

# Stålkonstruktioner klarer opgaven



## OM OS



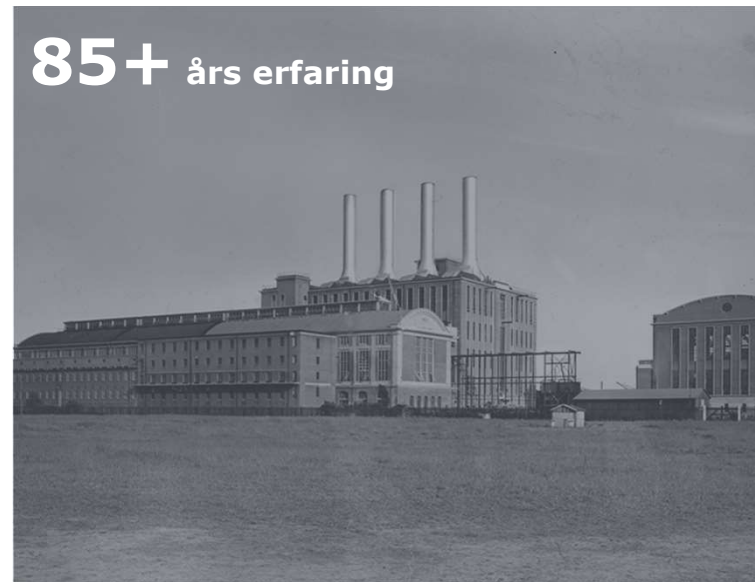
### **Lars Feldbech Andersen**

- Civilingeniør, Aarhus Universitet
- Energi & Industri, MOE Aarhus
- Fagingeniør, konstruktioner

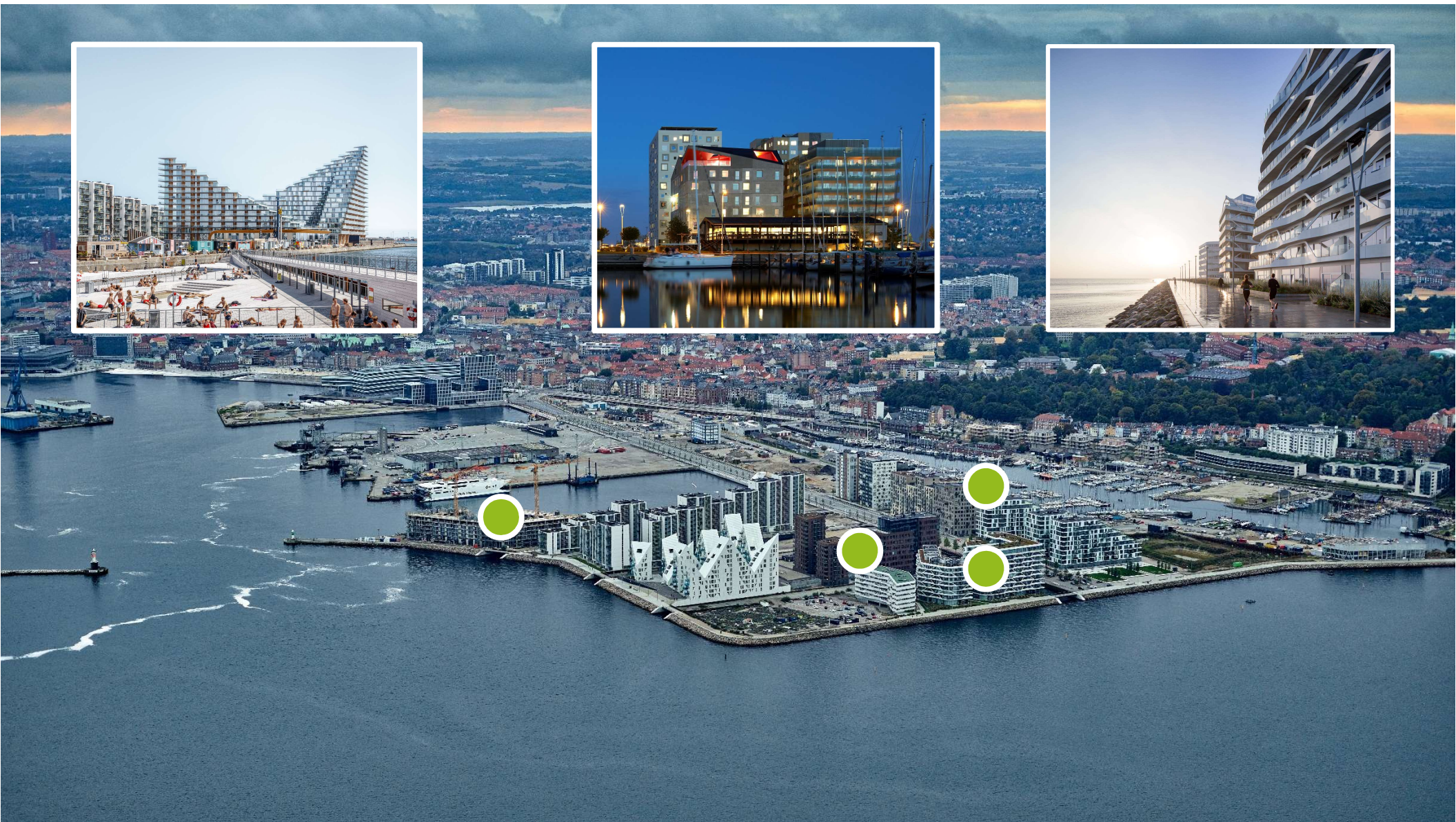
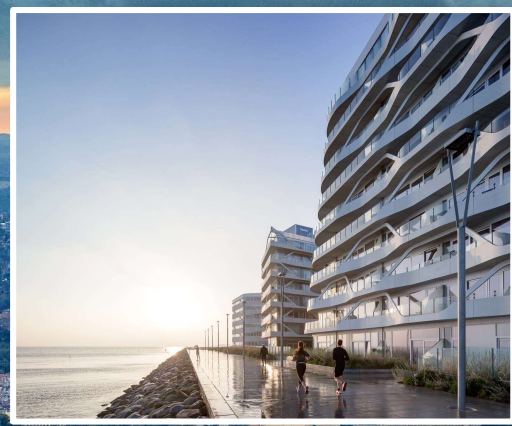


### **Martin Lykke Fiil Jensen**

- Civilingeniør, Aarhus Universitet
- Energi & Industri, MOE Aarhus
- Fagingeniør, konstruktioner











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SIDE 5



# Nyt liv til gamle bygninger

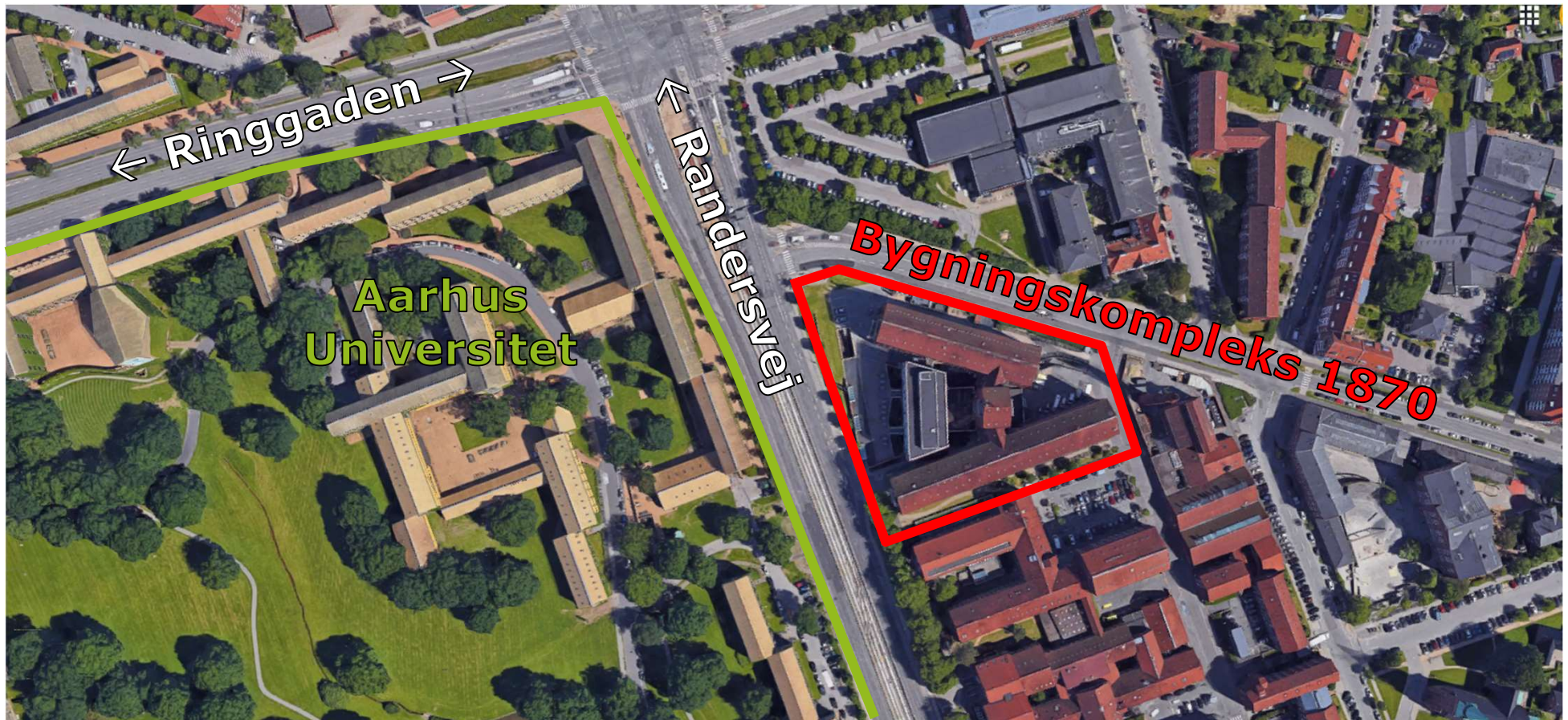
UNIVERSITETSBYEN BYGNINGSKOMPLEKS 1870

Lars Feldbech Andersen





# Universitetsbyen Bygningskompleks 1870



# Projektorganisation

**Bygherre**



**Arkitekt**



**Hovedentreprenør**



**Ingeniør på alle fag**



**Stålentreprenør**





# Universitetsbyen ved Universitetsparken



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BLDG 9



## Fakta & nøgletal

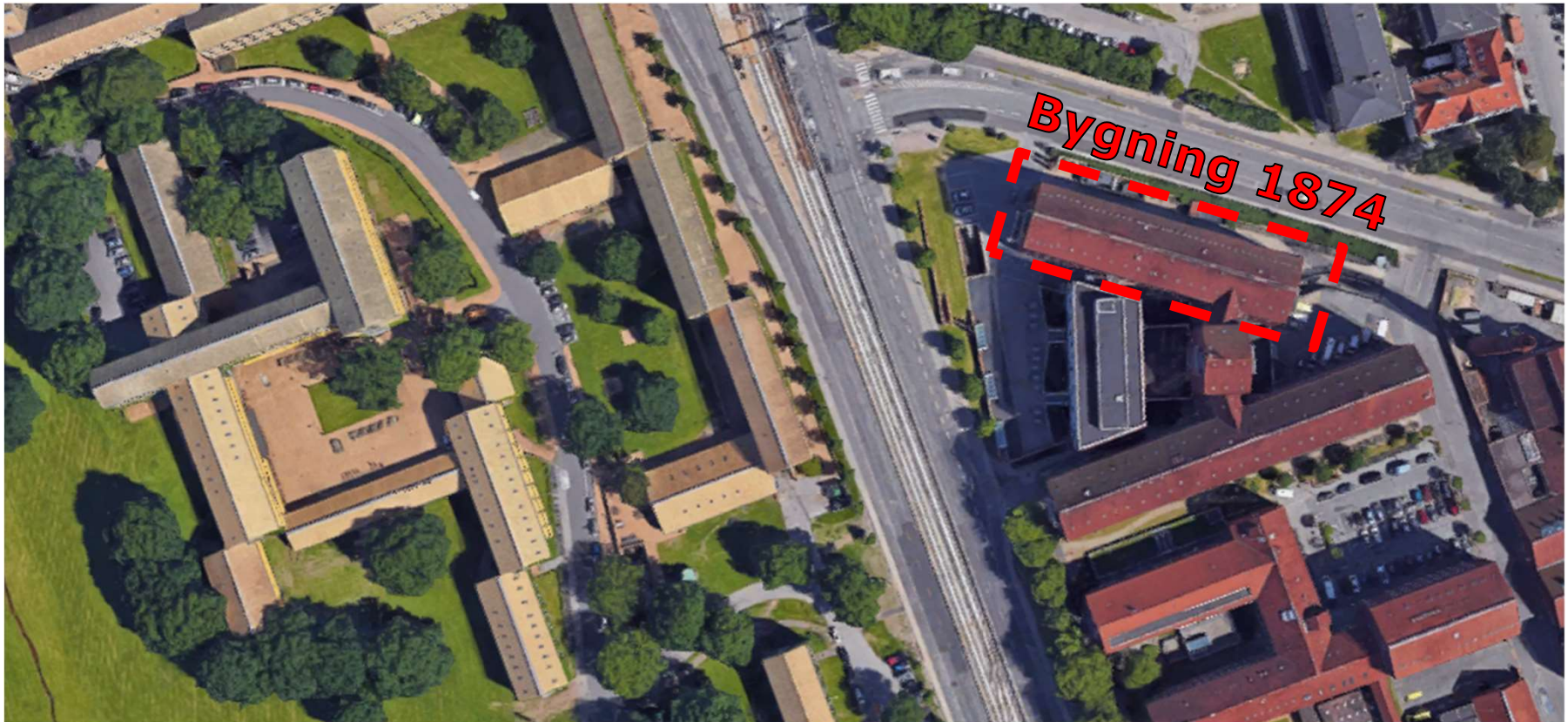
- Første bygninger opført i 1955
- Bevaringsværdigt
- Samlet areal: 29.000 m<sup>2</sup>
- Stål i hele projektet: ca. 88 tons
- Projektet forventes færdigt med udgangen af 2021

## Rådgiverydelser:

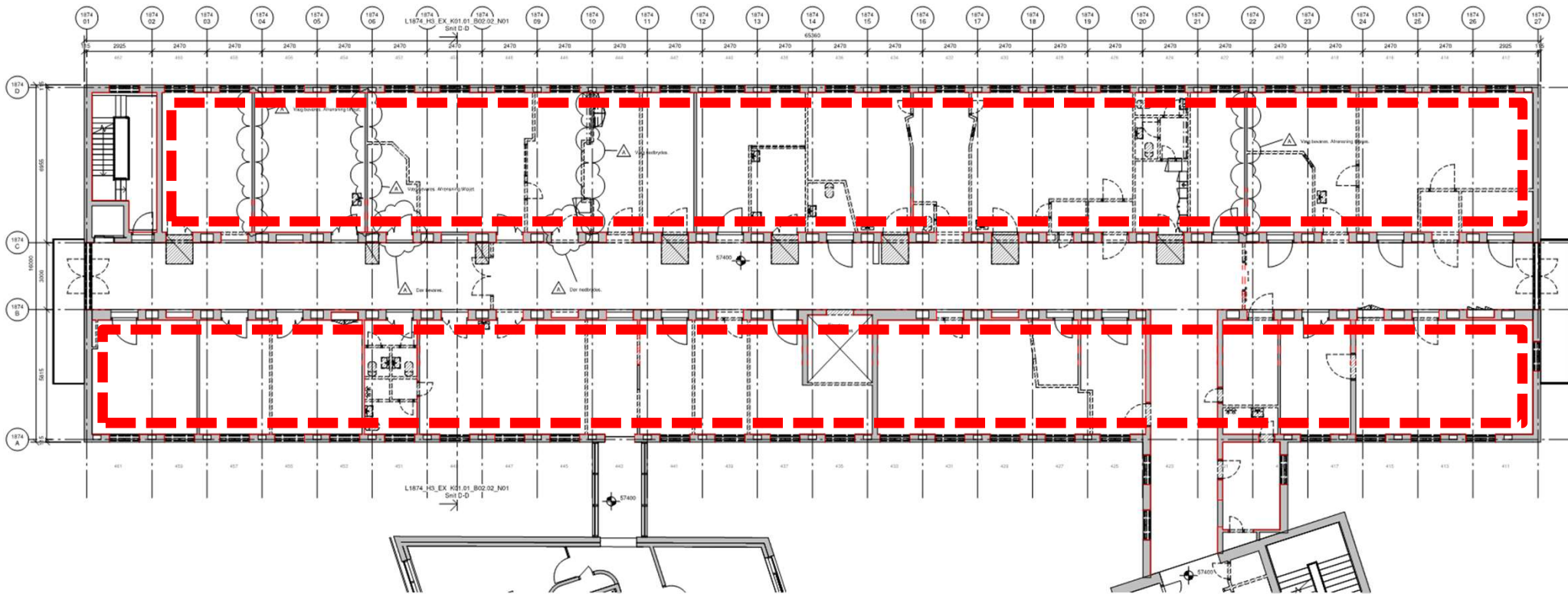
- Projekteringsledelse
- Installationer
- Indeklima
- Konstruktioner
- Brand
- Commissioning



# Universitetsbyen Bygningskompleks 1870



# Bygning 1874





# Statik

## Vindpåvirkning

Vind + sugning:  $80 + 16 = 96 \text{ kg/m}^2 \checkmark$

Ser man bort fra tværskillevæggene, skal vindkræfterne føres til gavlene gennem etageadskillelserne.

M pr. etage =  $\frac{1}{8} \cdot 3,3 \cdot 96 \cdot 65^2 = 167000 \text{ kgm} \checkmark$

$h = 1530 \text{ cm}$ ,  $h_n = 1500 \text{ cm}$ ,  $b = 20 \text{ cm}$ ,  $f = 5 \cdot 12 = 5,66 \text{ cm}^2$ ,

$\phi = 0,019$ ,  $\phi_j = 2020 \text{ at}$ ,  $\phi_b = 11 \text{ at}$

Q pr. etage =  $\frac{1}{2} \cdot 3,3 \cdot 96 \cdot 65 = 10300 \text{ kg} \checkmark$

Q ved gavl 1. etage = 6  $\leftarrow 10300 = 61800 \text{ kg}$  3?

$T_{\text{mur}} = \frac{61800}{35 \cdot 1290} = 1,37 \text{ at} \checkmark$

M på gavl  $\sim \frac{1}{2} \cdot 32,5 \cdot 96 \cdot 20^2 = 624000 \text{ kgm} \checkmark$

$\sigma \sim \frac{62400000}{6 \cdot 35 \cdot 1600^2} = 4,2 \text{ at} \checkmark$

Egenvægt af gavlmur:  $22,0 \cdot 13,3 \cdot 625 = 183000 \text{ kg} \checkmark$

" " altaner:  $6,1 \cdot 1,4 \cdot 6 \cdot 2 \cdot 340 = 34800 \text{ "}$

217800 kg

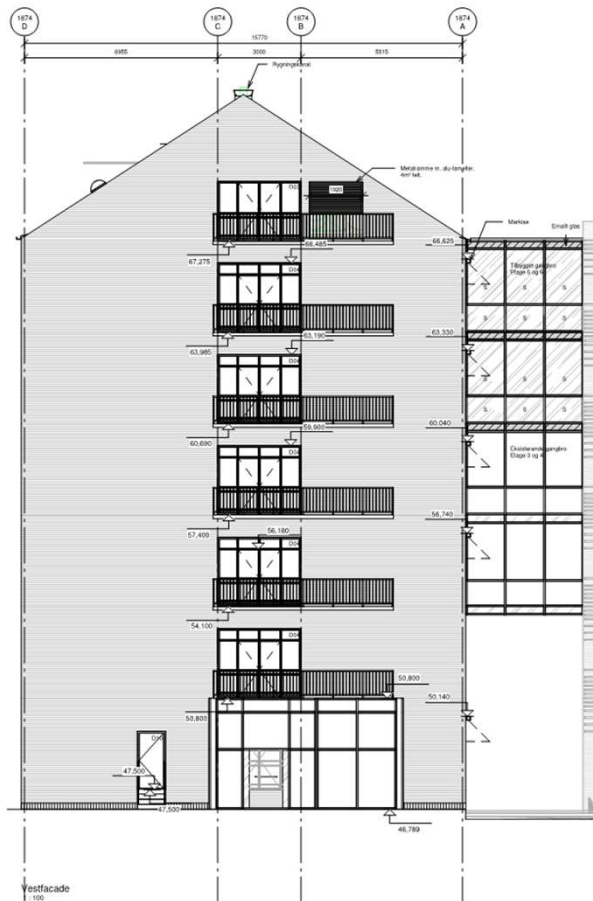
Ser man bort fra adhæsionen i nederste fuge og kun regner med friktionen, bliver sikkerheden mod glidning, idet friktionskoefficienten skønnes  $\sim 0,6$

$\frac{0,6 \cdot 217800}{61800} = 2,12 \checkmark$

Er det så OK?

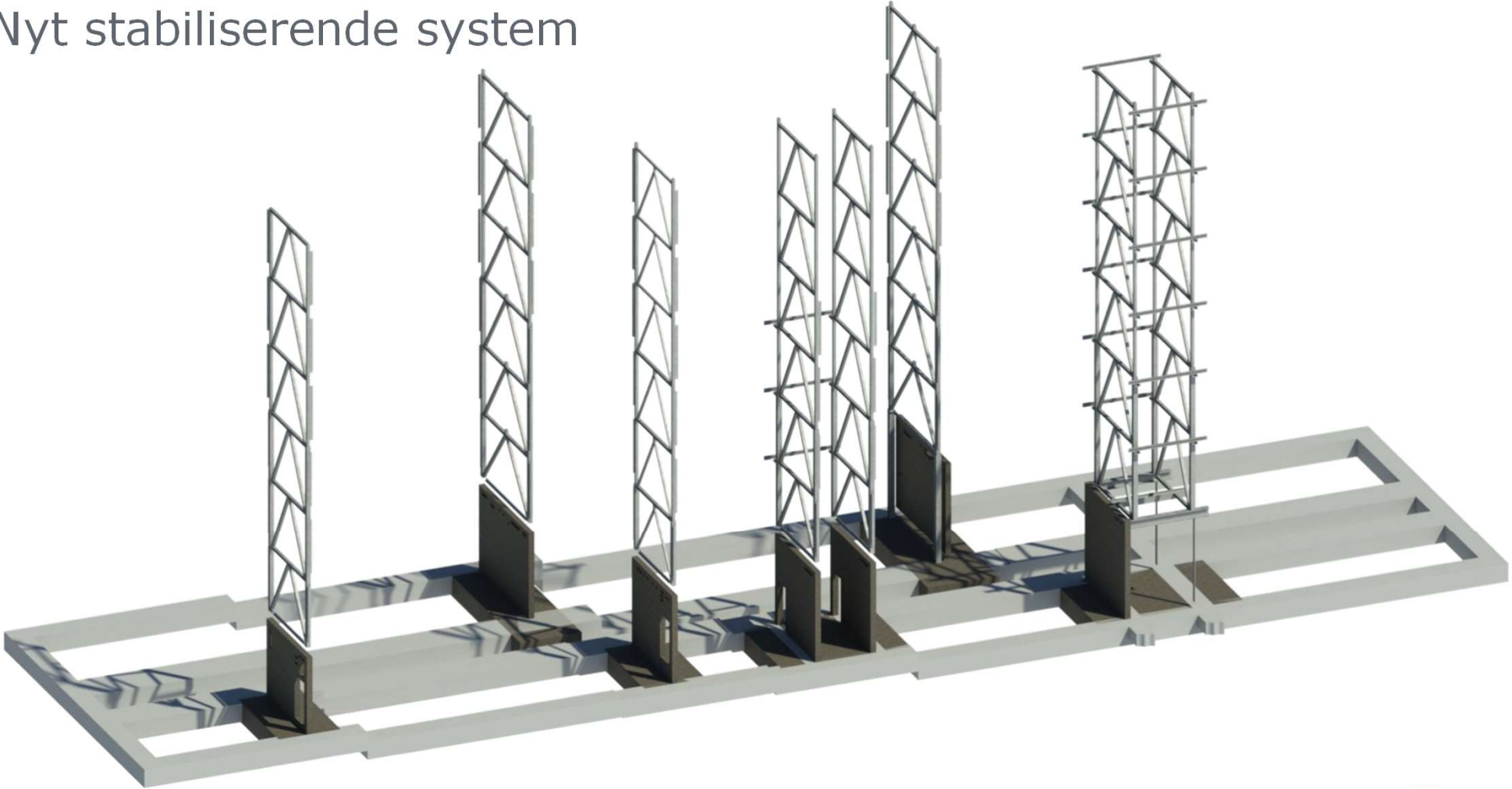
Hvad med de sidste 5,3 meter til kip?

# 16 meter lange ubrudte murede gavle

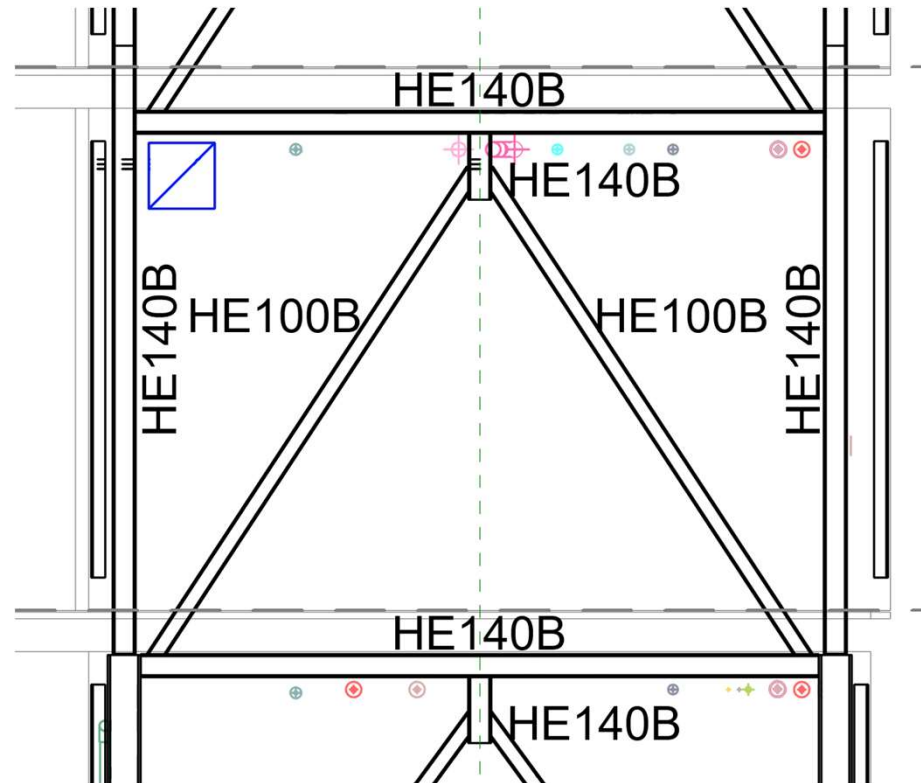




# Nyt stabiliserende system



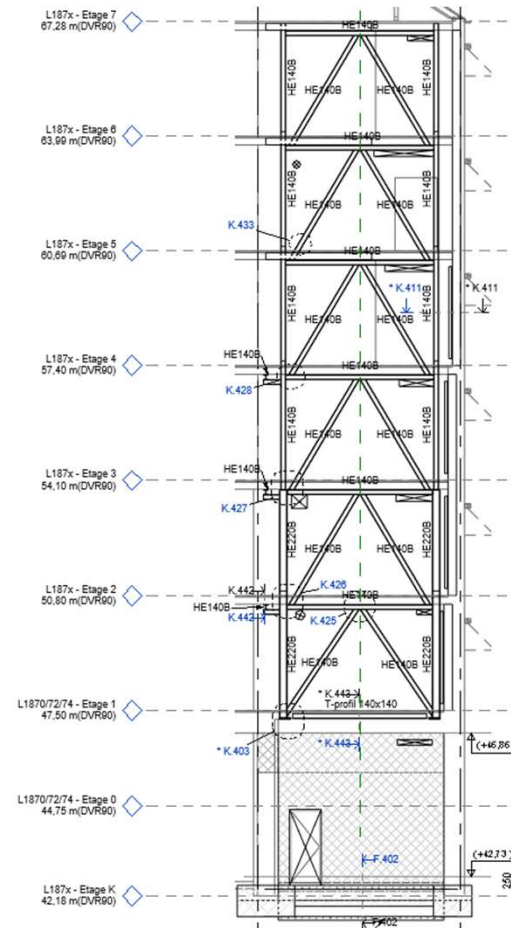
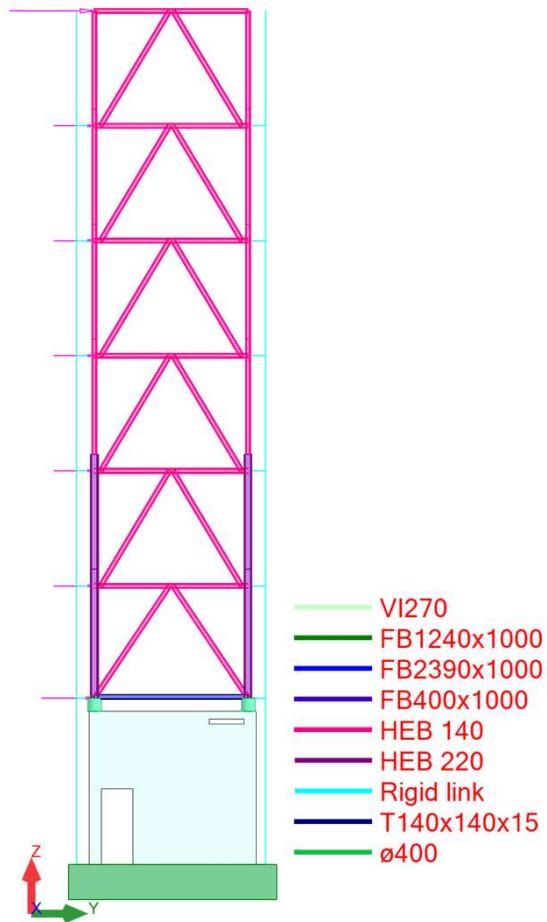
## Udfordringer – Hensyn til føringsveje og rumhøjde



Udsnit af opstalt med føringsveje på tværs af stål



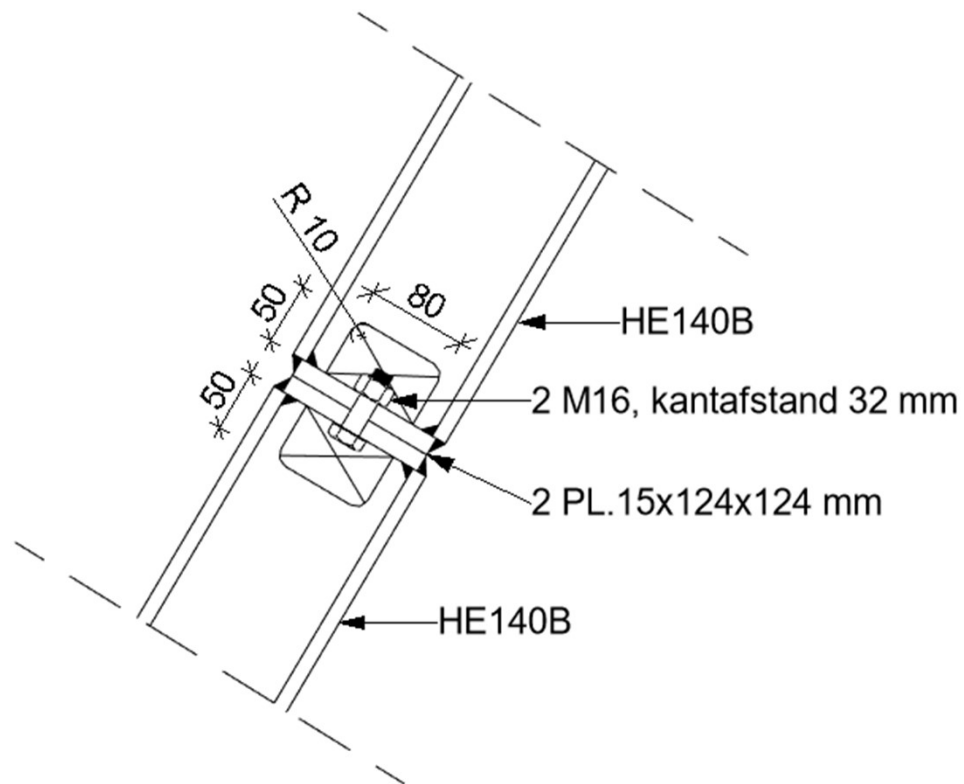
# Udfordringer – Ballast og samvirkning





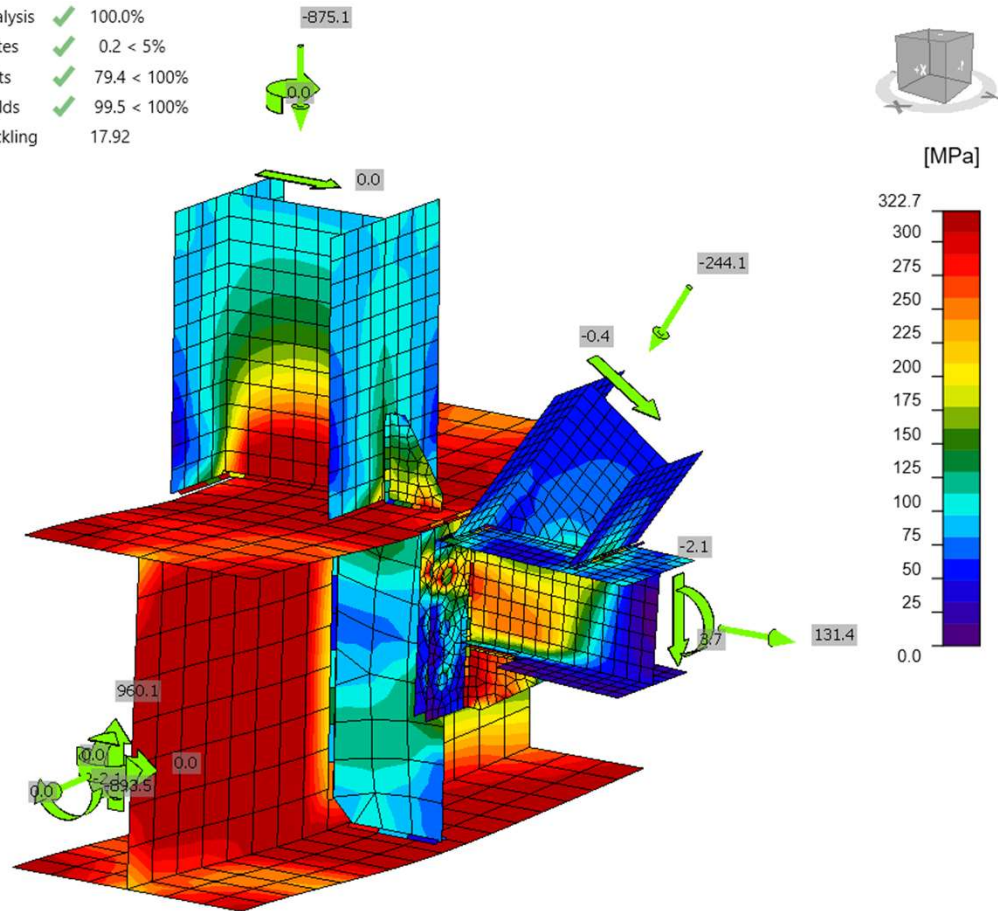


## Udfordringer – Hensyn til eks. konstruktioner og stålmontage



# Udfordringer – Samlinger

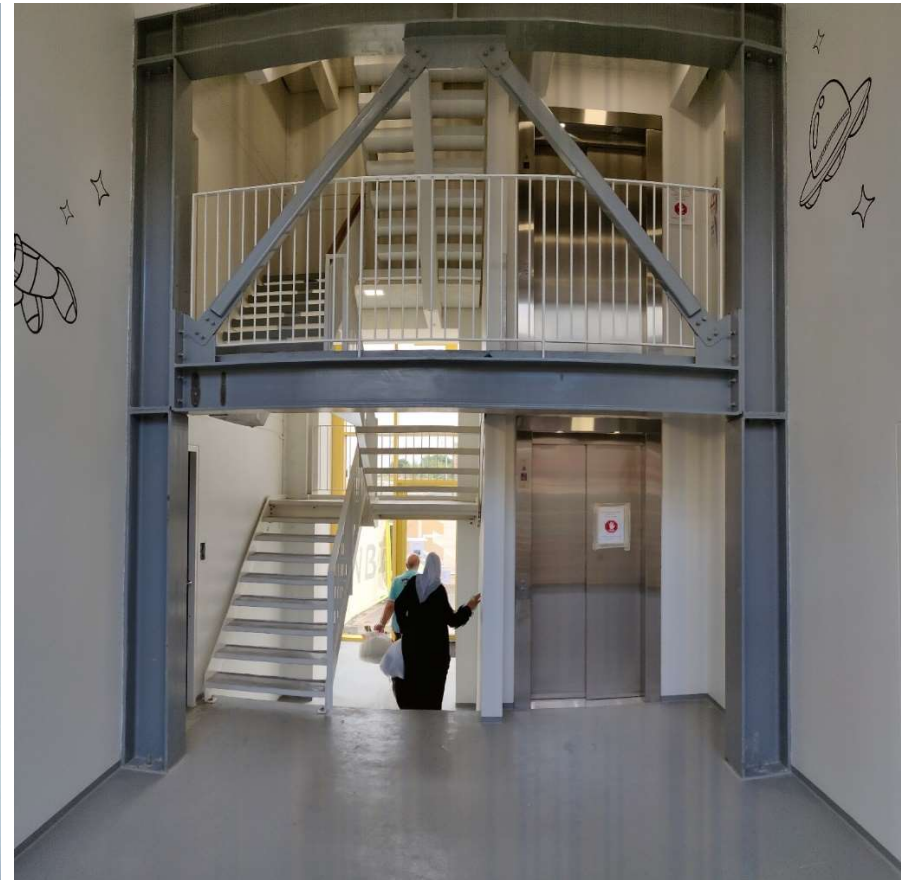
Analysis	✓	100.0%
Plates	✓	0.2 < 5%
Bolts	✓	79.4 < 100%
Welds	✓	99.5 < 100%
Buckling		17.92





# Helhedsplan Gellerup







# Spørgsmål?

NOVEMBER 2019

SIDE 23

# Digital projektering fra opstart til udførelse

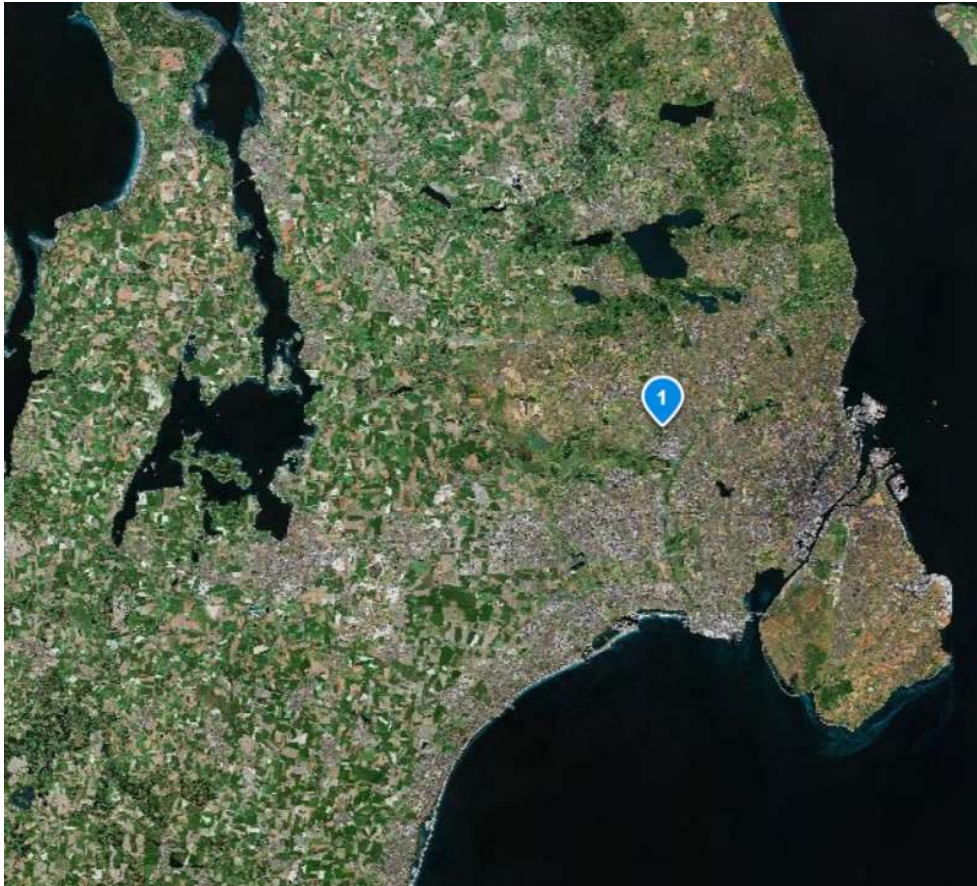
Stålstativ til Haloseprocessen  
Vestforbrænding

Martin Lykke Fiil Jensen





# Halosep - Vestforbrænding



# Projektorganisation

Bygherre



Halosep Proces

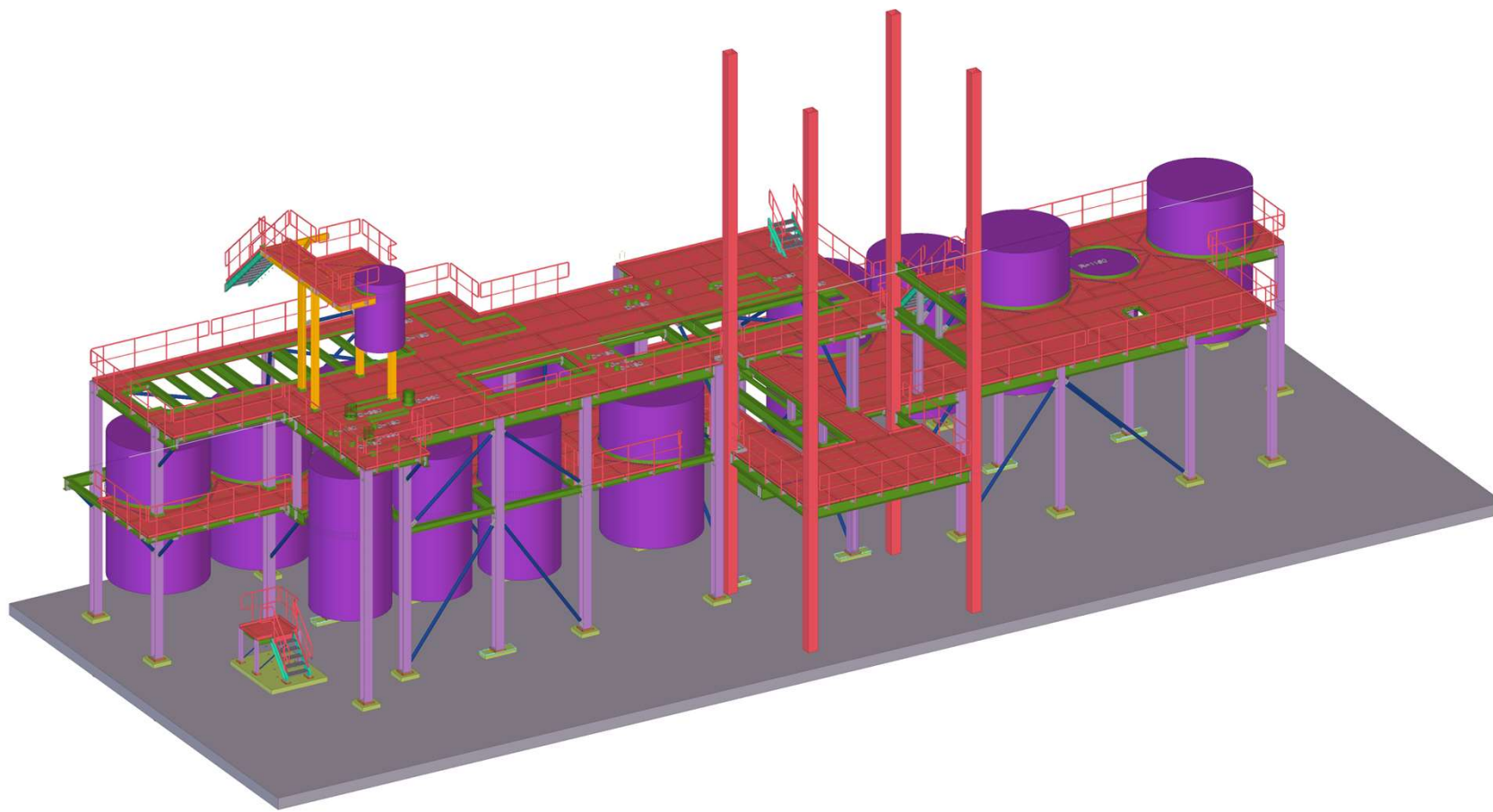


Totalentreprenør



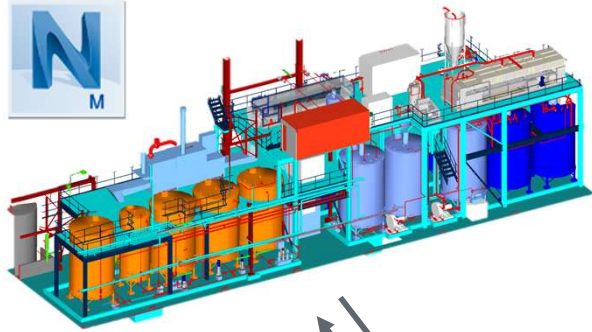
Ingeniør



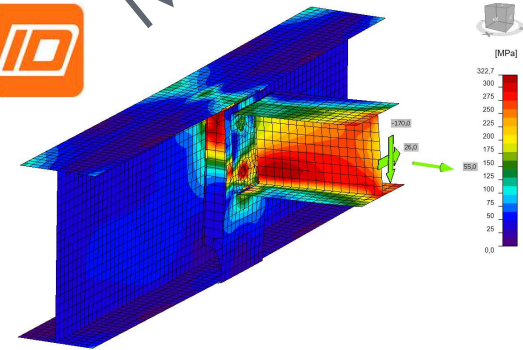
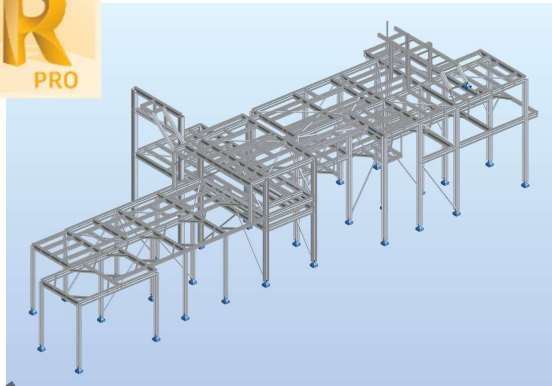
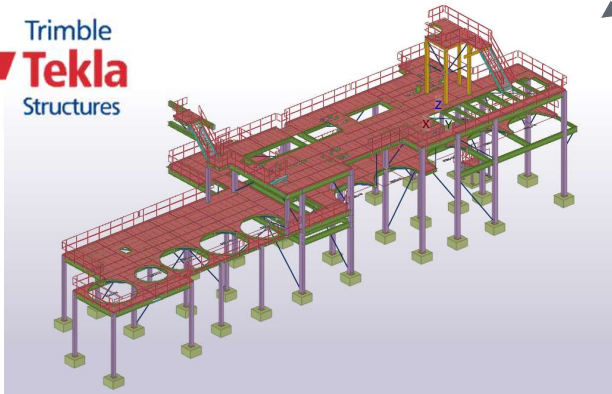




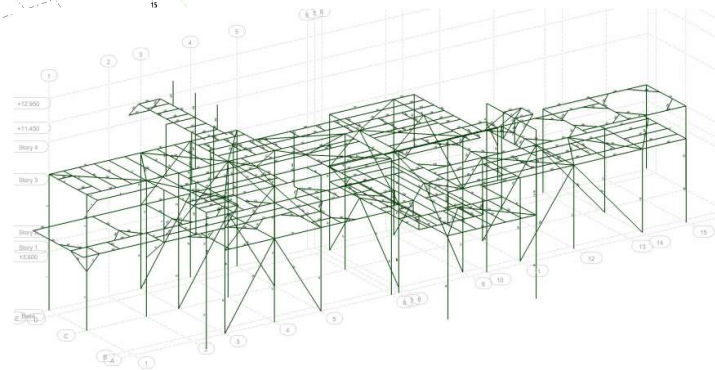
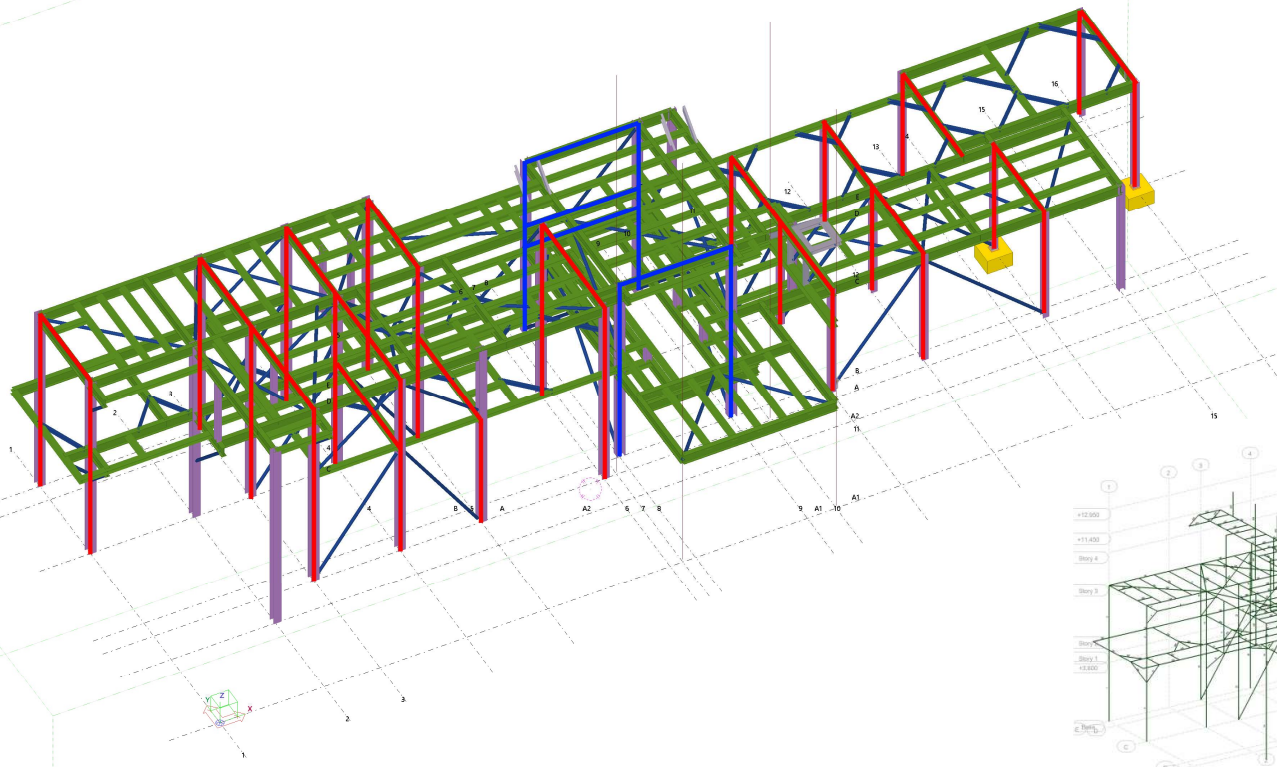
# 3D Projektering - Work flow



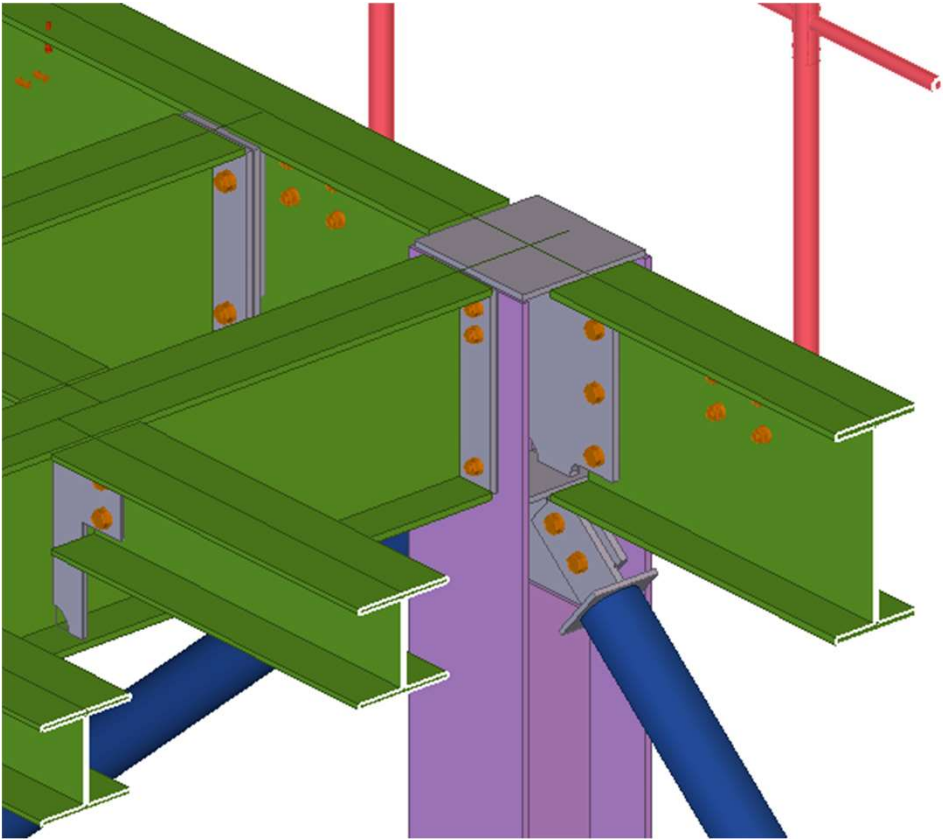
Trimble  
**Tekla**  
Structures



# Statisk system

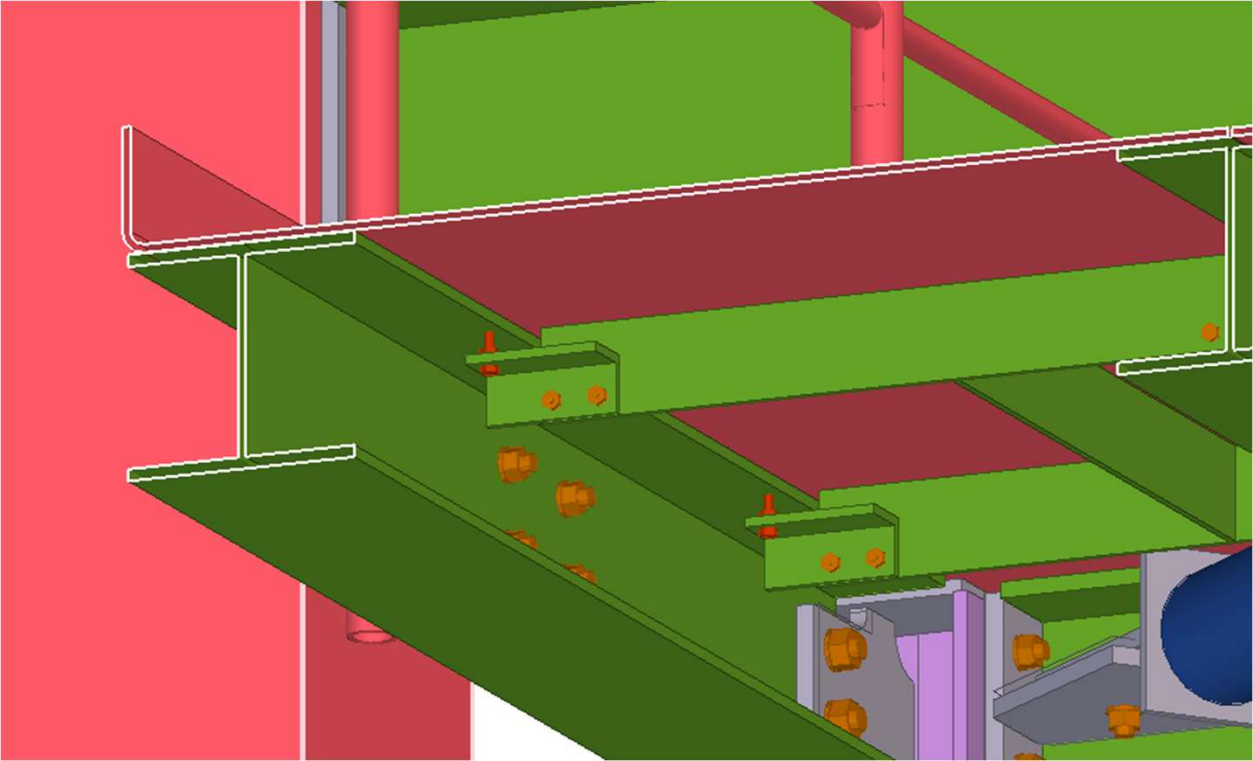


# Samlinger

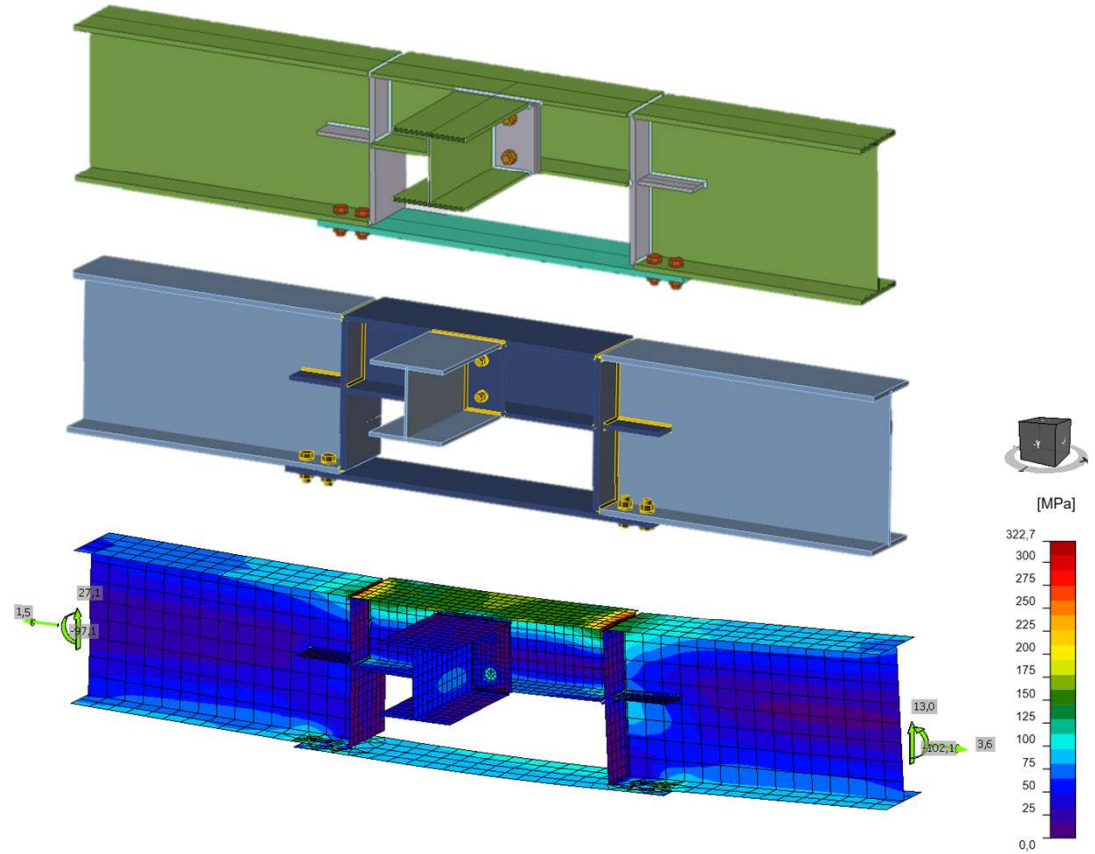
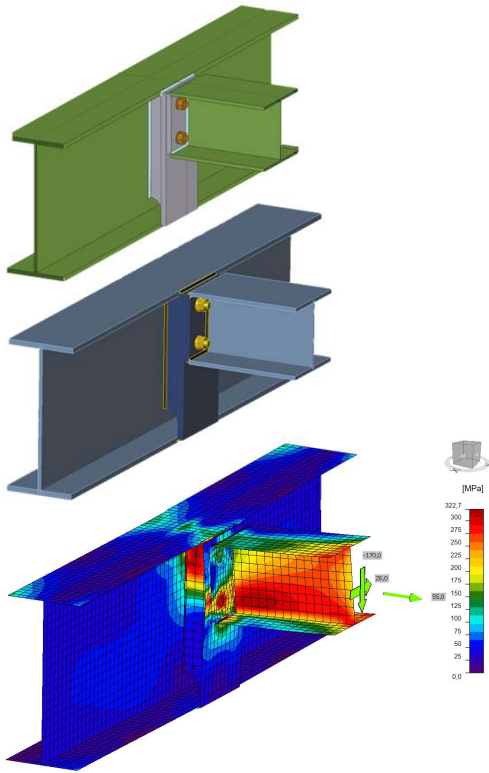




# Samlinger

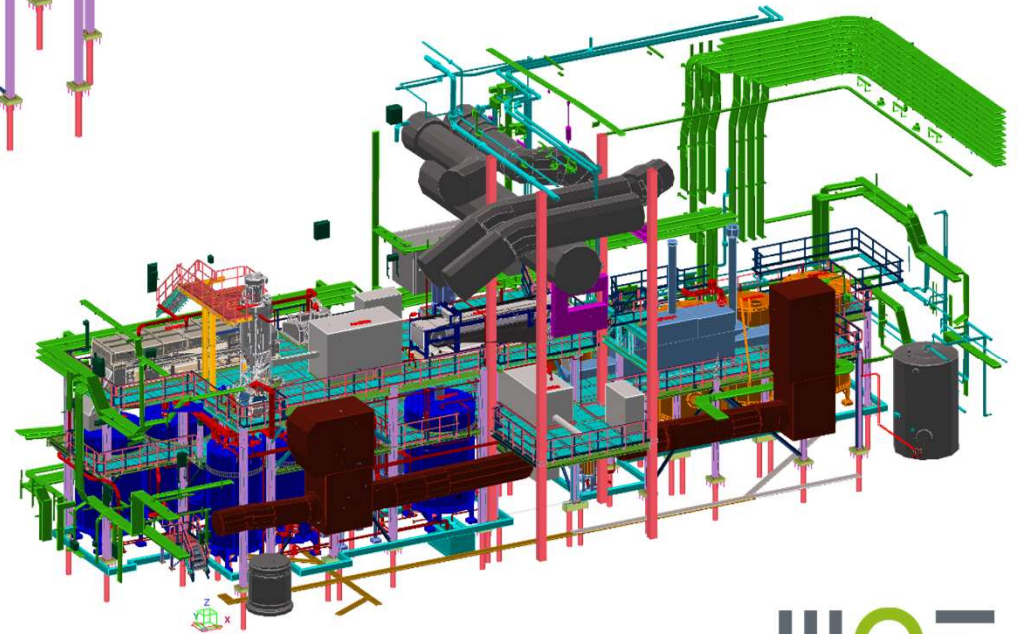
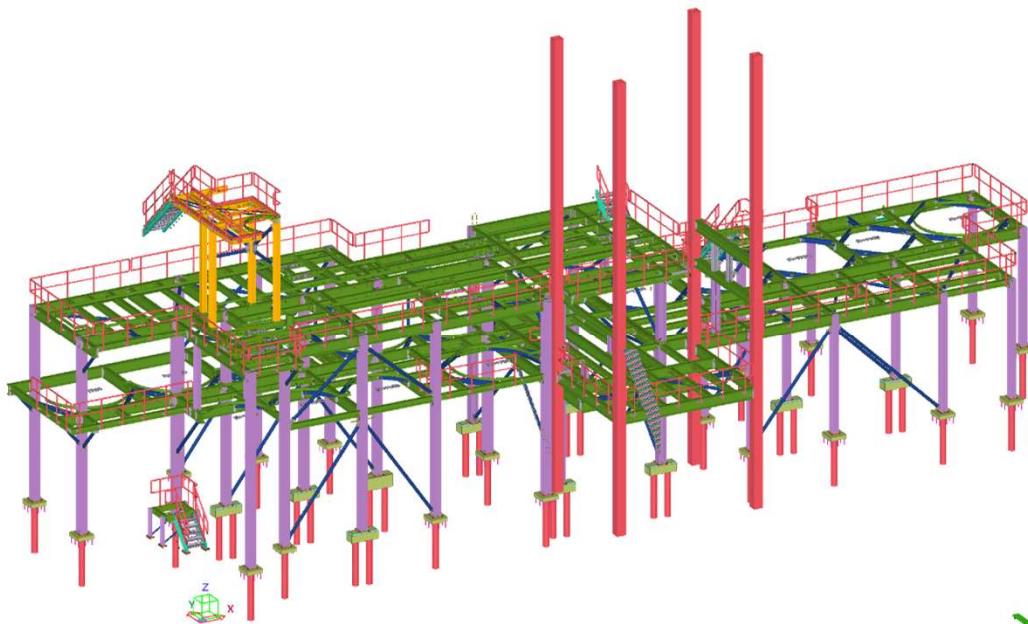


# Samlinger

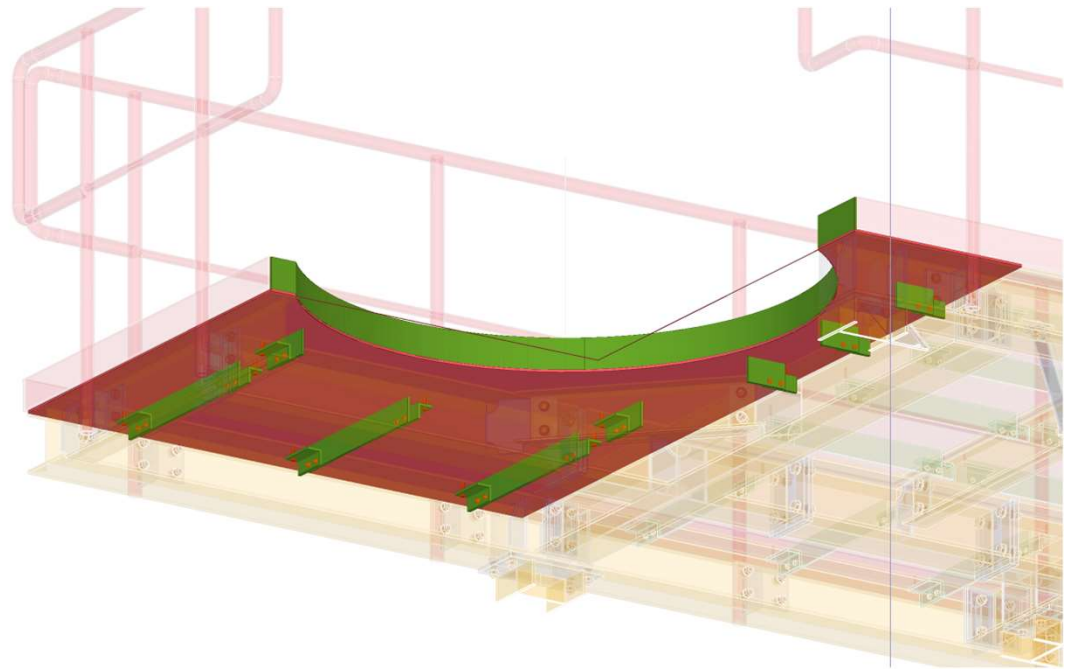
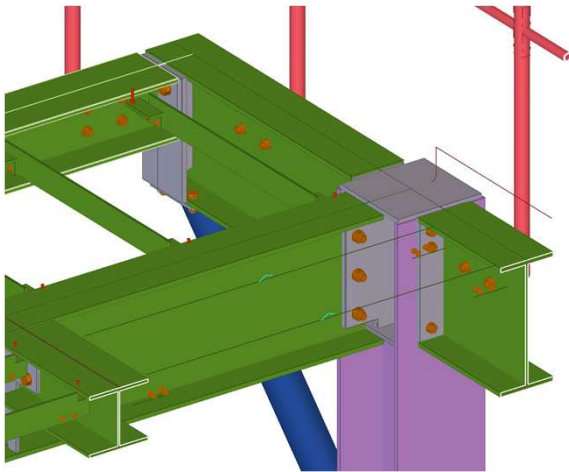
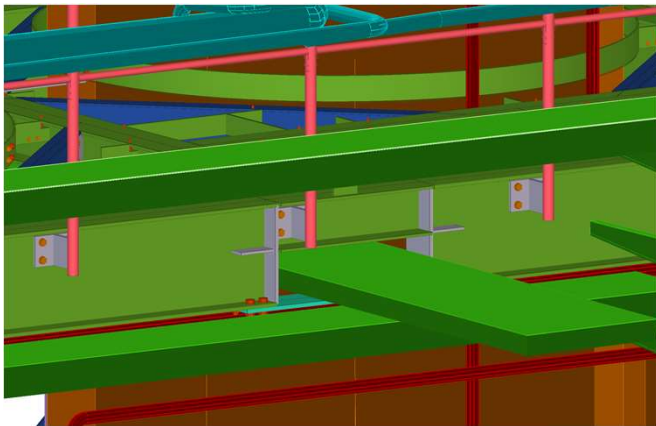




# Projektering – Tekla

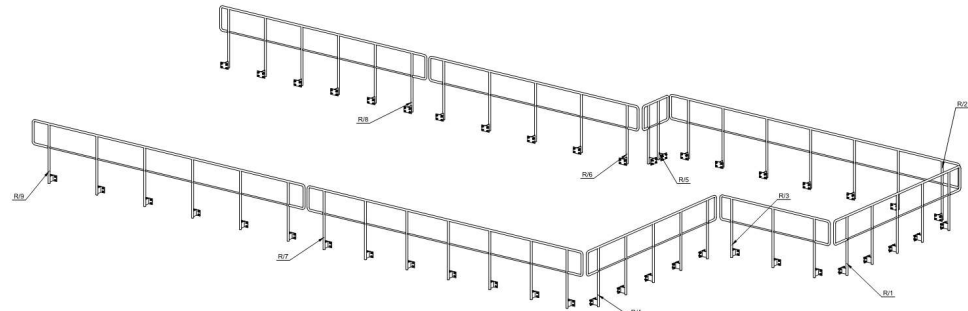
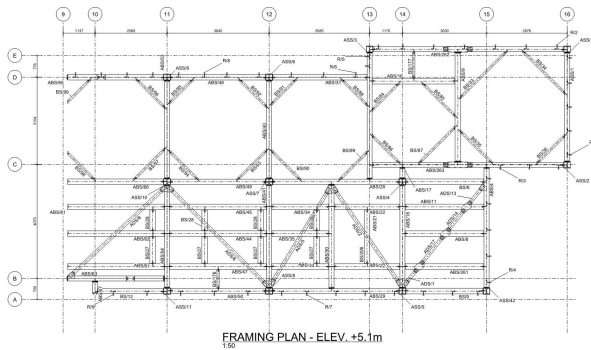
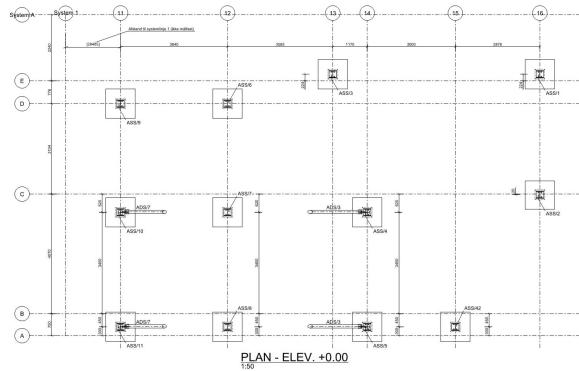


# Projektering – Tekla

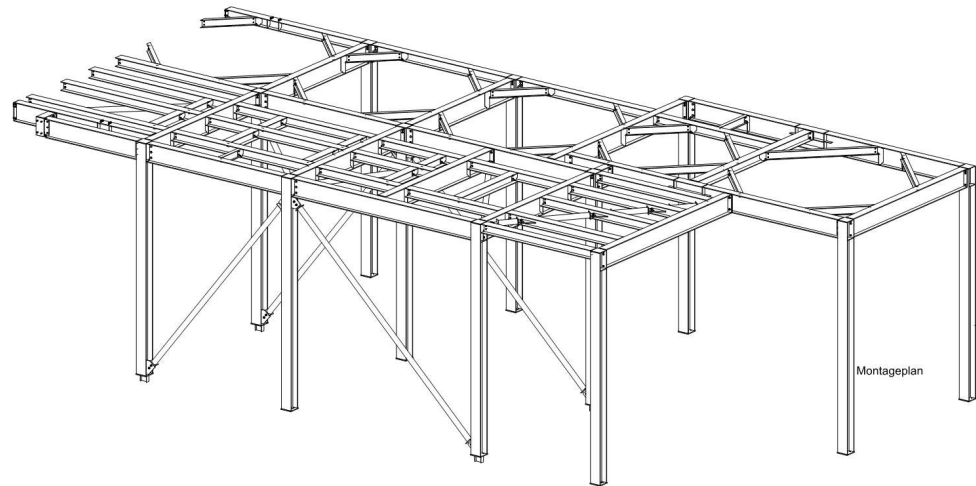




# GA-tegninger



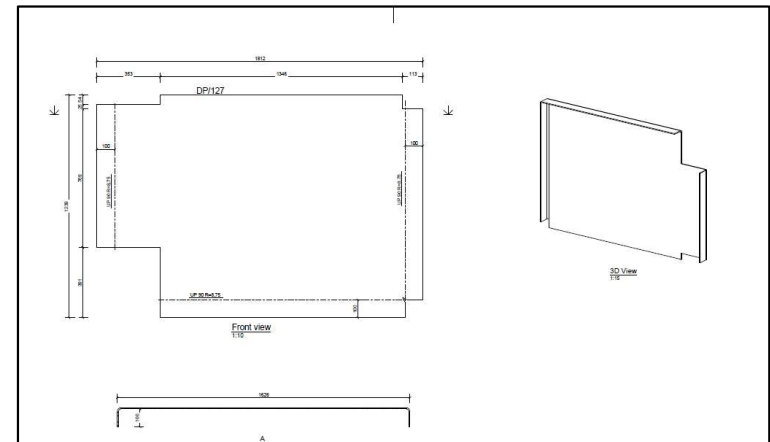
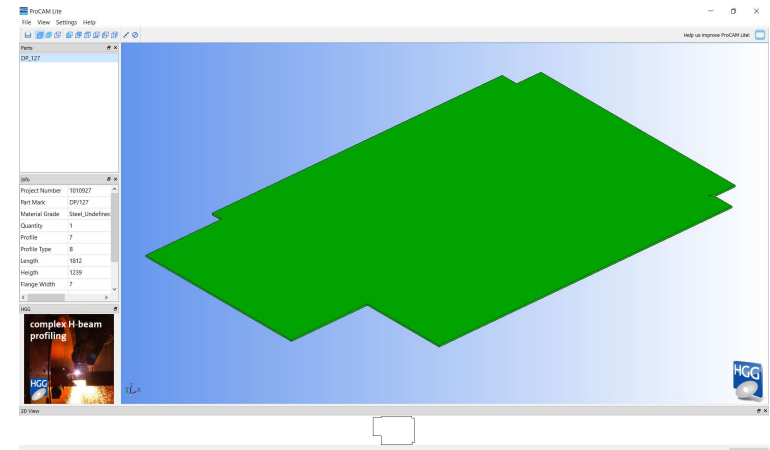
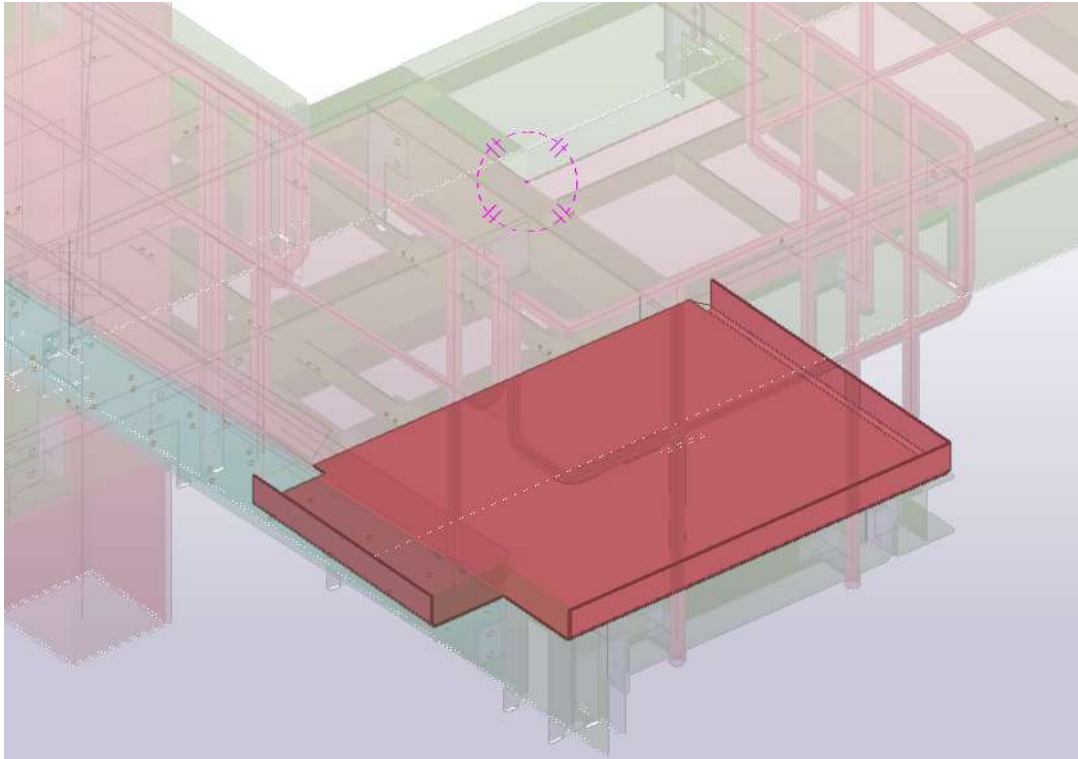
3D VIEW (HANDRAILS - ELEV.+5.1)  
1:50



3D VIEW (BEAMS - ELEV.+5.1)  
1:50



# Parttegninger / Skærefiler

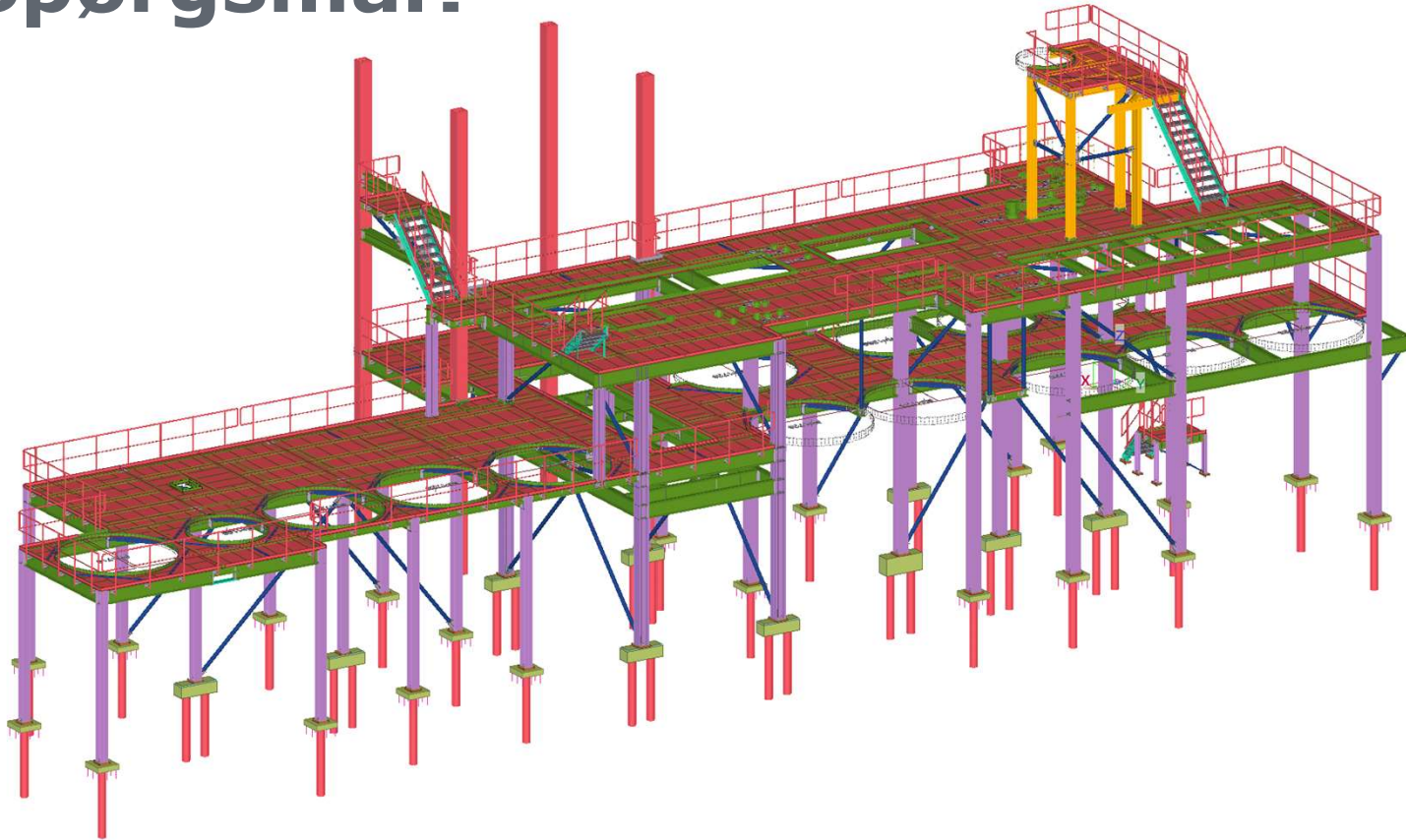




# Udførelse



# Spørgsmål?





Tak for jeres opmærksom