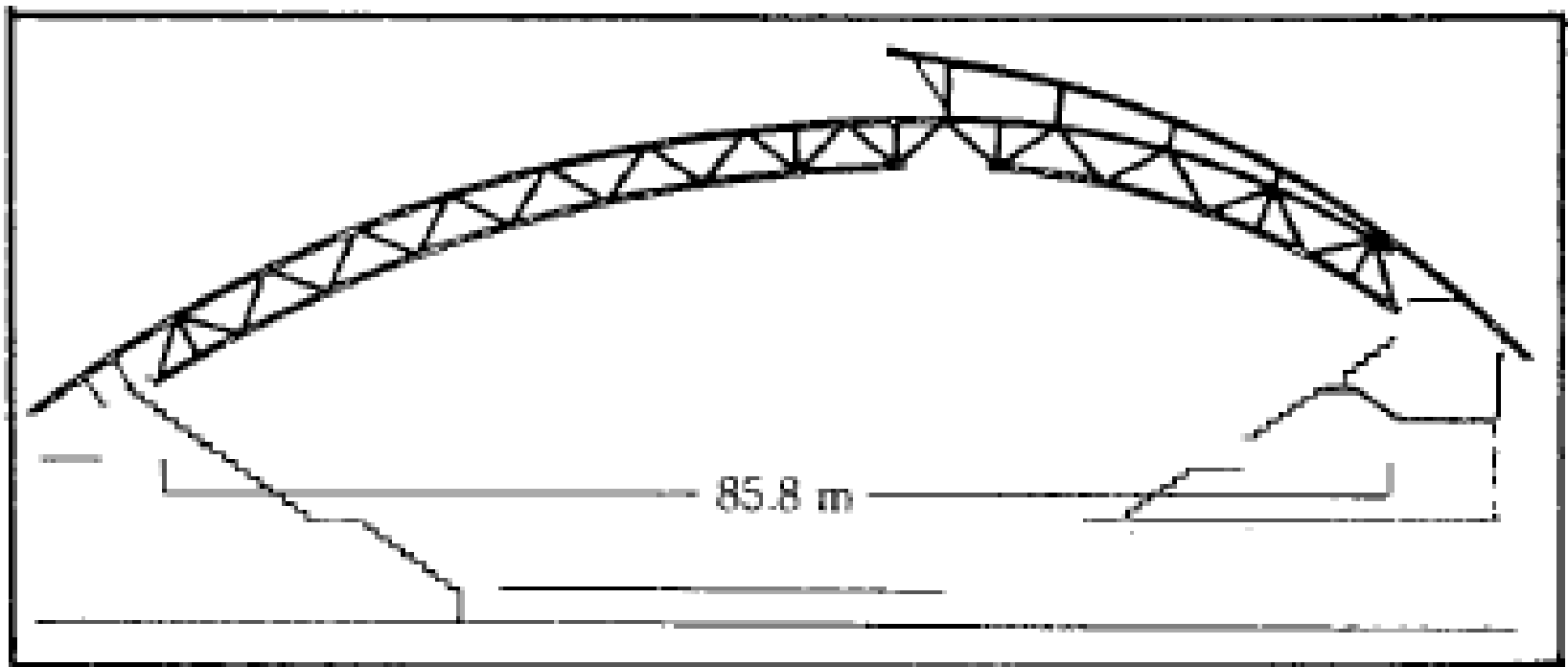






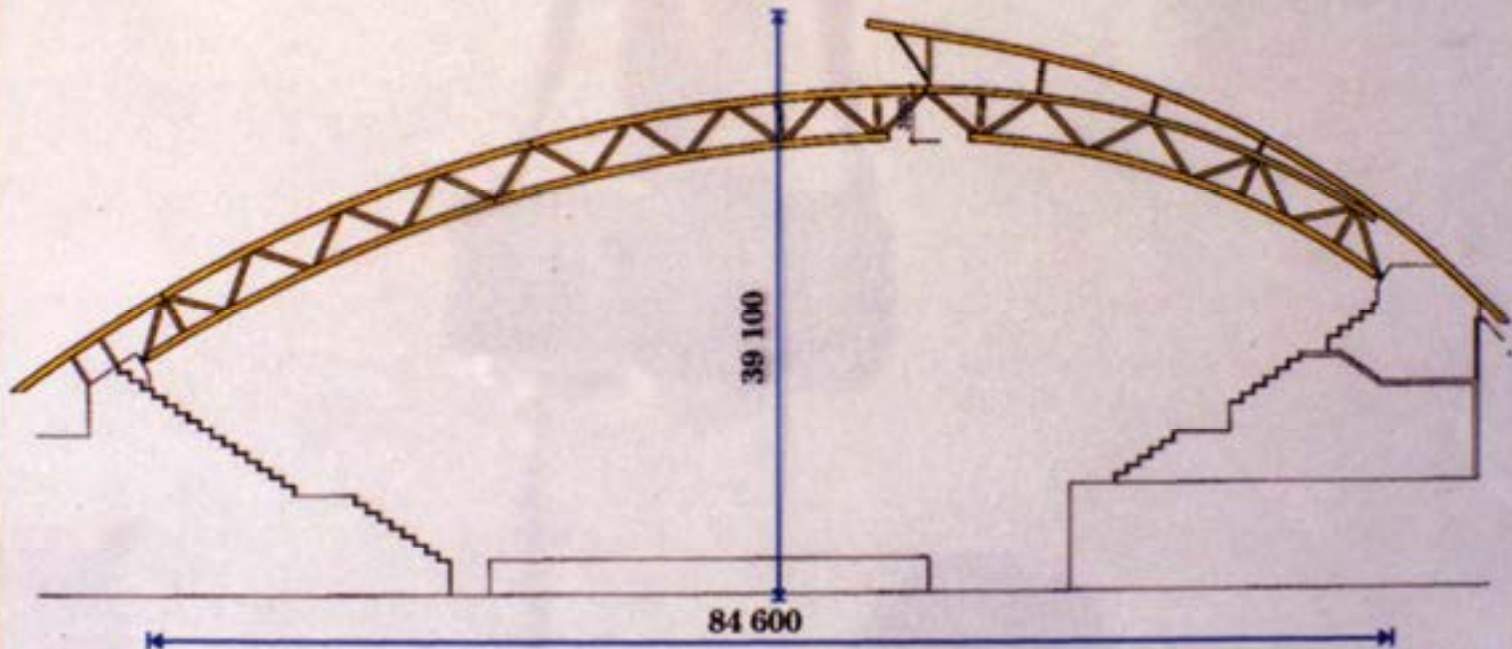


Håkon's Indoor Stadium



Håkon`s Indoor Stadium

LILLEHAMMER

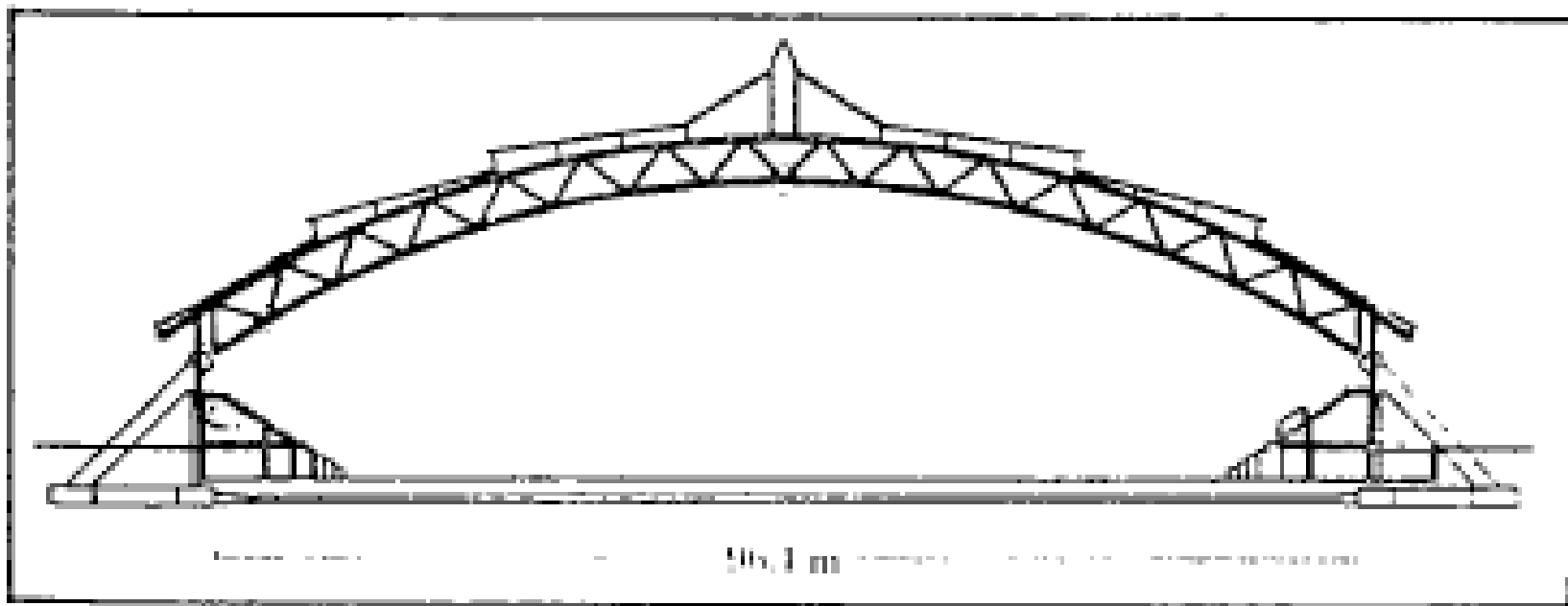






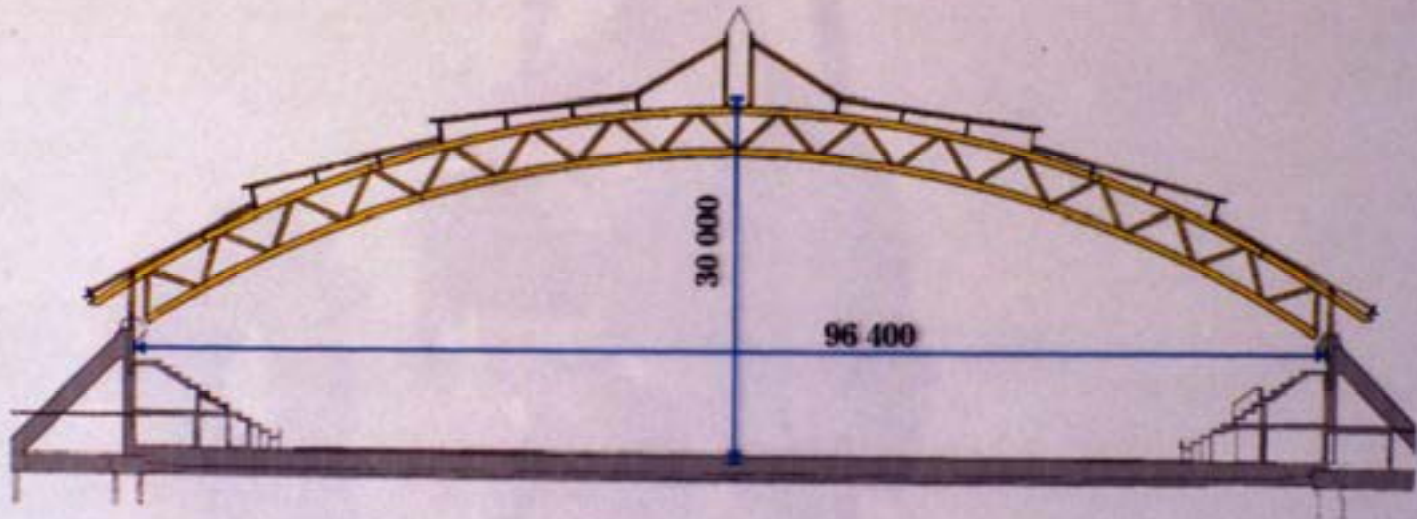






Hamar Olympic Indoor Stadium

The Viking Ship





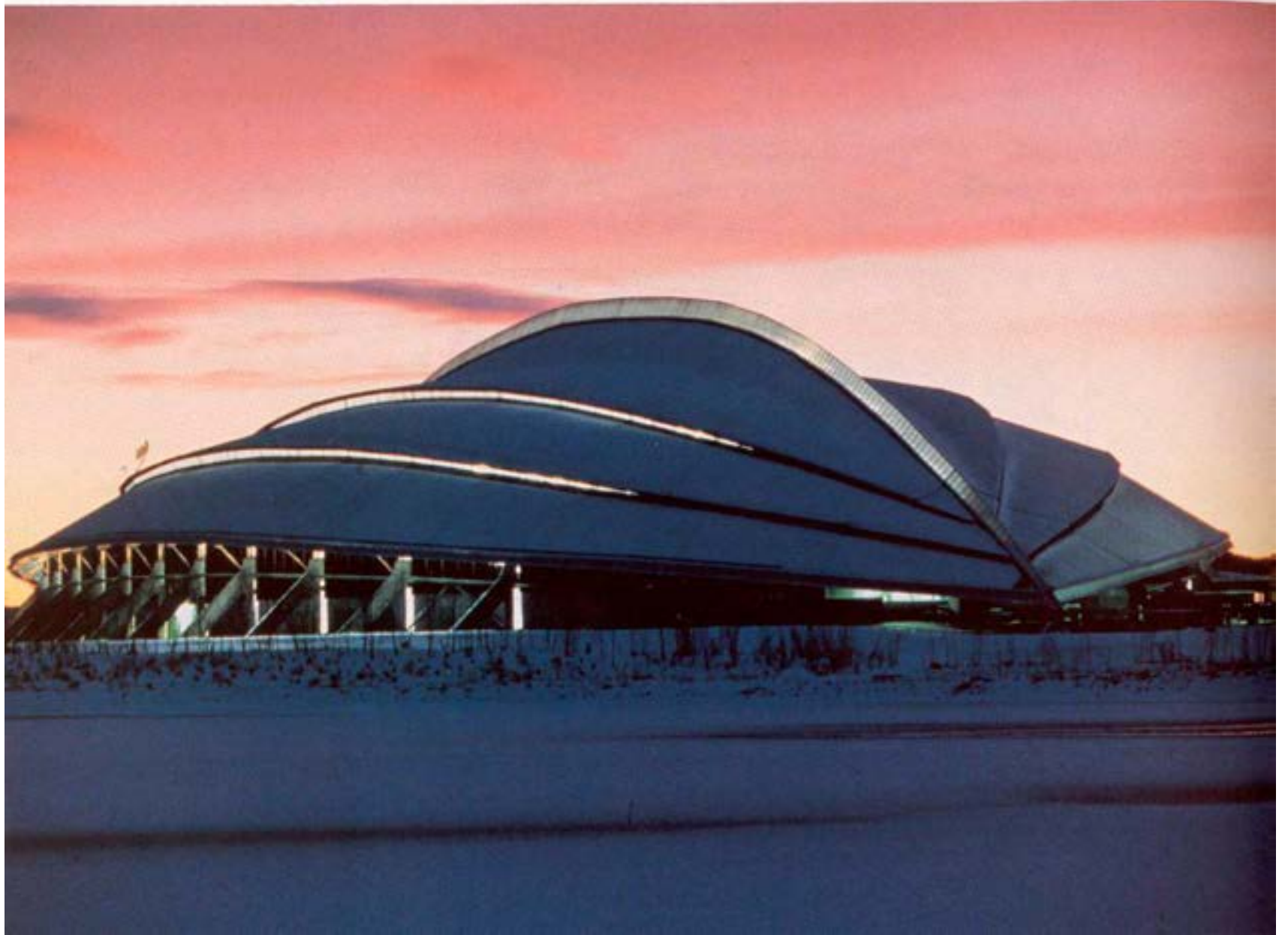
HÅMAR OLYMPIAHALL
Byggetid: 1968-1970
Arkitekt: A. Ryland
Byggherre: Håmar kommune
Byggeteknik: Treteknisk







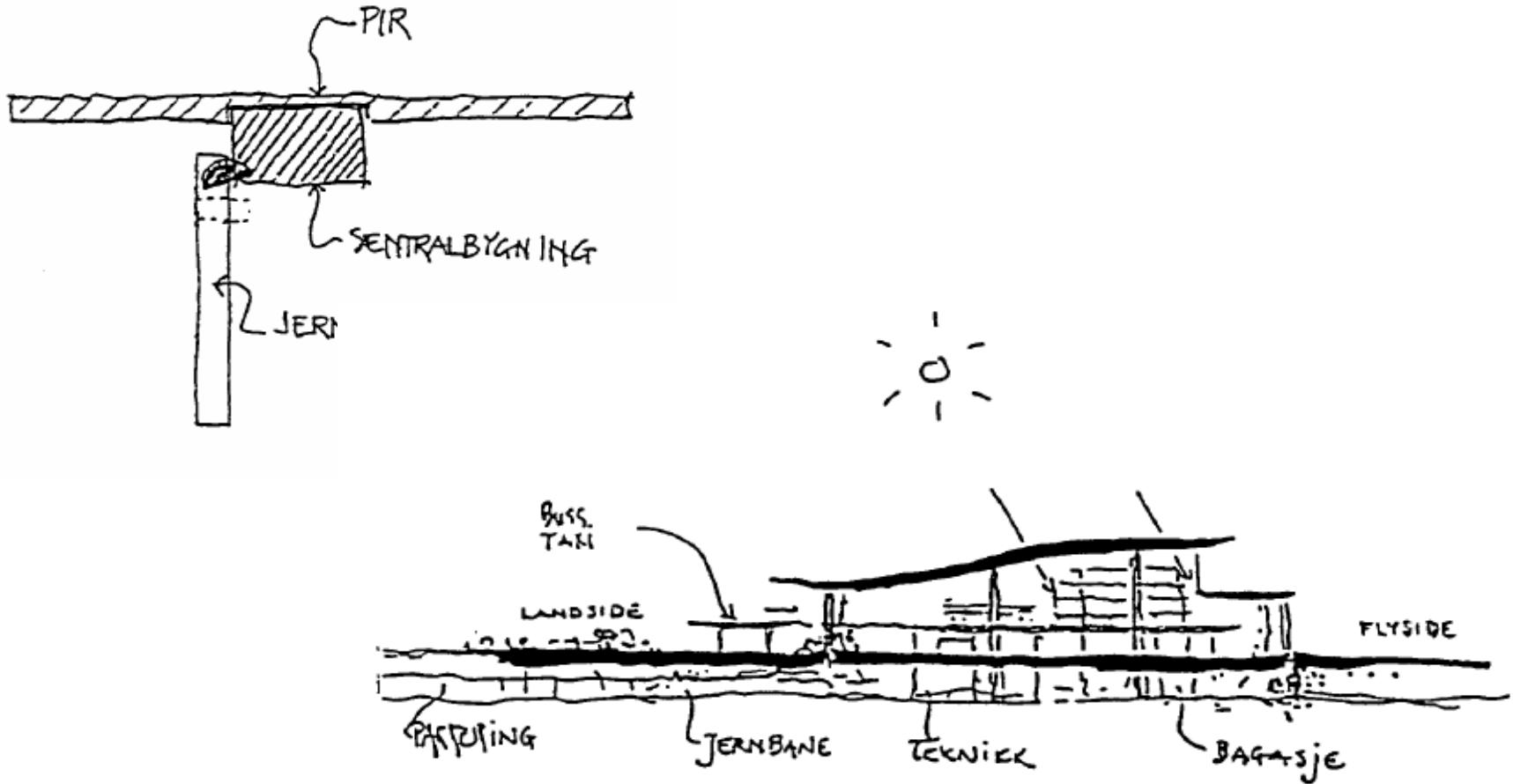




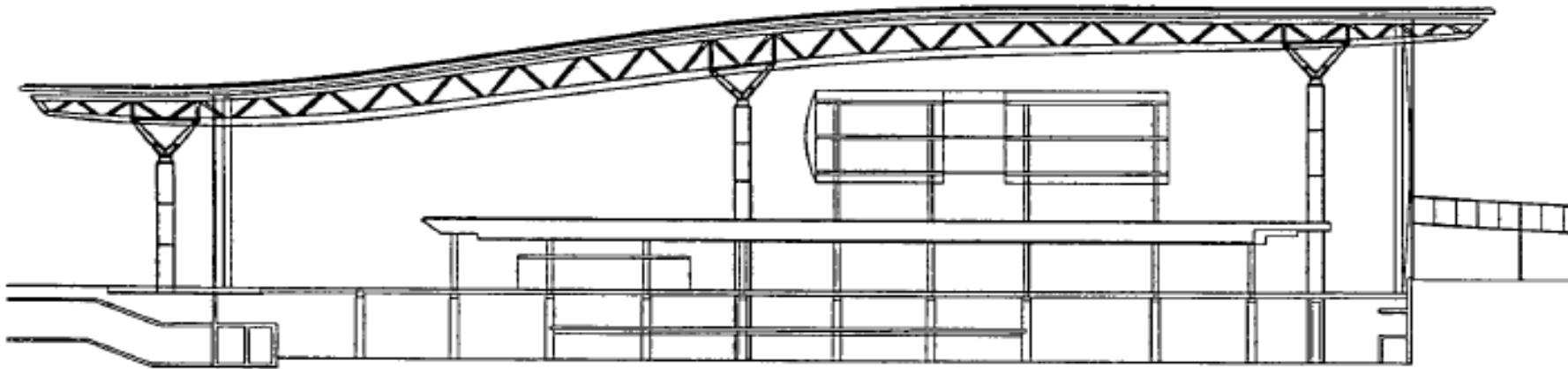
Oslo Airport Gardermoen

- 50 km north of Oslo
- 25 years discussions and planning
- Airport based on national traditions
- Opened in 1998

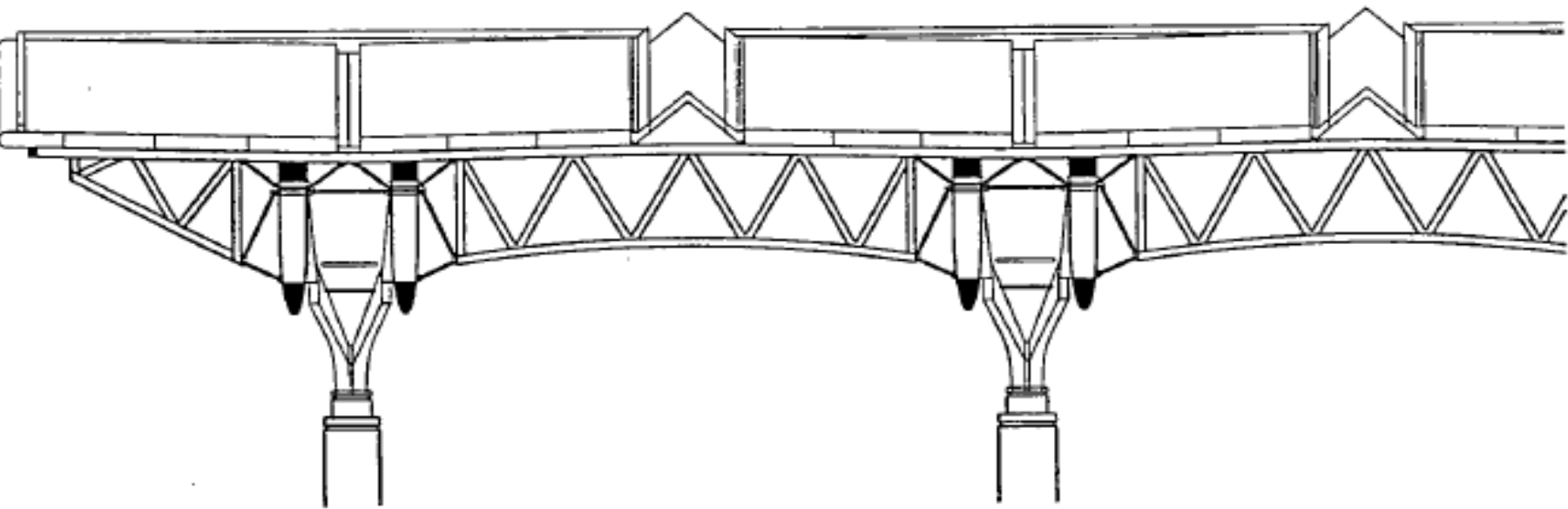
Very early sketches



Main glulam structure



Secondary glulam structure





















Timber Bridges

- **Nordic Timber Bridge Program**
- **Good cooperation with authorities**
- **Good chemical protection**
- **Many long new bridges**
- **Monitoring program**

Holmen Footbridge

- **Opened 1993**
- **Span: 40 m**
- **Length: 60 m**
- **Creosote impregnated**









Evenstad Bridge

- **Opened 1996**
- **Spans: 5 x 36 meters**
- **Stress laminated deck** (planks 28 x 223 mm)
- **Creosote impregnated**











Fønhus Bridge

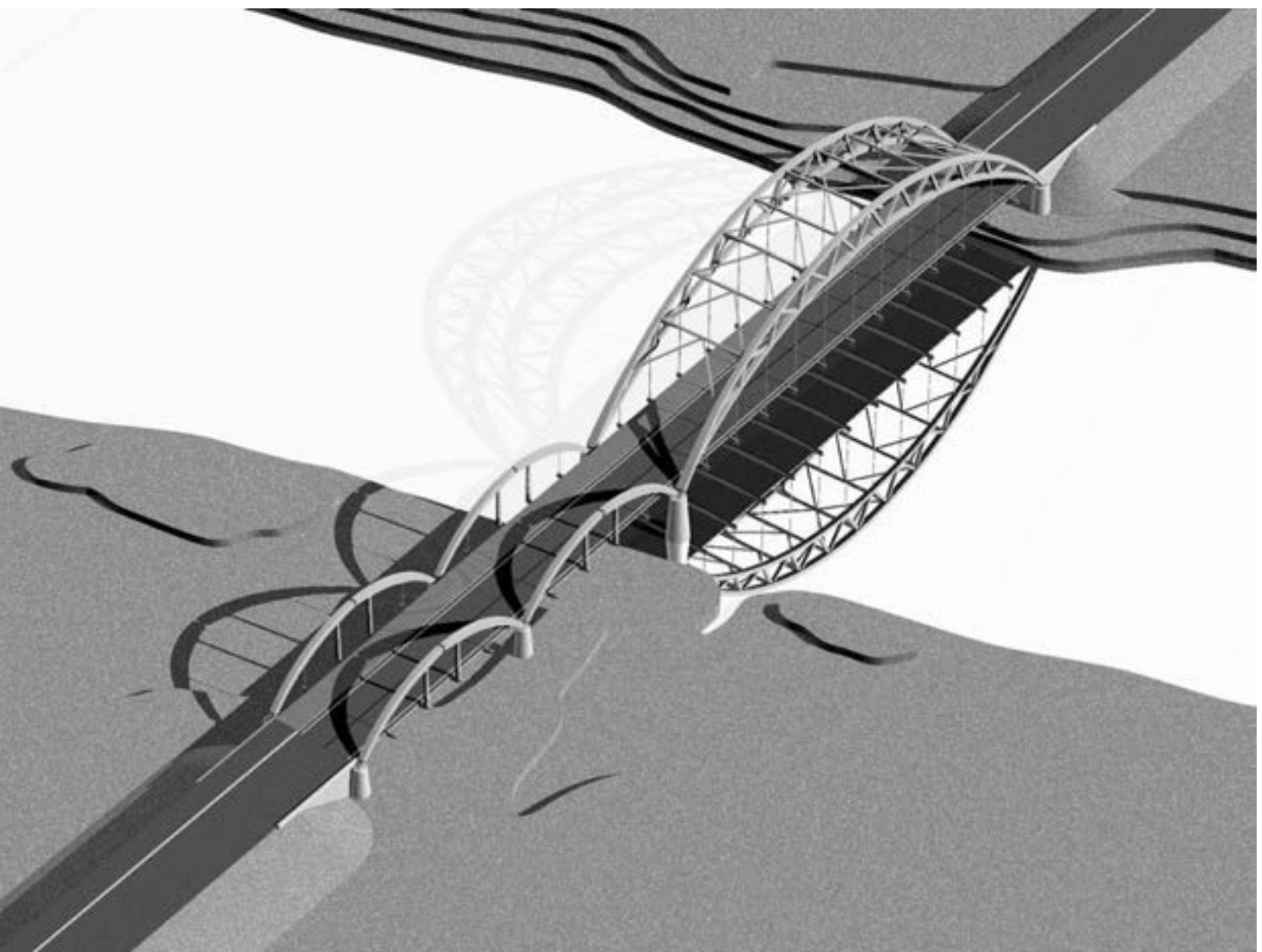
- **Opened 1998**
- **Span: 35 meters**
- **Stress laminated deck**
- **Double impregnation**

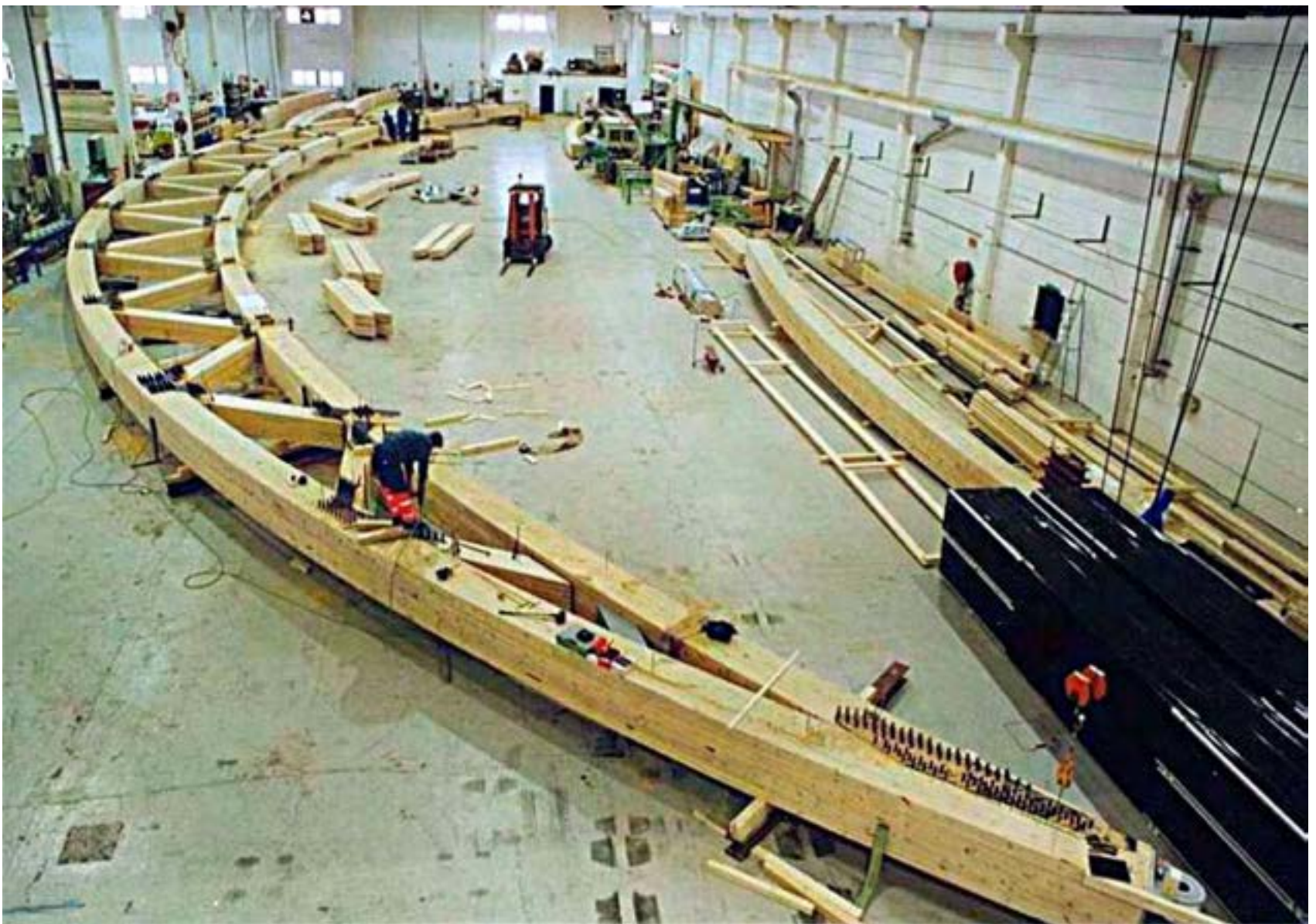




Tynset Bridge

- **Opened 2001**
- **Spans: 27 + 27 + 70 meters**
- **Stress laminated deck**
- **Double impregnation**













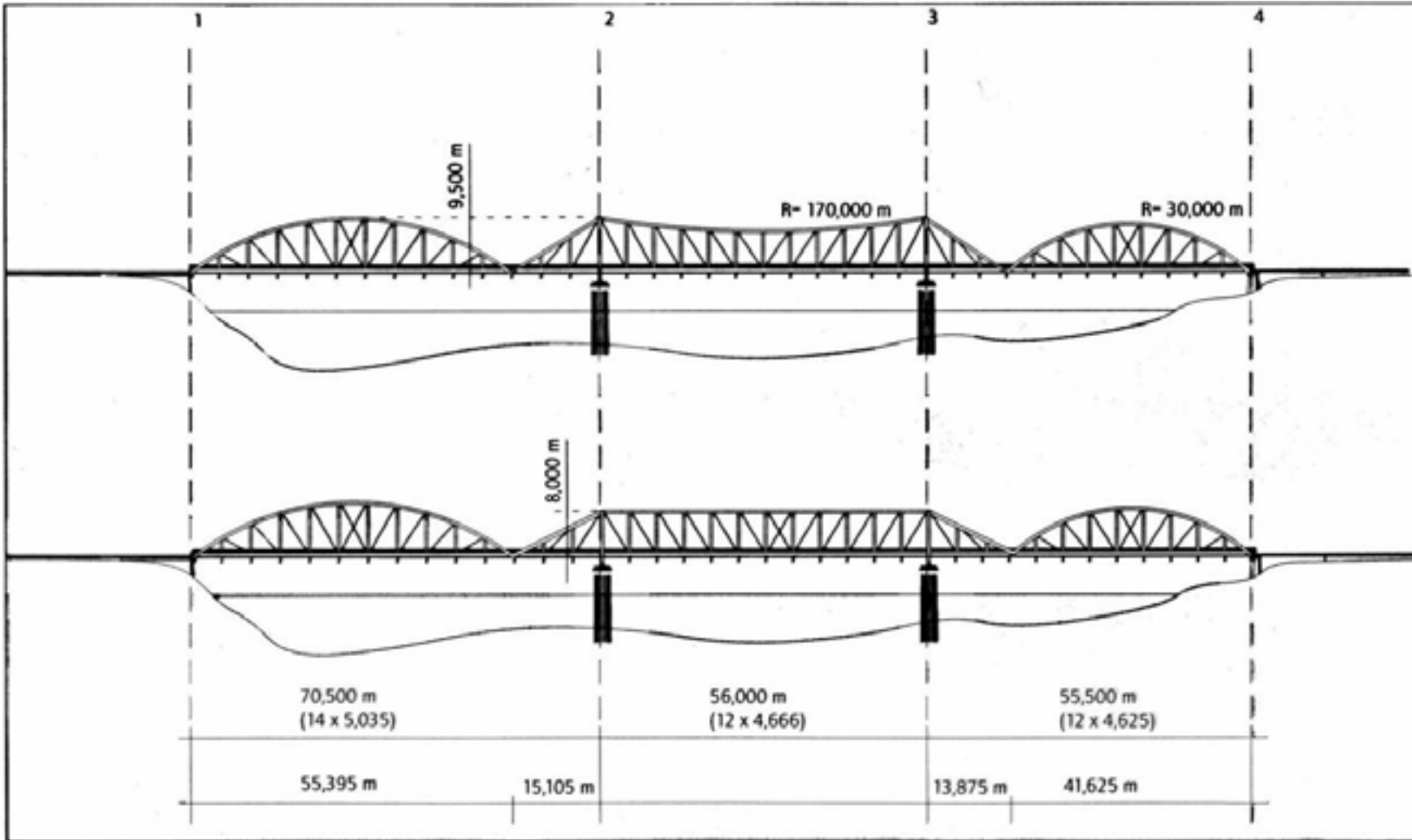


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Flisa Bridge

- **Constructed:** Spring 2003
- **Total length:** 181.5 m (trusses) and 196.0 m (deck)
- **Spans:** 55.2 + 56.0 + 70.3 m
- **Structural system:** Glulam trusses
- **Bridge deck:** Stress laminated 48 x 223 mm timber deck
- **Wood treatment:** The trusses are double impregnated with CCA, and with creosote with reduced absorption. The deck planks are treated with creosote

















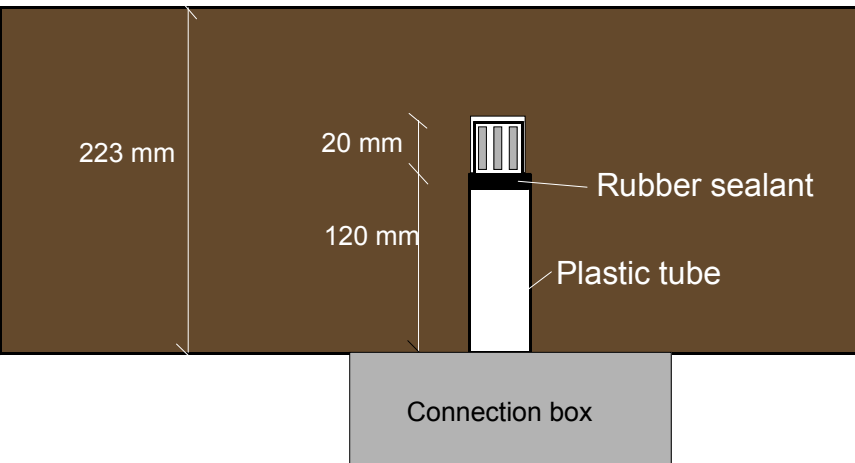
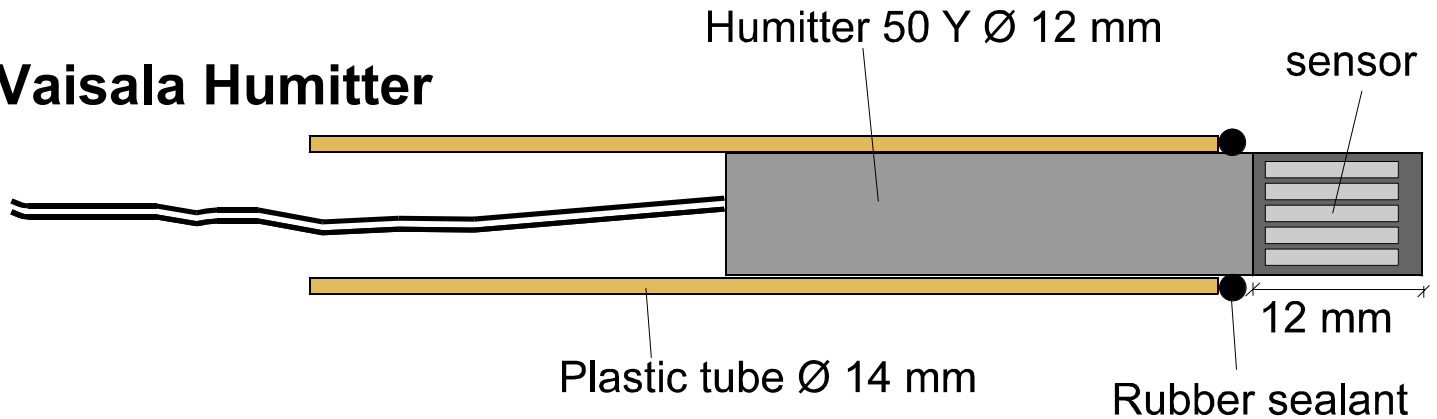






Instruments

- **Vaisala Humitter**



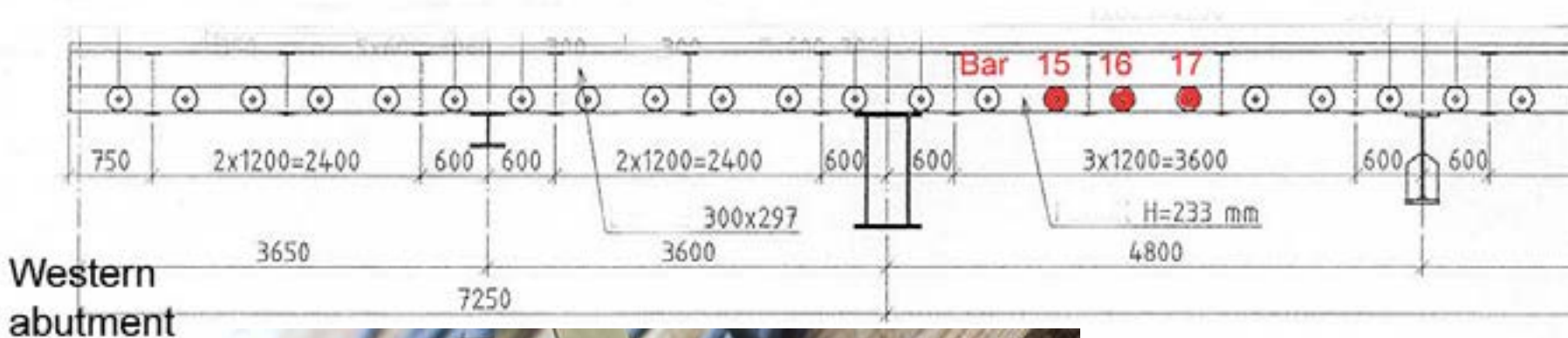
The MC-equation

$$MC = (5RH^3 - (589.1 - 0.76t)RH^2 + 100(370.1 - 0.7t)RH - 100(564.9 - 6.8t))10^{-5}$$

MC = moisture content in %, RH = relative humidity in % and t = temperature in °C.

Instruments

- Load cell Hottinger CR 6



Installation



Load cell

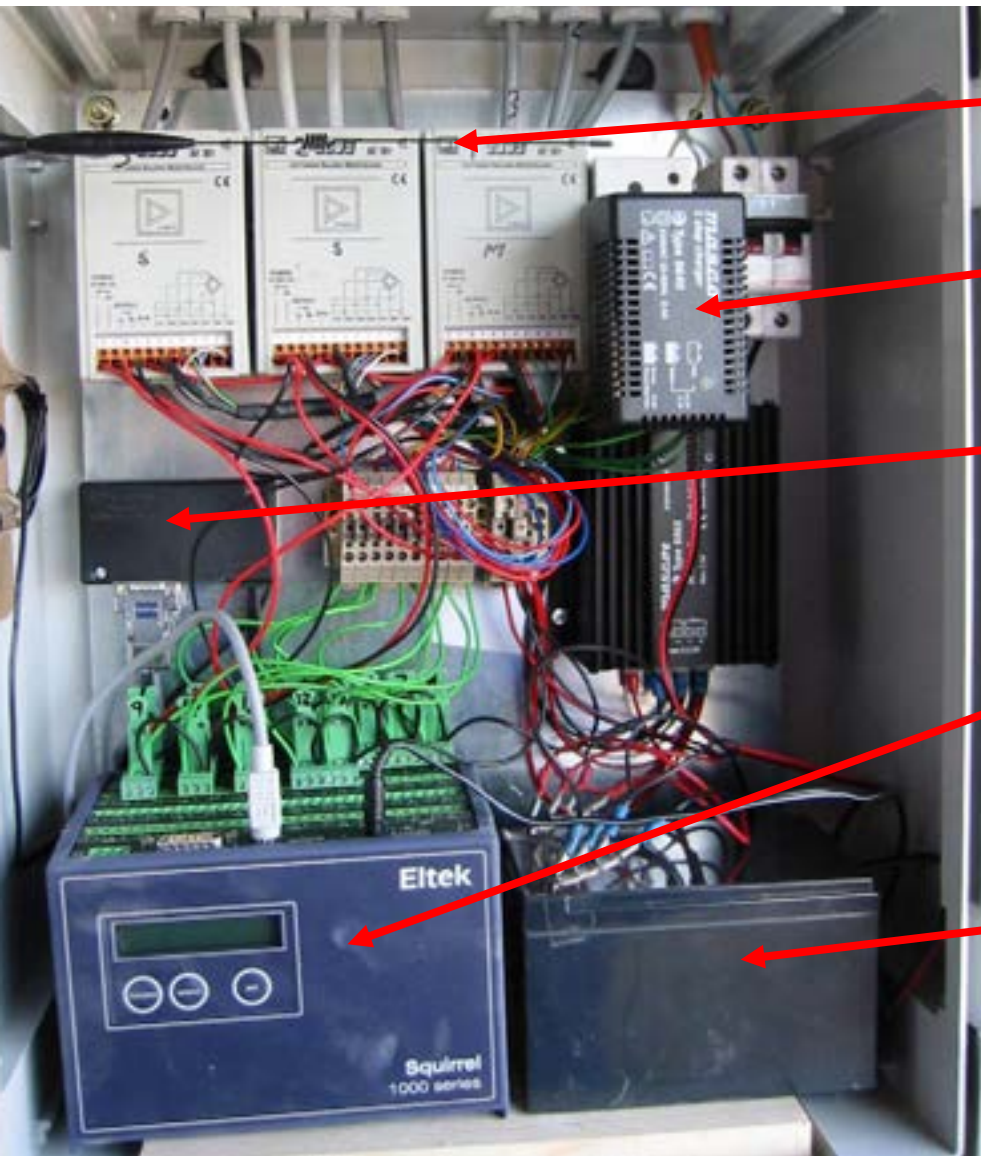
Air (temp/RH)



Dummy

Humitters

Transmission of data



Antenna

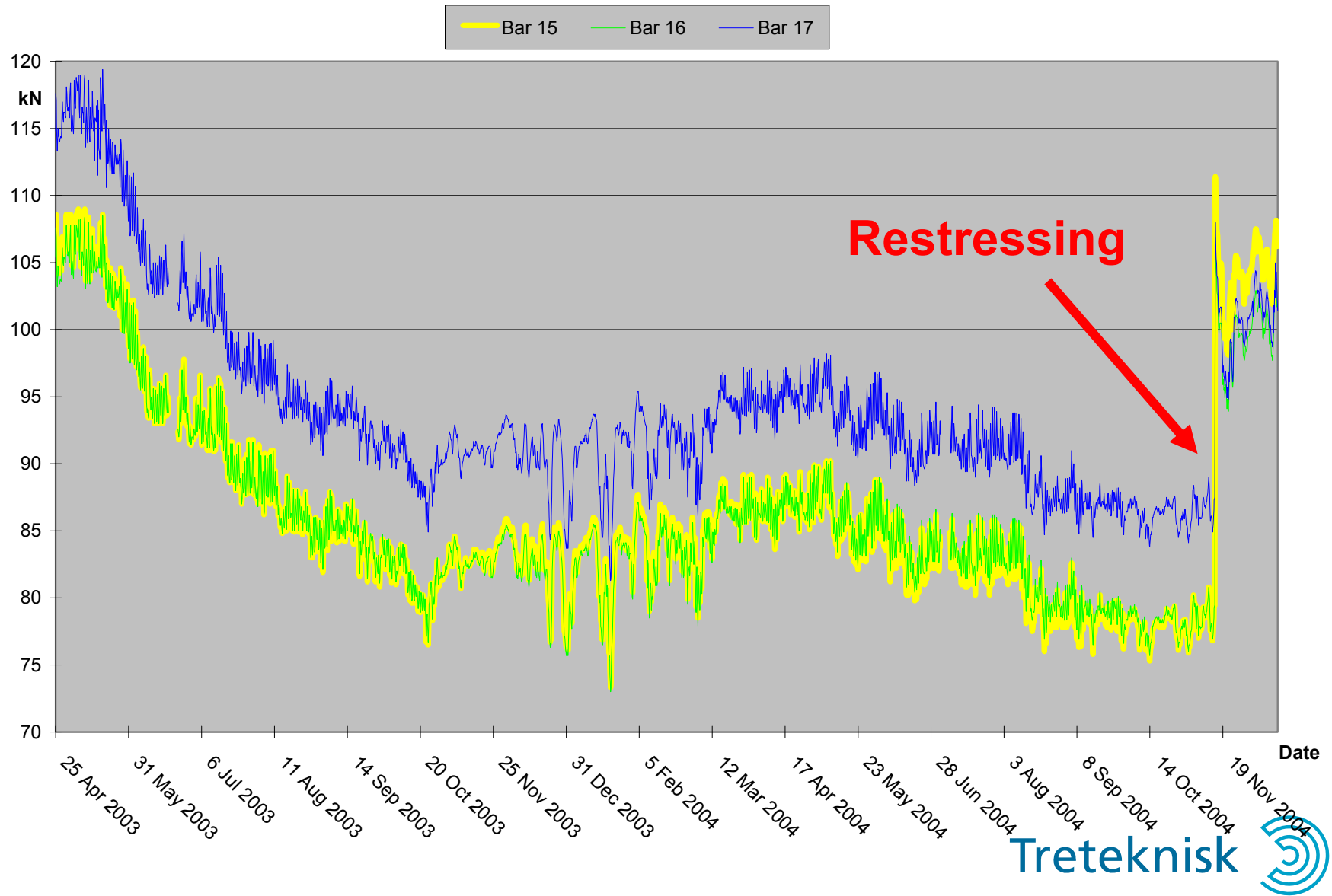
El. charger

Mobil phone

Data logger

Battery

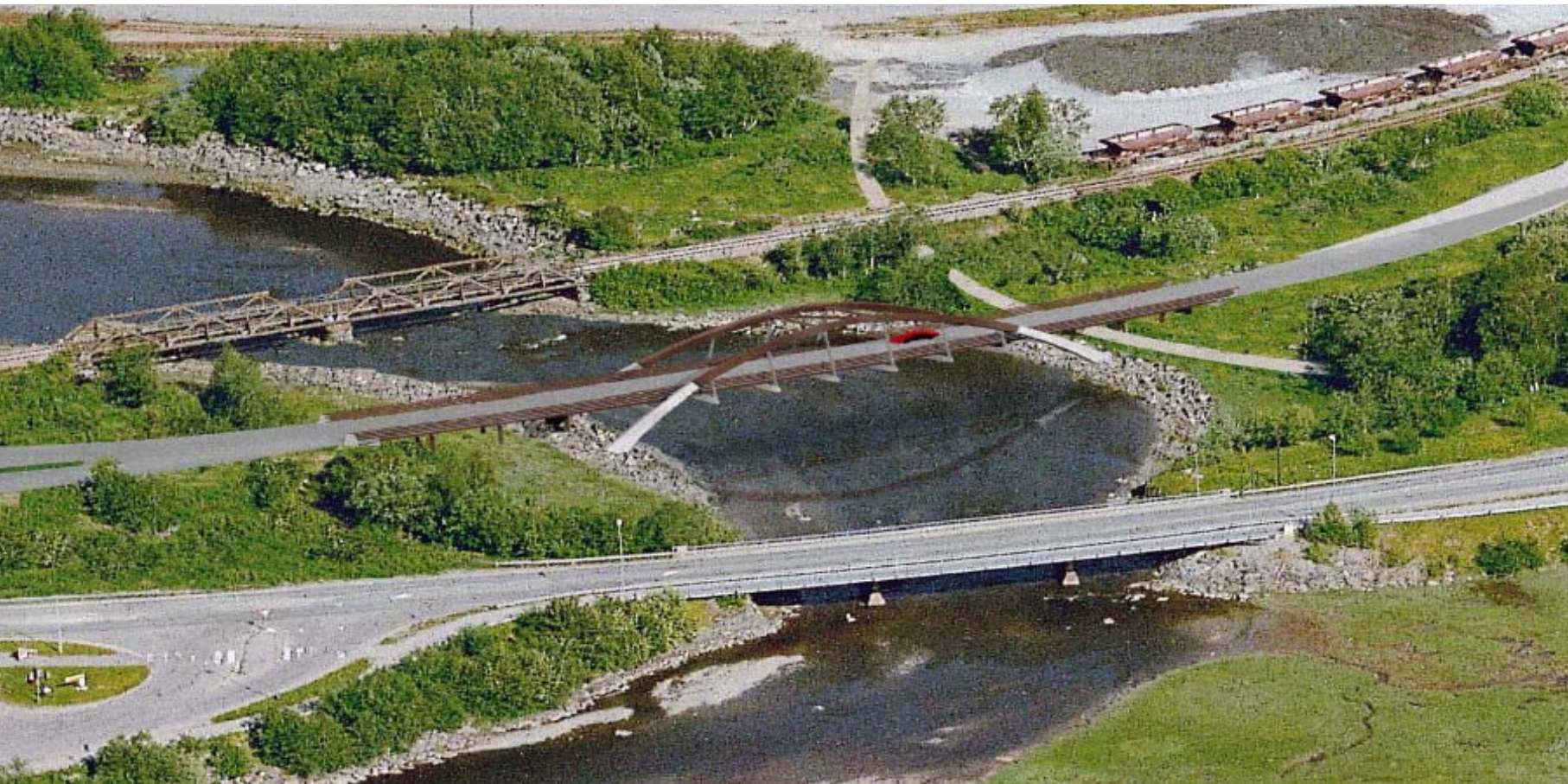
Bar forces





Måsør Bridge

- Opened 2005
- Span 50 m
- Length 83 m
- E6









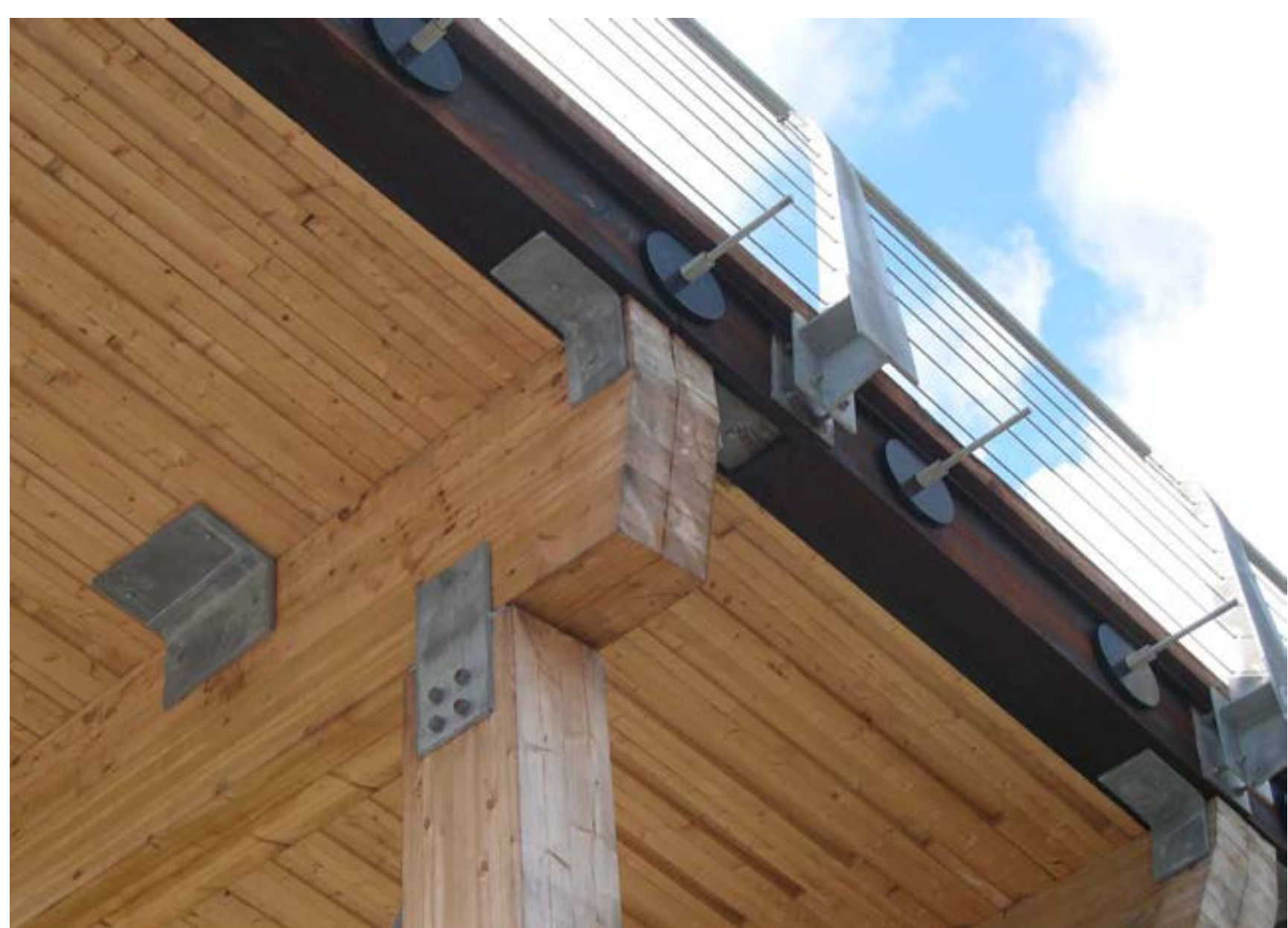


Klemetsrud Bridge

- **Opened 2005**
- **Span 45 m**
- **Length 160 m**
- **Footbridge**
- **Untreated deck**











Rena Bridge

- **Opened 2005**
- **110 tons**







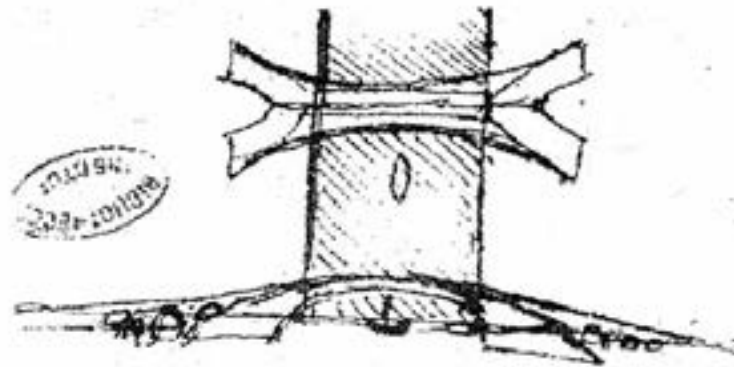








The Leonardo Bridge



Thank you for your attention!

