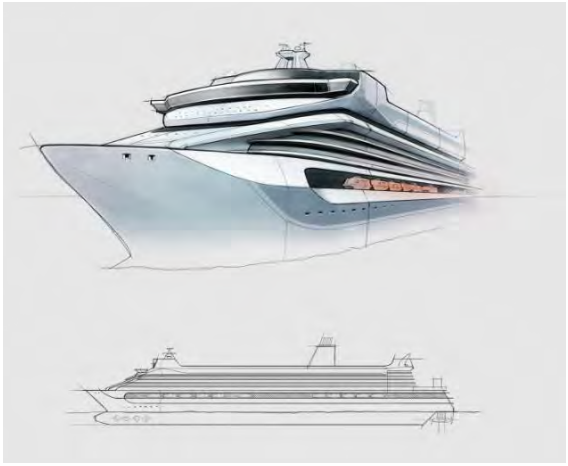
sapa:



E Läss
Finspång, Sweden

Chris Moyle
9th November 2016

sapa:

sapa in figures

Presence in more than **40** countries

World leader in aluminium solutions

100+ production units

20,000+ customers

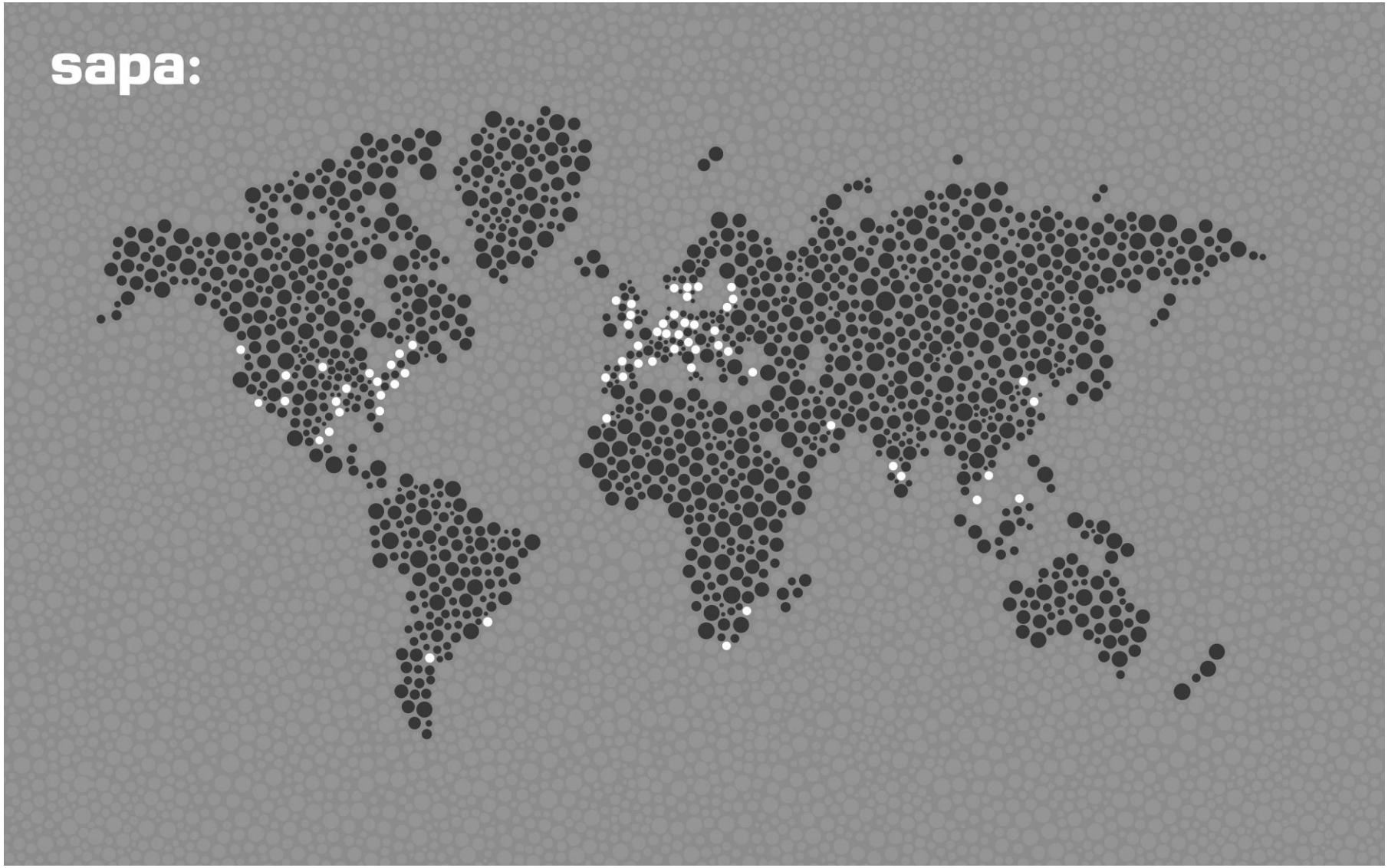
~45,000 suppliers

NOK **46.4** billion sales*

23,500 employees

*Sales figure equivalent to EUR 5.6 billion, USD 7.4 billion

sapa:



sapa:

Together, we are better

21 cast-houses

39 anodizing lines

14 welding lines

24 paint lines

155 presses

sapa:

So how do we work in the Marine Industry?

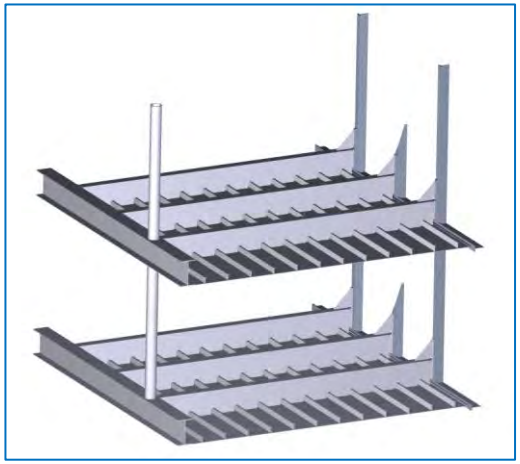
sapa:

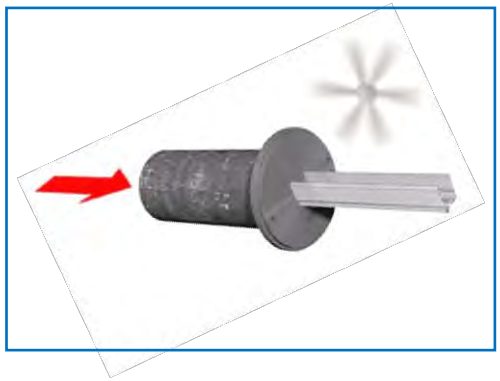
It starts with either a **need**, a **desire** or an **idea** from a customer

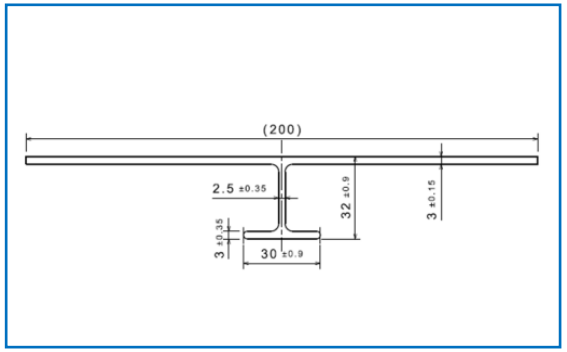
a) To **reduce weight**
b) To **reduce** production **cost**
c) To **reduce** production **time**
d) To **improve strength**
e) To incorporate **functionality** for a **smarter design**

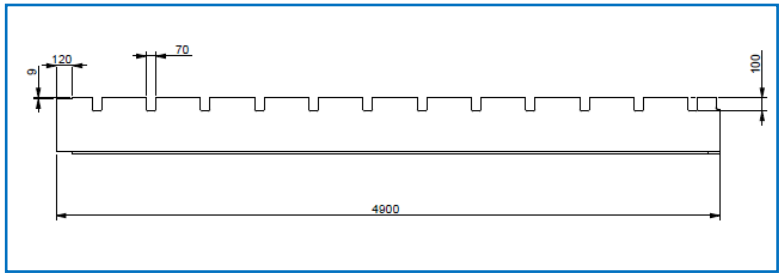
sapa:

FROM CONCEPT TO REALITY







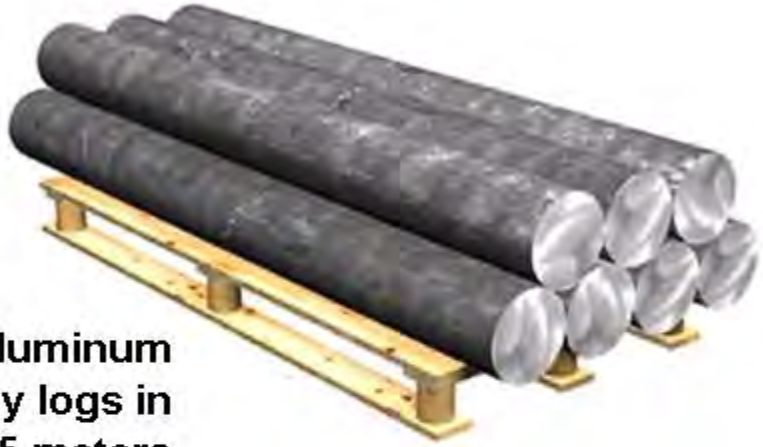


sapa:

FROM CONCEPT TO REALITY

sapa:

Extrusion process



Aluminum alloy logs in 4-8.5 meters lengths…

…cut to lengths (billets) adjusted for the press operation…

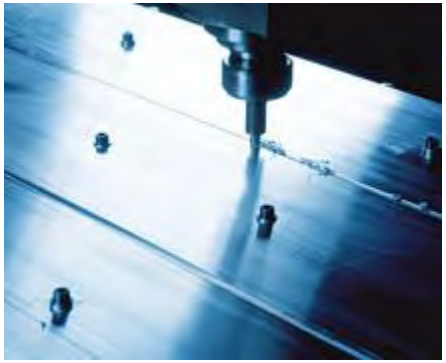
…heated to about 500 degrees C…

…the metal is extruded through the die and immediately cooled off.

sapa:

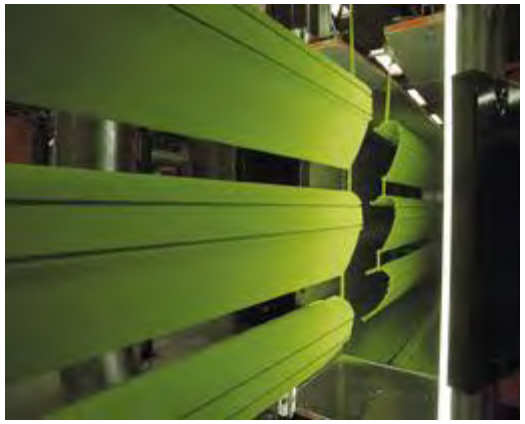
Machining and fabrication

CNC machining, welding, Friction Stir Welding, bending, punching, drilling, cutting, milling…



sapa:

Surface treatment



Painting, Anodizing, Decoral…

sapa:

OVERVIEW

Cruise Vessels

Predominantly European Customers

- **Scope of Supply**
  - FSW Deck Panels & Bulkheads
  - Machined structural profiles
  - Balcony Components
  - Funnels

Mega Yachts

Customers Globally

- **Scope of Supply**
  - FSW Deck Panels & Bulkheads
  - Structural profiles
  - Components

Fast Ferries

Customers Globally

- **Scope of Supply**
  - FSW Deck Panels & Bulkheads
  - Machined structural profiles
  - Hull plating

OVERVIEW

Defence Vessels

Customers Globally

- **Scope of Supply**
  - FSW Deck Panels & Bulkheads
  - Machined structural profiles
  - FSW Helodecks
  - Masts

Offshore Vessels

Predominantly Europe

- **Scope of Supply**
  - FSW panels
  - Profiles for helicopter decks

Offshore structures

World wide

- **Scope of Supply**
  - FSW Panels & profiles for Living quarters
  - Stair Tower Structures
  - Boarding Gangways

sapa:

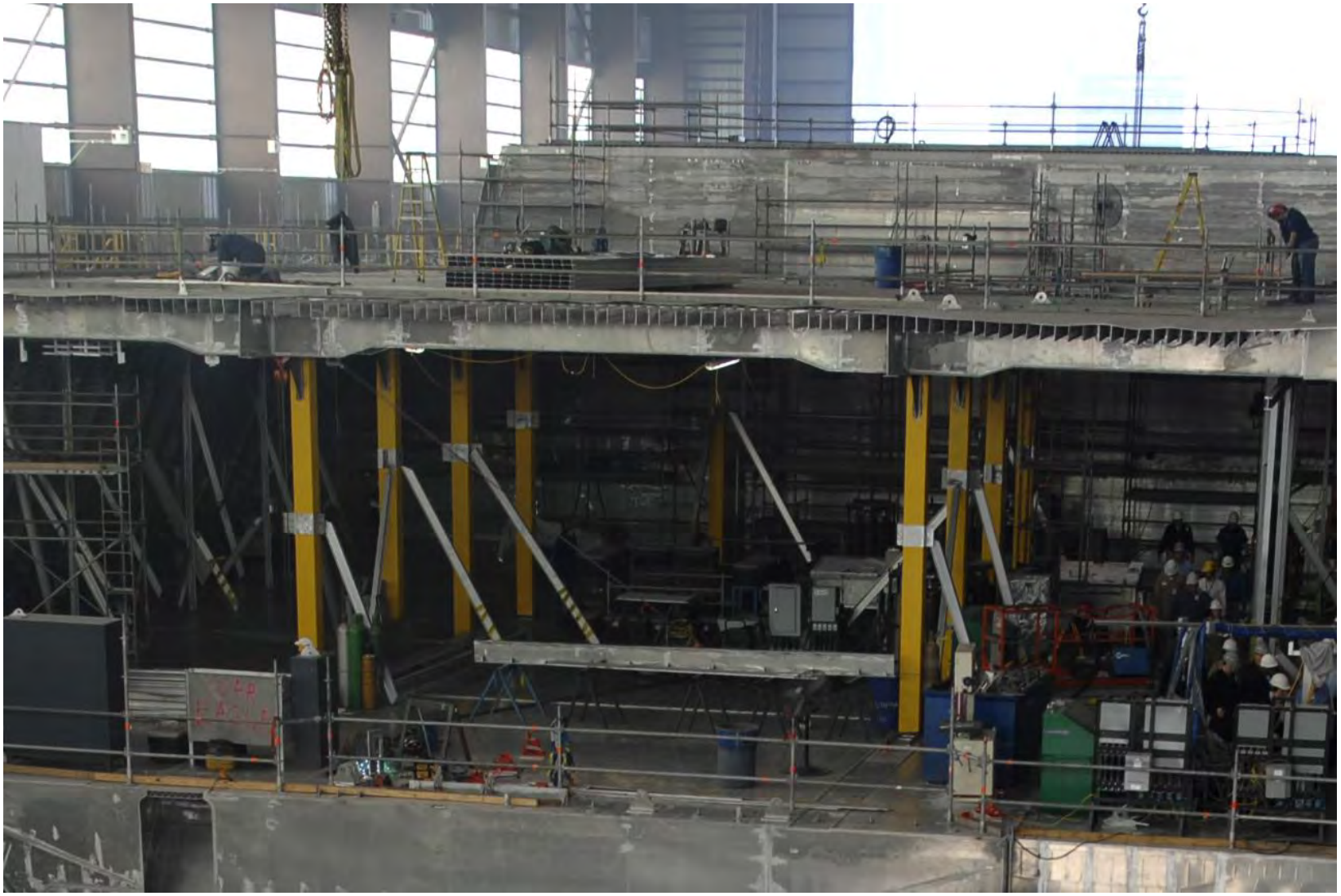
AUSTAL SHIPS USA SAVE WEIGHT ON HELODECK

AUSTAL

sapa:

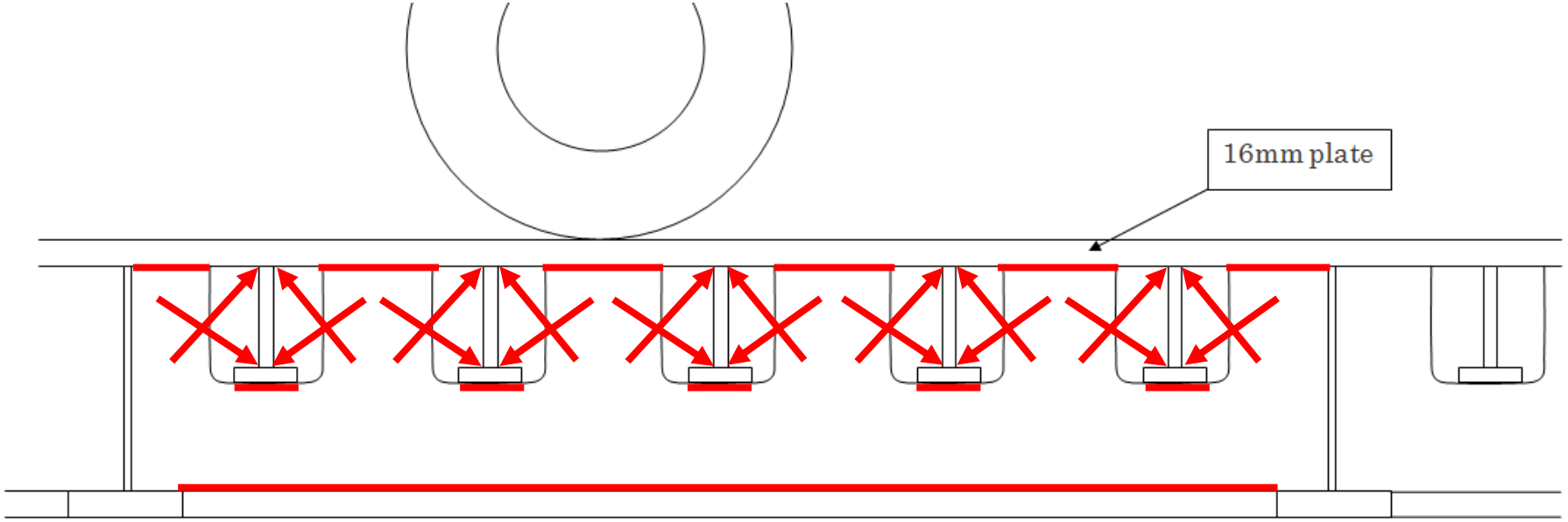
AUSTAL SHIPS USA
SAVE WEIGHT ON HELODECK

Helicopter deck



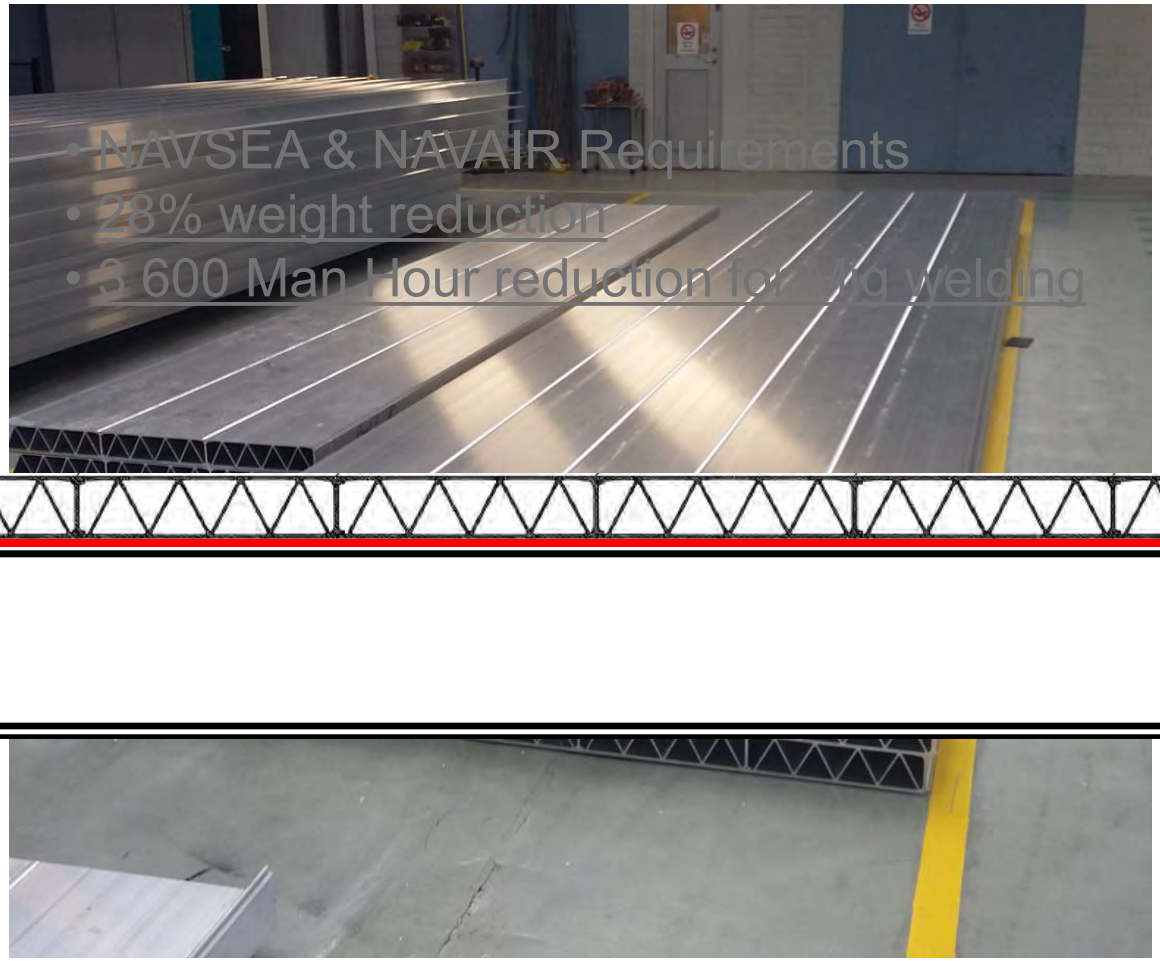
sapa:

WEIGHT SAVING
ALUMINIUM PLATE TO EXTRUSION



sapa:

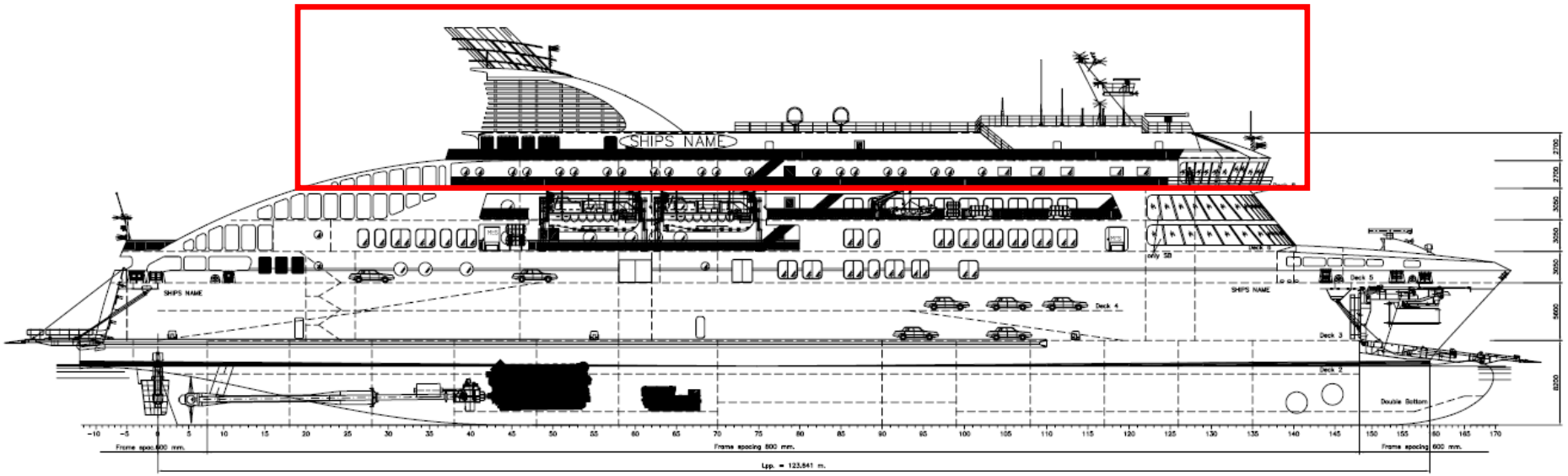
WEIGHT SAVING ALUMINIUM PLATE TO EXTRUSION



sapa:

FACTORIAS VULCANO, VIGO

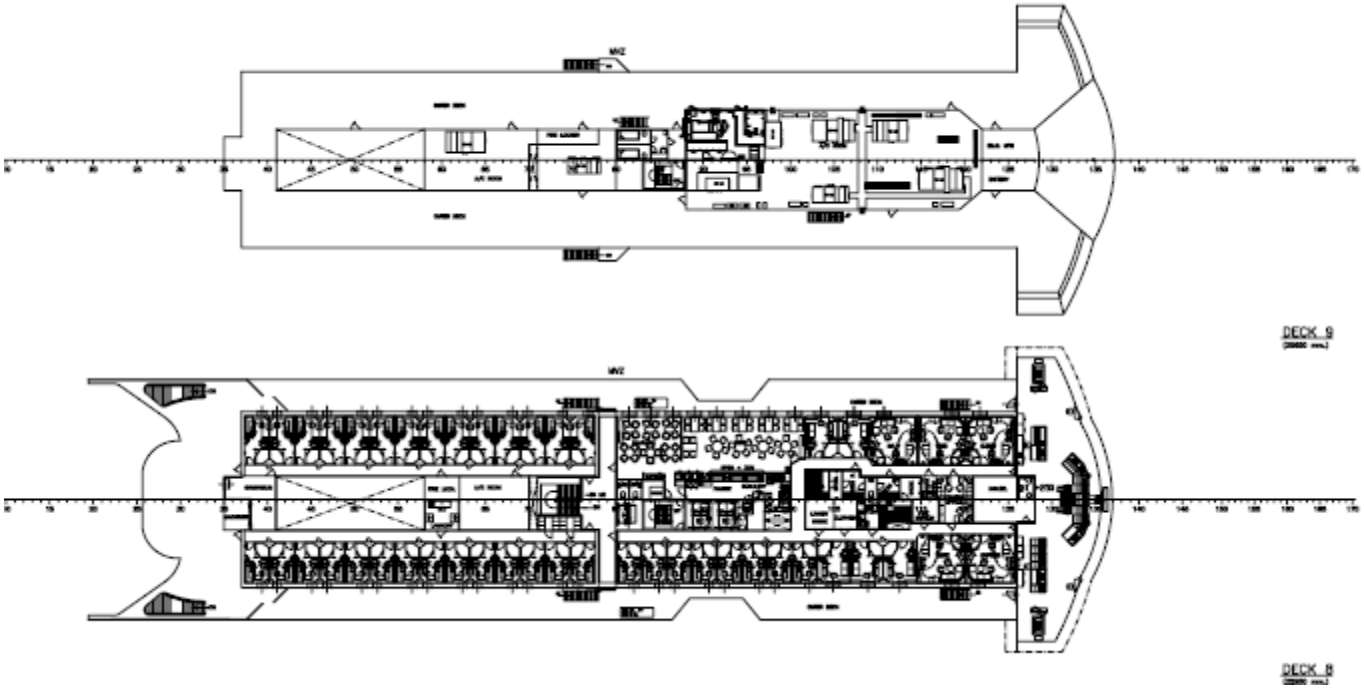
FACTORIAS VULCANO



sapa:

FACTORIAS VULCANO, VIGO

FACTORIAS VULCANO



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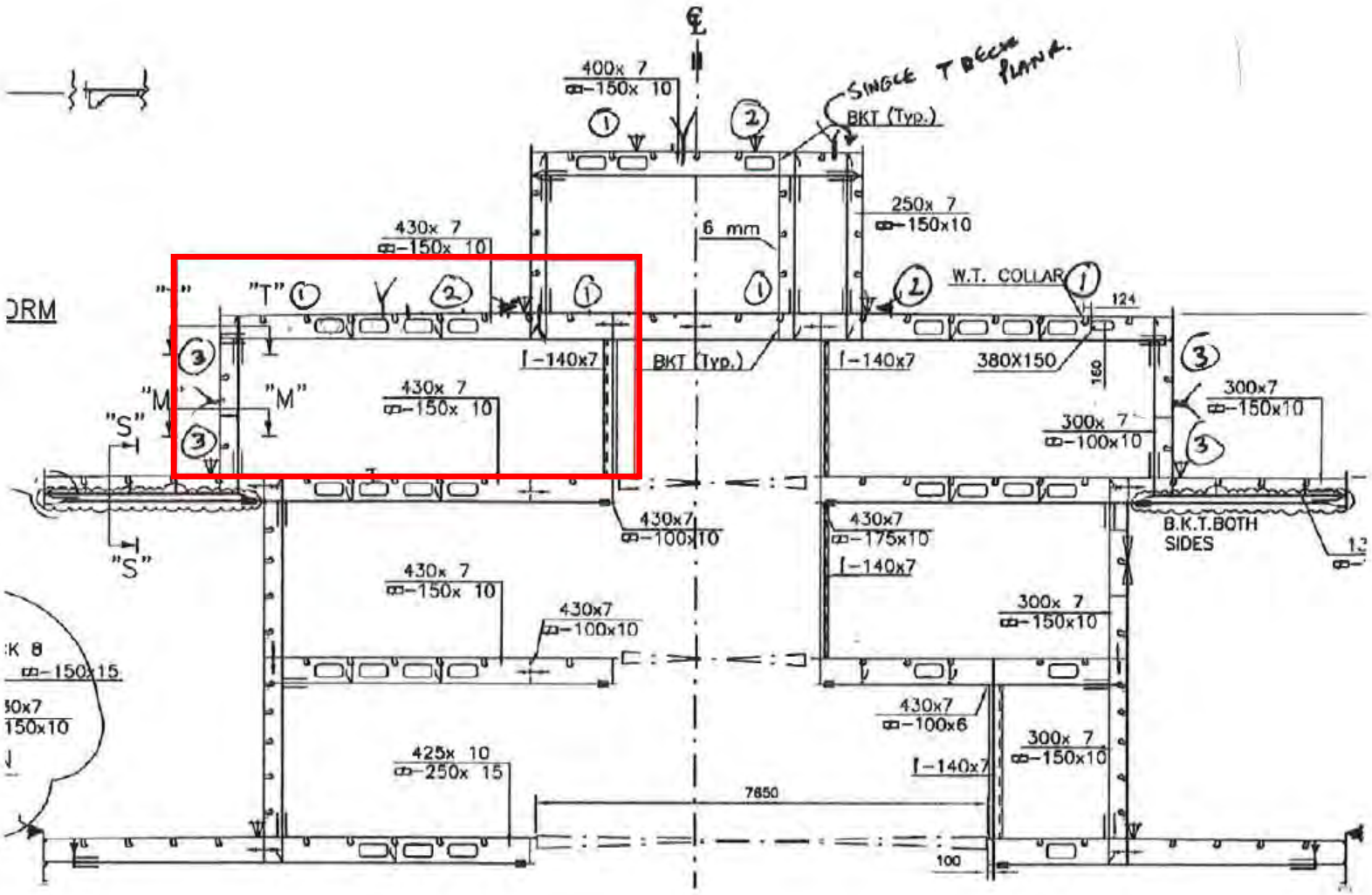
FACTORIAS VULCANO, VIGO

FACTORIAS VULCANO



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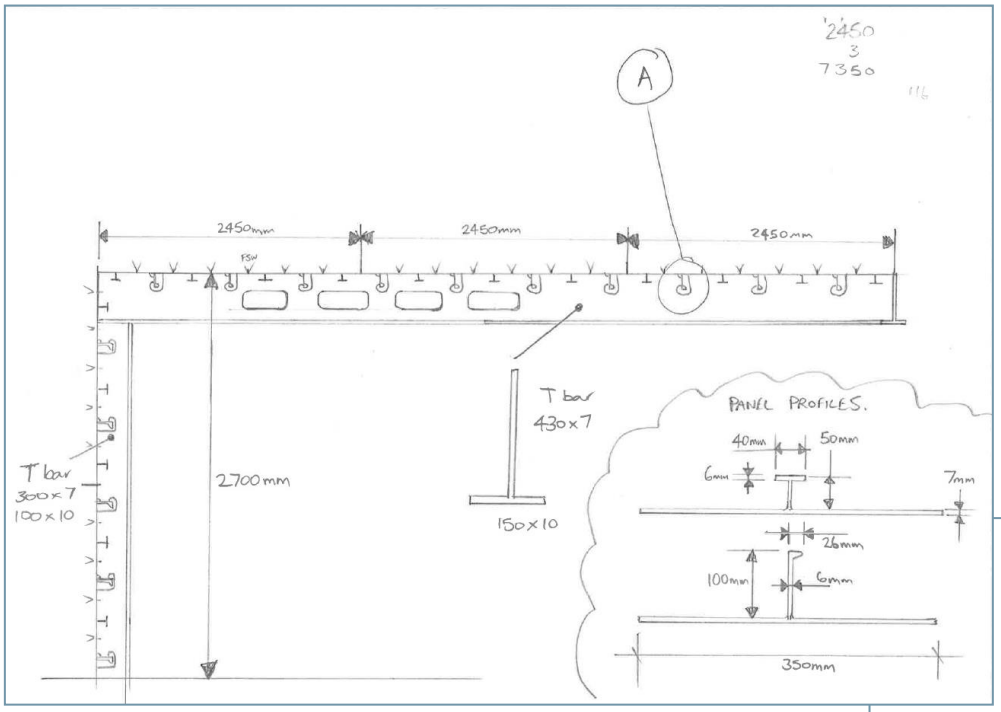
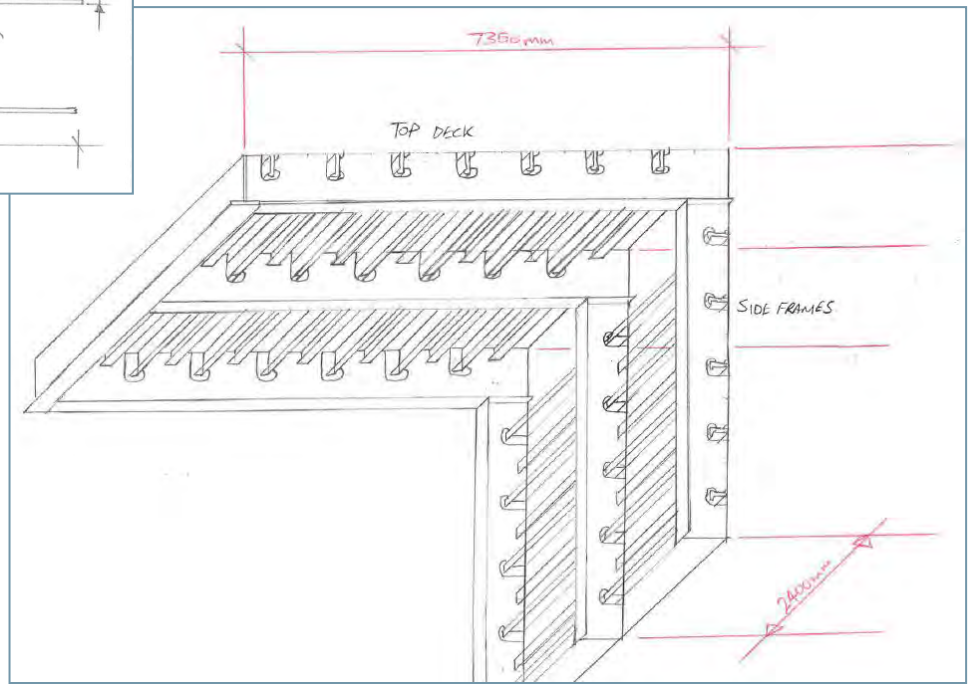
FACTORIAS VULCANO, VIGO

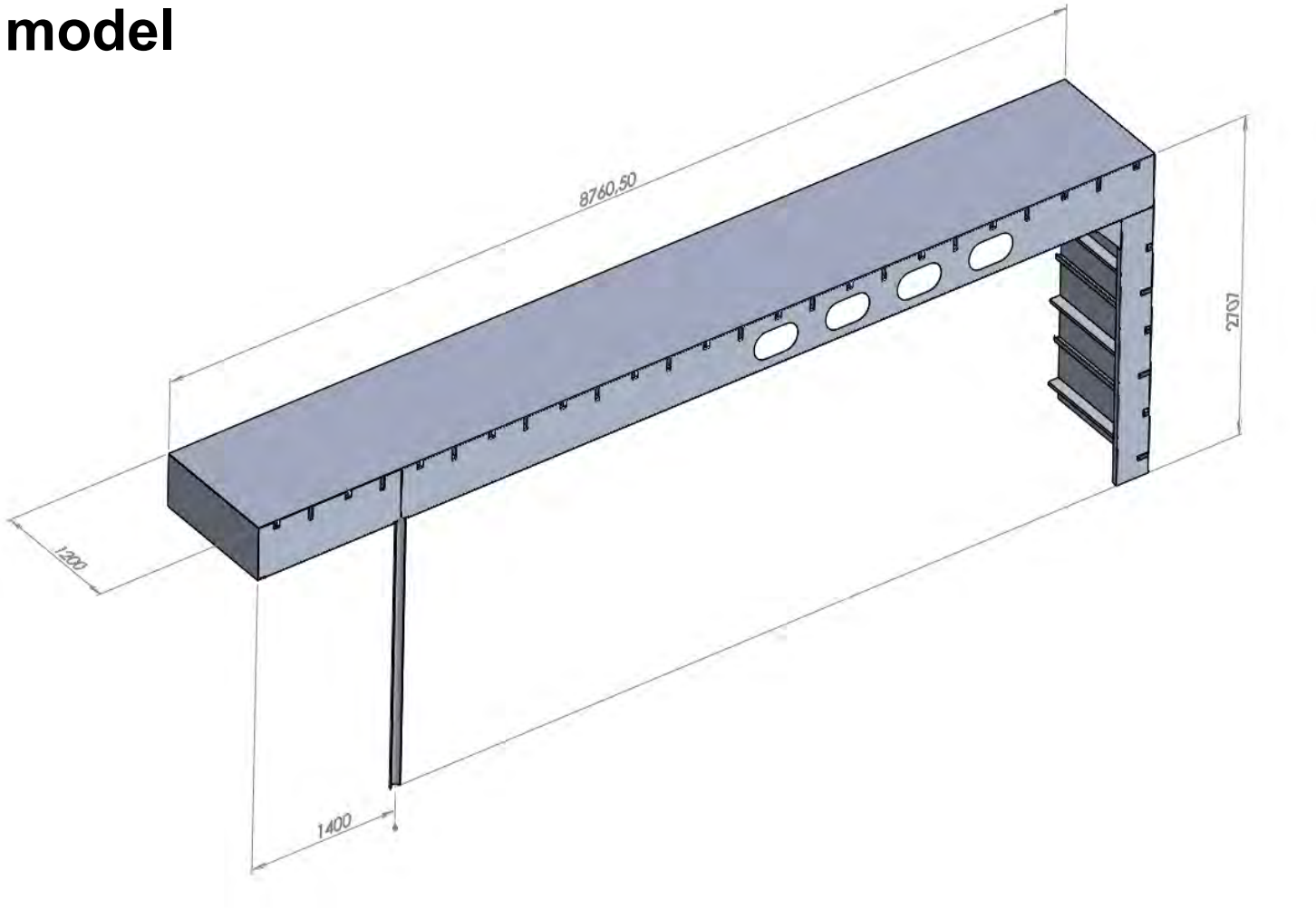
FACTORIAS VULCANO





FACTORIAS VULCANO, VIGO

The model

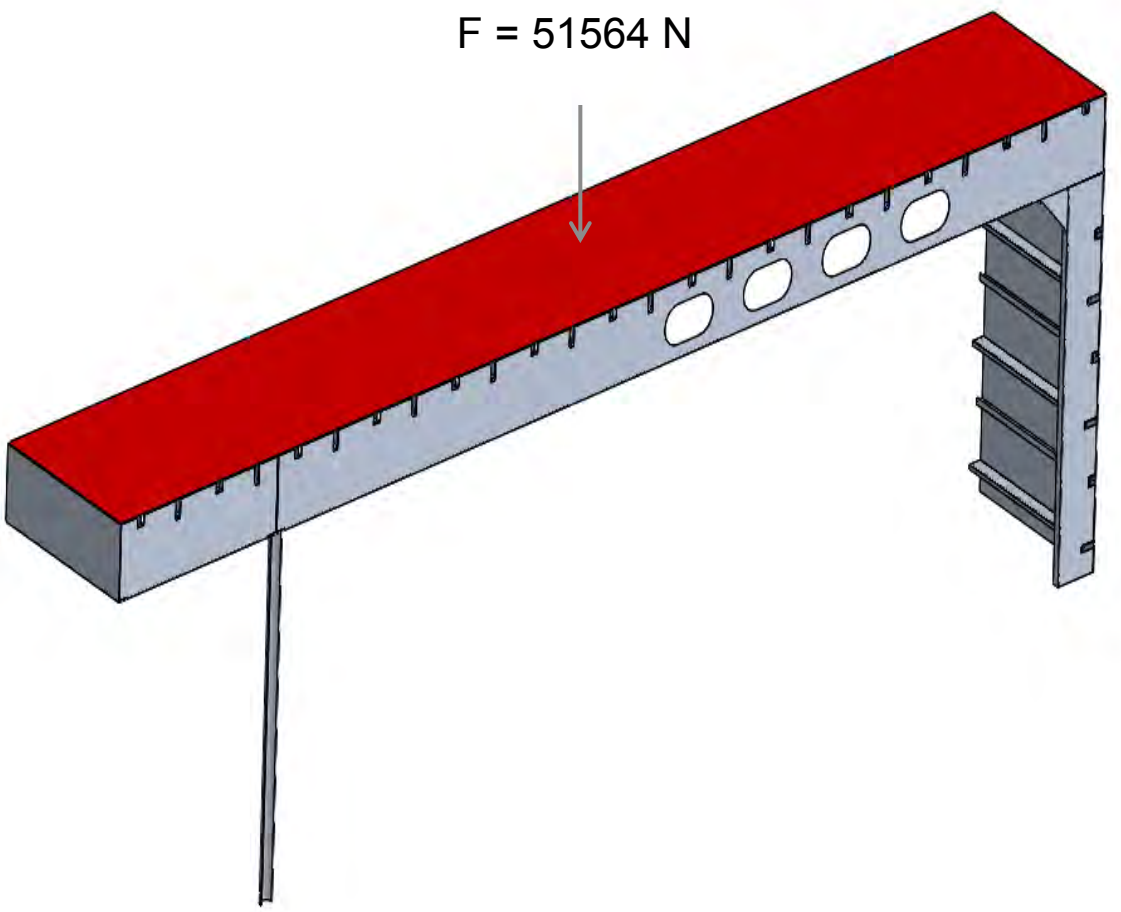


FACTORIAS VULCANO, VIGO

Load

500 kg/m² x 9,81m/s² x 1,2 m x 8,7605 m = 51564 N

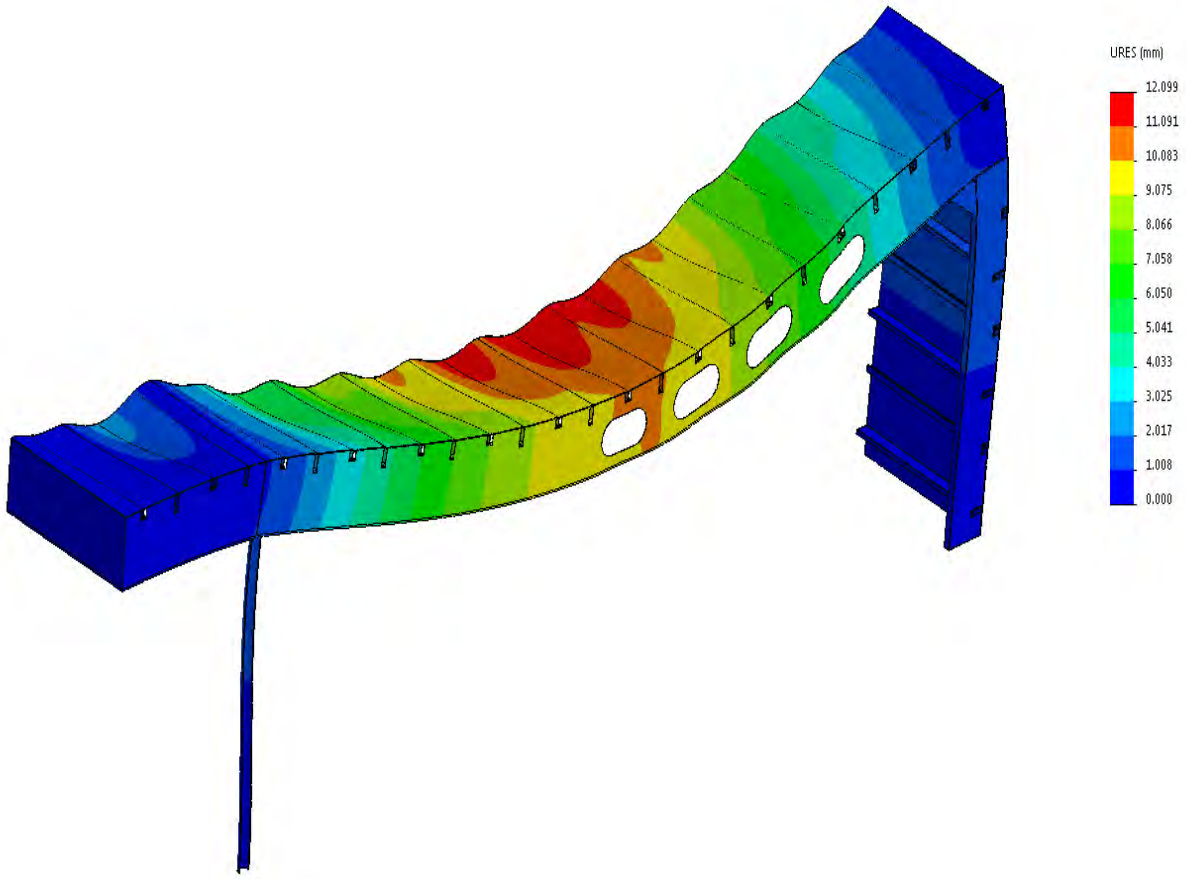
The dead weight of the material is included in the calculation (gravity)



Modulus of elasticity
70 kN/mm²

FACTORIAS VULCANO, VIGO

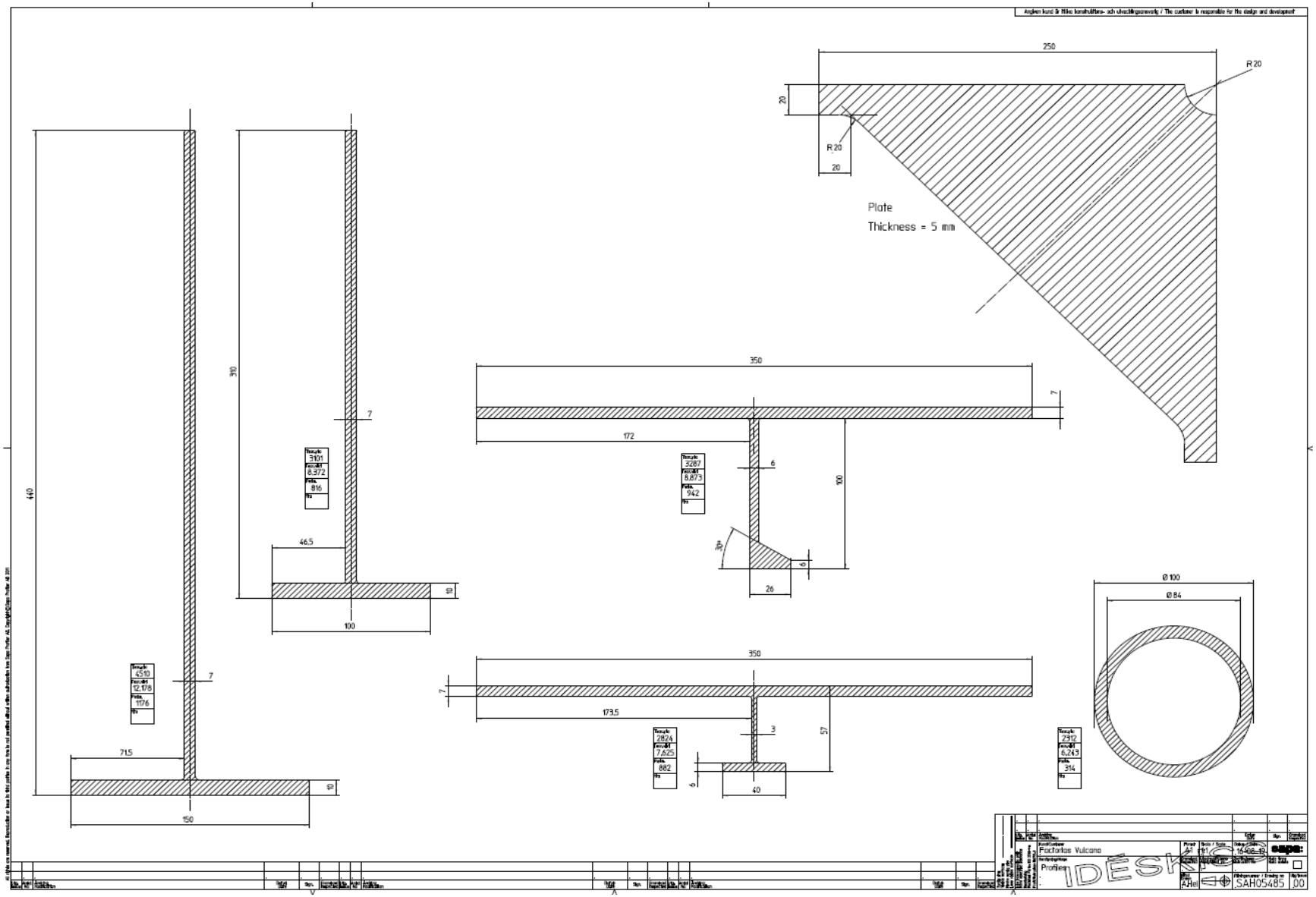
Deflection



sapa:

FACTORIAS VULCANO, VIGO

Profiles



FACTORIAS VULCANO, VIGO

Summery

1. Keeping existing measurements to minimize changes with Lloyds
   - Did not meet deflection criteria
   - 32% weight reduction from steel design

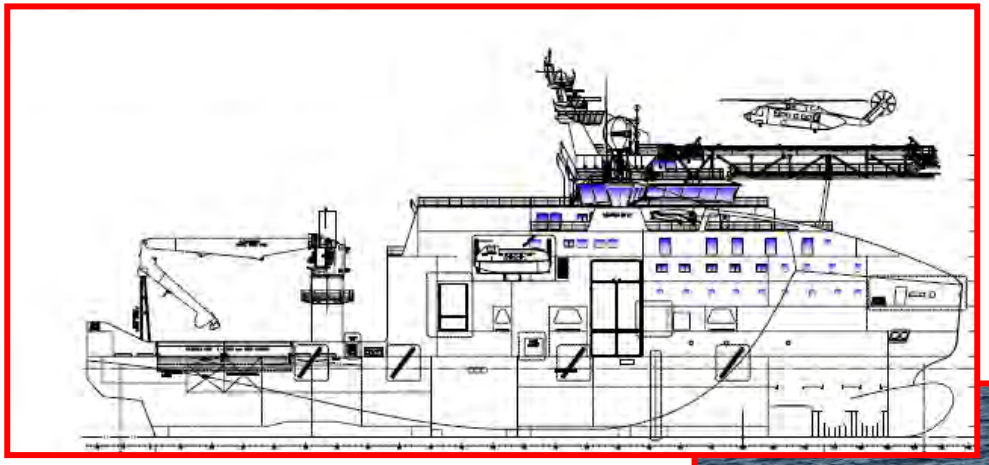
2. Adding an additional transverse frame
   - Meets deflection criteria

3. Optimizing the profiles to reduce weight
   - Weight reduction of 44% from original steel structure including additional frames and fire protection

sapa:

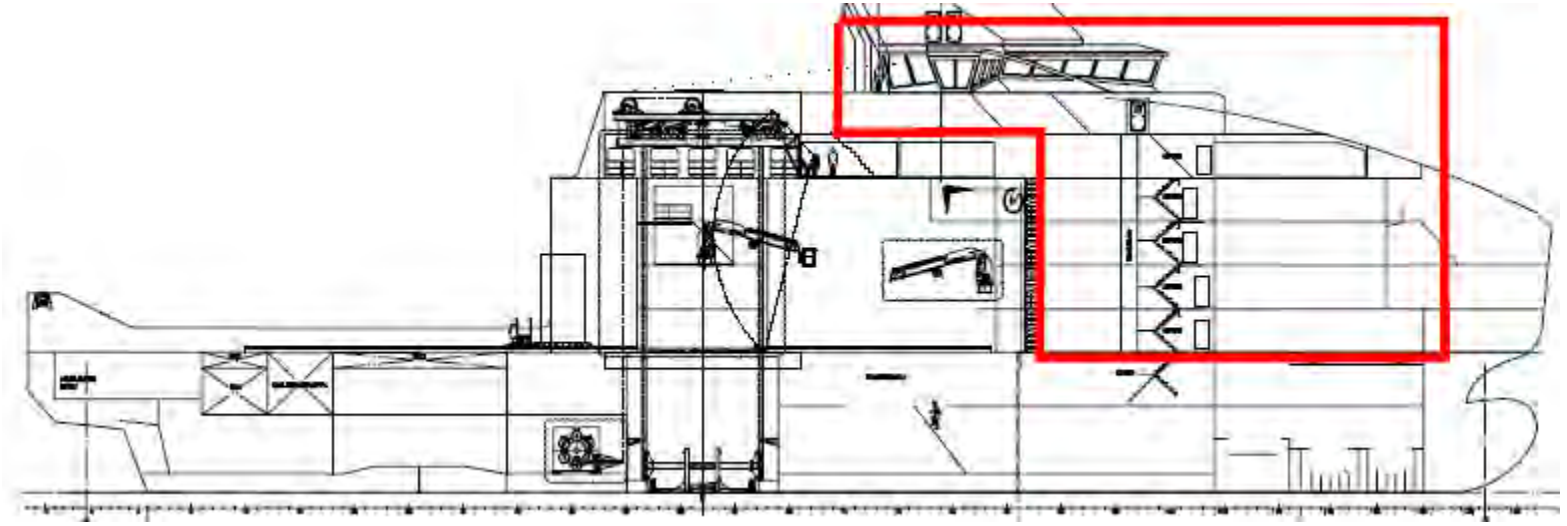
Offshore Vessel Project

"Save us as much weight as possible through changing to aluminium"



Focus area

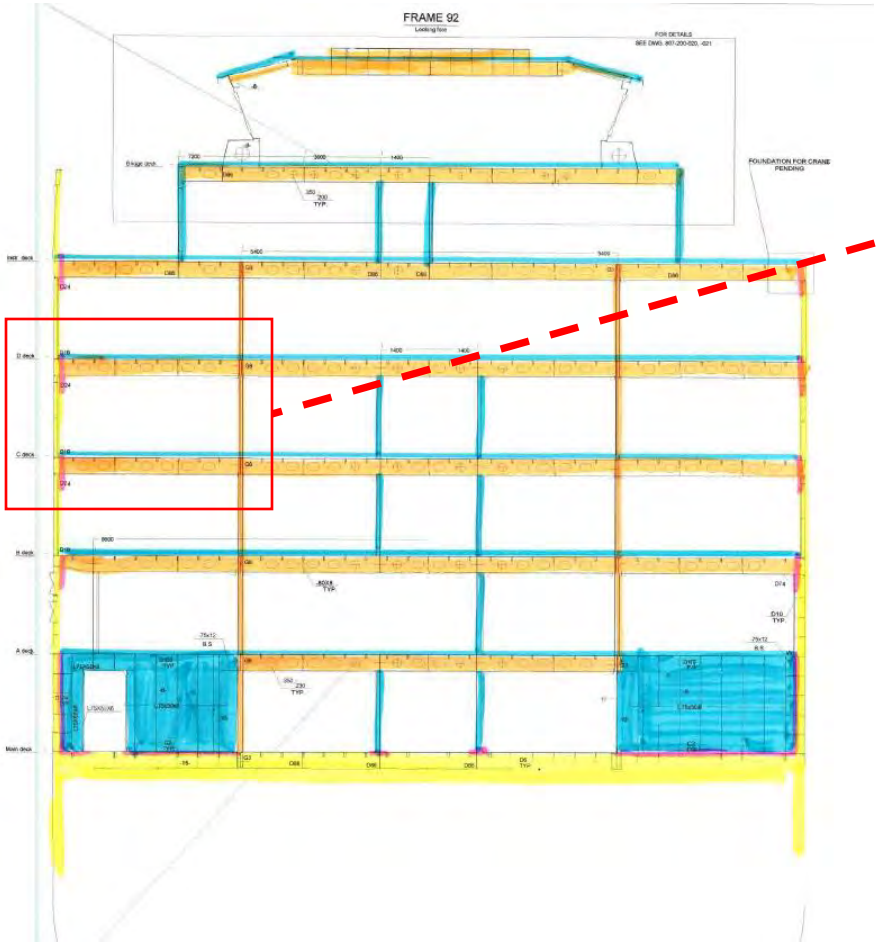
- Focus on suggested area
  - Discussed whole superstructure in aluminium
  - Discussed external shell plating & connection to steel
  - Discussed assembly process
  - Discussed only central section in aluminium
  - **Focused on internal structure, maintaining steel shell**

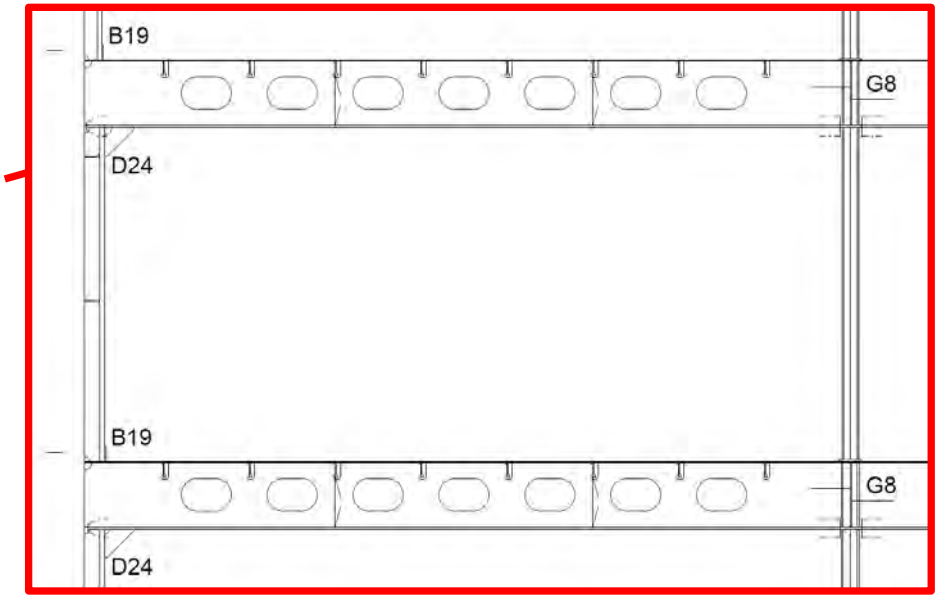


sapa:

Focus area

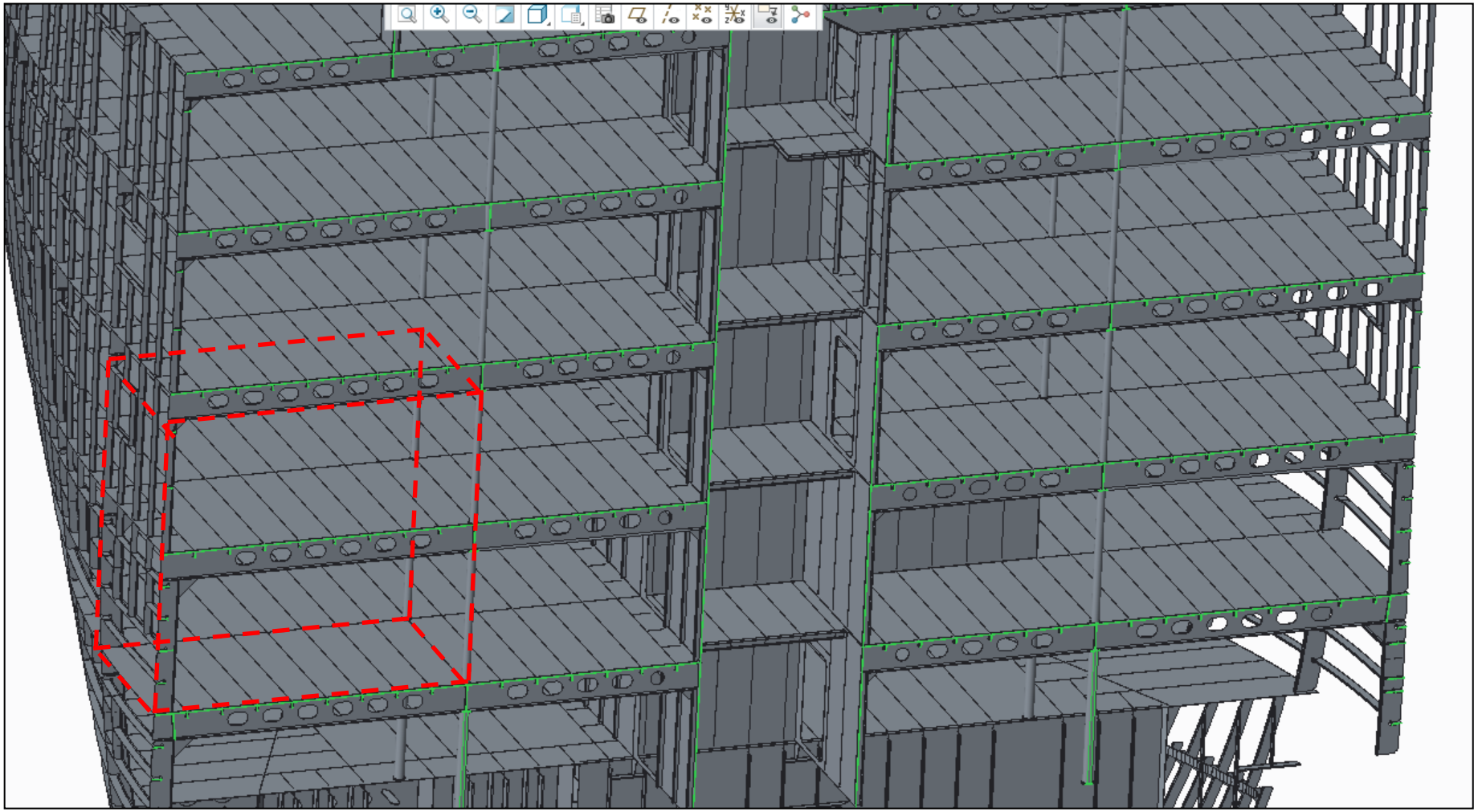
- Focus on suggested area
  - Focused on internal structure, maintaining steel shell





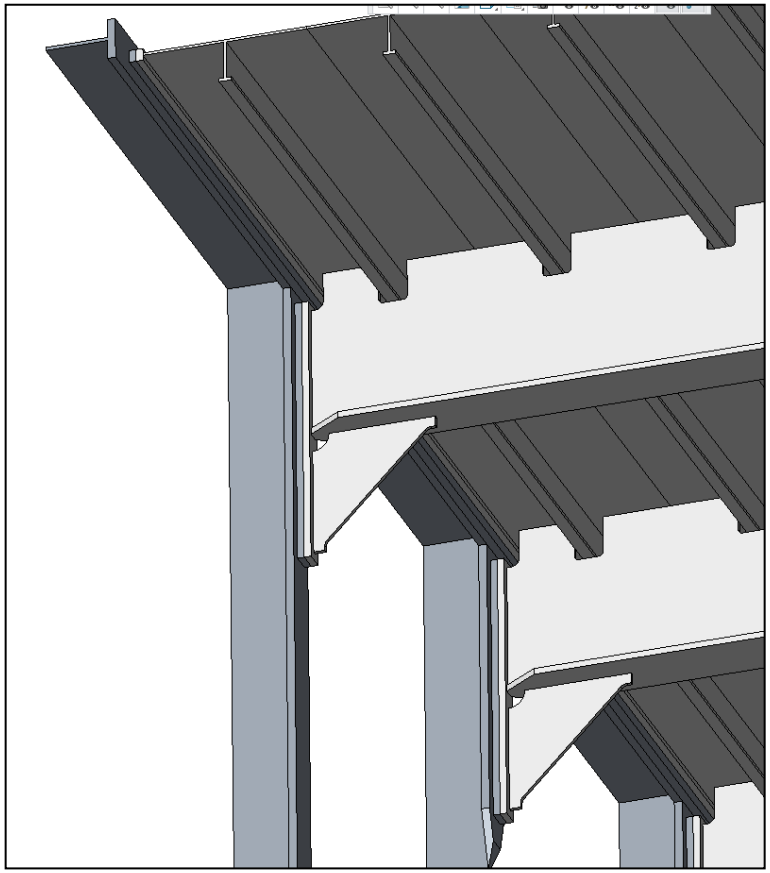
sapa:

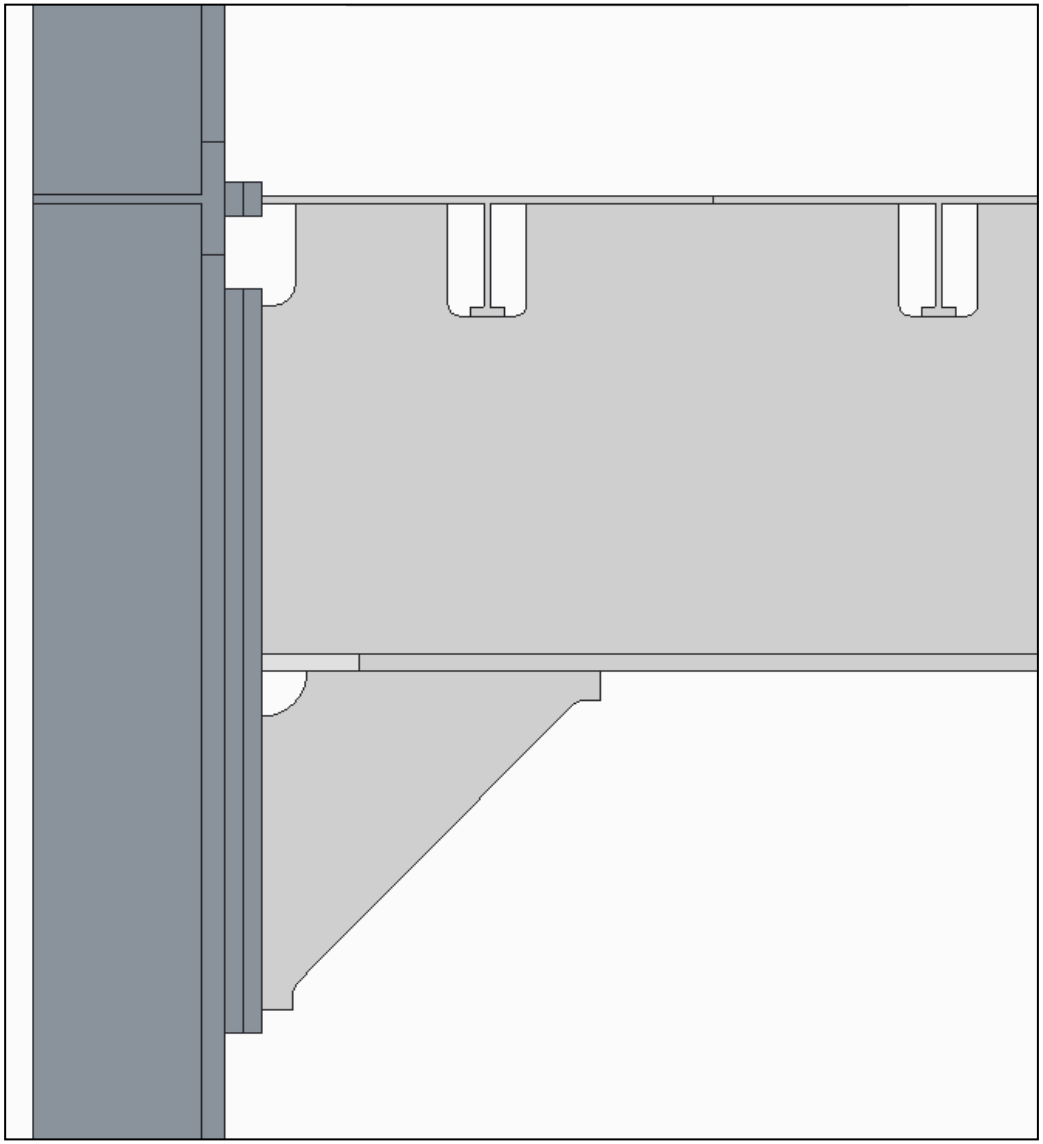
Area of the ship that is studied



sapa:

Version 1





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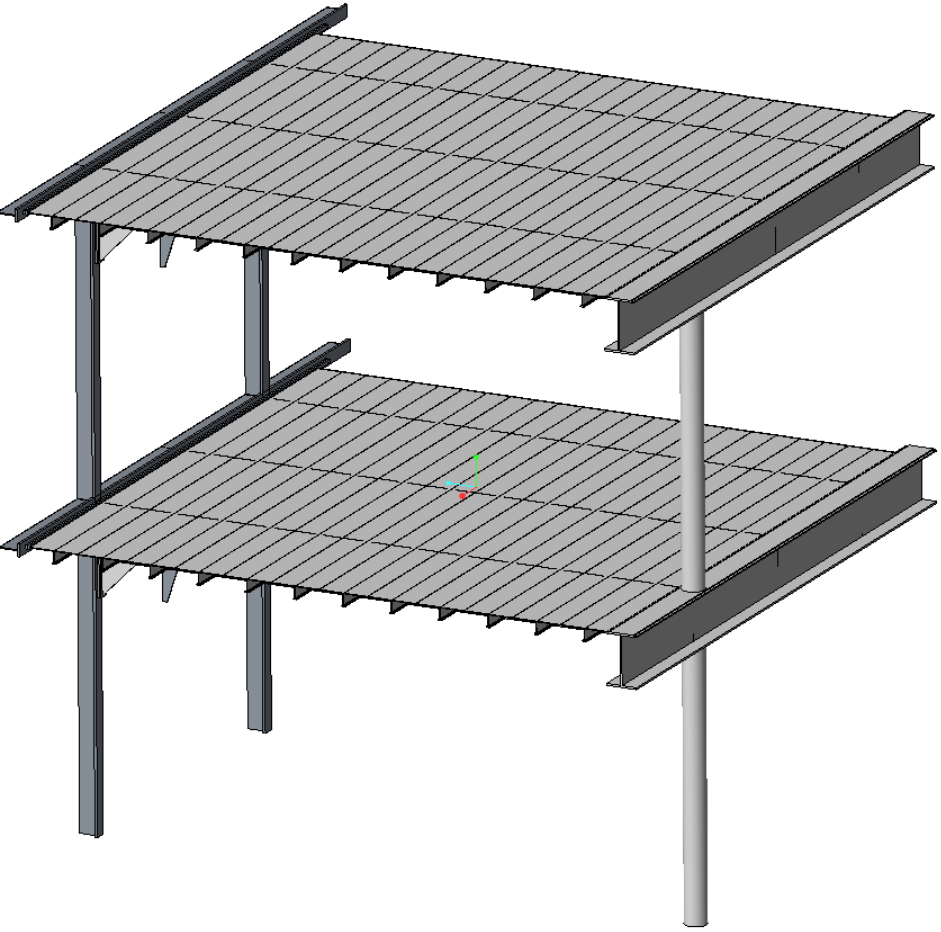
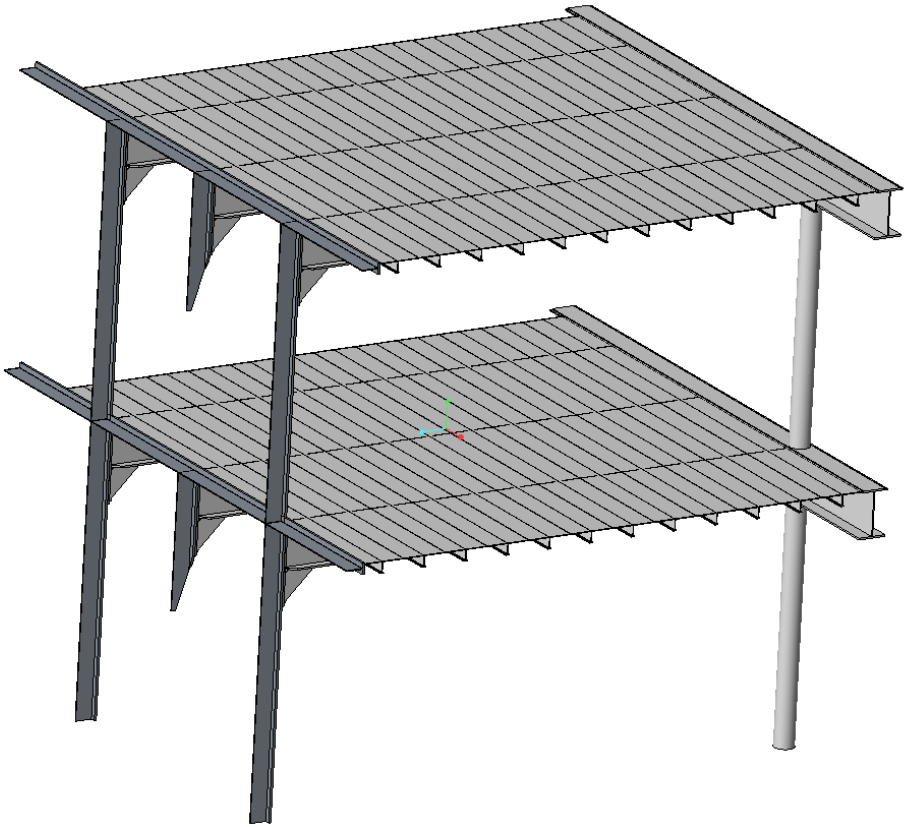
Version 1

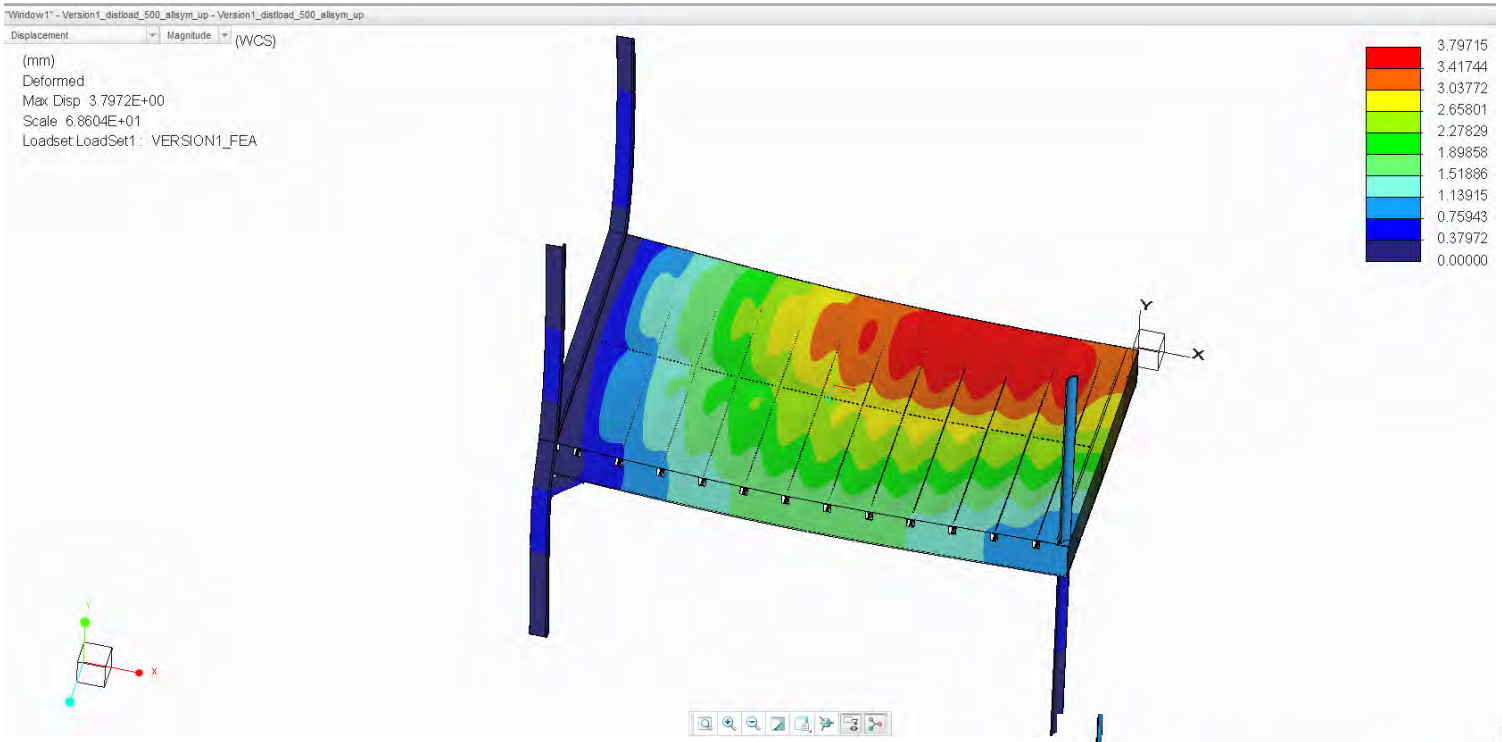




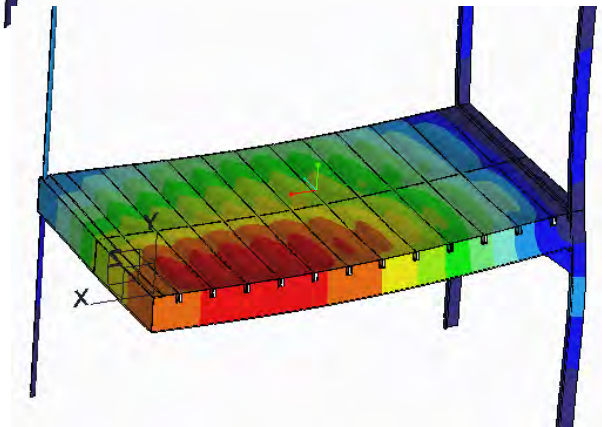
sapa:

Displacement [mm]

Version 1, Displacement (mm)



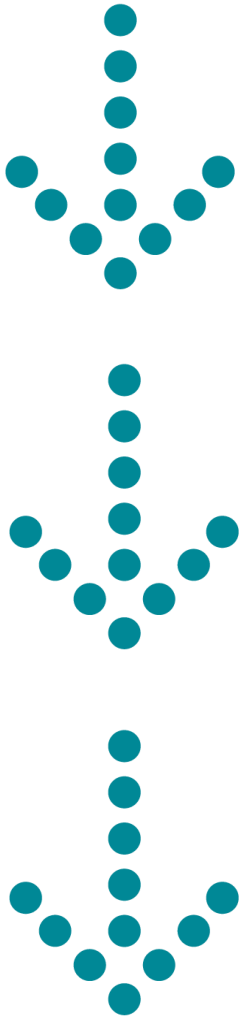
Free span = 9810 mm
Requirement 9810/300 = 32.7 mm
=> App. 1/8.6 of the requirement



sapa:

Considering selected area
Concept Vs current steel design

- Current Steel weight = 1 277 kg
- First concept weight = 682 kg
- Reduction of = 595 kg
- Approx weight reduction = 46%
- Weight saving per sqm = 43 kg
- Increased weight savings in
  - Between Longitudinal Girders
  - Transverse & Longitudinal Bulkheads
  - Optimizing the extrusions

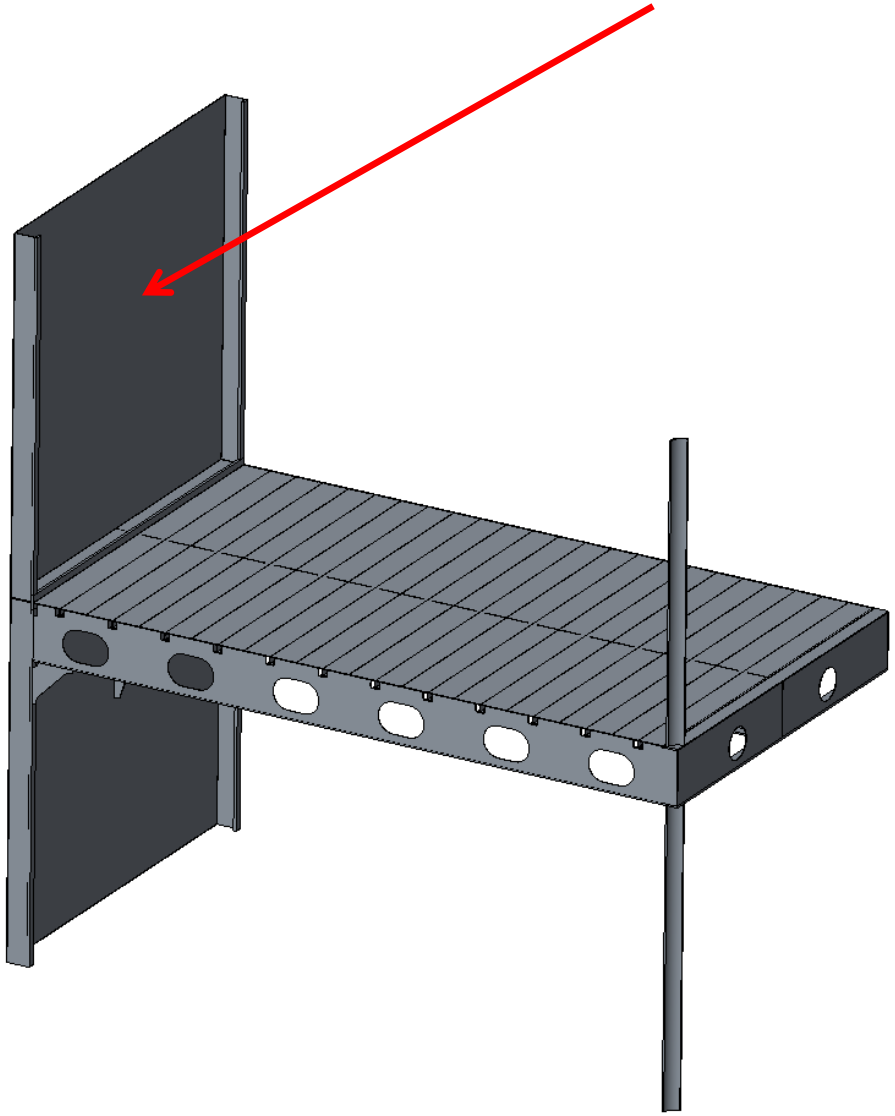


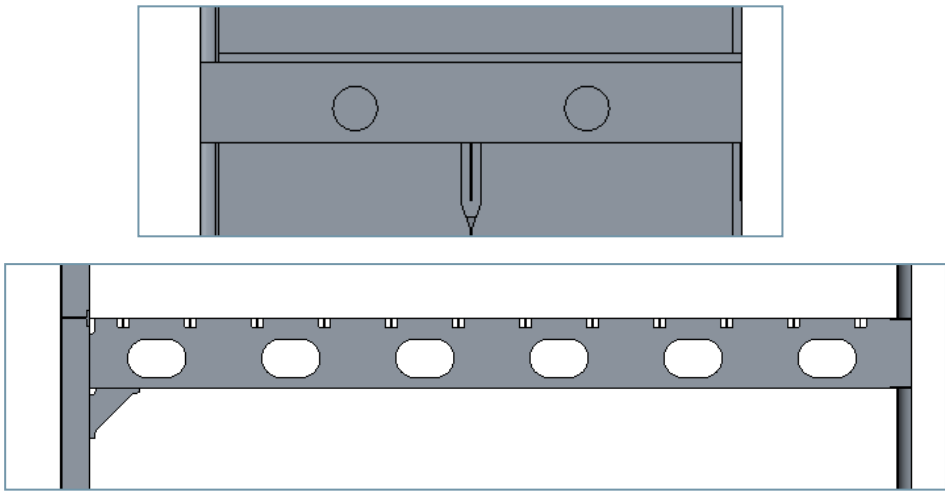
New concept design after implementation of:

1. Feedback and input from customer
   a) Vibration
   b) Sound proofing
   c) Lightening holes for services

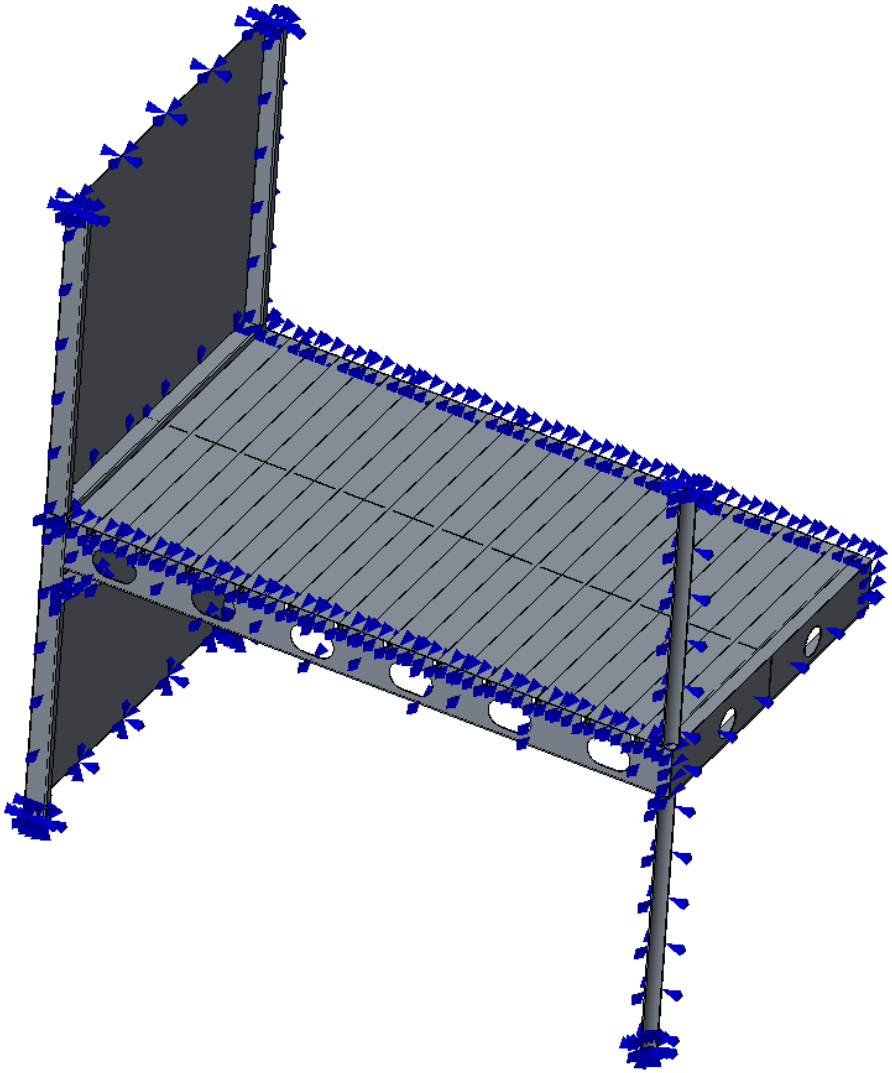
2. Input and information from DNV-GL (2015)
   a) Location & position of cut outs
   b) Vibration
   c) Minimum plate thicknesses

Version 2, Hull plates added (6mm steel)

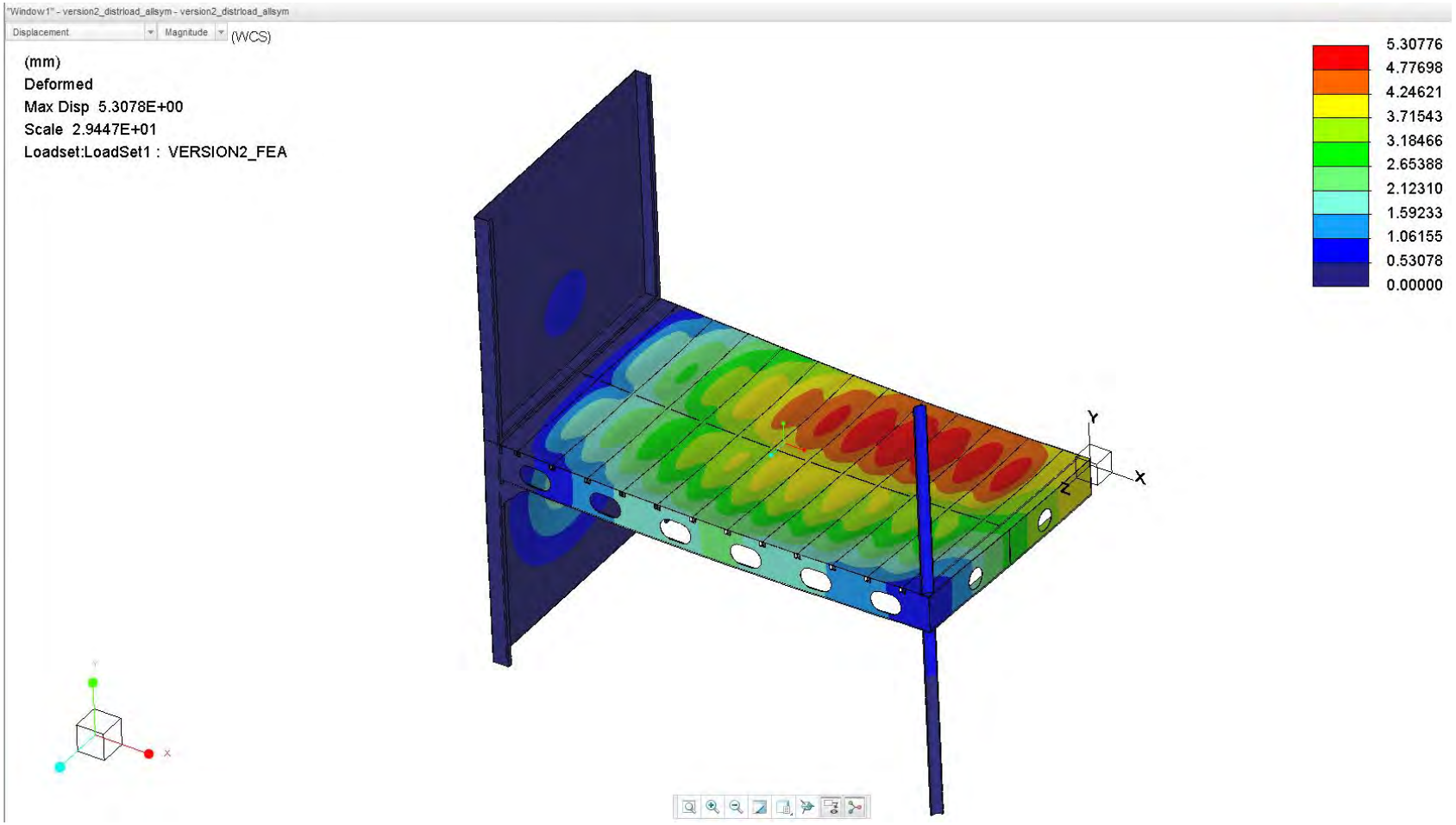




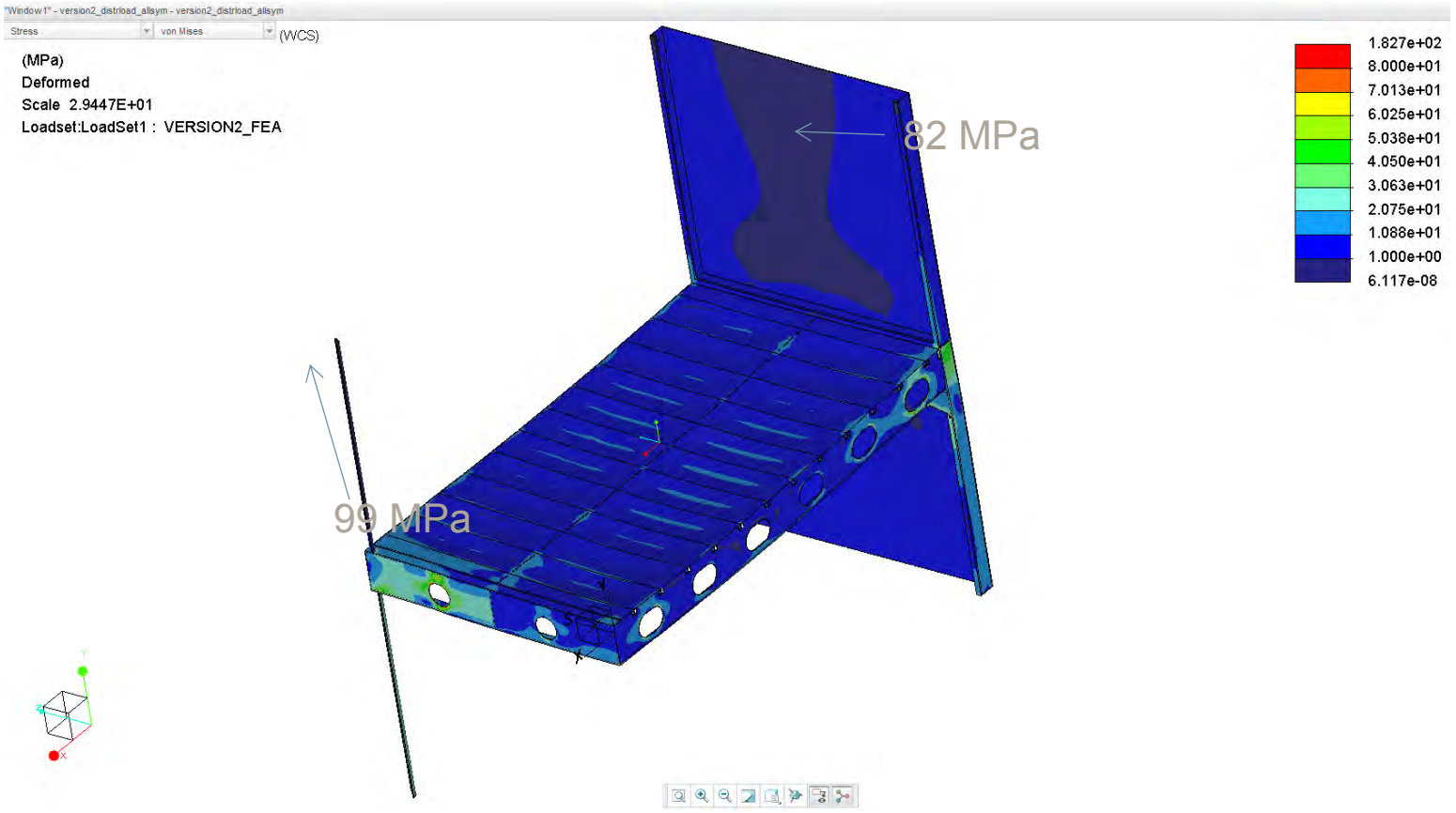
Static analysis of structure, Ver 2



Version 2 Displacement, full symmetry



Version 2, von Mises stress, full symmetry



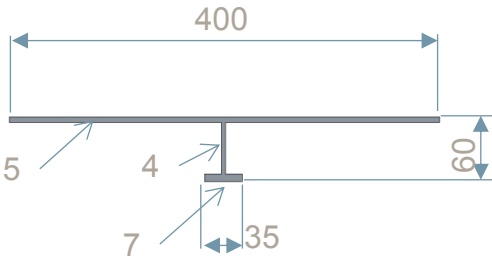
Weight estimate for Optimized Concept

Aluminium parts

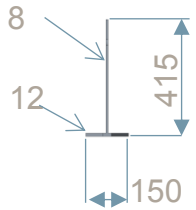
- Floor planks 12 x 18,49 kg = **221,88** kg
- Transversal 1 x **55,9** kg
- Longitudinal 1 x **35,91** kg
- Gussets 3 x 1,06 kg = **3,18** kg
- Compression posts 2 x 9,385 kg = **18,8** kg (2x ¼ posts)

Total aluminium weight 336kg

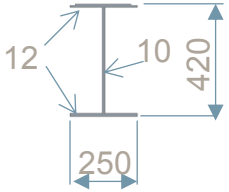
Deck panel profile



Transversal ”T” Bar



Longitudinal ”I” Beam



Weight estimate for Optimized Concept

Steel weight

- ½ frame 1 x 21kg
- Transverse side frames 1 x 65kg
- Longitudinal side girder 1 x 70kg

Total Steel weight = 156kg

Triclad weight

- Gusset connection 2 x (659 x 50 mm)
- Floor to Hull 1 x (2800 x 50 mm)

Total = 30kg

Weight estimate for Optimized Concept

Overall total weight (New concept) = 522kg

Customers steel design = 1277kg

Total saving = 59% weight reduction

Thank You
Any Questions???