

CESM SOCCER CENTER IN MONTREAL
TIMBER ENGINEERING CASE STUDY

Jean-Marc Dubois- Director of Business Development

NORDIC STRUCTURES

CESM SOCCER CENTER IN MONTREAL

- Introduction
- Design
- Connections
- Fabrication
- Erection
- Conclusion and acknowledgements

NORDIC STRUCTURES

Introduction – Manufacturer View

- City of Montreal architectural design contest
- Saucier-Perrotte Architectes (SPA) contacted Nordic for the feasibility of the project
- Nordic won the bid for providing the product and engineering for the wood structure
- SNC provides support for the design of the beams and validation of the connections

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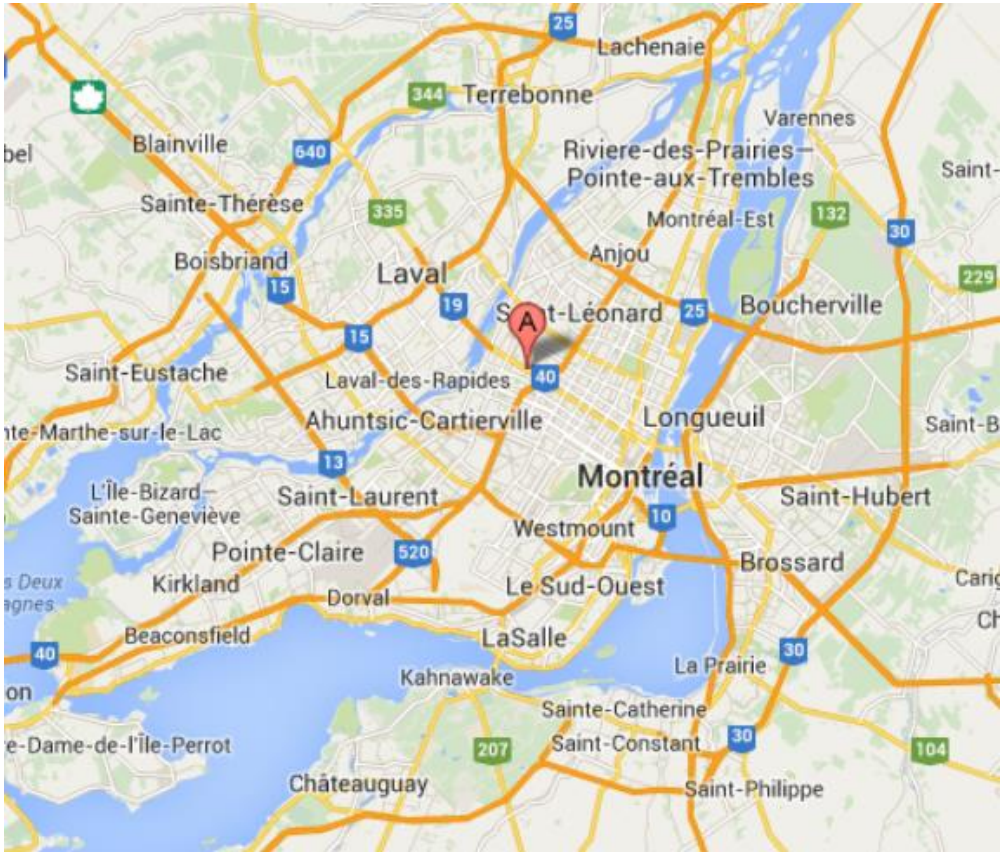
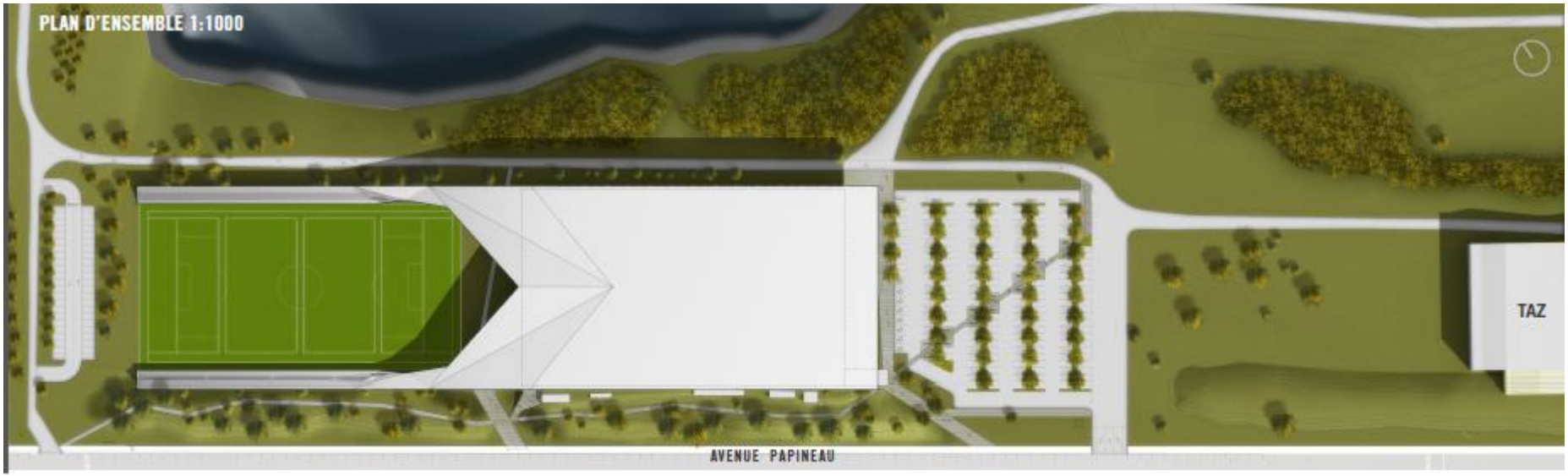
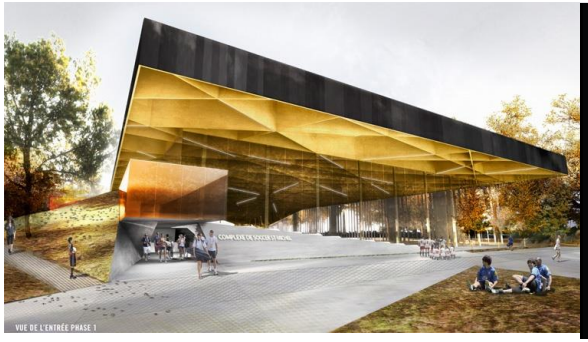
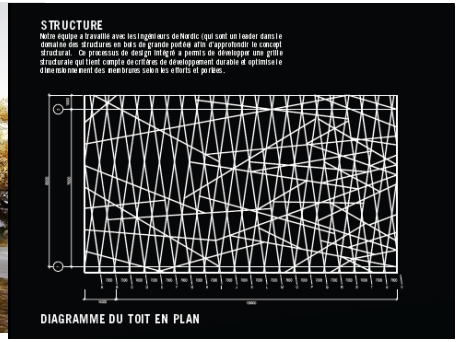
PROJECT LOCATION



ARCHITECTURAL CONCEPT







- Transformation of an old quarry and an landfill into a major urban park.
- 1000 seat indoor soccer stadium is part of this transformation plan.
- Architectural contest in 2011.

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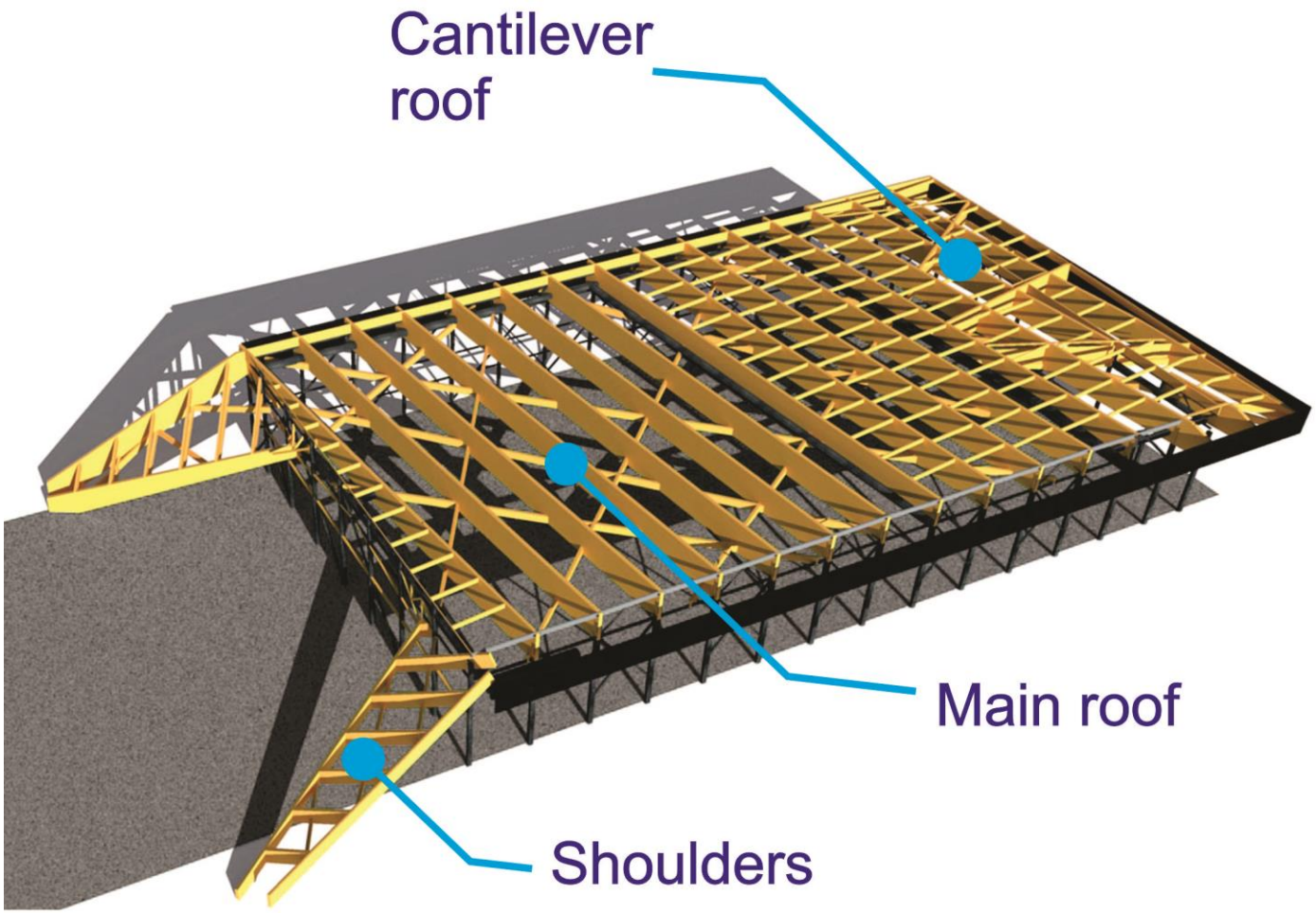
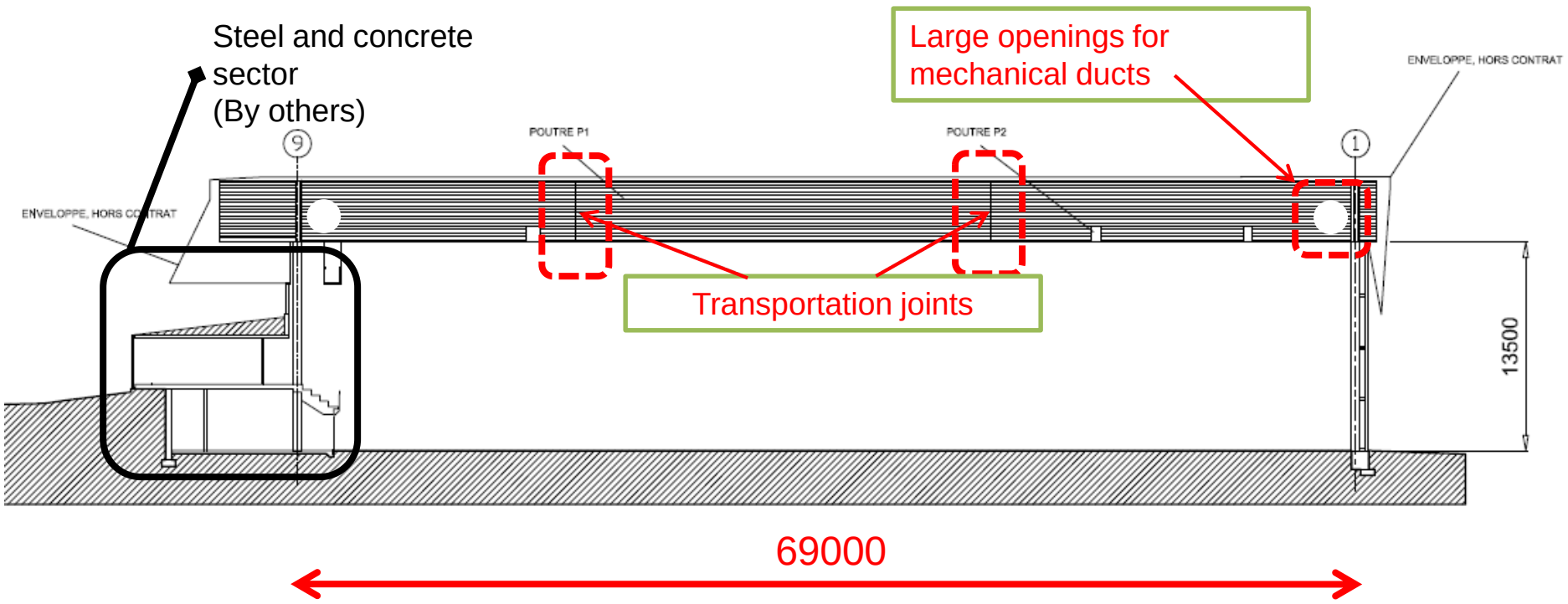
STRUCTURE



NORDIC
STRUCTURES

SECT0R 1 – BEAMS P1



Section SECTOR 1

Roof loads
-Snow: 2.77kPa
-Dead: 0.93kPa

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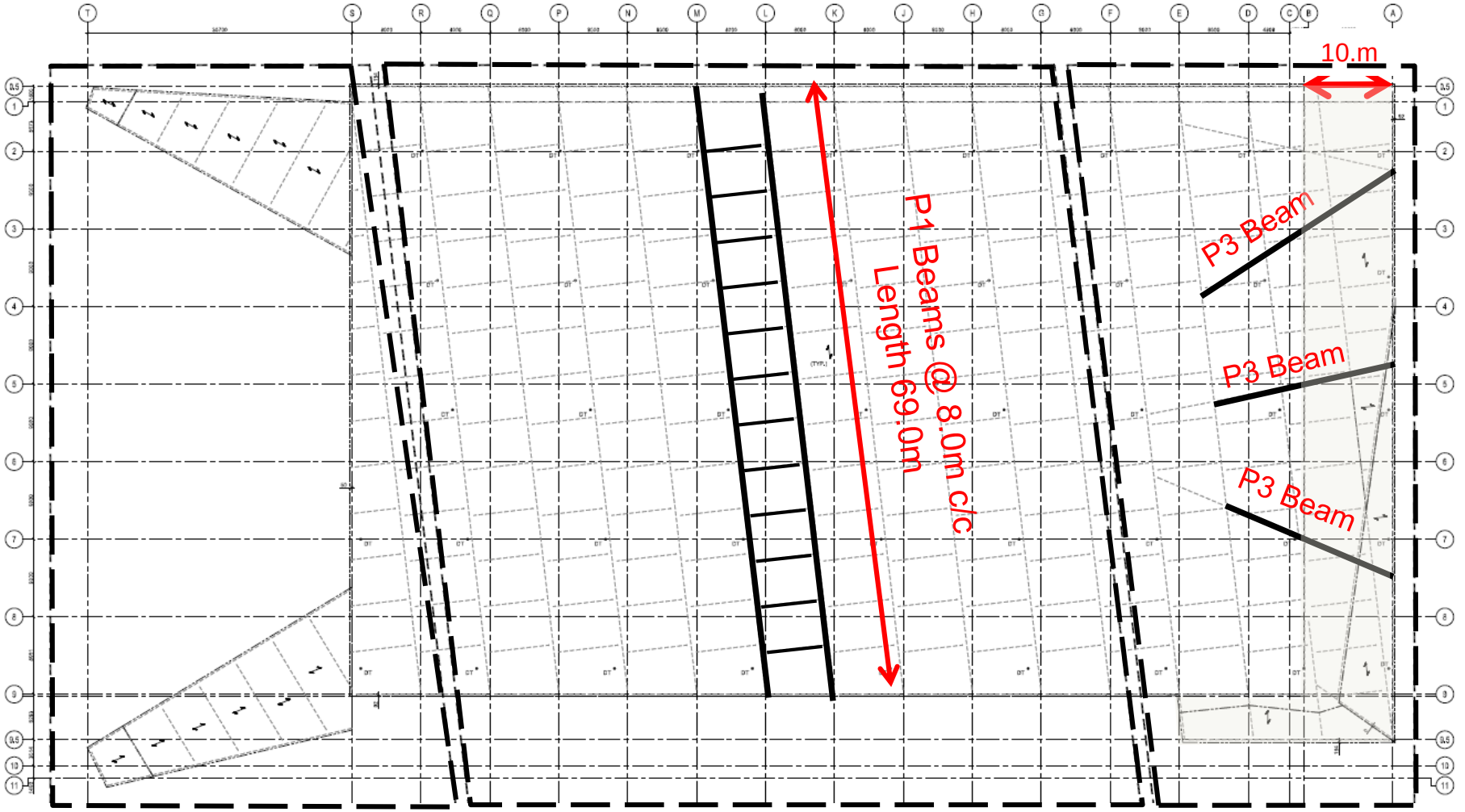
Roof sectors



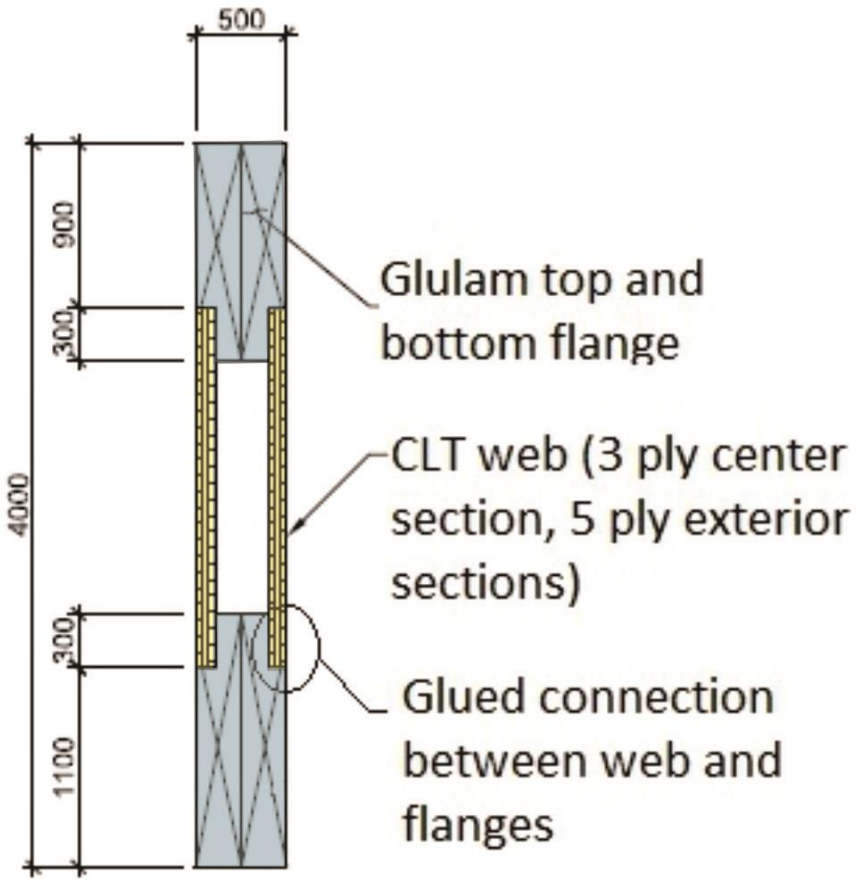
SECT0R 3
Shoulders

SECTOR 1
13 Simply supported beams 69m

SECTOR 2
10m Cantilever

STRUCTURES

SECT0R 1 – BEAMS P1

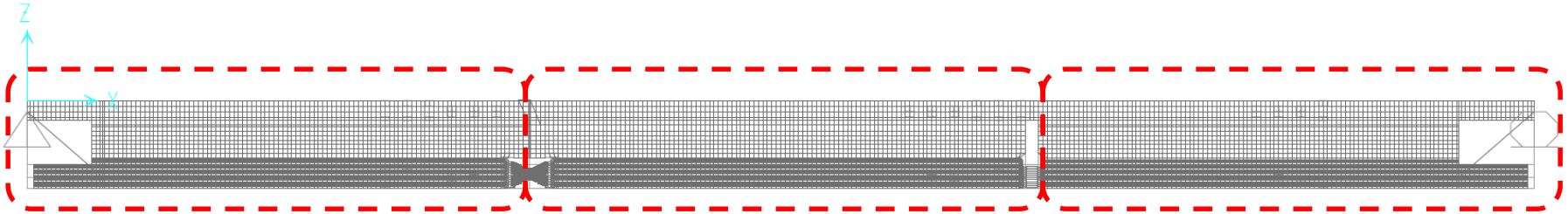


Initial design parameters:

- Straight beam/ simply supported
- Box girder beam 4000mm x 500mm
- Glulam top and bottom cords
- CLT web.
- All elements glued

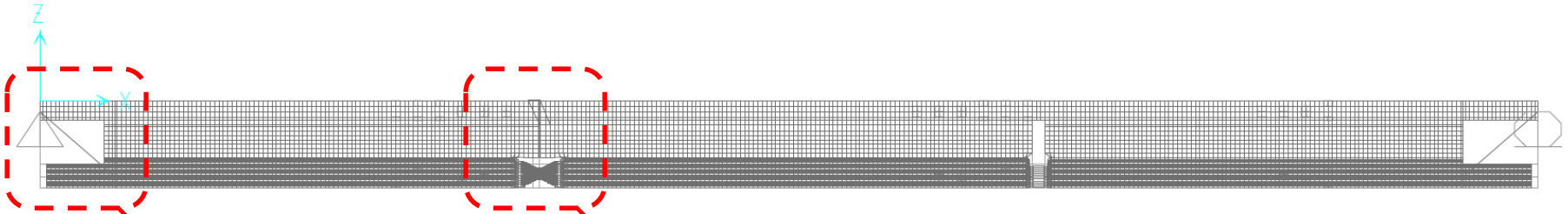
DESIGN OF P1 BEAMS

1) BEAM DESIGN



A: End section B: Central section A: End section

2) CONNEXIONS DESIGN



C: Support connection

D: Transportation joint connection

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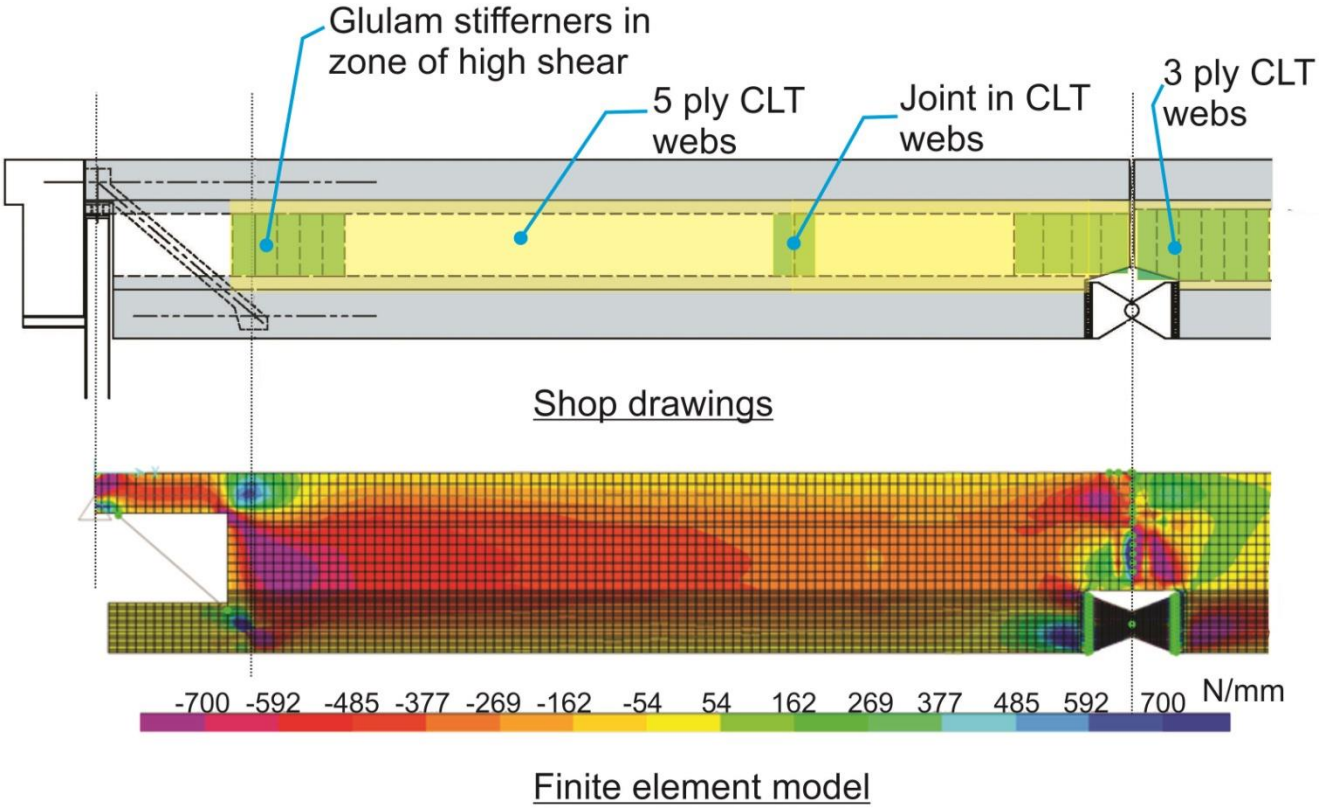
A: END SECTIONS

- Shear stresses.



-Maximum shear at support = 1950 kN
-CLT web optimized.
    -5 ply End sections
    -3 ply Central section
-Stiffners added at critical zones
    -Ends
    -Joint in web

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SHEAR CAPACITY

-One of the difficulties faced with the design of the P1 beam was the various shear strength to be considered:

- •Shear strength of glued assembly between glulam plies
- •Shear strength of glued assembly between CLT and glulam
- •Plane shear of CLT panel
- •Rolling shear

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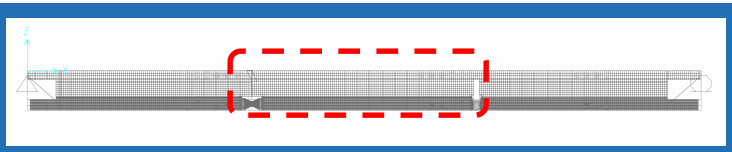
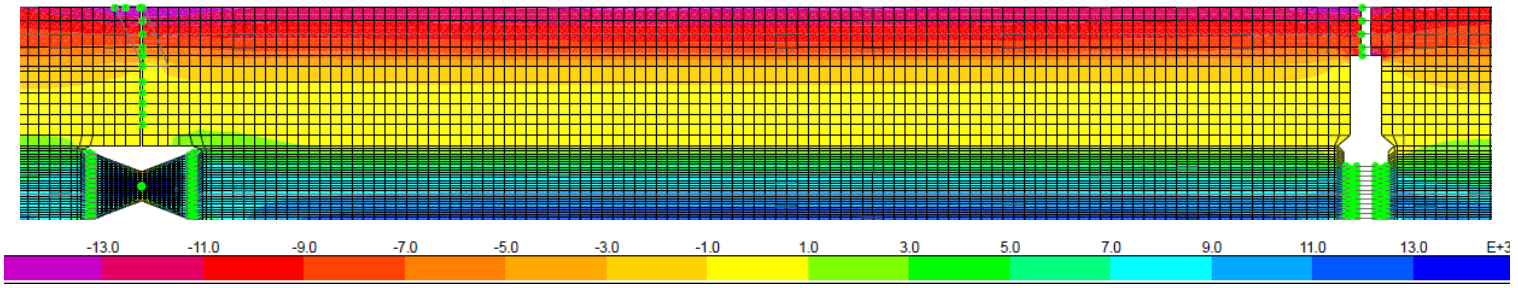
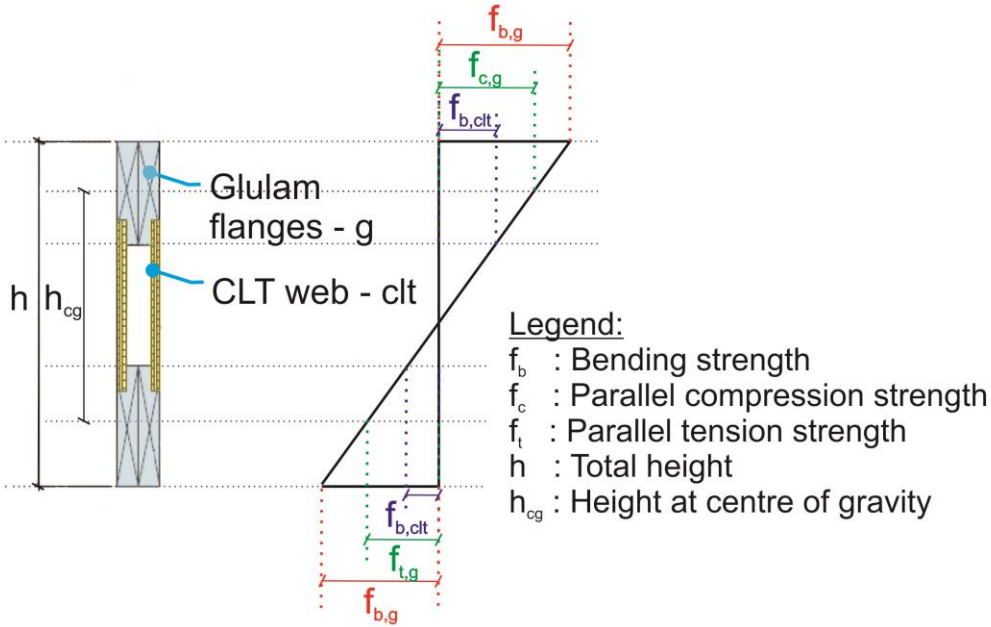
B: CENTRAL SECTION



- Moment stresses.





-Maximum moment= 35 000 kNm
-Height of glulam cords optimized for central section. Same used for ends.

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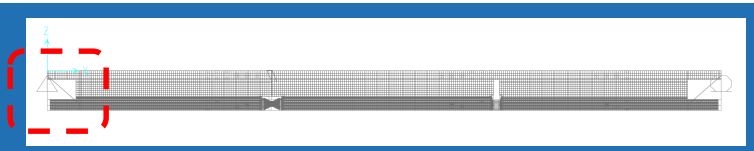
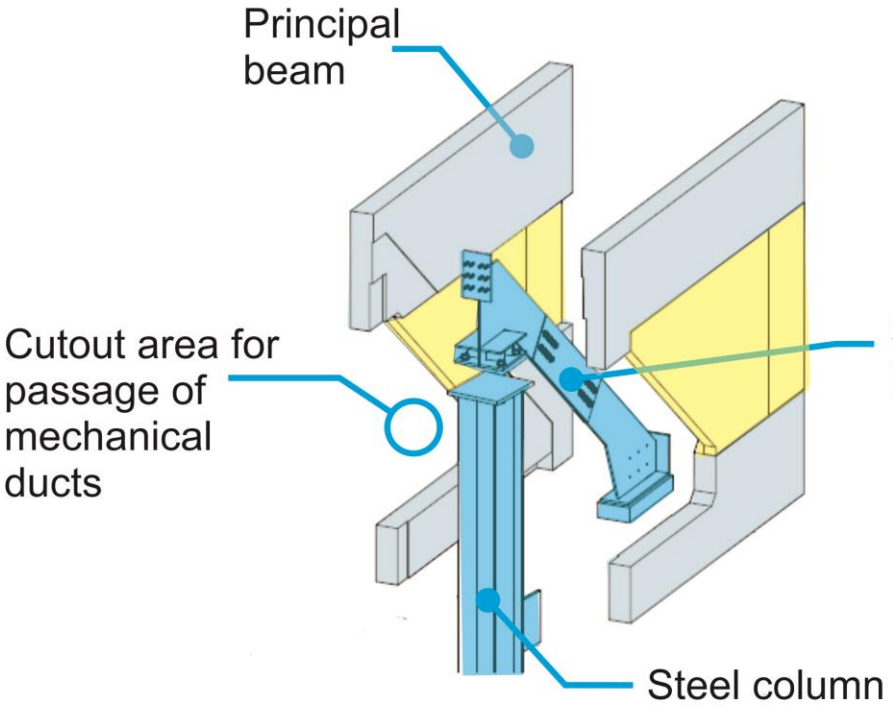
C: SUPPORT





Tf = 2000kN

-Internal steel connection:

- Allow passage of mechanical ducts
-Reduce shear stress in CLT web
-Reduce shrinkage effects to be considered in wall envelop

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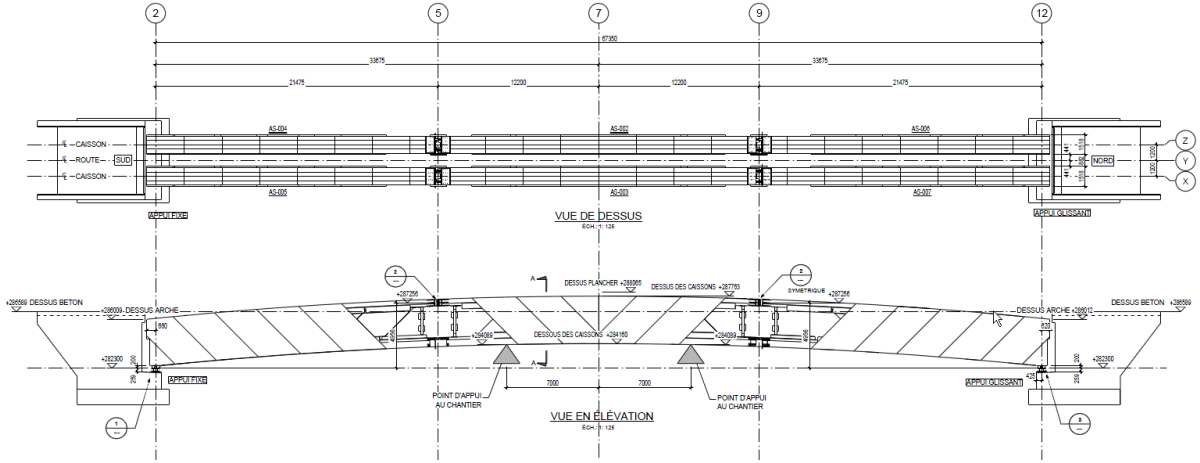
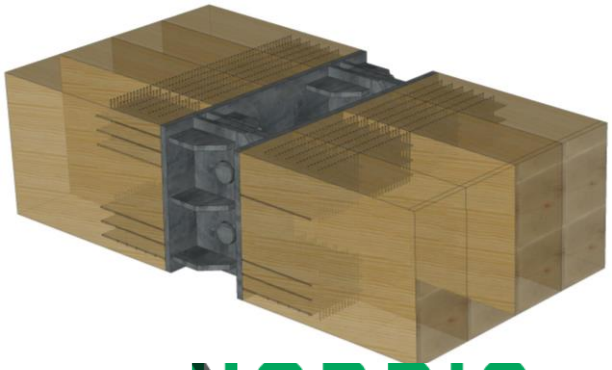
COMPARABLES

- Moment = 24 000 kNm
- Tension connection designed for 8000 kN
- Internal plates with self tapping screws





NORDIC STRUCTURES

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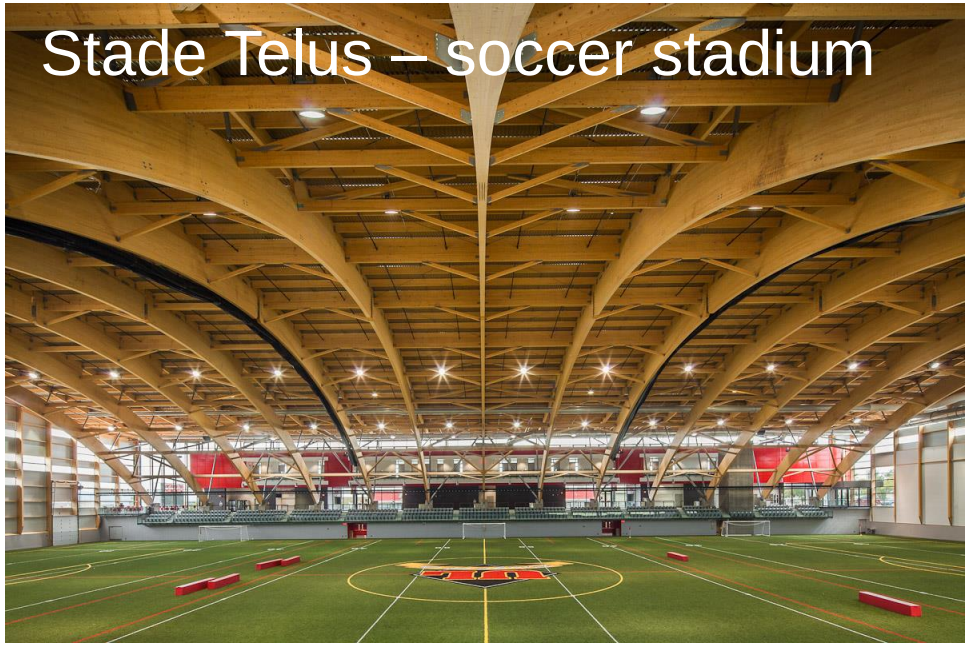
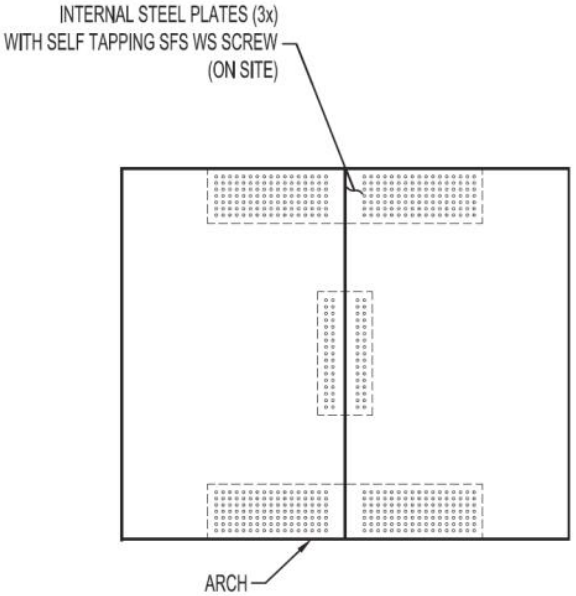
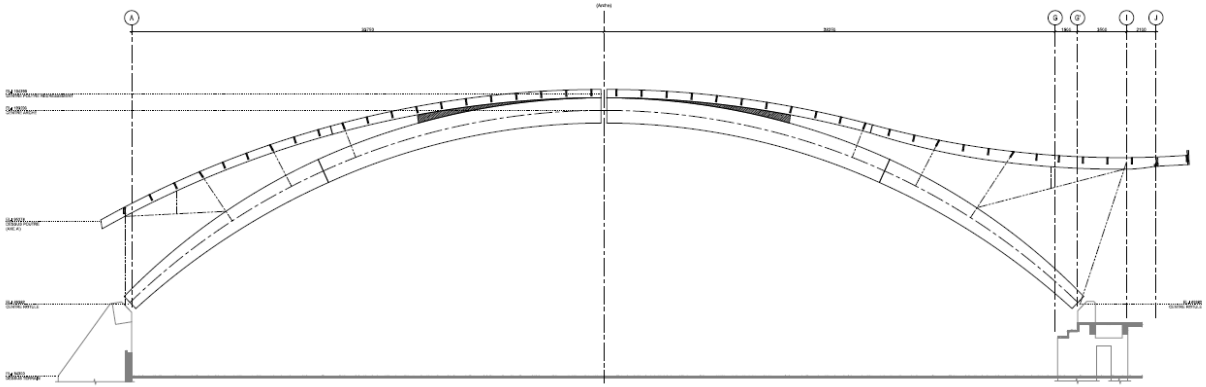
COMPARABLES



- Moment = 1850 kNm
- Internal steel plates with self tapping SFS screws





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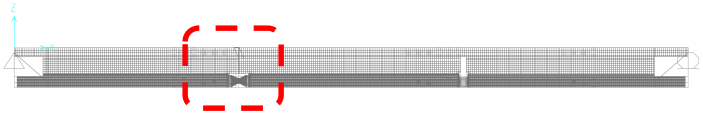
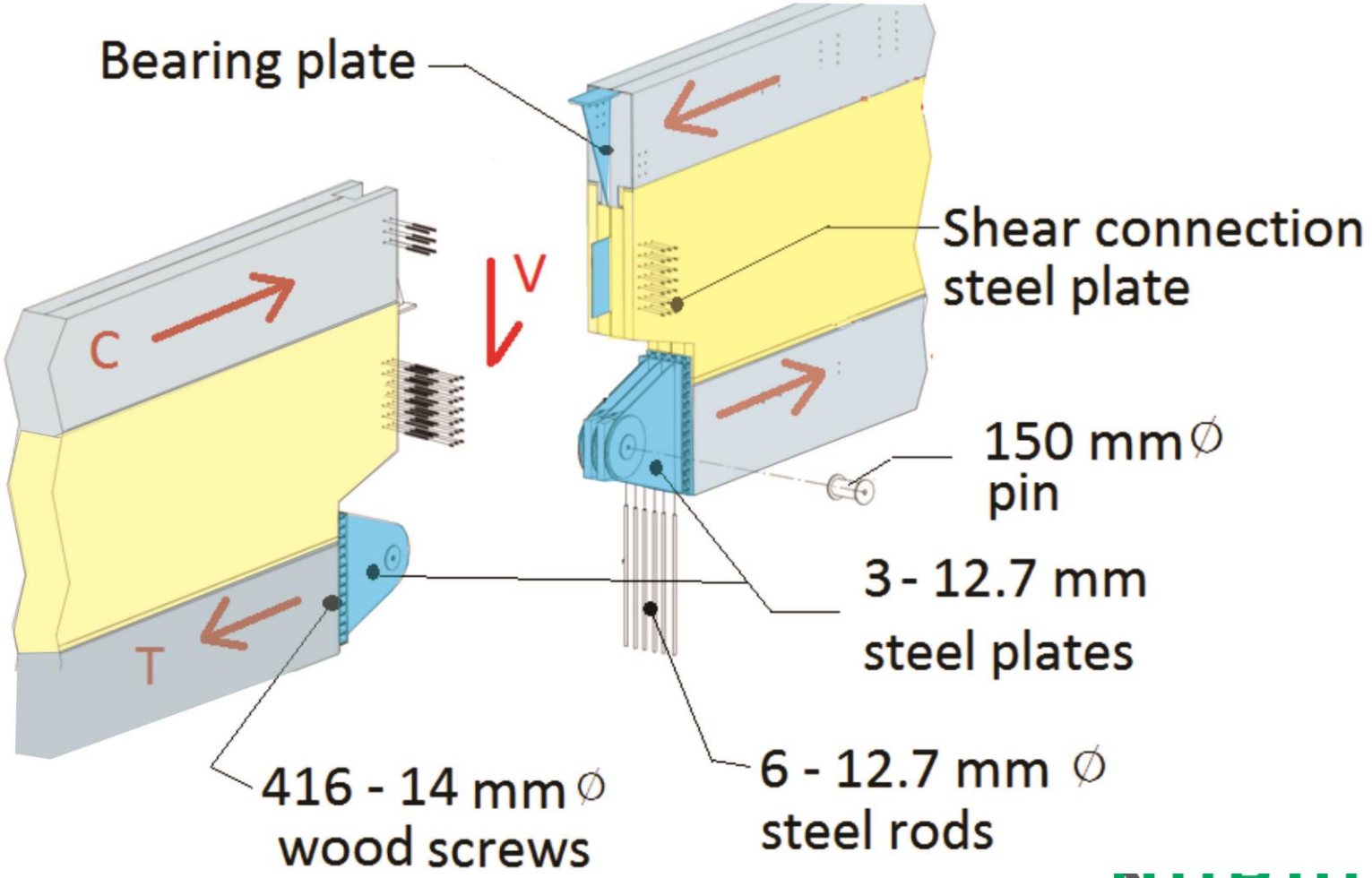
D: TRANSPORT JOINT





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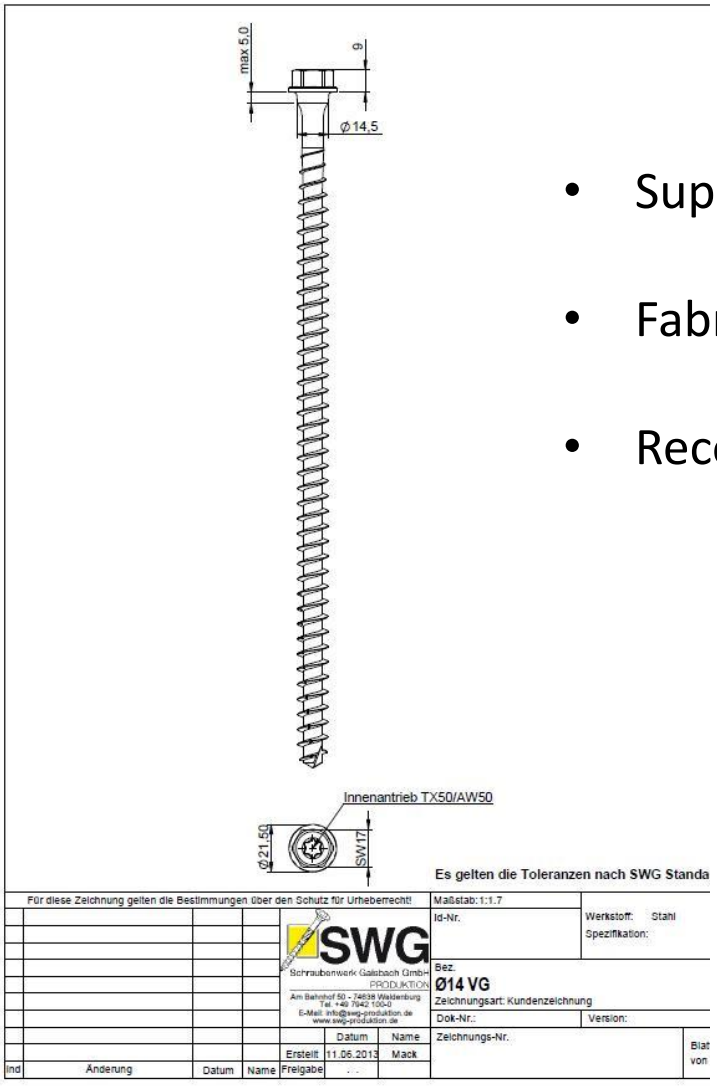
Connections- Transportation joint

- Different type of connexions possible (screws, glued rods, Bertsche system, self-taping stack screws with metal plates, etc
- Nordic contacted suppliers of the differents products
- Choice of the screw system:
  1. Best connection for quality-control
  2. It is a mechanical system good in every condition.
  3. Failure mode in the steel

NORDIC STRUCTURES

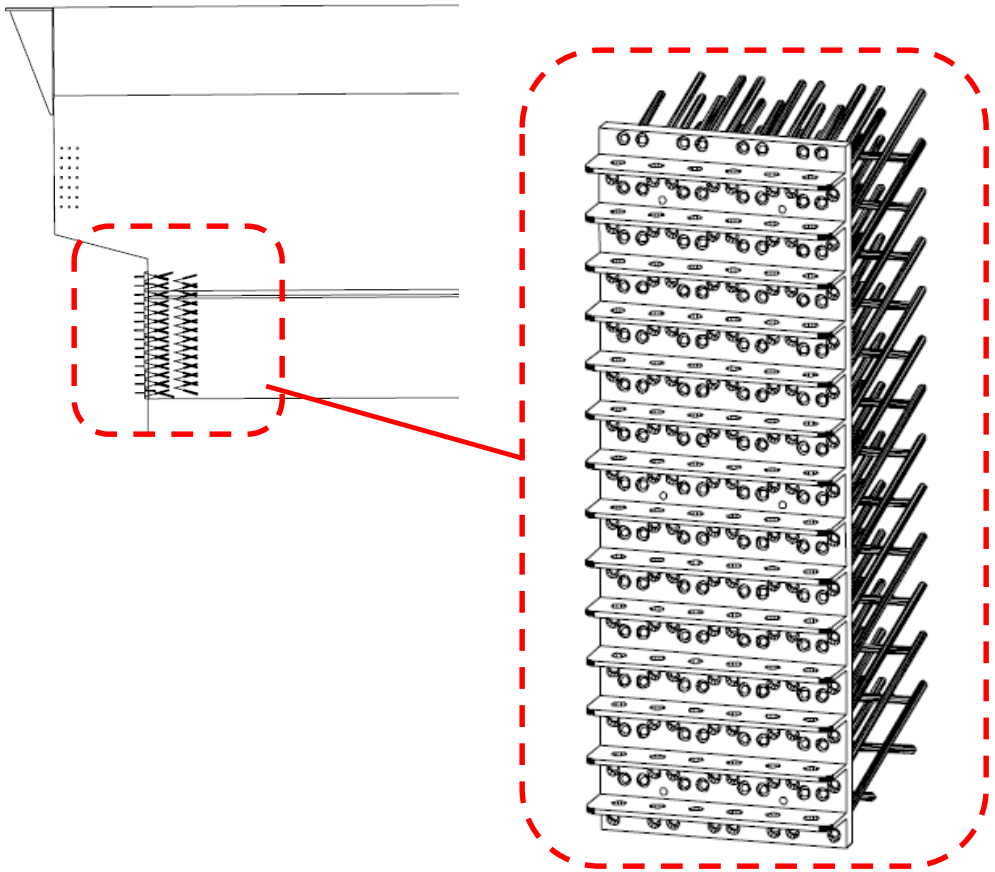
Connections- Transportation joint



- Support by SWG for the design
- Fabrication of a new type of screw
- Recommendations for a full-scale test

NORDIC STRUCTURES

Connections- Transportation joint



- Tension connection designed for 10 000 kN
- Long high capacity screws at a slight angle into the end grain of glulam member (416 screws)
- Elaborate screw pattern to maximized the number of screws.
- Embedment of screws to develop full tension capacity of the screws.
- Hand calculations validated by laboratory tests.

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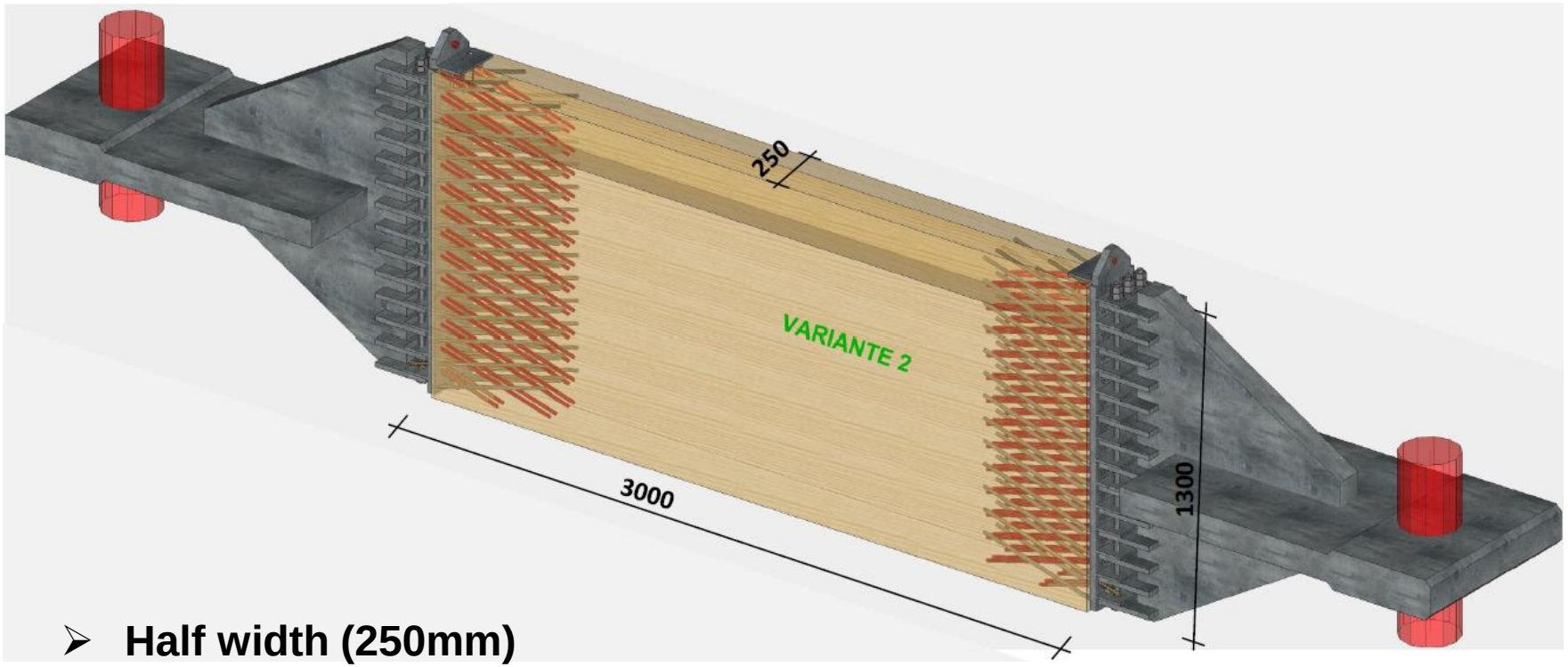
Connections- Transportation joint



- **Half width (250mm)**
- **Same configuration**
- **Find a laboratory for the tests**

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Connections- Transportation joint

Stuttgart University, Germany
Capacity 10 000kN in traction

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Connections- Transportation joint

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Connections- Transportation joint

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Connections- Transportation joint

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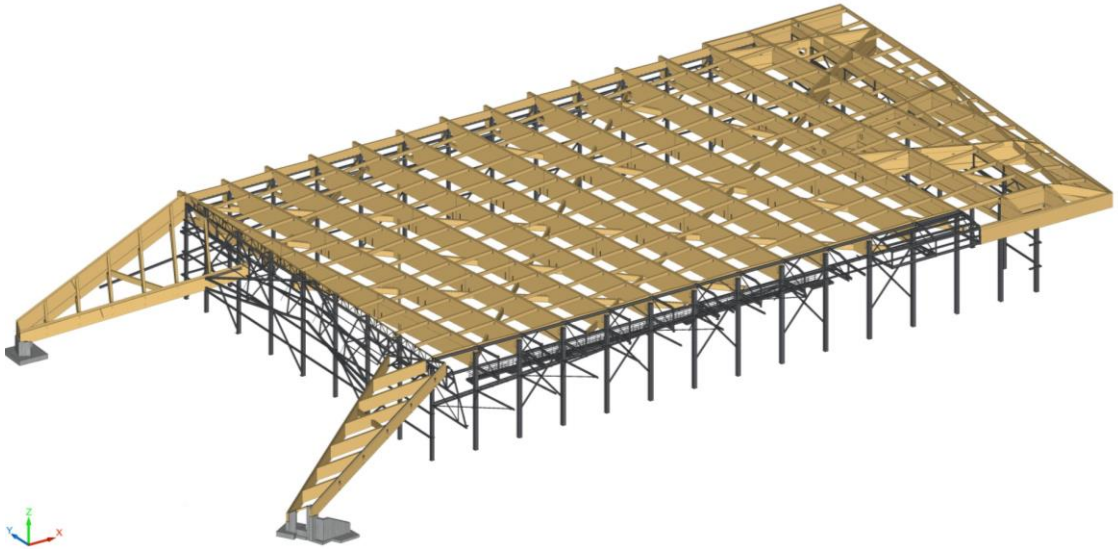
Fabrication

- More than 4 000 cubic-meter of wood
- Separated in 3 zones for production
- The main construction site: Chibougamau



NORDIC STRUCTURES

Fabrication – Main beam

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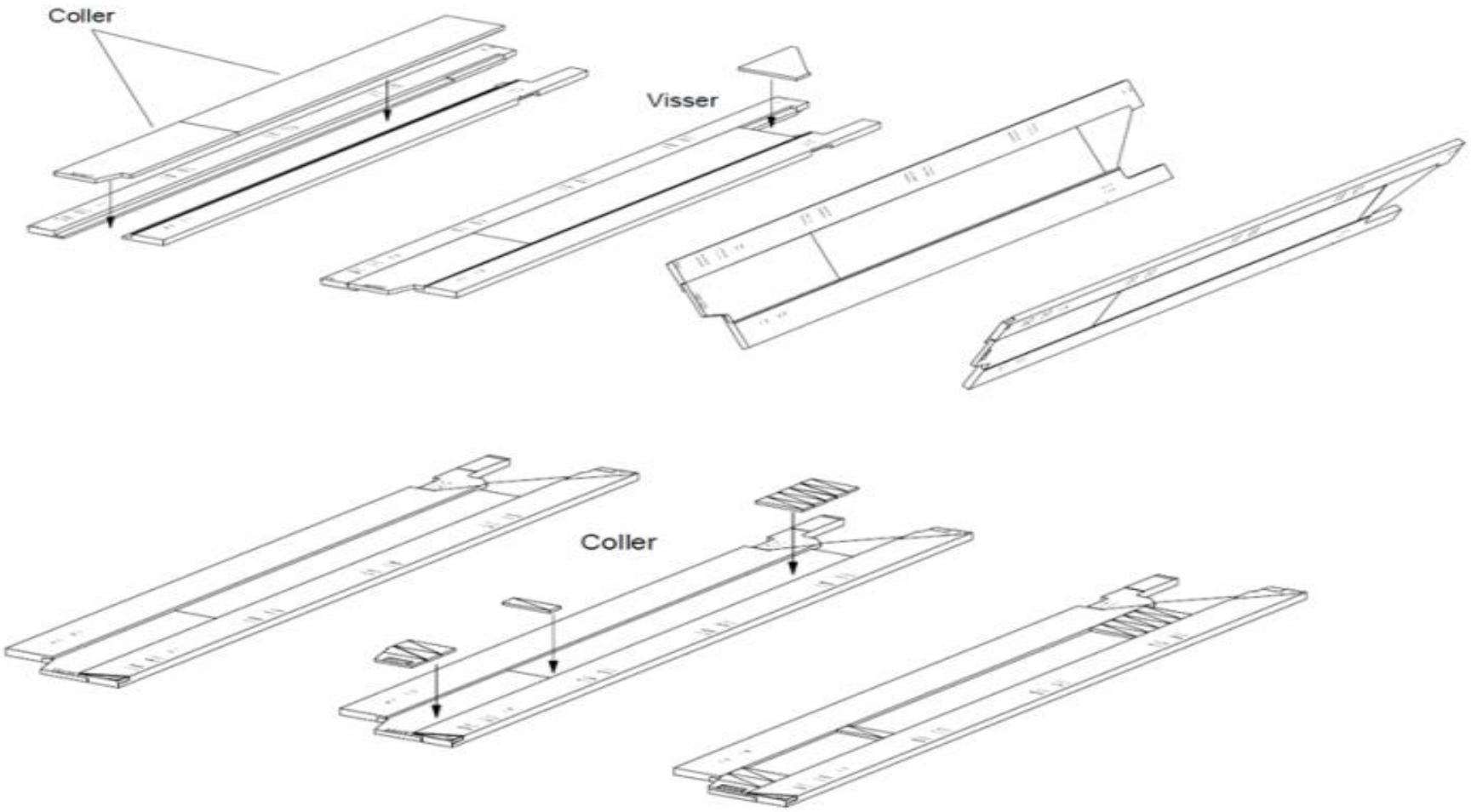
Fabrication – Main beam



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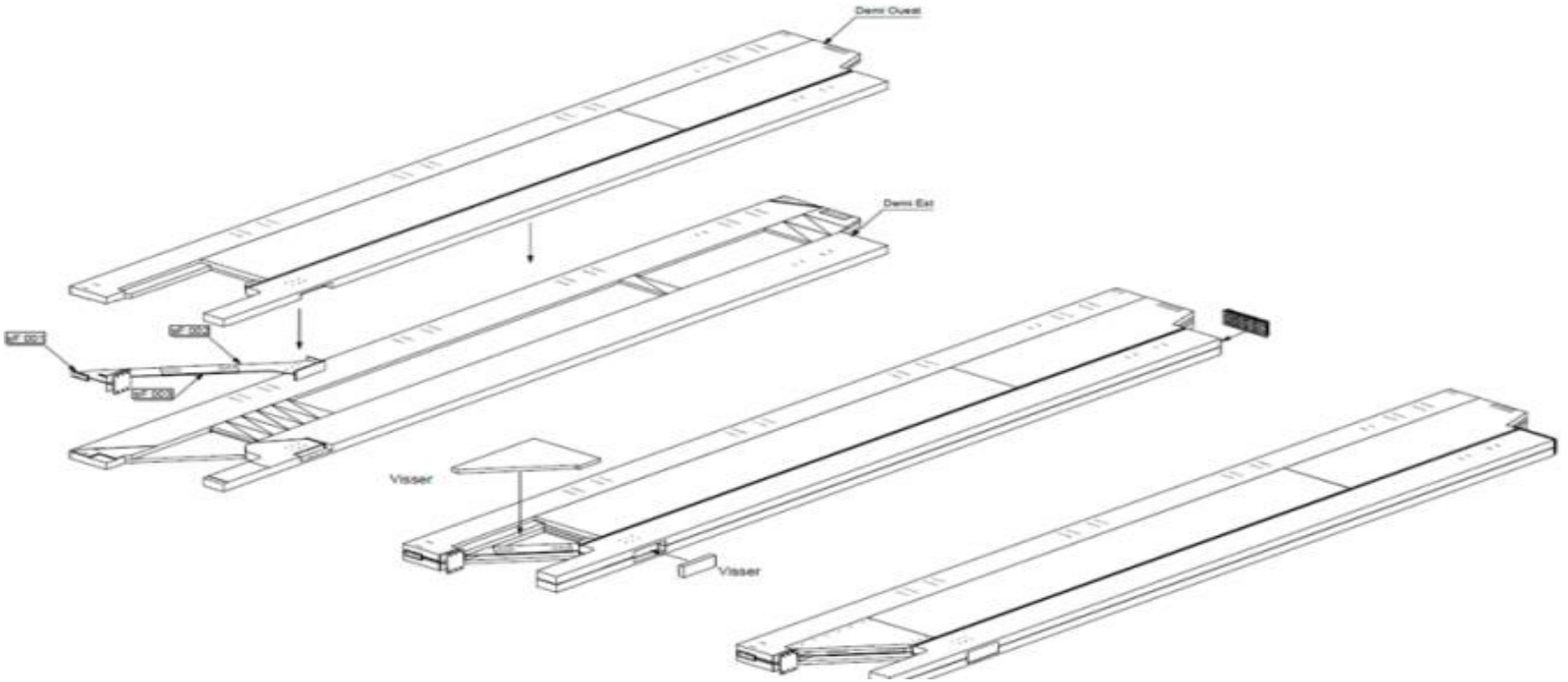
Fabrication – Main beam



NORDIC STRUCTURES

Fabrication – Main beam

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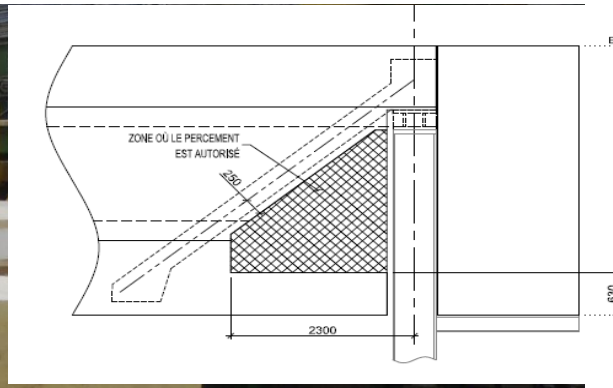

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Fabrication – Main beam

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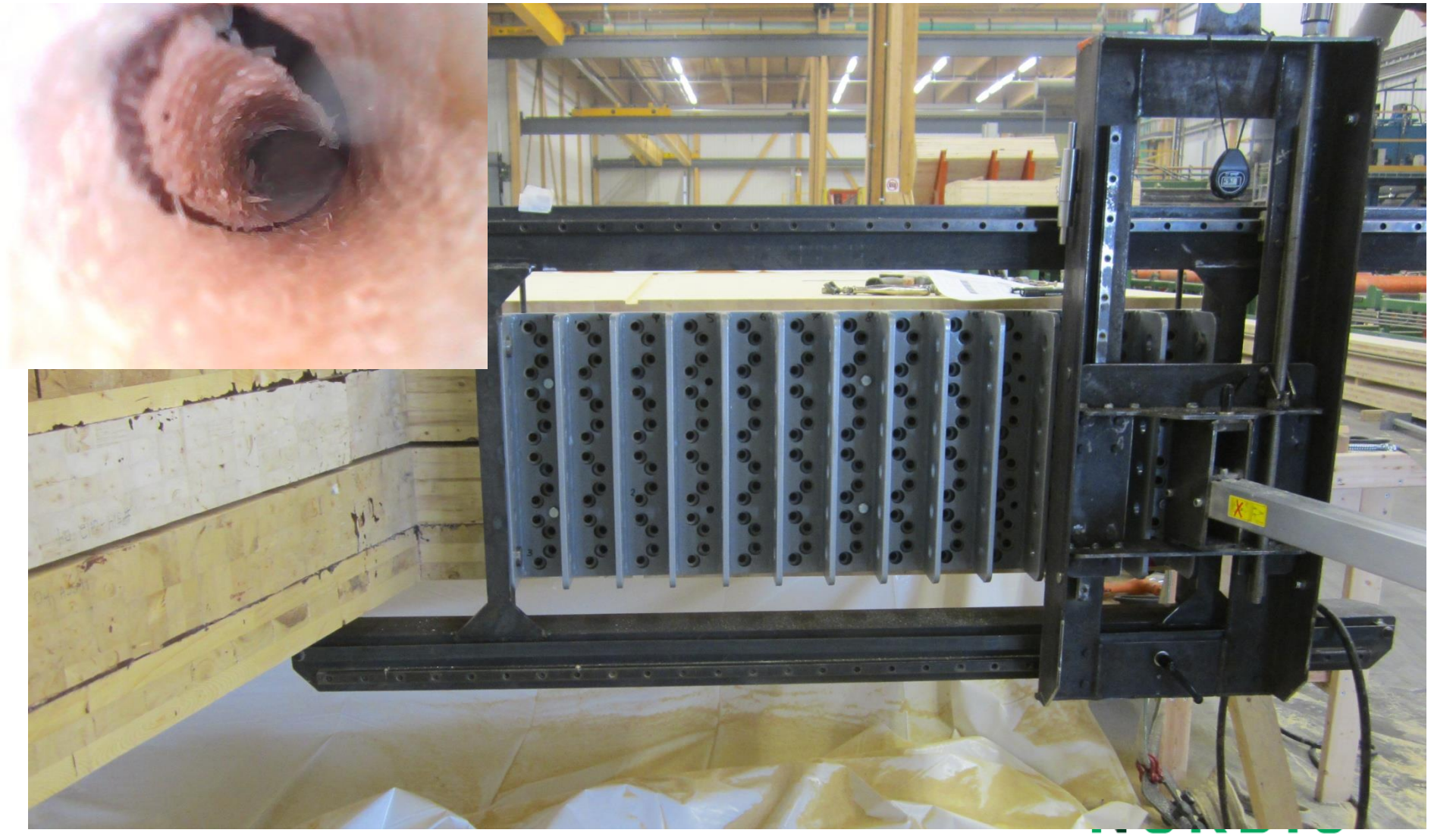

STRUCTURES

Fabrication – Main beam

NORDIC STRUCTURES

Fabrication – Main beam

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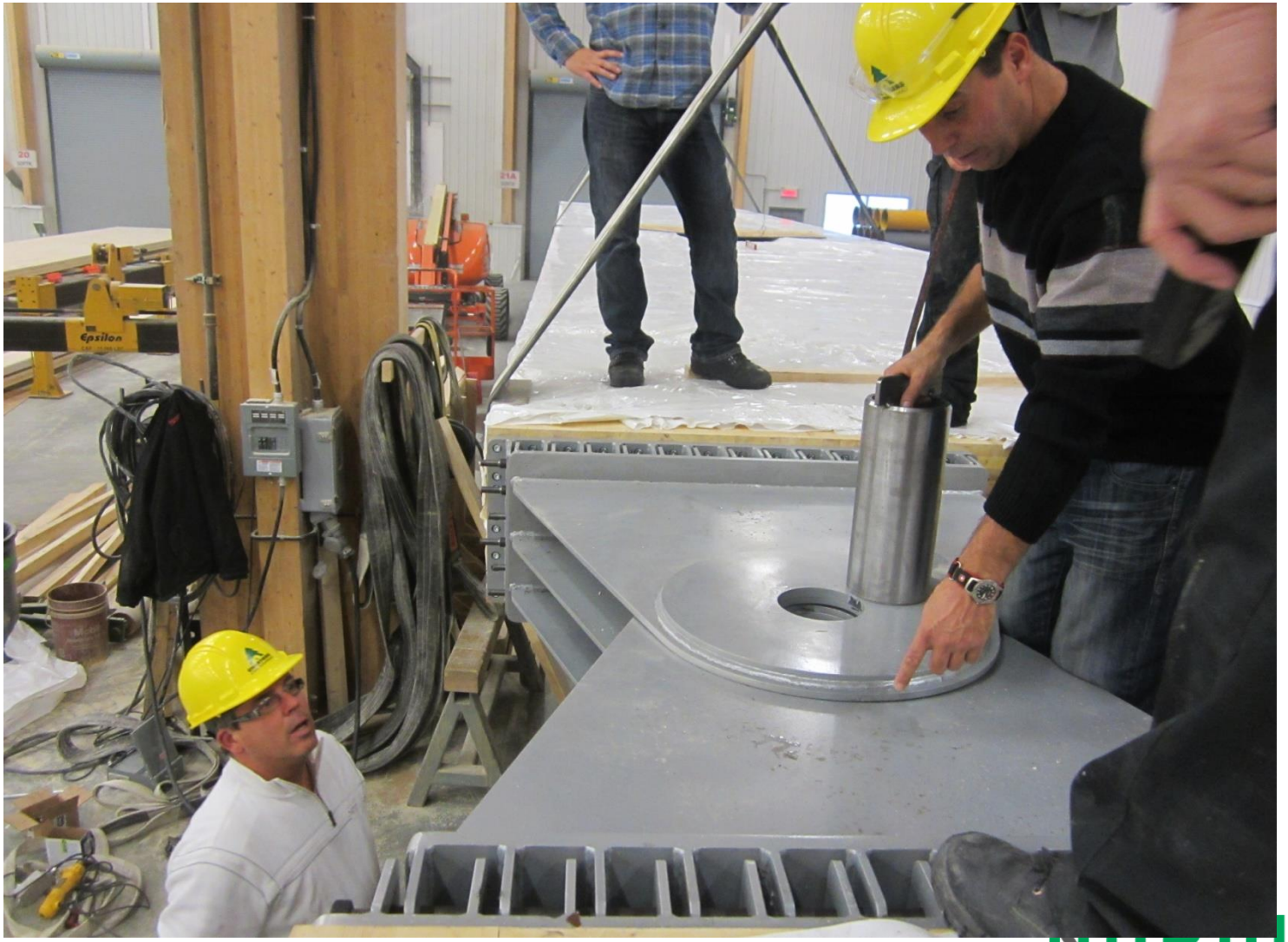
Fabrication – Main beam



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Fabrication – Main beam

STRUCTURES

Installation – November 15th 2013

NORDIC STRUCTURES

Installation – December 9th 2013

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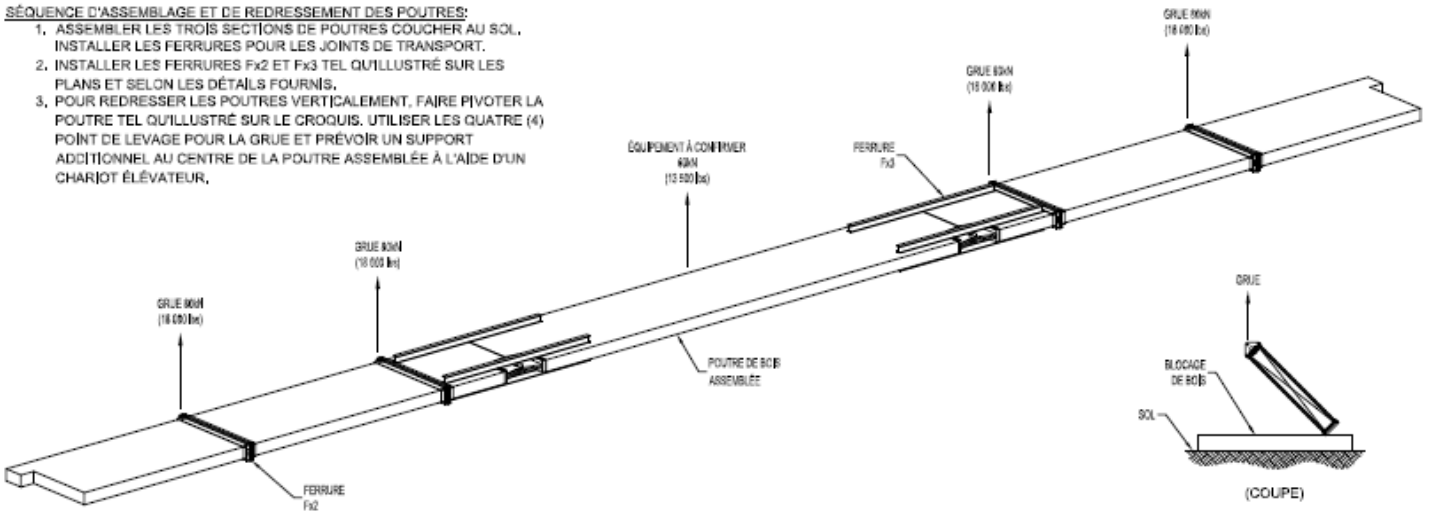
Installation

Flipping the beam upright



ASSEMBLAGE ET REDRESSEMENT DES SECTIONS DE POUTRES

1:150

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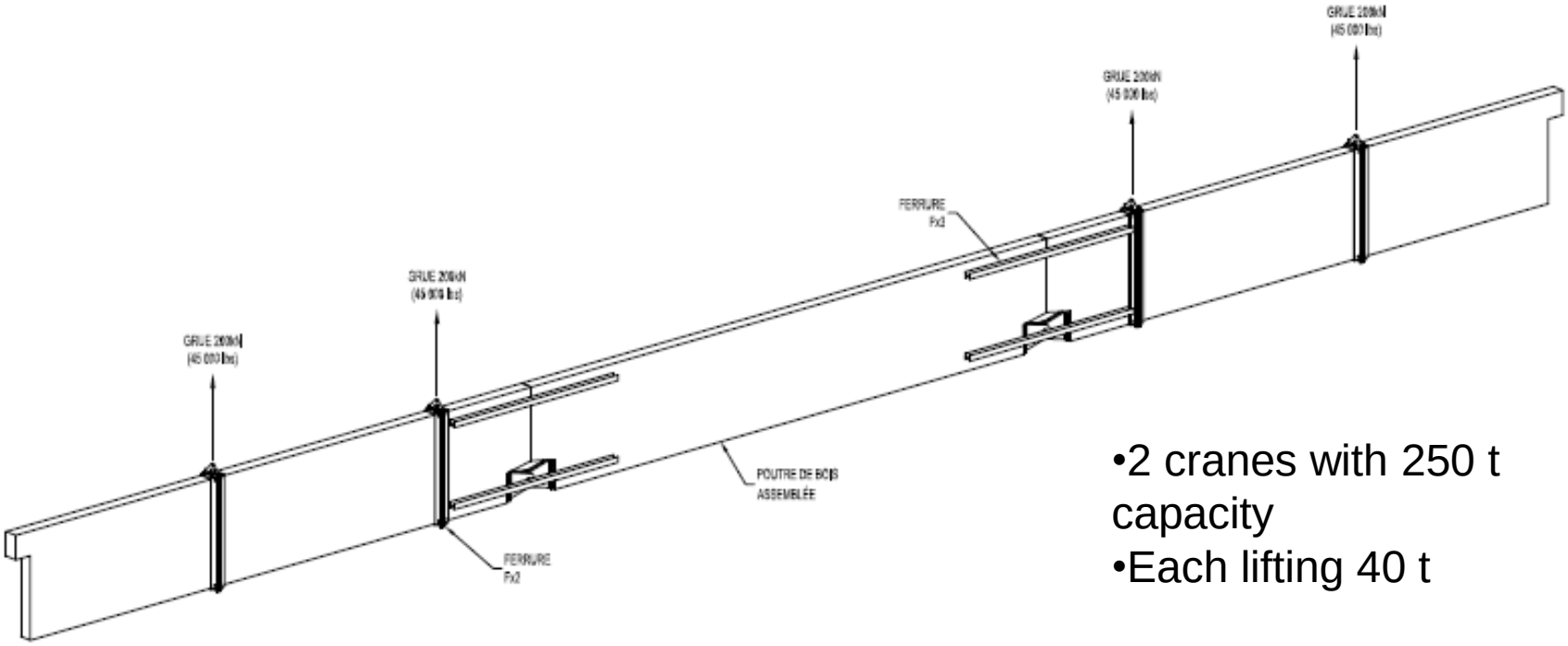
Installation

Lift of beams (80 t)



LEVAGE DE LA POUTRE ASSEMBLÉE

1:150

- 2 cranes with 250 t capacity
- Each lifting 40 t

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Installation

(1) Assembled flat on supports

(2) Beam flipped up vertically

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Installation

Photo: Jacques Nadeau - Le Devoir

NORDIC STRUCTURES

Installation

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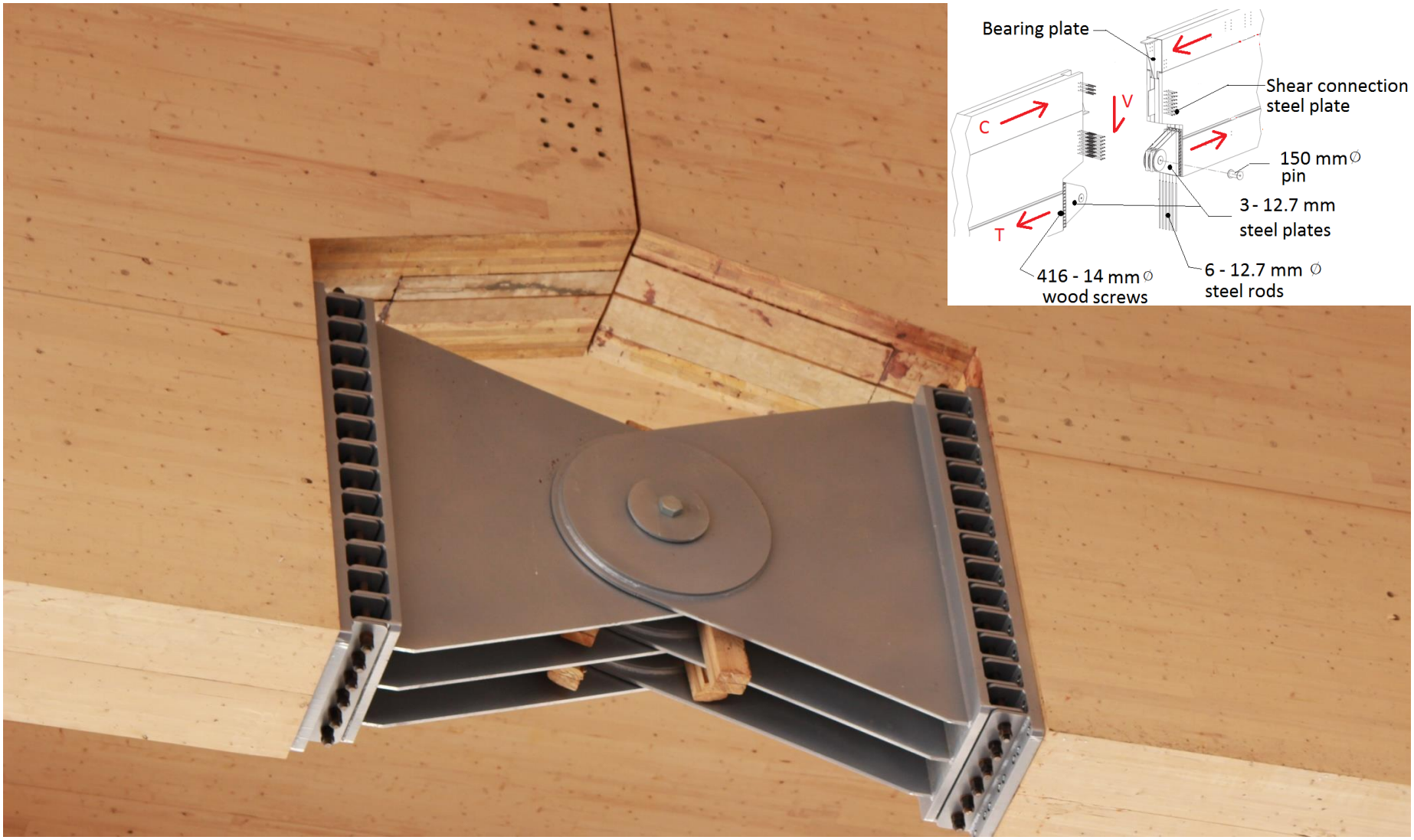
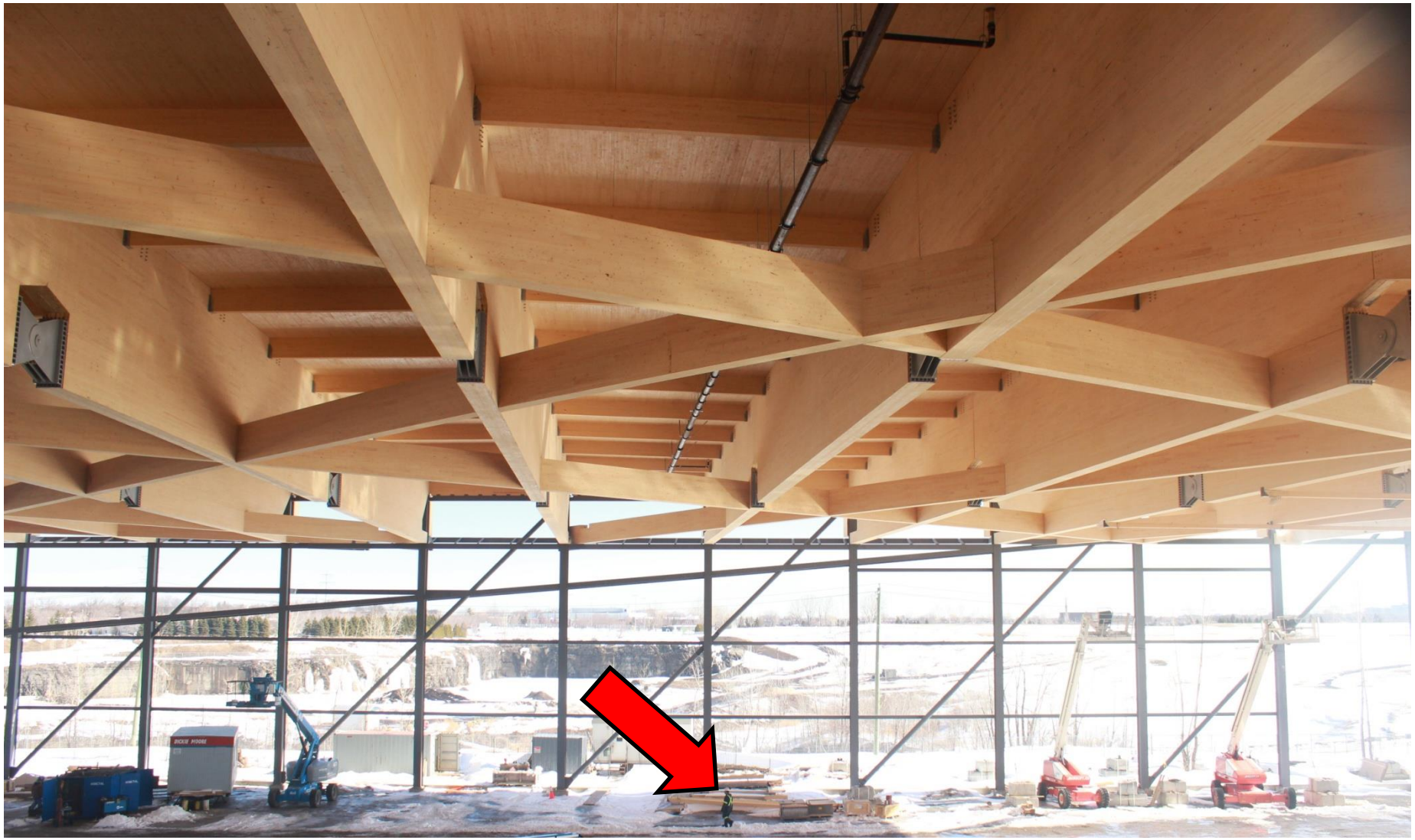


NORDIC STRUCTURES

Installation



NORDIC STRUCTURES

Installation

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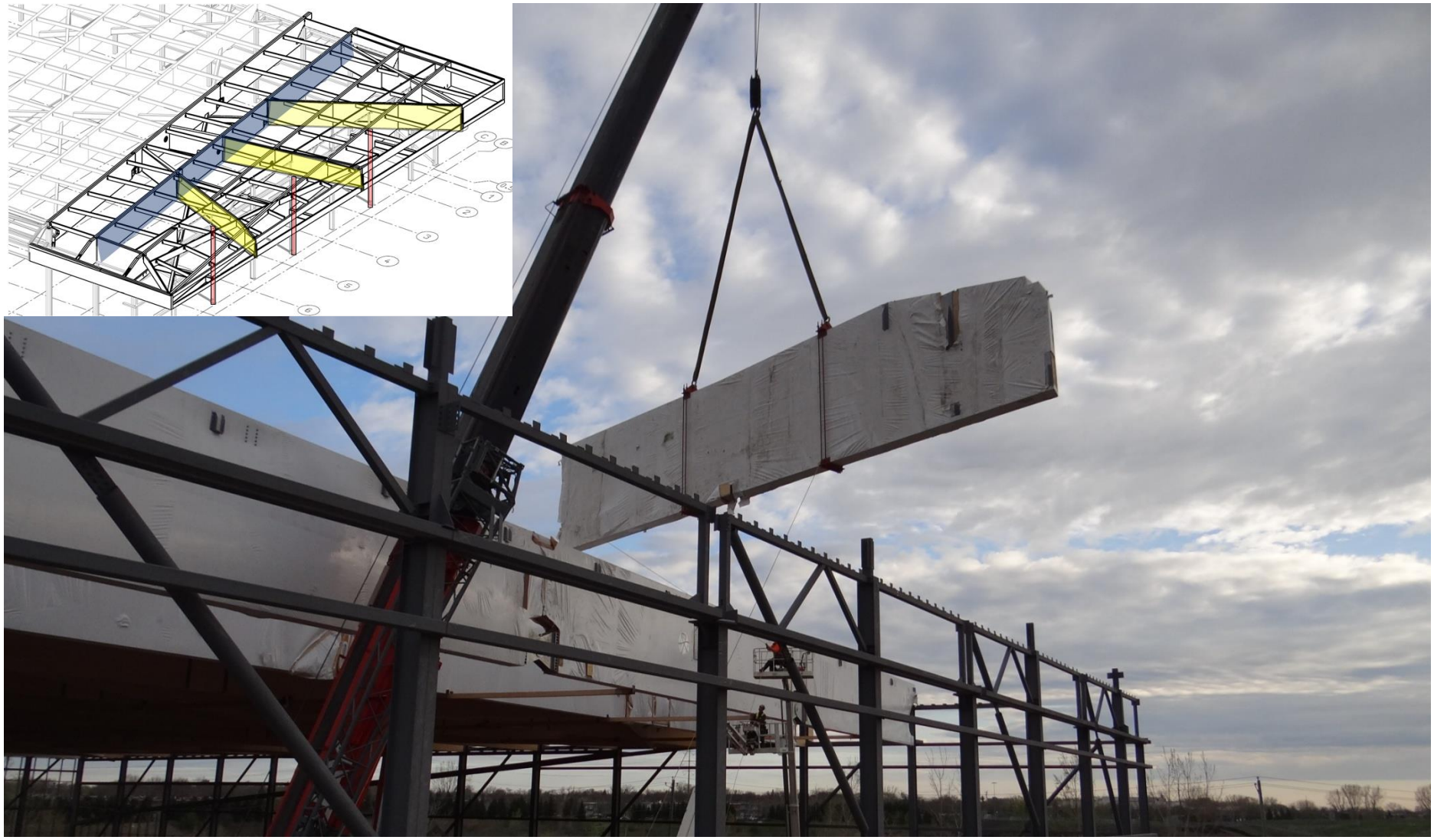

NORDIC STRUCTURES

Installation

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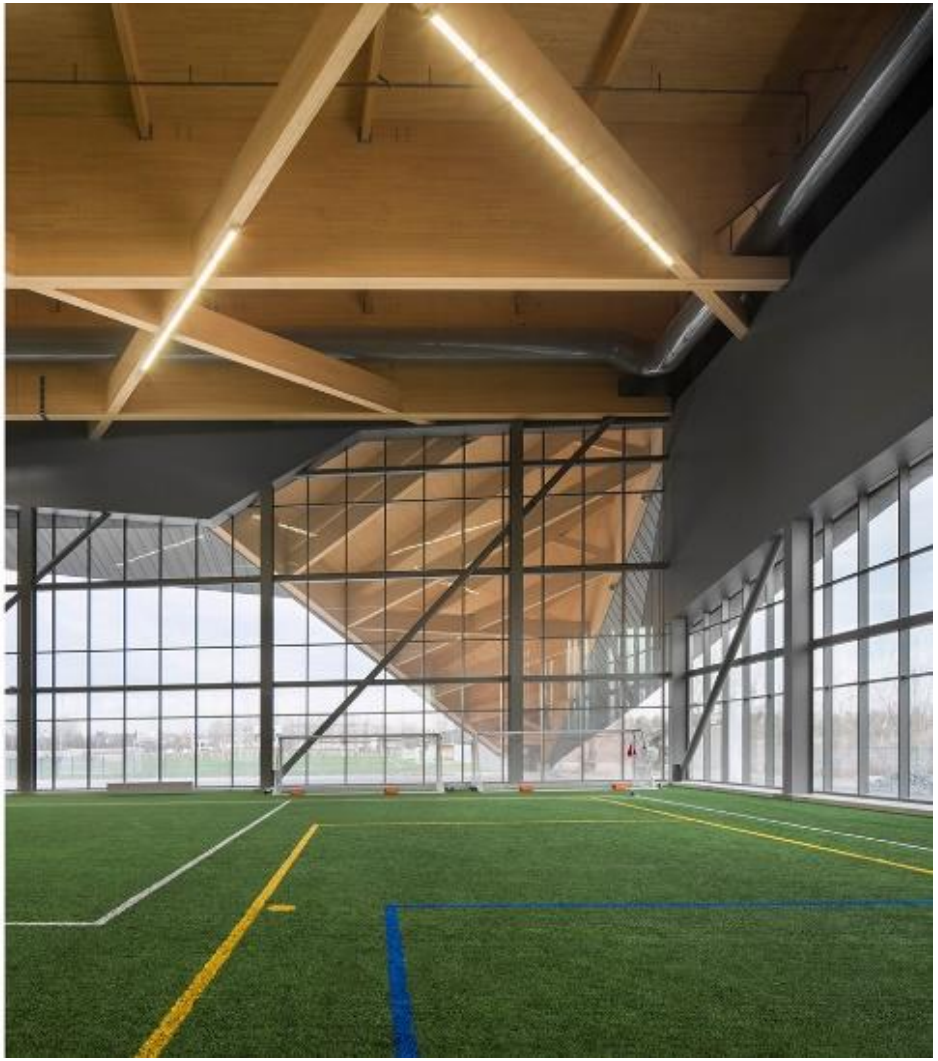

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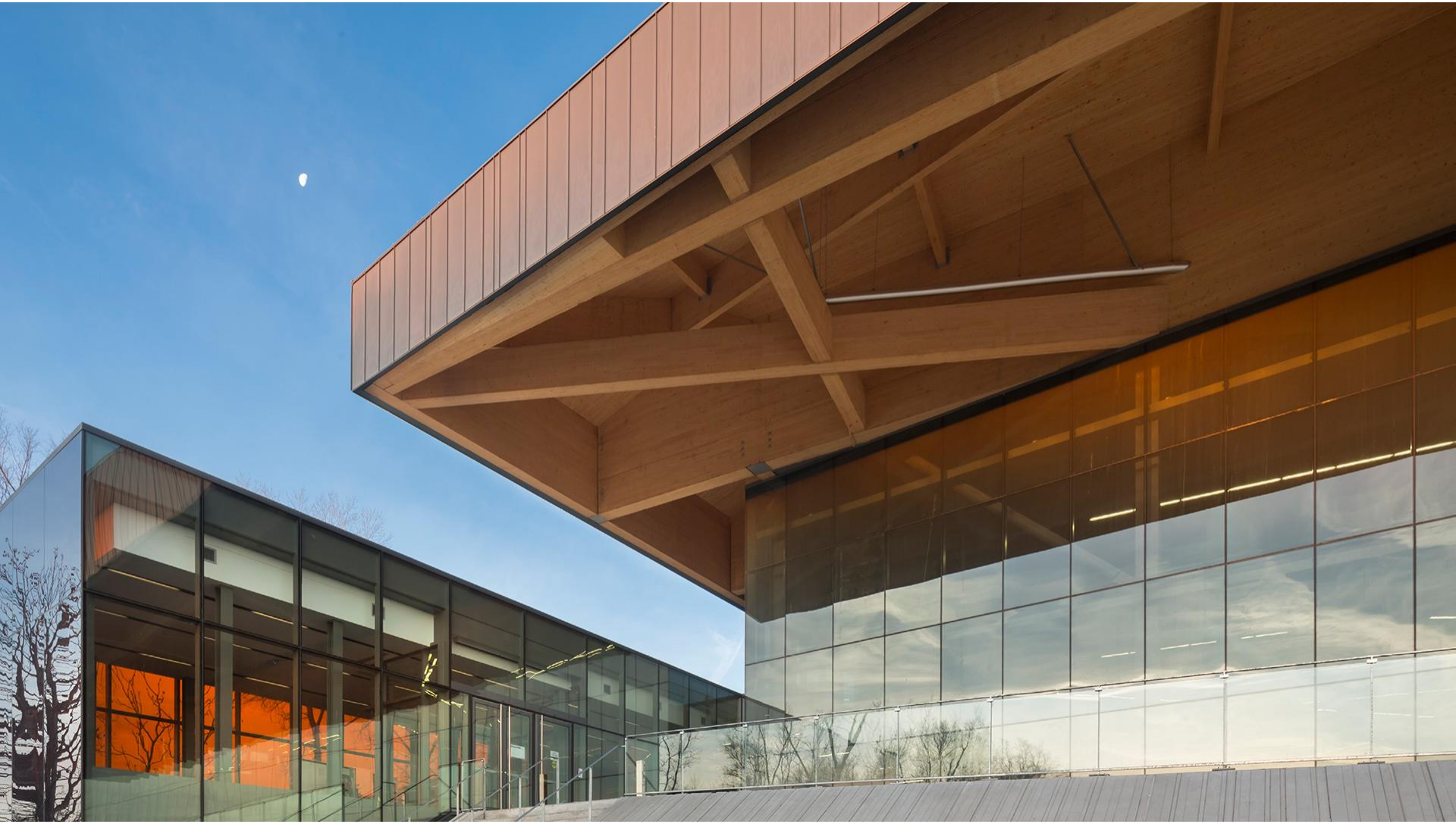

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Installation

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Conclusion and Acknowlegements

•The CESM soccer stadium is a project that **started with the willingness of the City of Montreal to create something beautiful** in order to revitalise a borough in the heart of town.

•This desire took shape with the **amazing creativity of SAUCIER PEROTTE architects** who chose wood to express their concept.

•Then, Nordic Wood Structures (with the help of many) had to build a structure that **respects the level of expectation** of the people who first dreamed it.

•Now that the project is built, it is possible to confirm that this impressive structure has **pushed the limits of timber construction in North America**.

NORDIC STRUCTURES

Conclusion and Acknowledgements

- **Thanks to all who participated in this project**
  - **SNC-Lavalin:** Patrick Boutin**,** Dominic Ouellet, and others
  - **Nordic Montréal:** Florian Lagarde, Mathias Oberholzer, Simon Gallagher, Hubertus Punzman, David Croteau, Jean-Claude Baudry, Fernando Leblanc-C., David Cady, Geneviève Lapierre, Julie Frappier David Croteau
  - **Chantier Chibougamau:** Bernard Gariépy, Denis Cossette, Robert Ménard, Jean-Louis Cassista, Maxim Gauthier, Dave Bouchard, Dany Roy, Carl Lapointe, Emilien Racine, Dominic Lavoie, Jacques Filion and scores of workers that worked day and night
  - **Construction FGP:** Normand Beauchemin, Simon Beauchemin, Guy, Louis-Phillipe, et tous les monteurs qui ont travaillé à l'extérieur au cours d'un des hivers les plus froids depuis longtemps.

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