

powered by



# WELKOM

## Dag van de constructeur

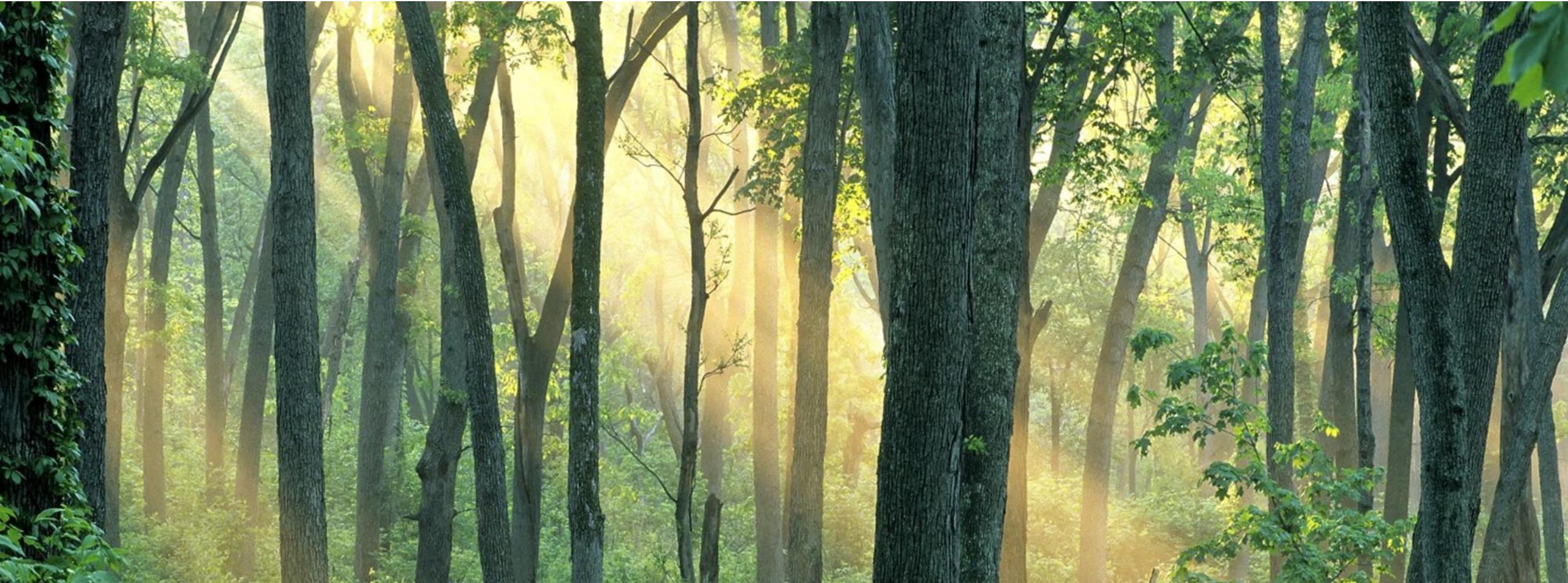
Mede mogelijk gemaakt door:



# #Form Follows Sustainability

Mathew Vola

Director | Sustainable development



# An incomplete history

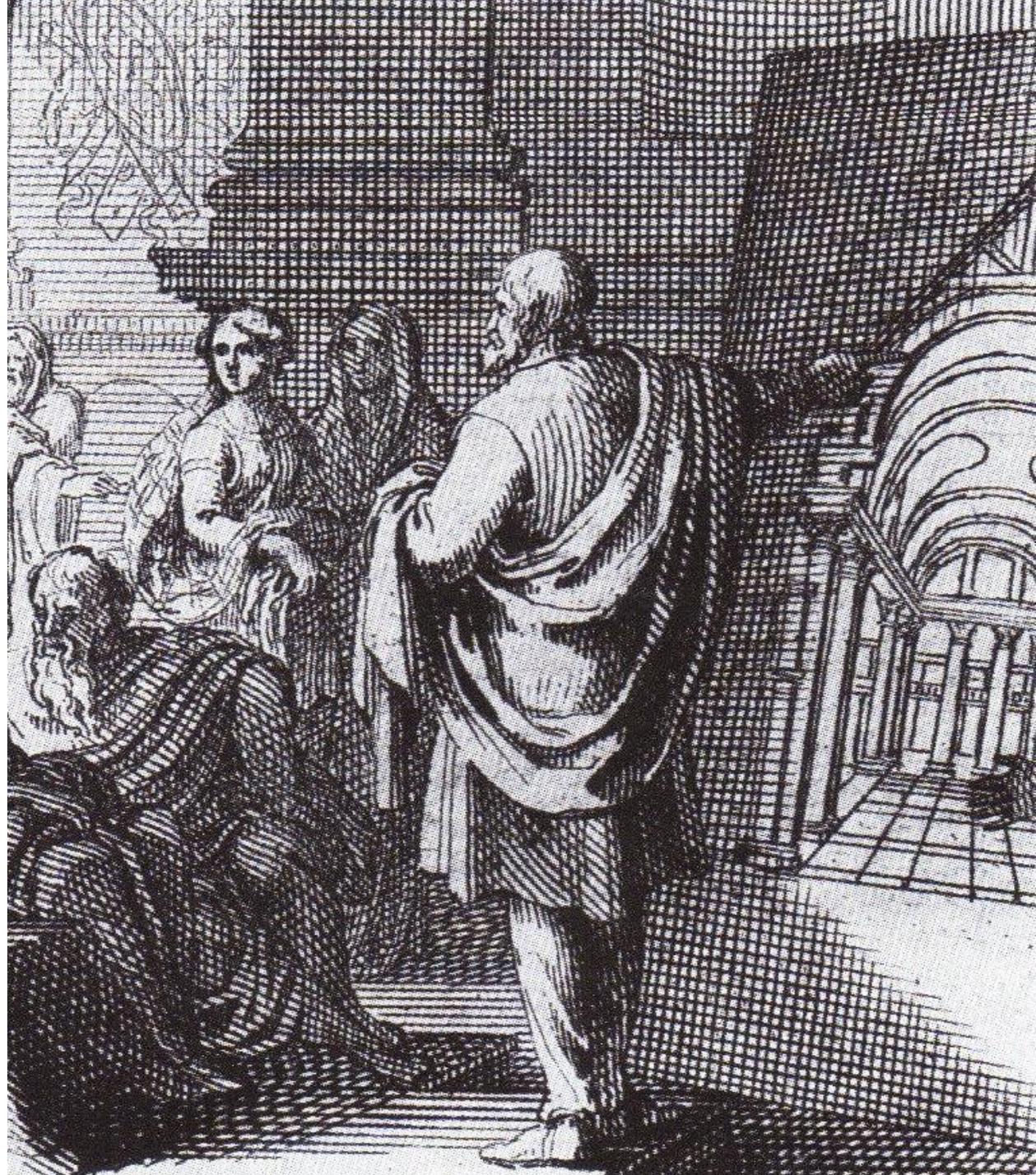
80-70 BC, Marcus Vitruvius Pollio

*De architectura:*

*Firmitas*

*Utilitas*

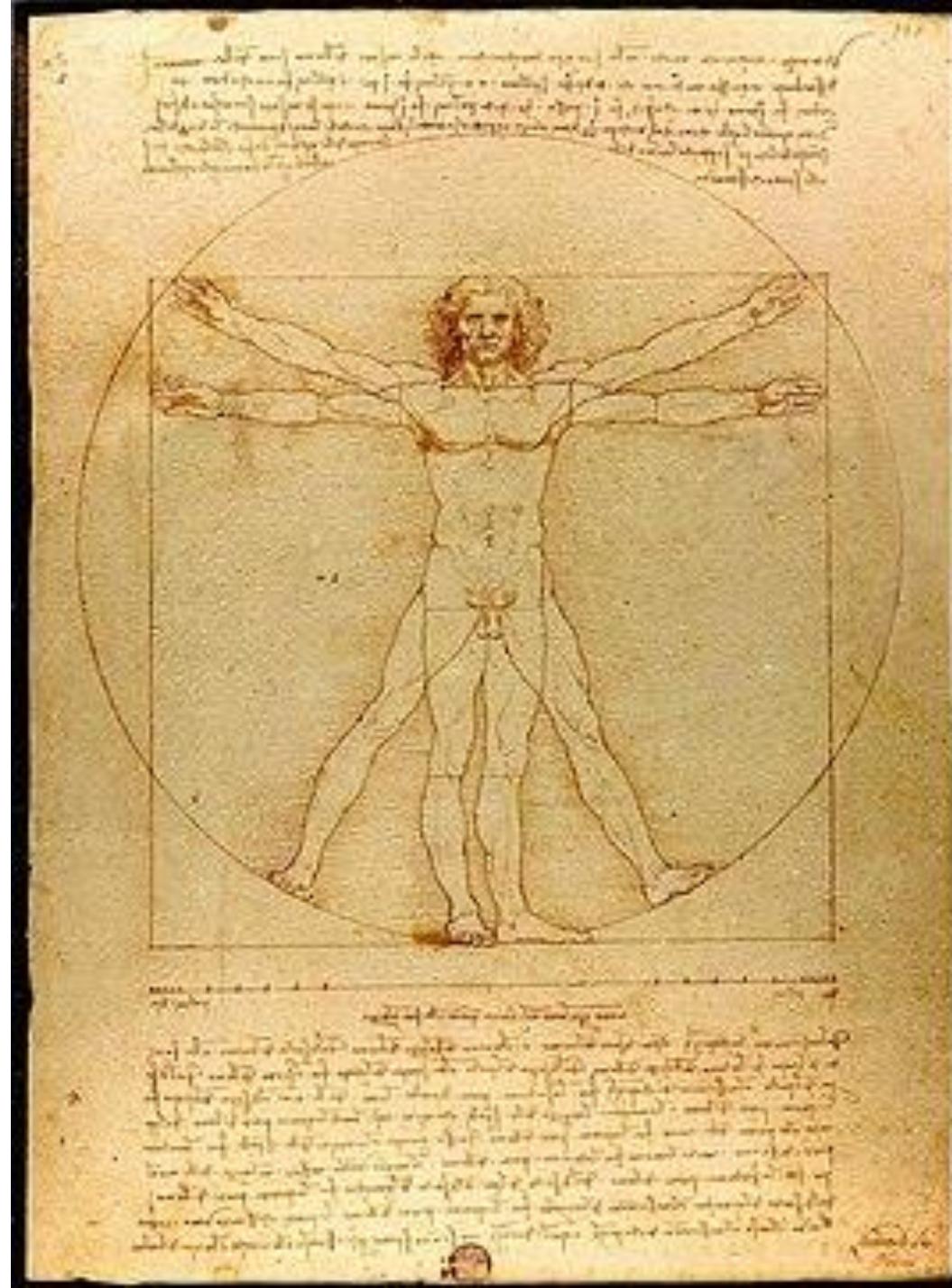
*Venustas*



# An incomplete history

1490 AD, Leonardo Da Vinci

*Reenvisaged the architectural proportions  
as derived from nature*



# An incomplete history

1856 - 1924, Louis Sullivan

*It is the pervading law of all things organic and inorganic, of all things physical and metaphysical, of all things human and all things superhuman, of all true manifestations of the head, of the heart, of the soul, that the life is recognizable in its expression, that form ever follows function. This is the law.*



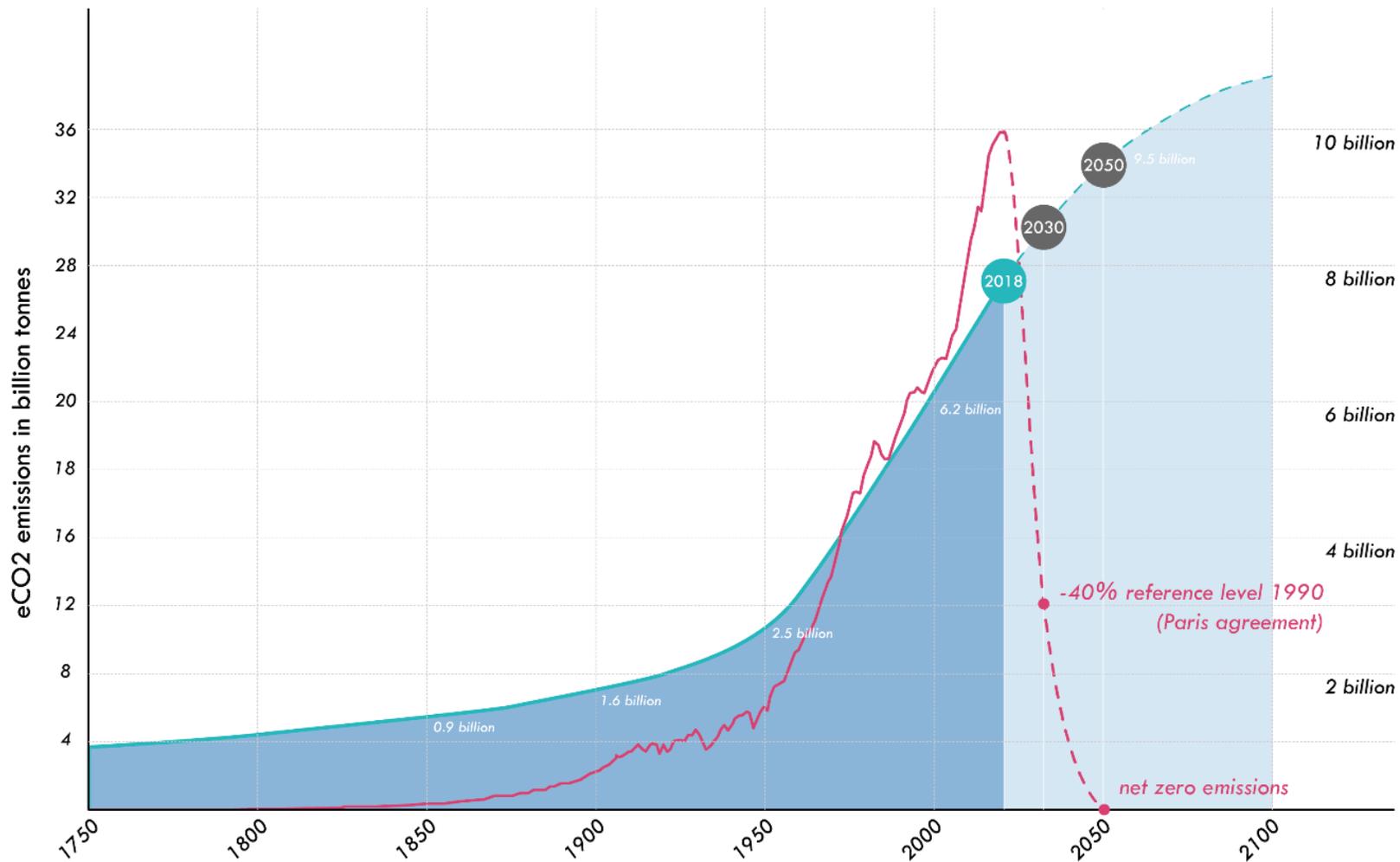
# Times are changing

2 Billion m<sup>2</sup> / year



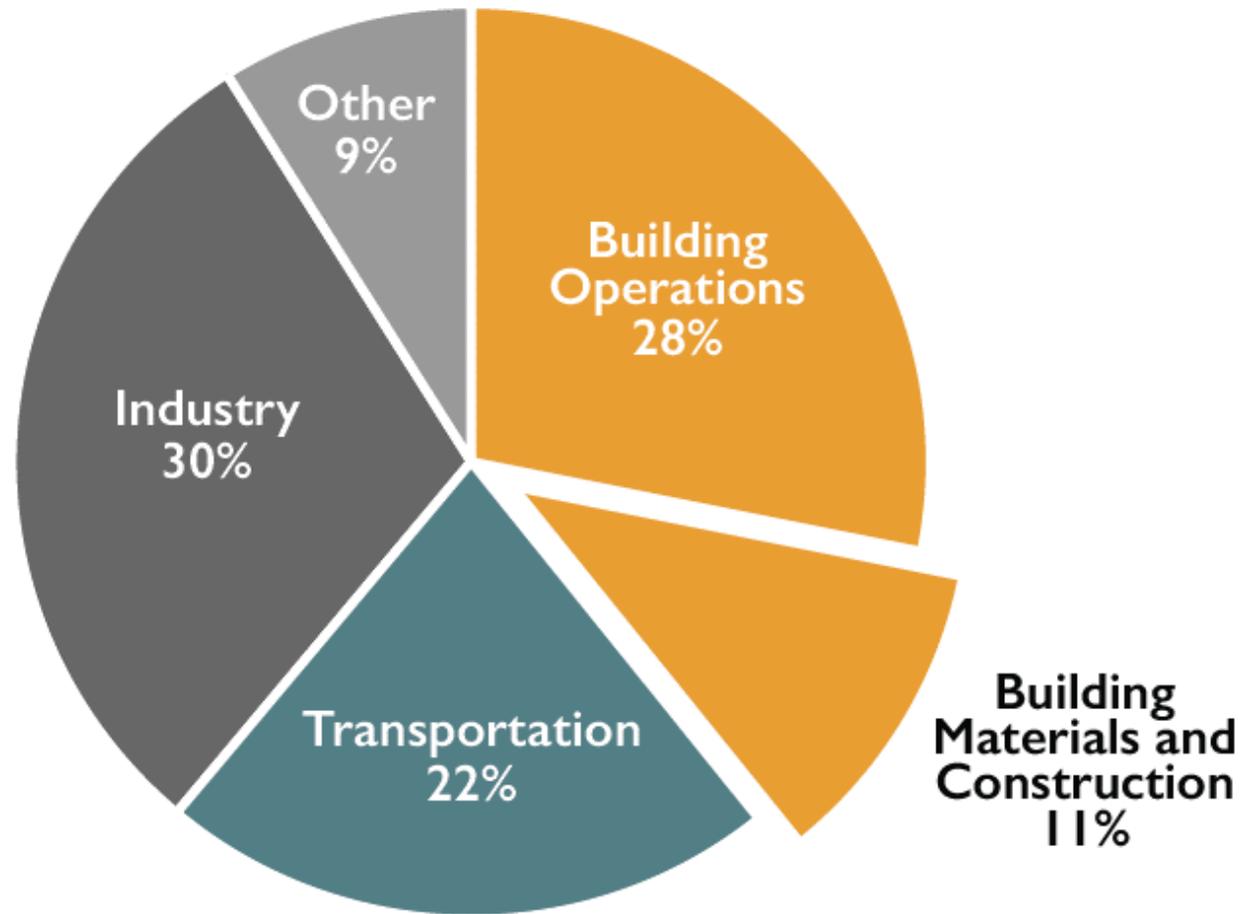
# Times are changing

## World population vs CO<sub>2</sub> emissions



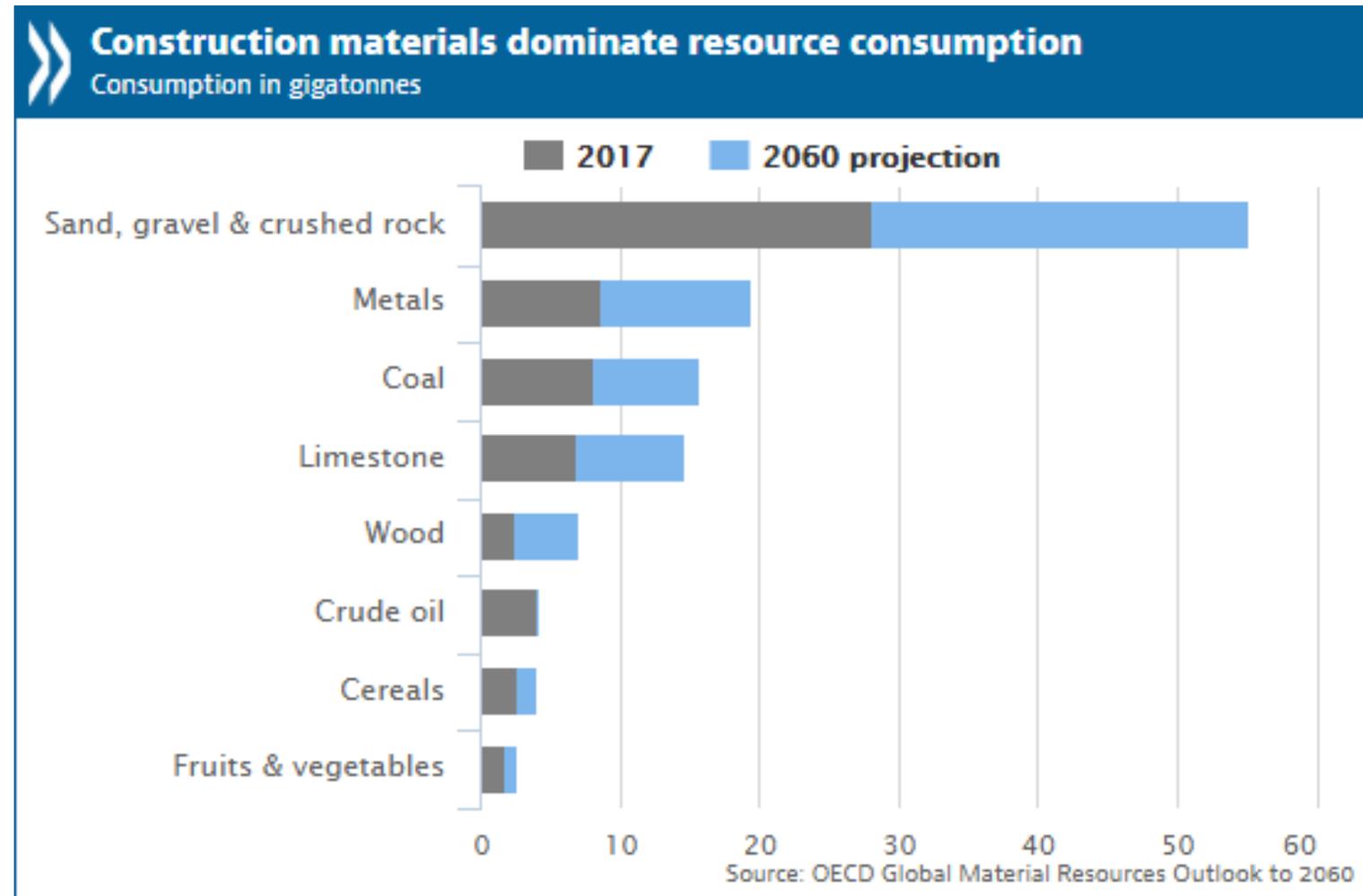
# Times are changing

## CO<sub>2</sub> Emissions



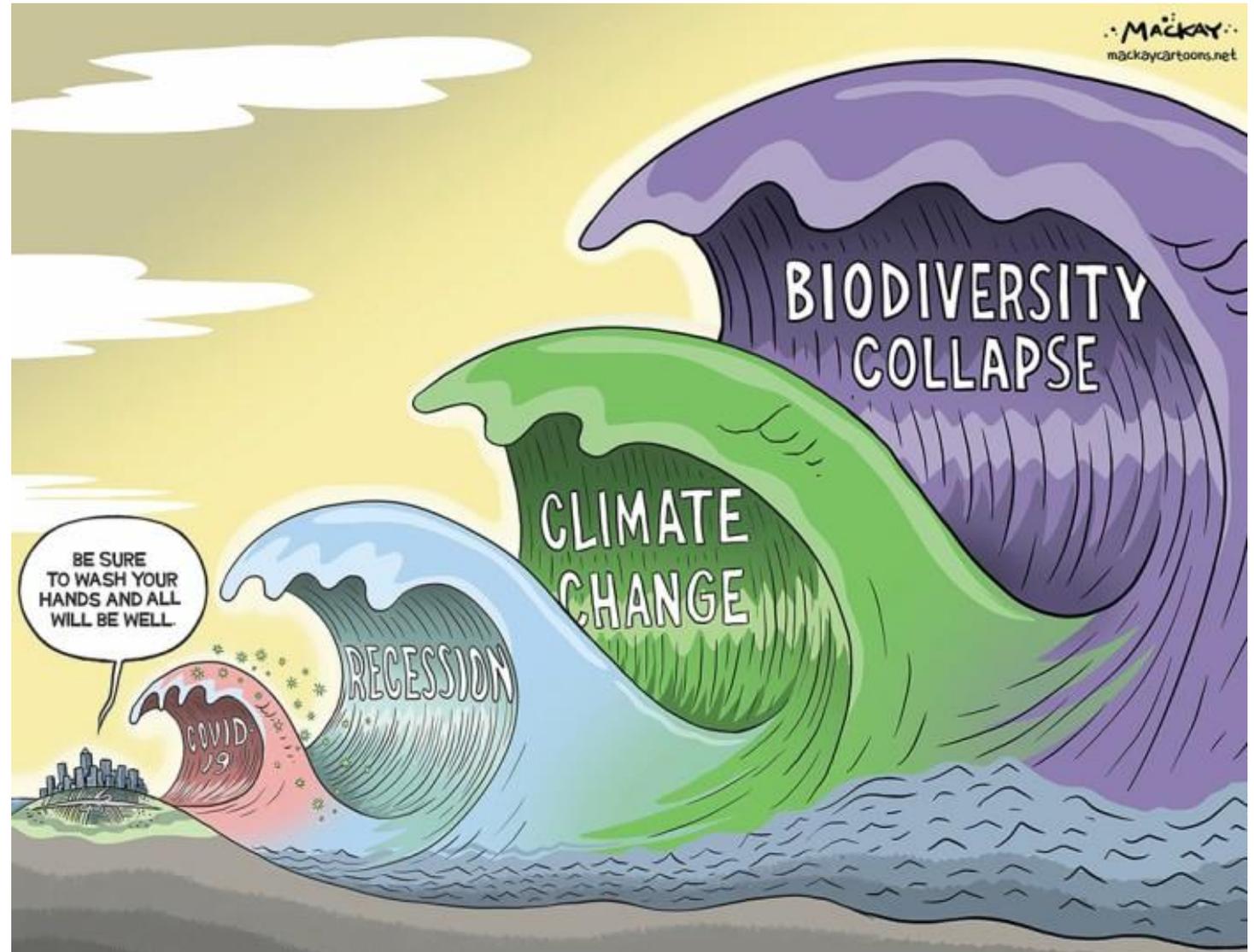
# Times are changing

## Resource depletion



# Times are changing

Biodiversity collapse



# An incomplete history

1814-1879, Violet le Duc / Louis Sullivan

*A rationally designed structure may not necessarily be beautiful, but no building can be beautiful that does not have a rationally designed structure.*

#Form follows function

# Time for a new paradigm

Reframing Violet Le Duc and Louis Sullivan

*A sustainable structure may not necessarily be functional,  
but no building can be functional that does not have a  
sustainably designed structure.*

#Form follows sustainability

# # Form Follows function

## The how

*#1 Re-use or Repurpose*

*#2 Shape efficiency*

*#3 Move beyond the code*

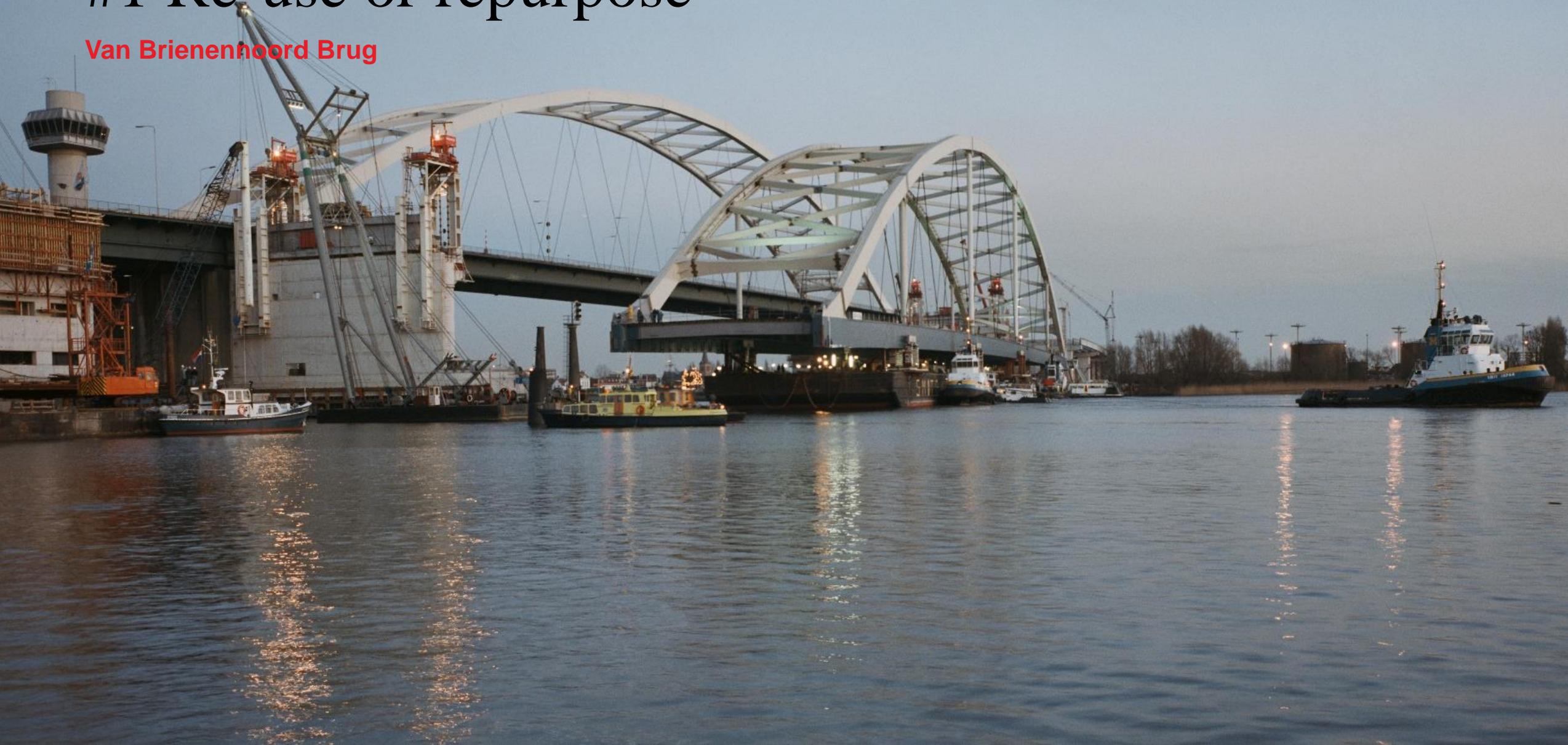
*#4 Embrace circularity*

*#5 Sustainable materials*

*#6 Data driven, generative design*

# #1 Re-use or repurpose

Van Brienenhoord Brug



# #1 Re-use or repurpose

Het Binnenhof



# #1 Re-use or repurpose

Het Stedelijk Museum



# #1 Re-use or repurpose

SintLucas, Eindhoven

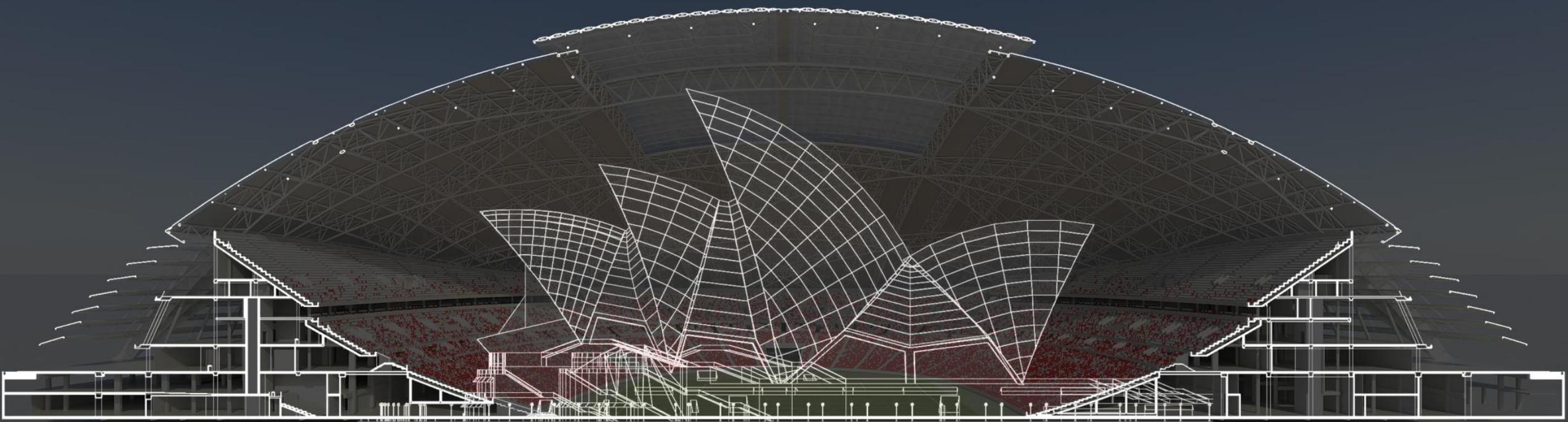


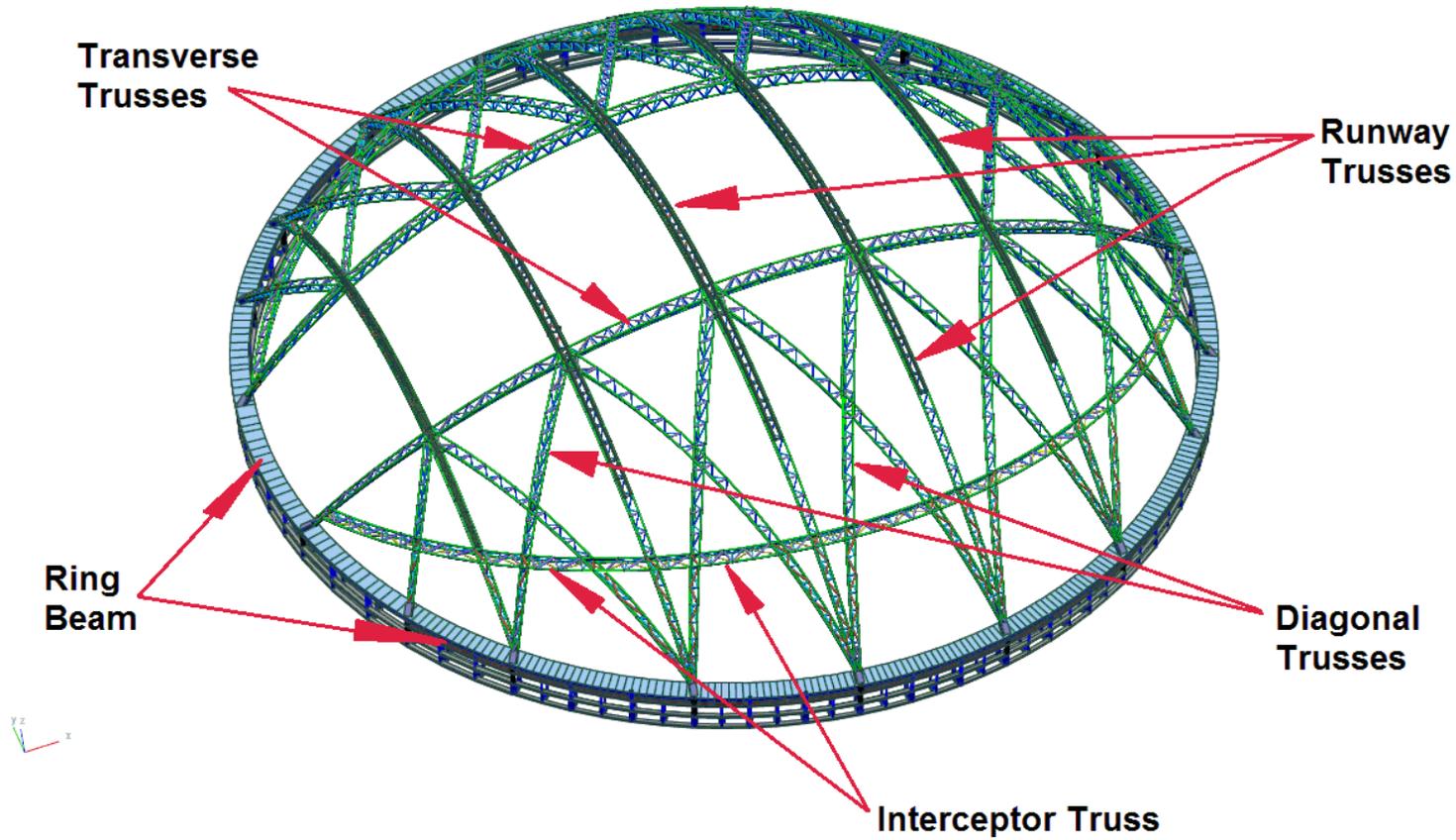
# #2 Shaping efficiency

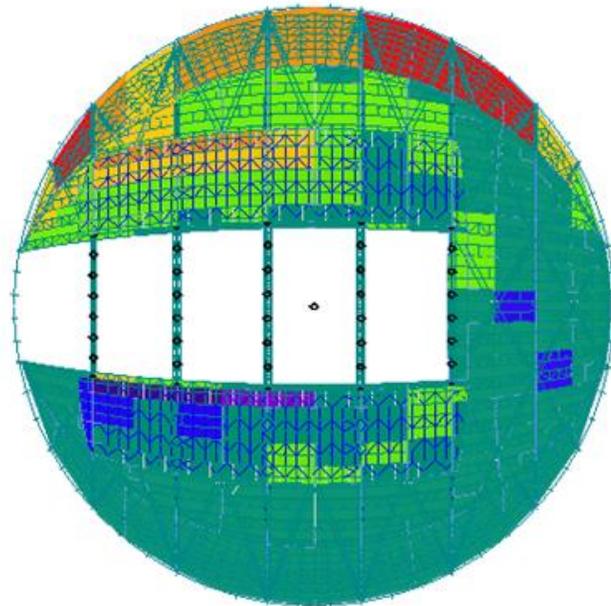
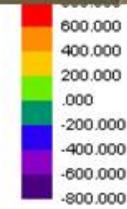
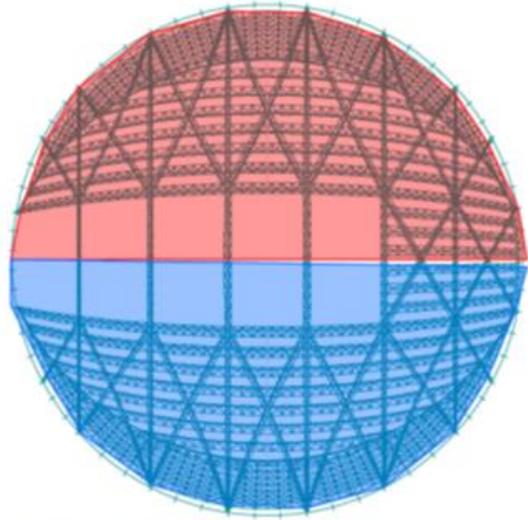
## Singapore Sports Hub



Architect **Arup/DPA Architects**  
Contractor **Dragages Singapore**  
Steel Contractor **Yongnam**







‘Influence Surface’ time history approach to optimising design.

## #2 Shaping efficiency

Singapore Sports Hub

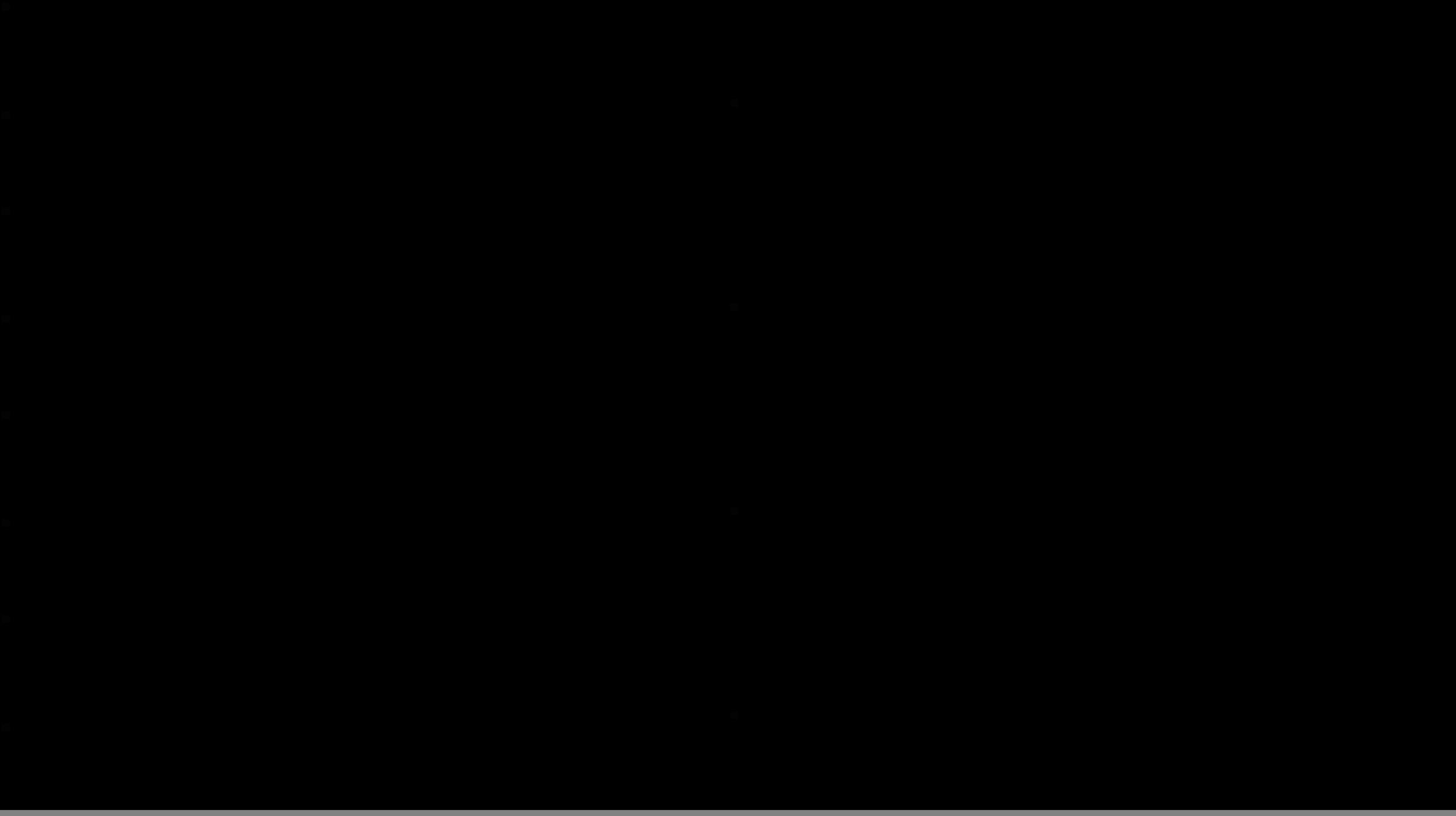
*310 m span*

*7400 tonnes of steel CF355 steel including connections*

*Approx. 100kg / m<sup>2</sup>*

*Another 20% of steel saving possible in S500*

*Another 30% of steel saving possible in S690*





# #3 Beyond the code

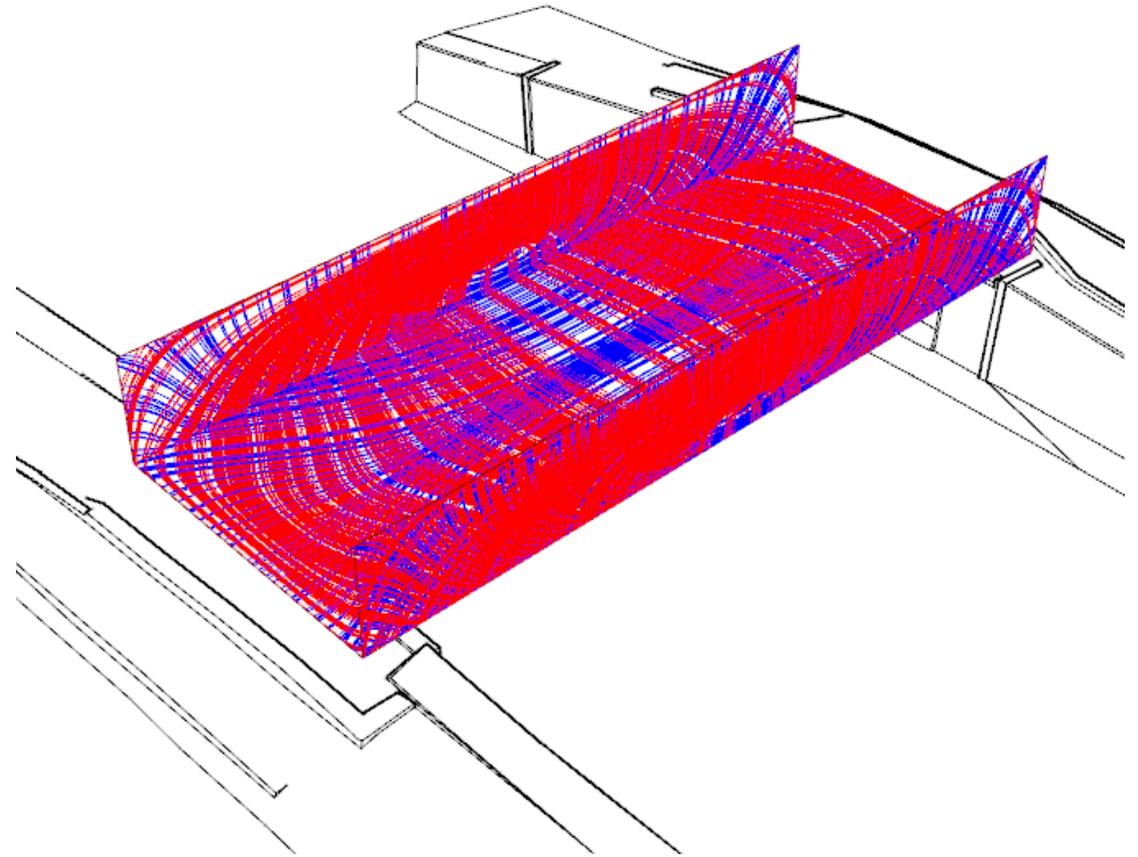
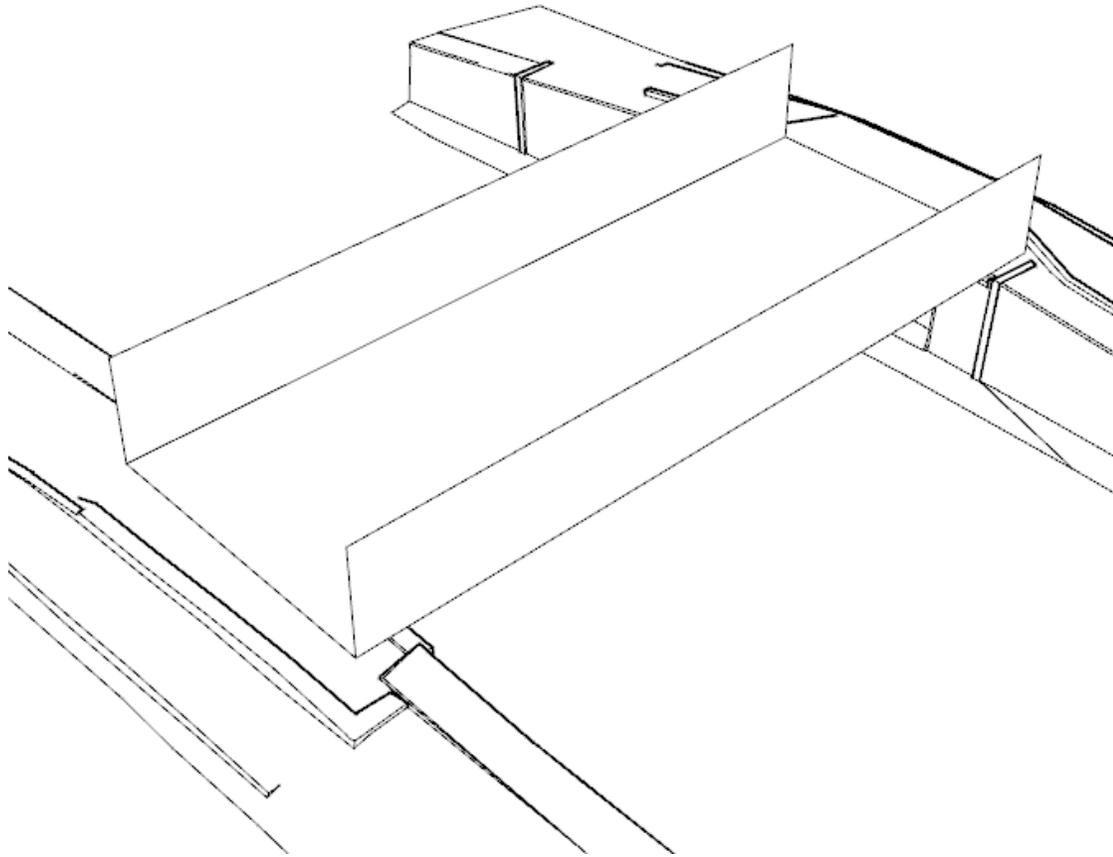
MX3D Brug, Amsterdam



Designer **Joris Laarman**  
Fabricator **MX3D**

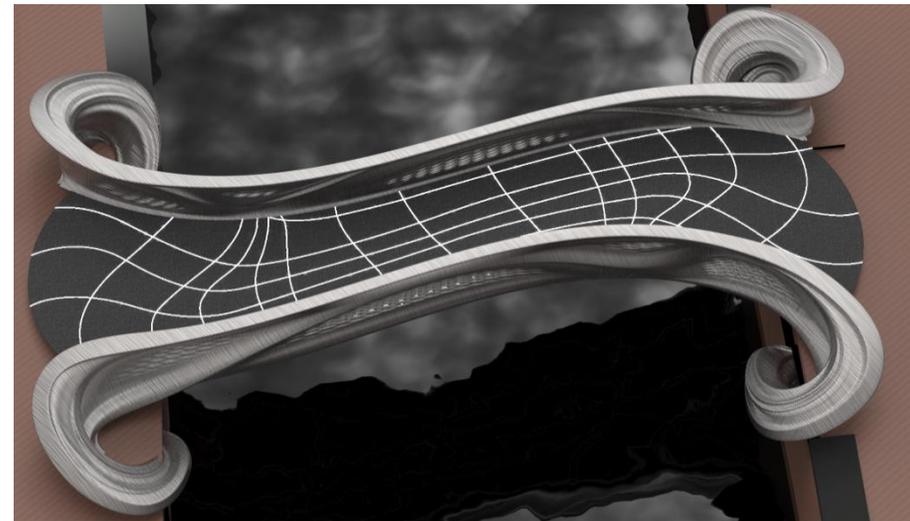
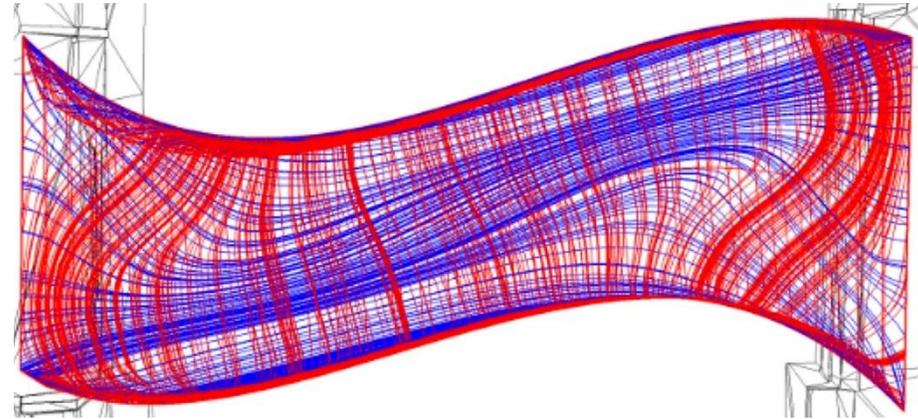
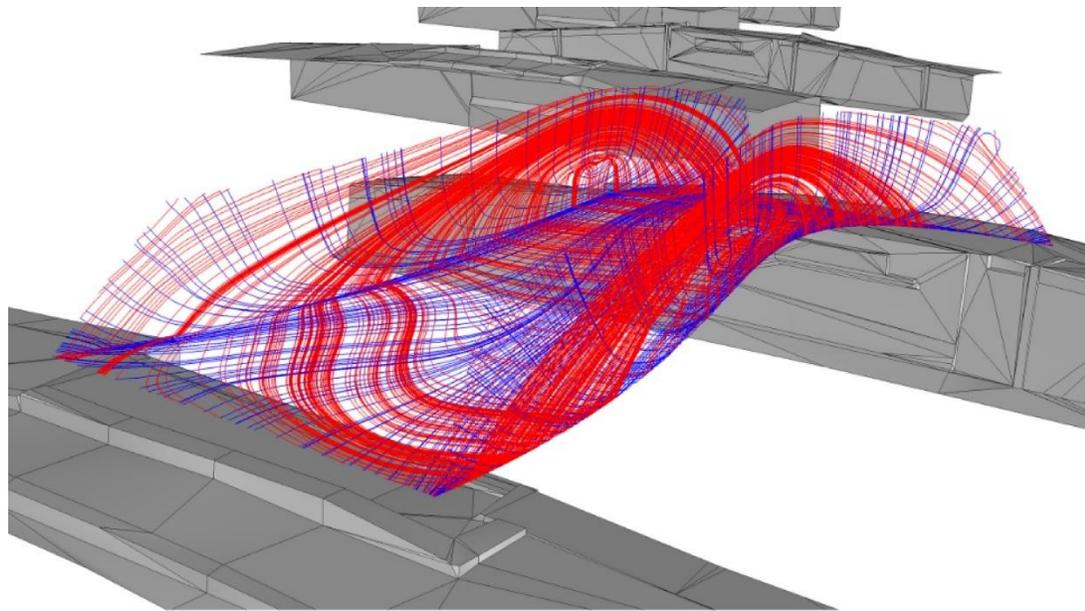
# #3 Beyond the code

MX3D Brug, Amsterdam



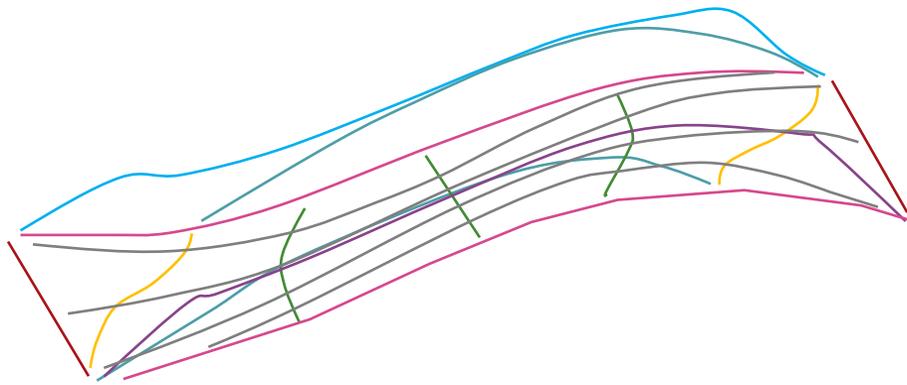
# #3 Beyond the code

MX3D Brug, Amsterdam

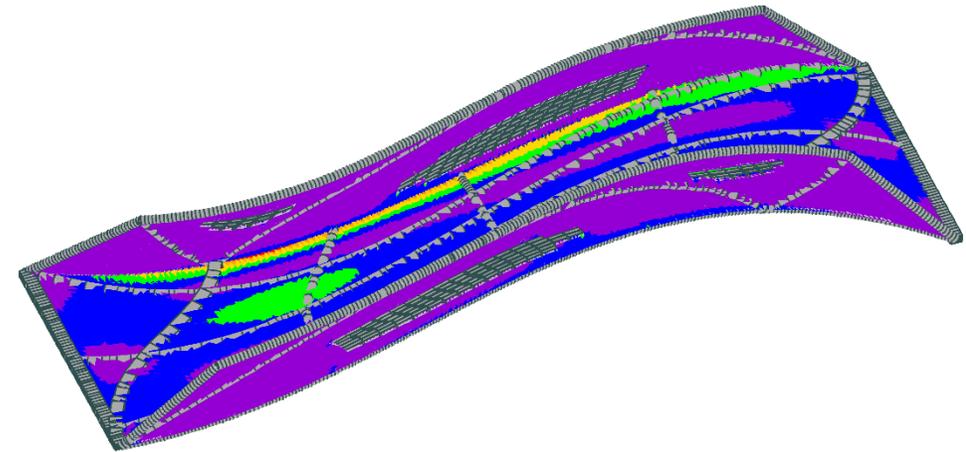


# #3 Beyond the code

MX3D Brug, Amsterdam



Simplified GSA model



1D beam with 2D shell

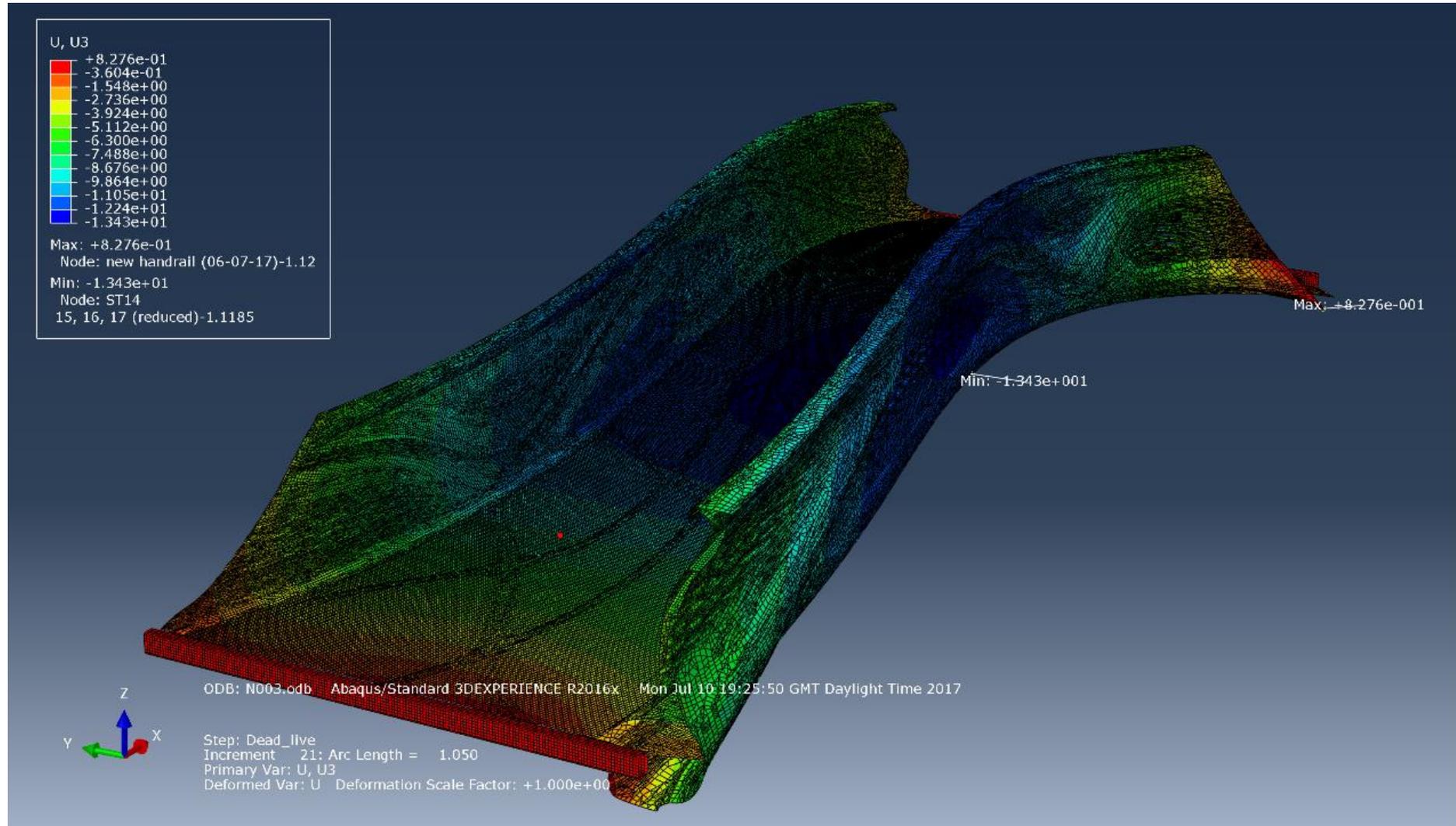
# #3 Beyond the code

MX3D Brug, Amsterdam



# #3 Beyond the code

## MX3D Brug, Amsterdam



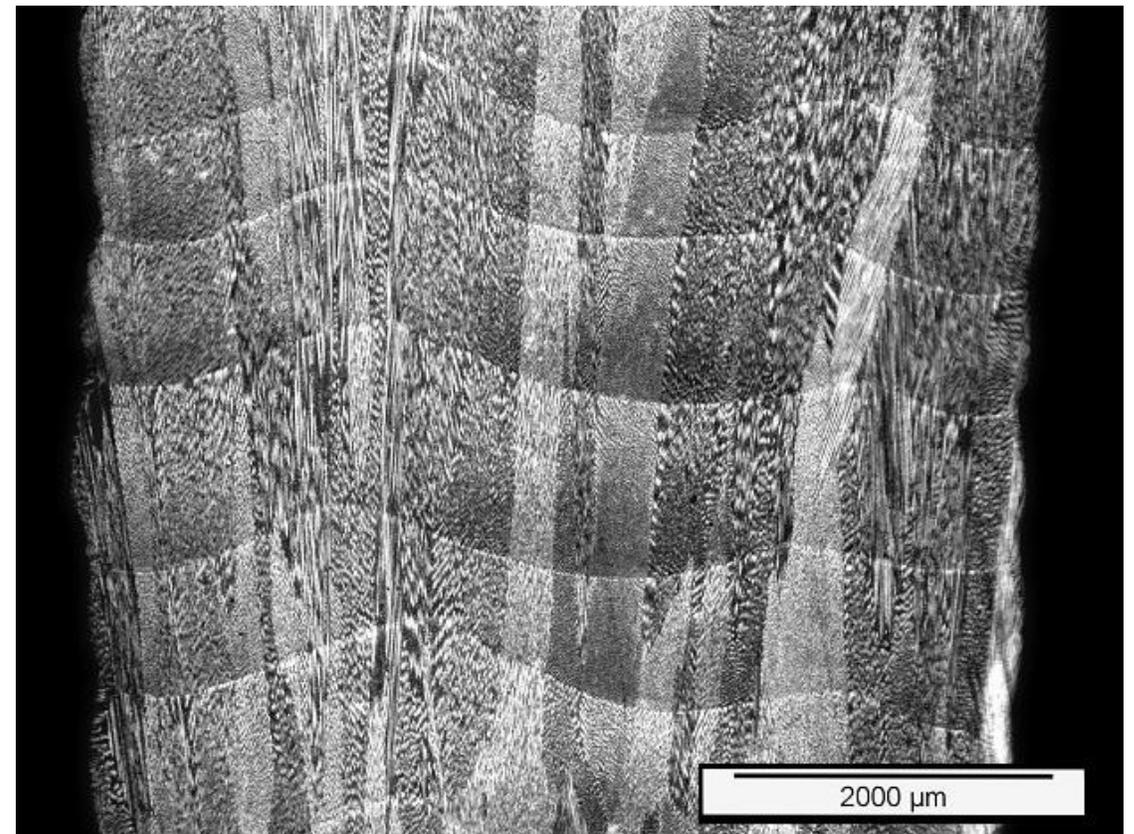
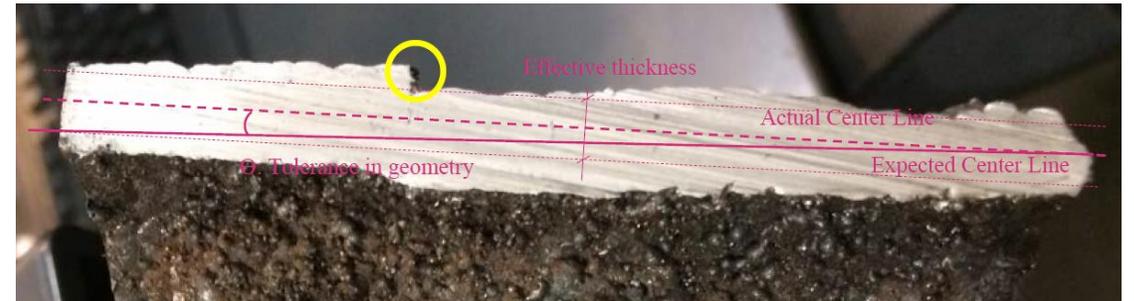
Full model in ABAQUS (with Imperial College London) – Nonlinear 2D Element

# #3 Beyond the code

## MX3D Brug, Amsterdam

### *Design Challenges:*

- Unknown material properties
- Tolerances
- Geometrical inaccuracies and imperfections
- Microstructural behavior and residual stresses
- Welding defects



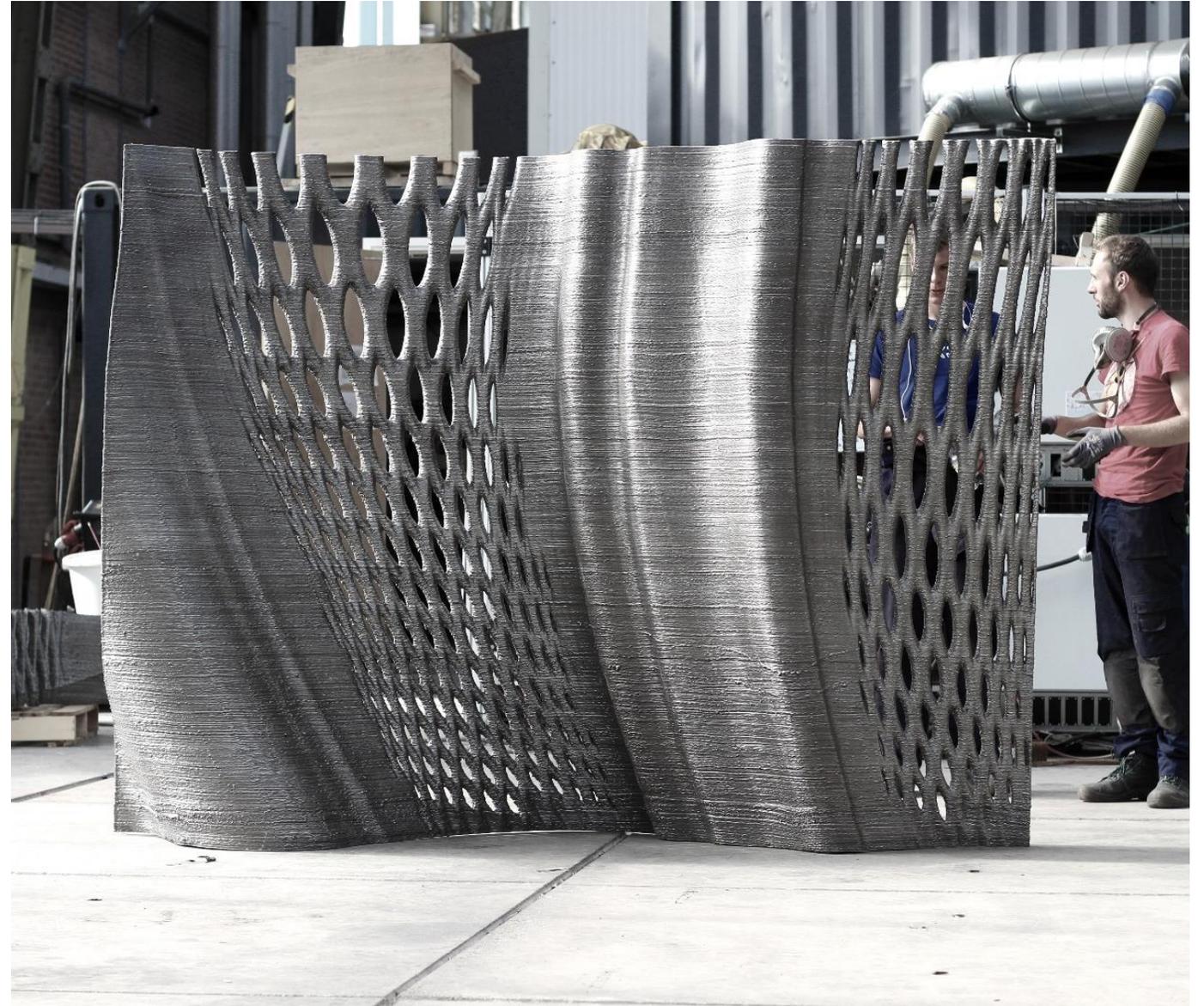
# #3 Beyond the code

## MX3D Brug, Amsterdam

### Testing:

*design beyond the codified materials with the help of experiments to demonstrate structural safety and serviceability. Set up a protocol and system for interpretation of the experiments results at three levels:*

- Lab test results
- Structural element test results
- Full scale final test results



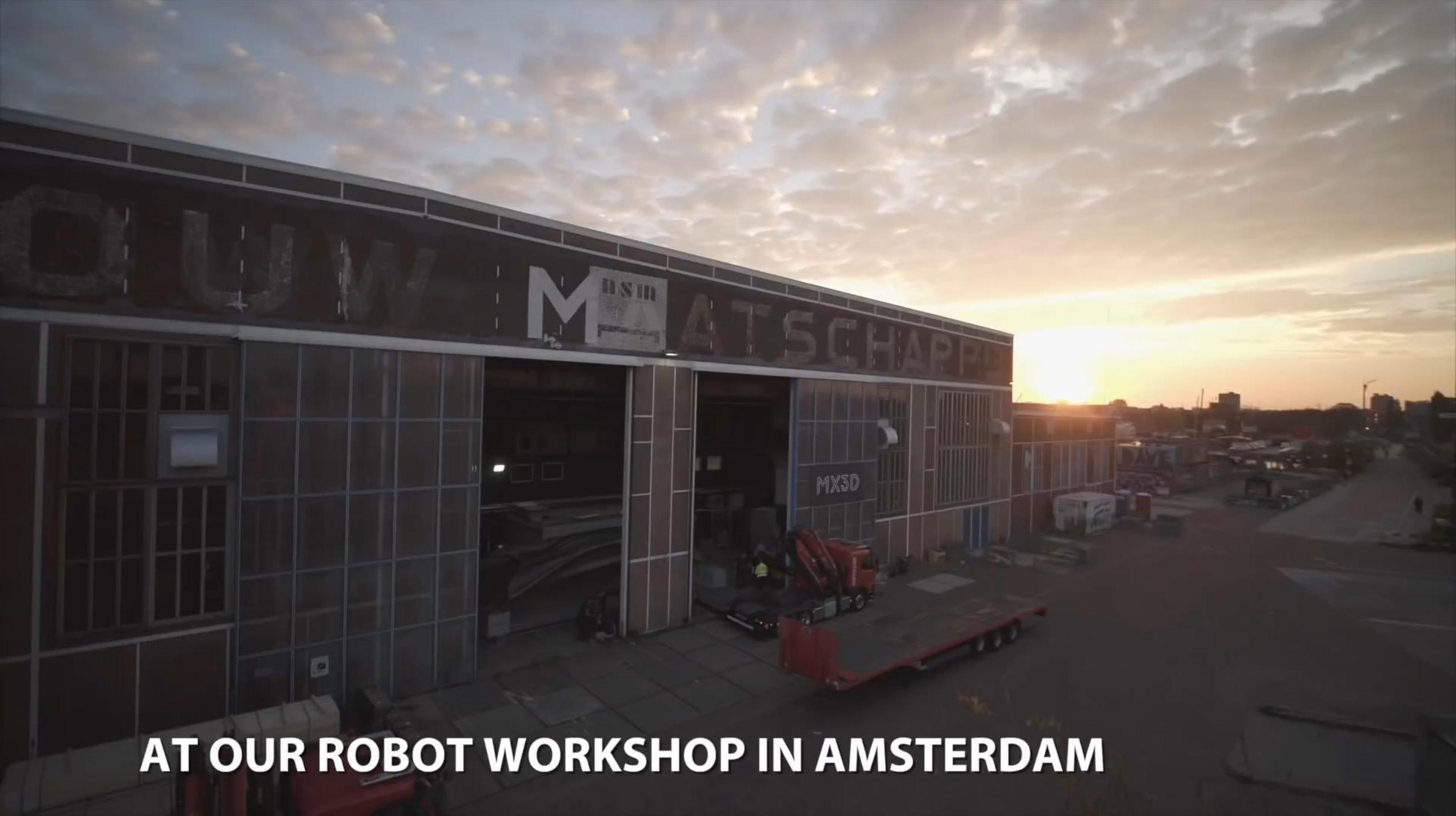
# #3 Beyond the code

**MX3D Brug, Amsterdam**

***Monitoring the bridge during its lifetime:***

- Live monitoring of deflection and support forces
- Monitoring of corrosion





**AT OUR ROBOT WORKSHOP IN AMSTERDAM**

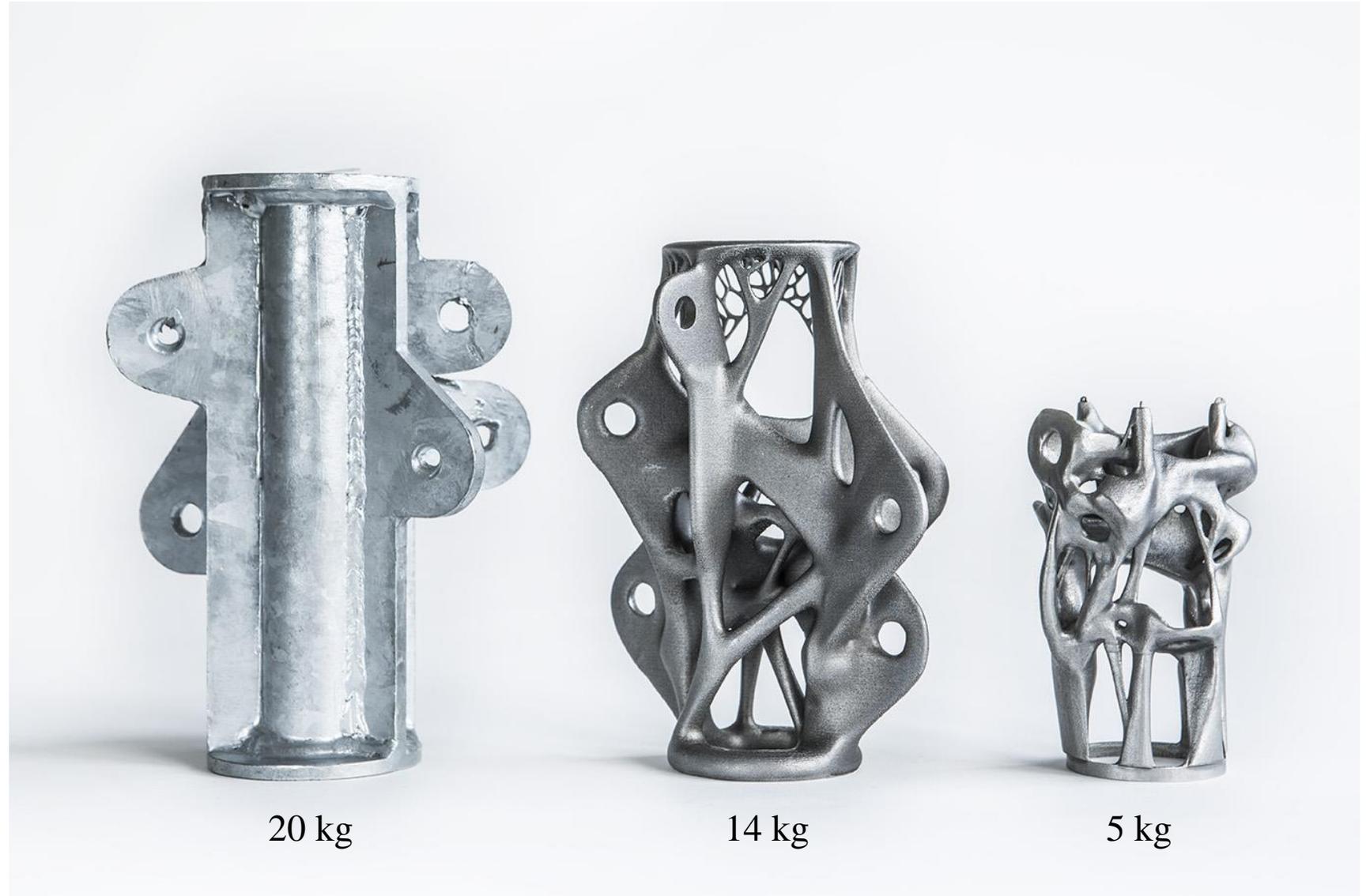




ARUP

# #3 Beyond the code

MX3D Brug, Amsterdam



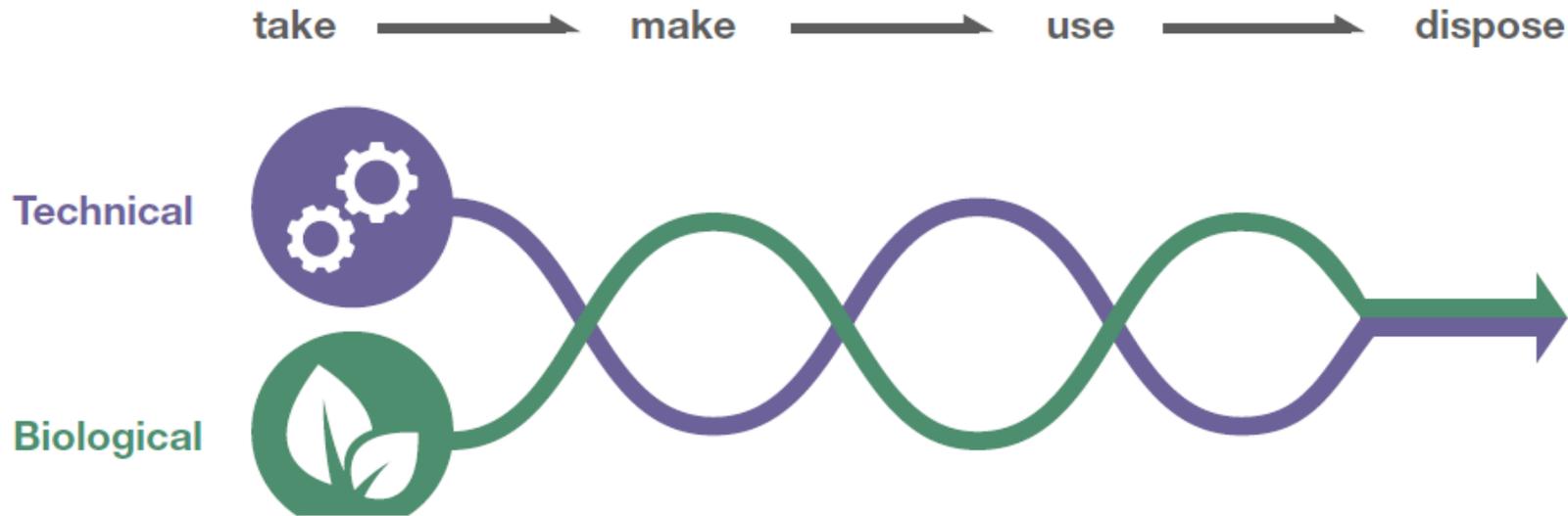
# #4 Embrace the circular economy

Peoples Pavilion, eindhoven



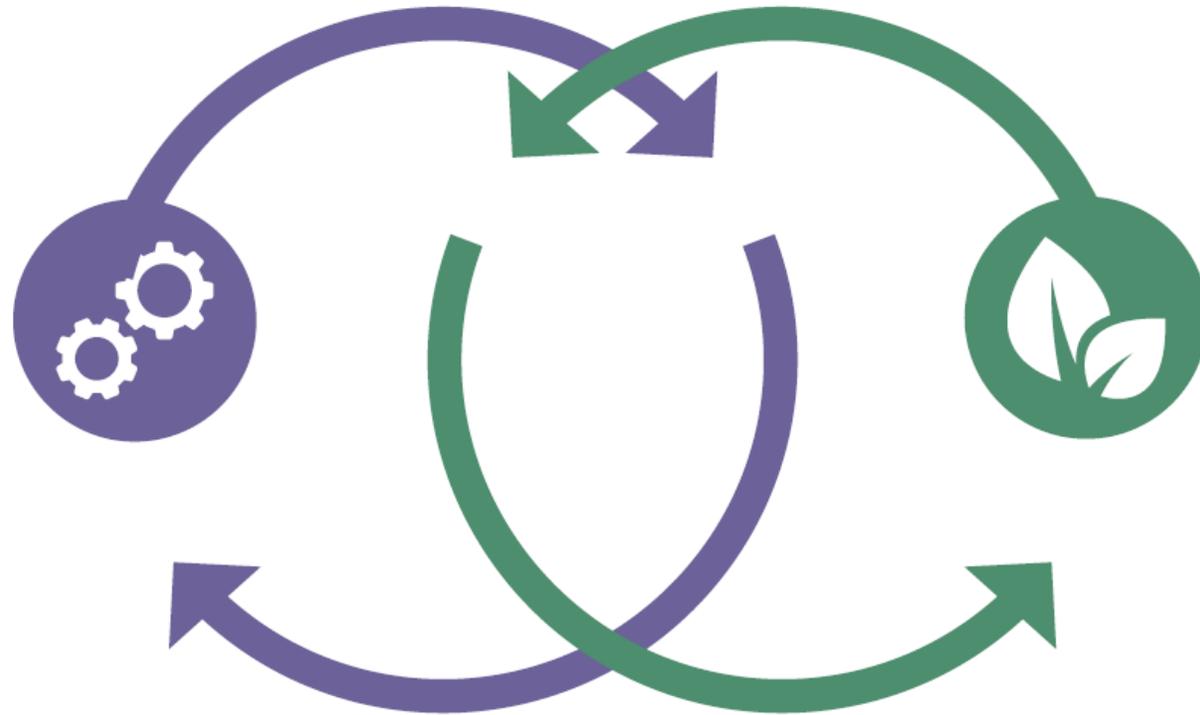
Architect:  
Bureau Sla / Overtreders

# Linear Economy



**Technical + Biological Nutrients mixed up**  
Energy From Finite Resources

## Circular Economy

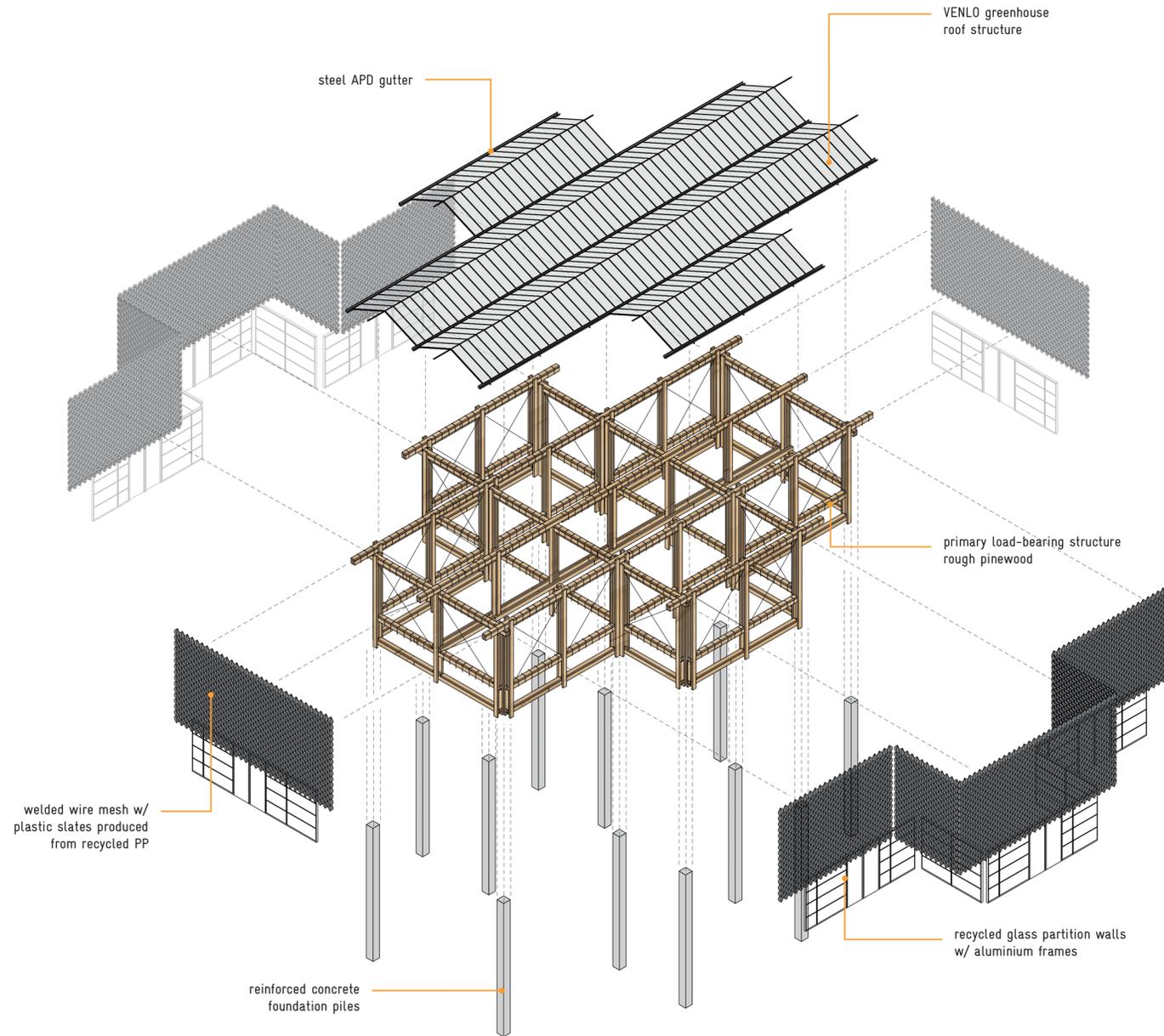


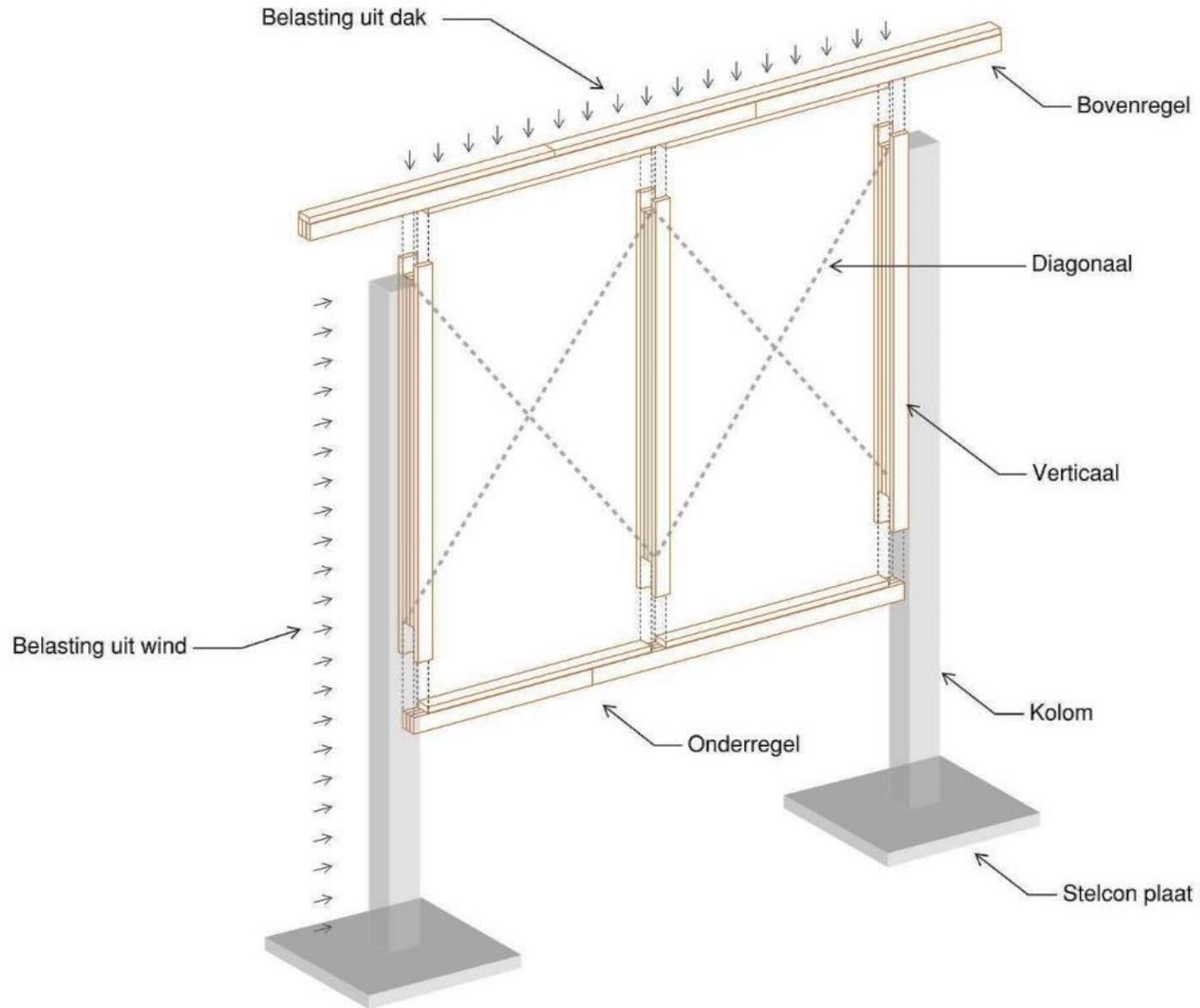
## Living Systems

Energy From Renewable Resources



BORROWED MATERIALS

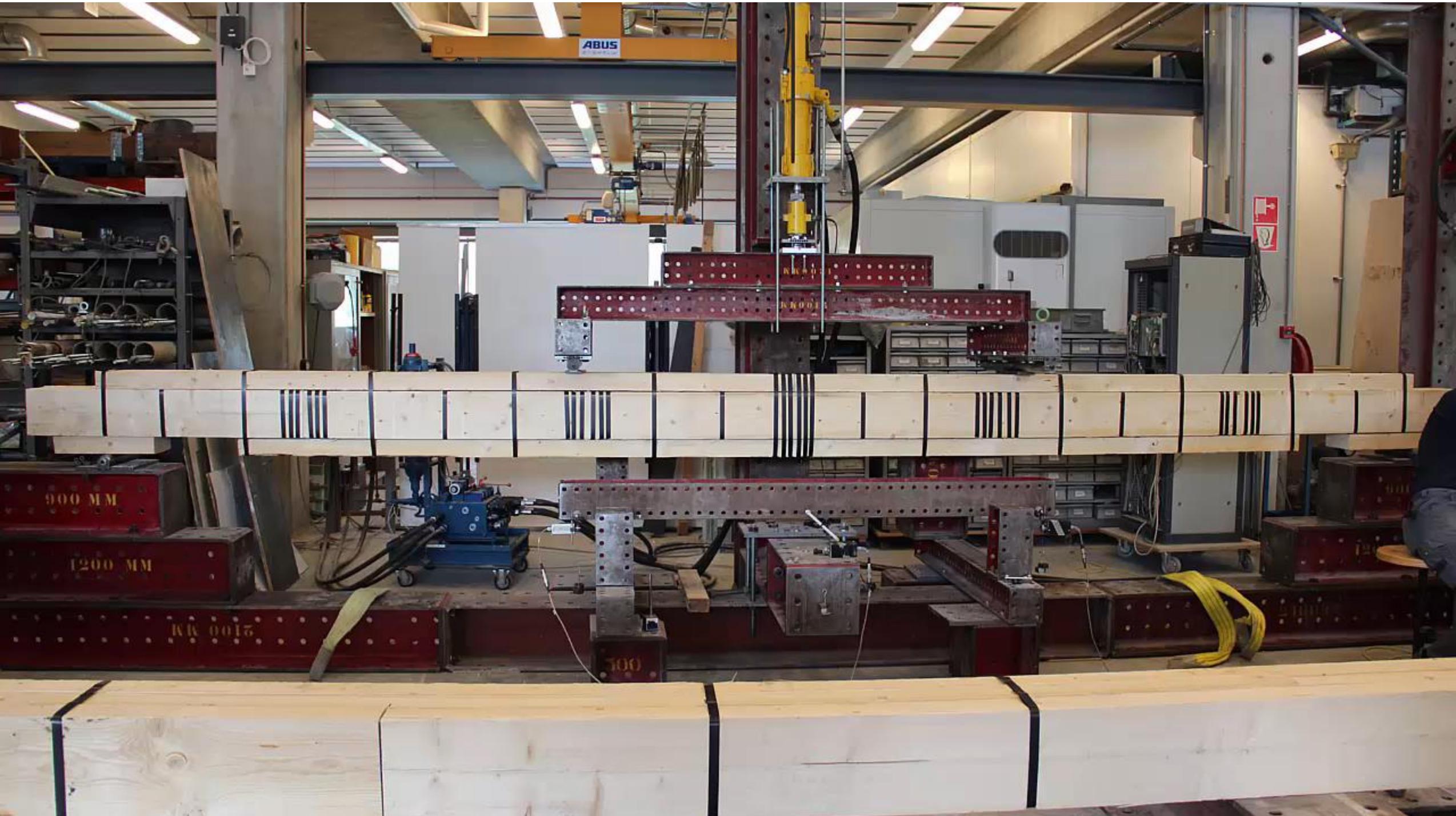








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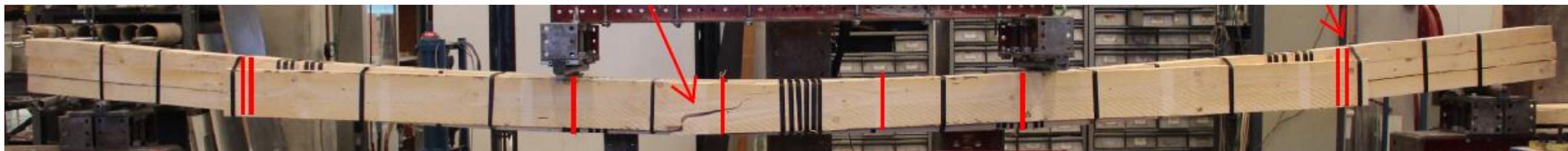
ABUS

900 MM

1200 MM

KW 0017

100







ARUP

# #5 Sustainable Materials

## Haut Amsterdam



Developer: **Lingotto**

Architect: **Team V**

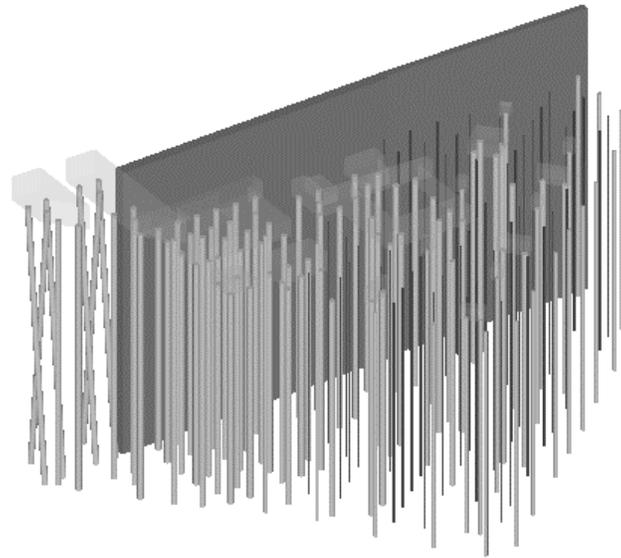
Contractor: **JP van Eesterern**

IMAGE: TEAM V &  
ZWARTLICHT

# Structural Design

## Foundations

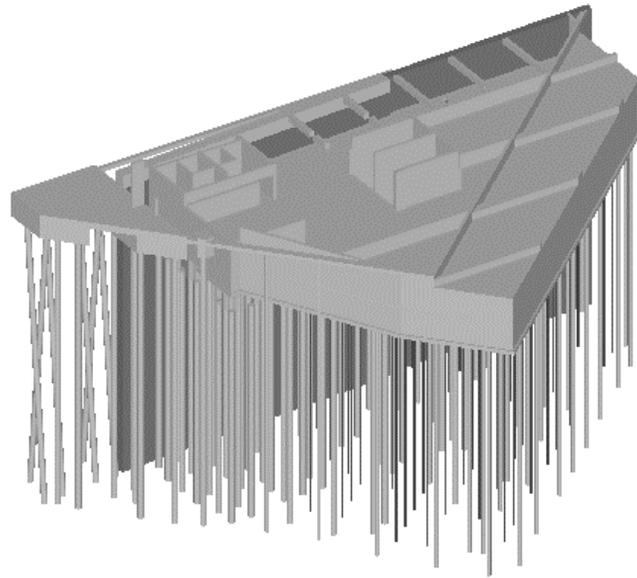
- Load bearing diaphragm wall
- 104 'Tubex' steel casing piles
- 54 tension anchors



# Structural Design

## Basement

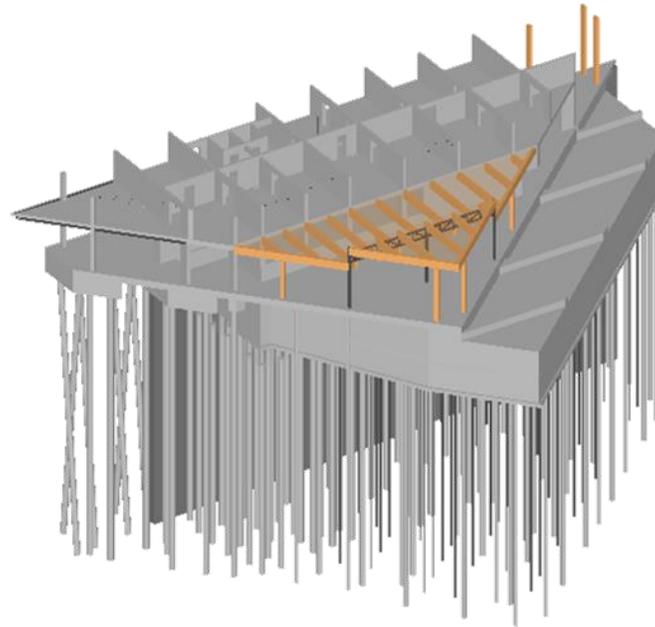
- Two levels basement
- In-situ concrete



# Structural Design

## Plinth

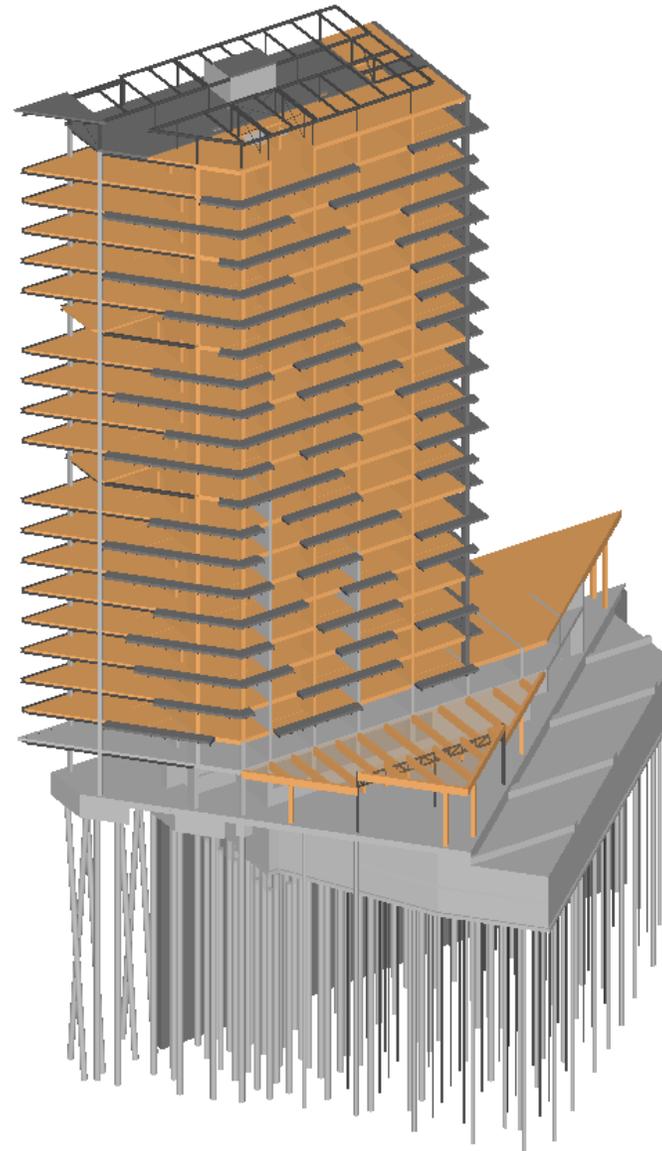
- Ground- and first floor in concrete where high-rise is supported
- Timber plinth



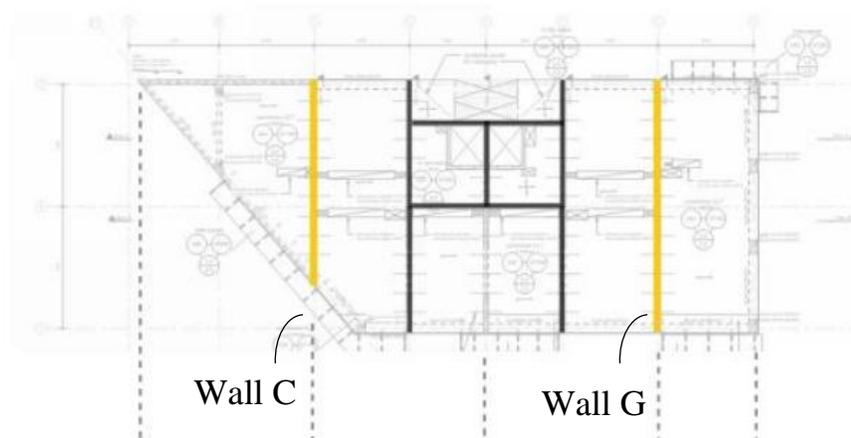
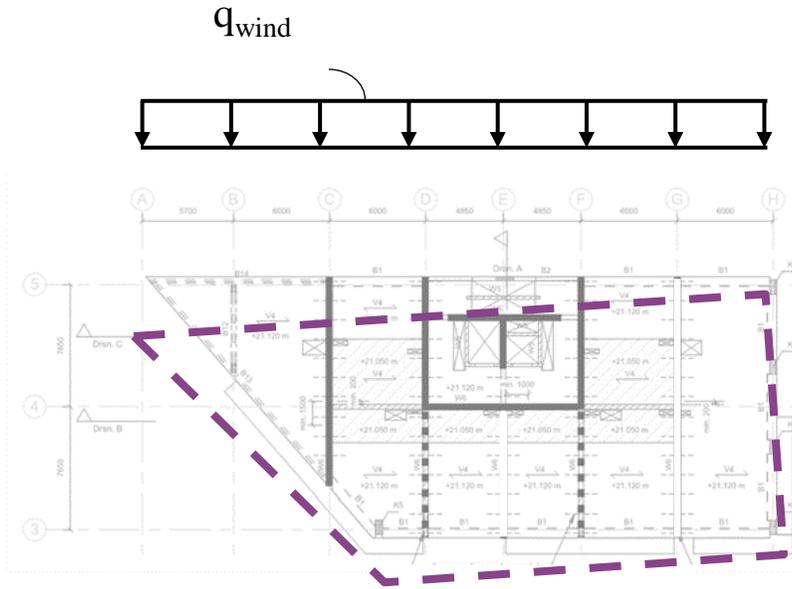
# Structural Design

## Superstructure

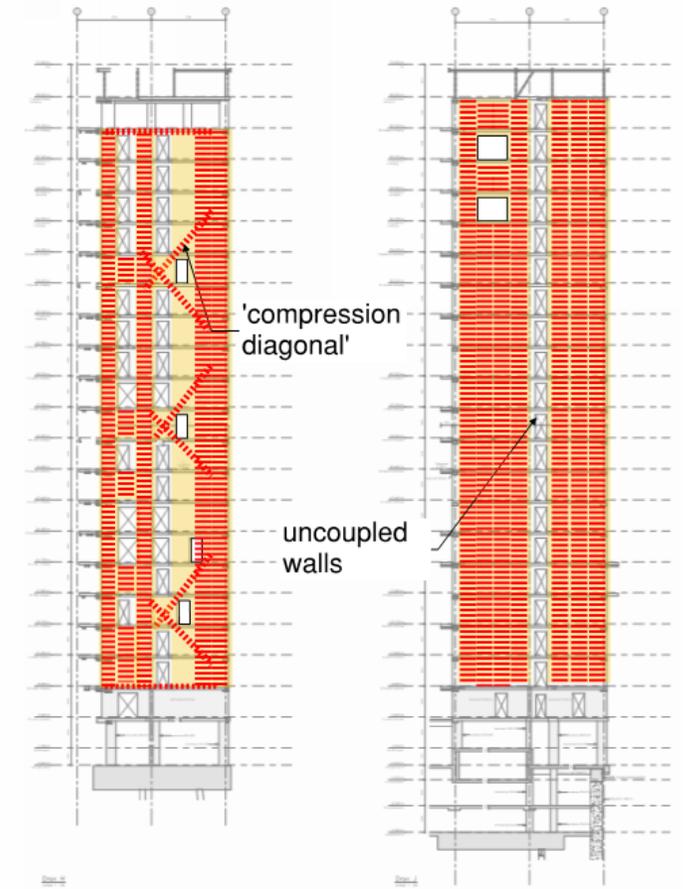
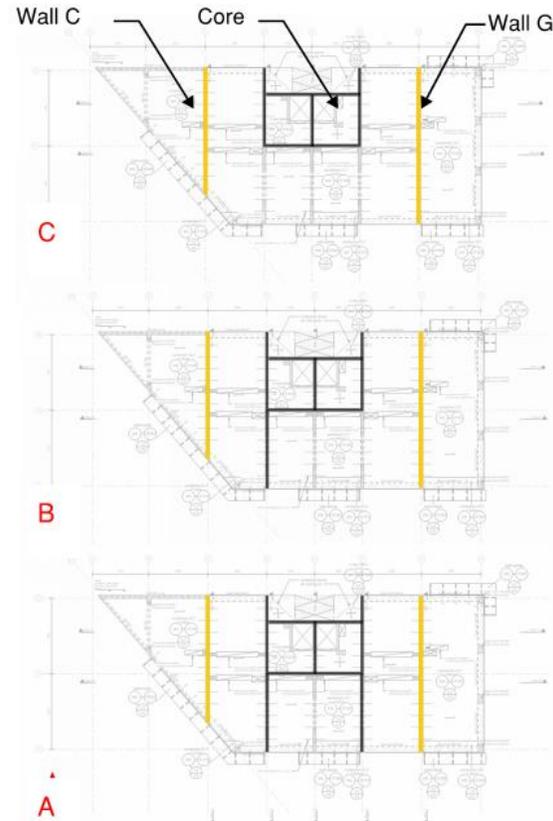
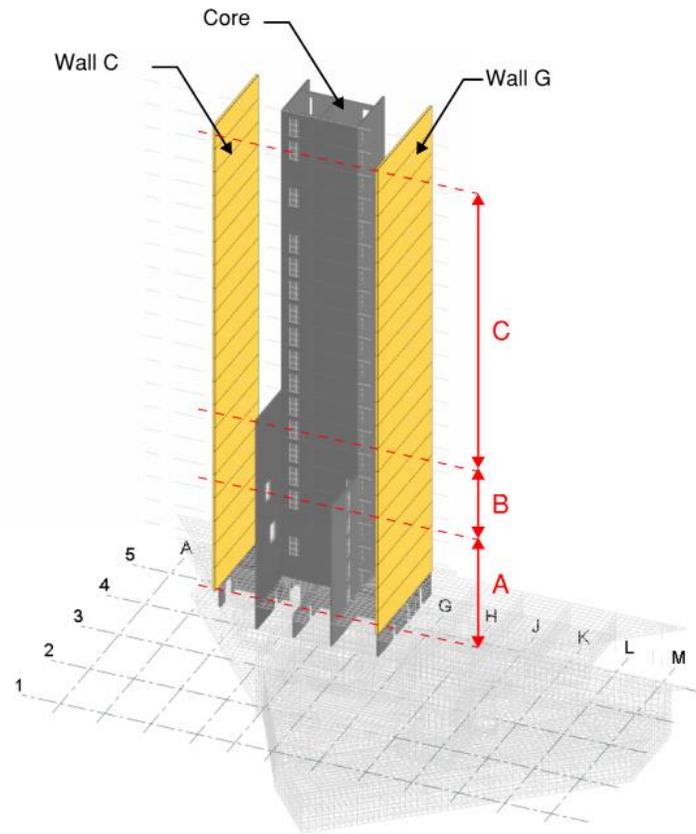
- CLT / Concrete Floors
- CLT Walls
- Glulam Columns
- Concrete Core



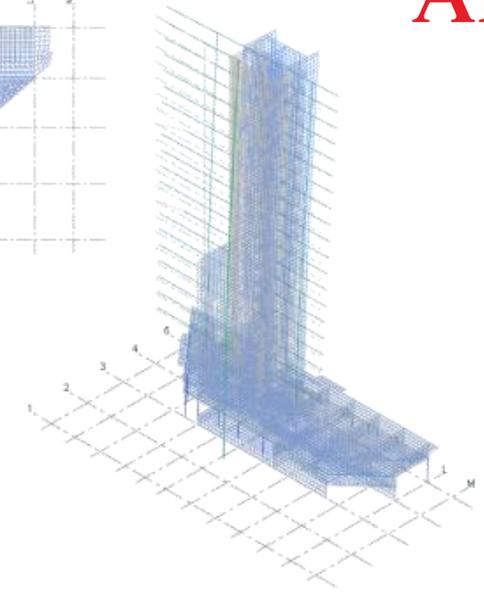
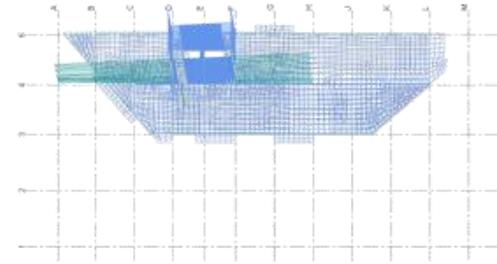
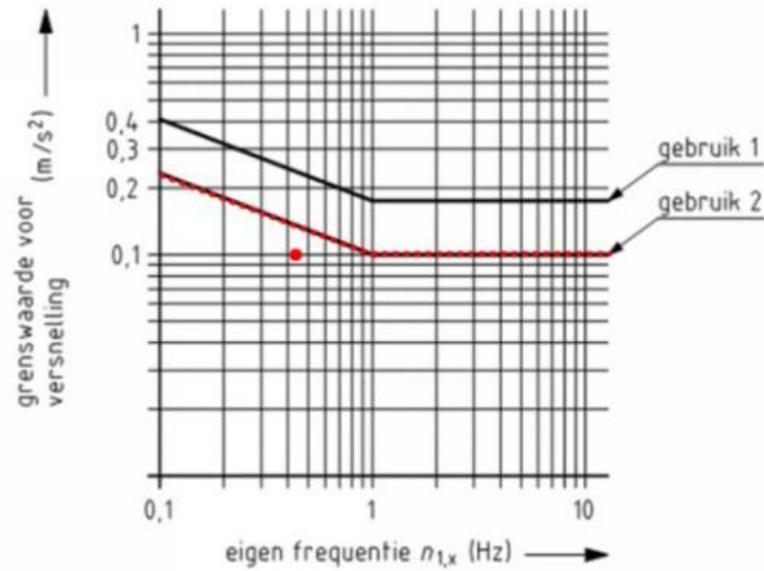
# Stability



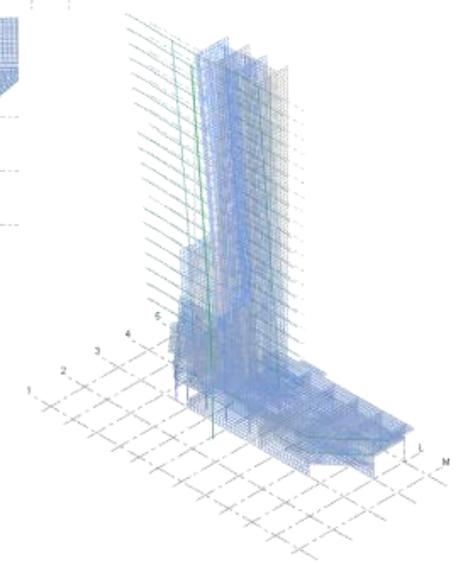
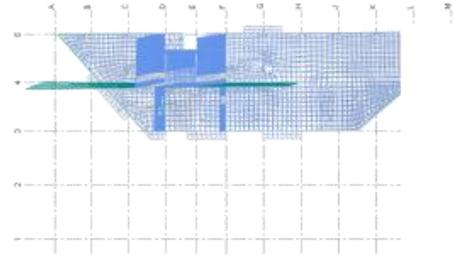
# Stability



# Vibration

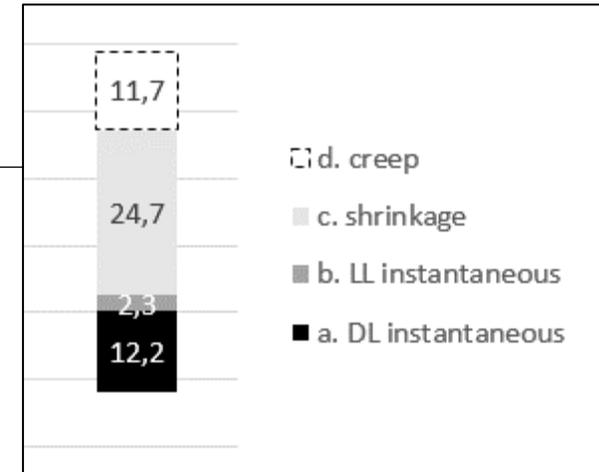
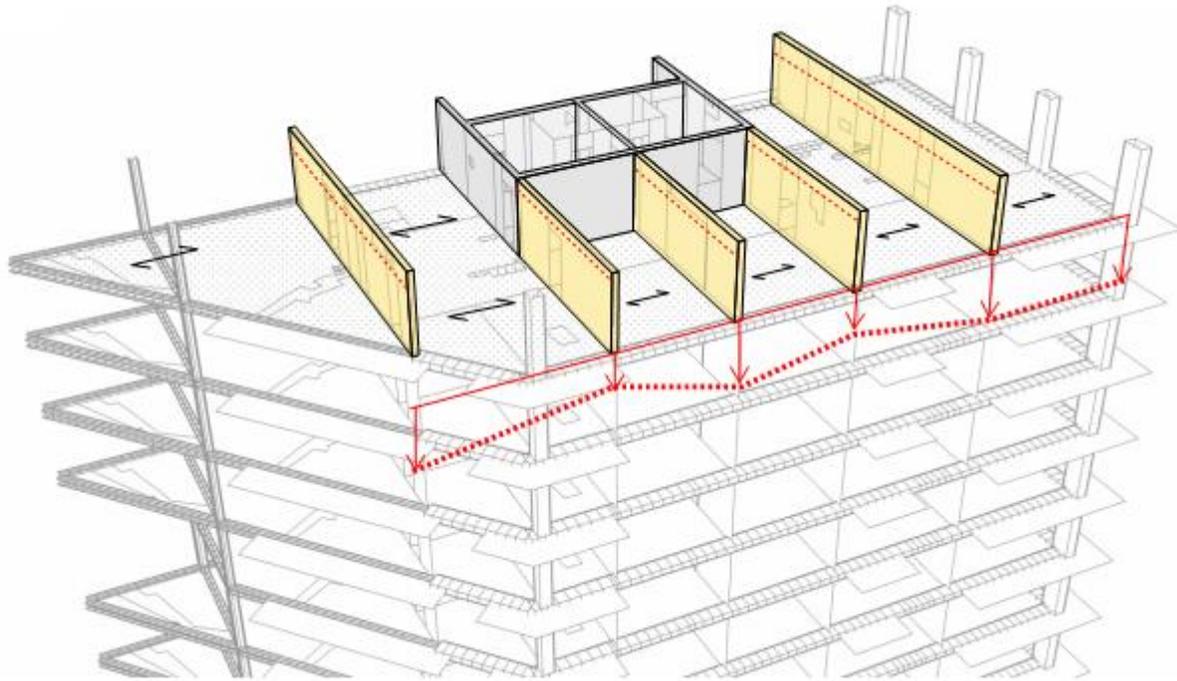


ANALYSIS LAYER  
Part is excluded by volume  
Scale: 1.446,6  
Deformation magnification: 5,000  
Case: A4 : Modal Analysis : Mode 1  
Mode 1  
Frequency: 0.4342Hz  
Period: 2,303s

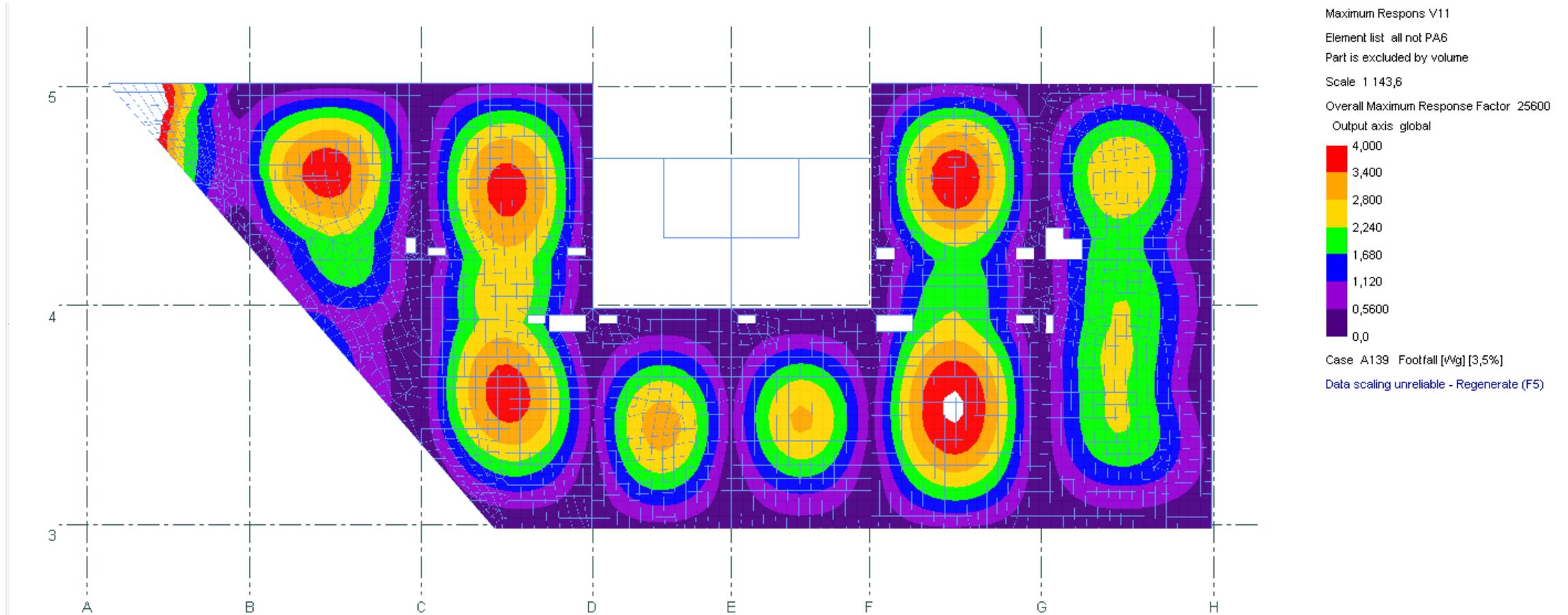


ANALYSIS LAYER  
Part is excluded by volume  
Scale: 1.446,6  
Deformation magnification: 5,000  
Case: A5 : Modal Analysis : Mode 2  
Mode 2  
Frequency: 0.5412Hz  
Period: 1,848s

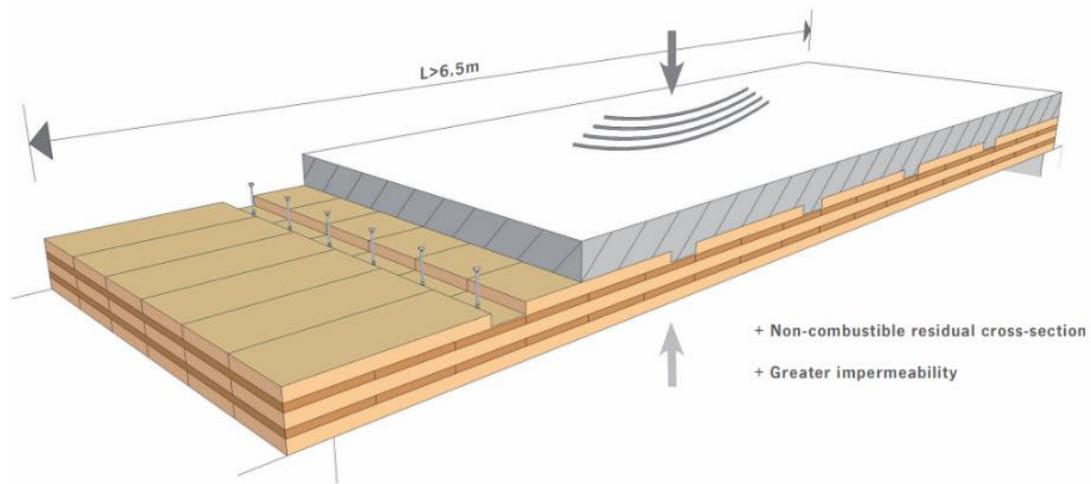
# Differential settlement



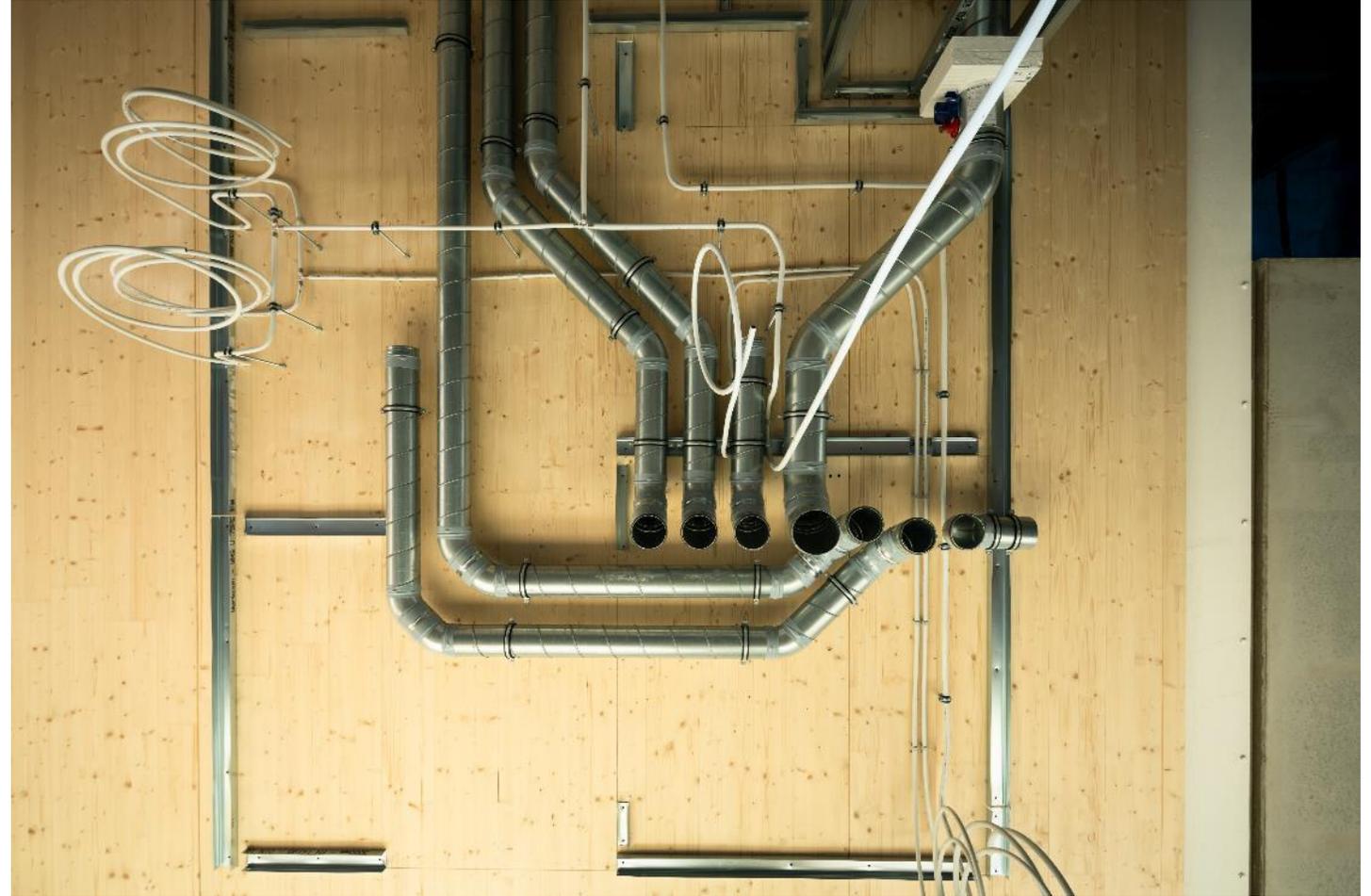
# Foot Fall Vibration



# Composite slab action

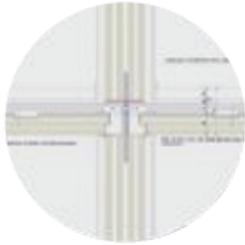


# MEP Integration

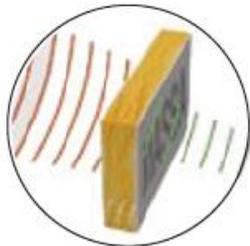


# Holistic Design

ARUP



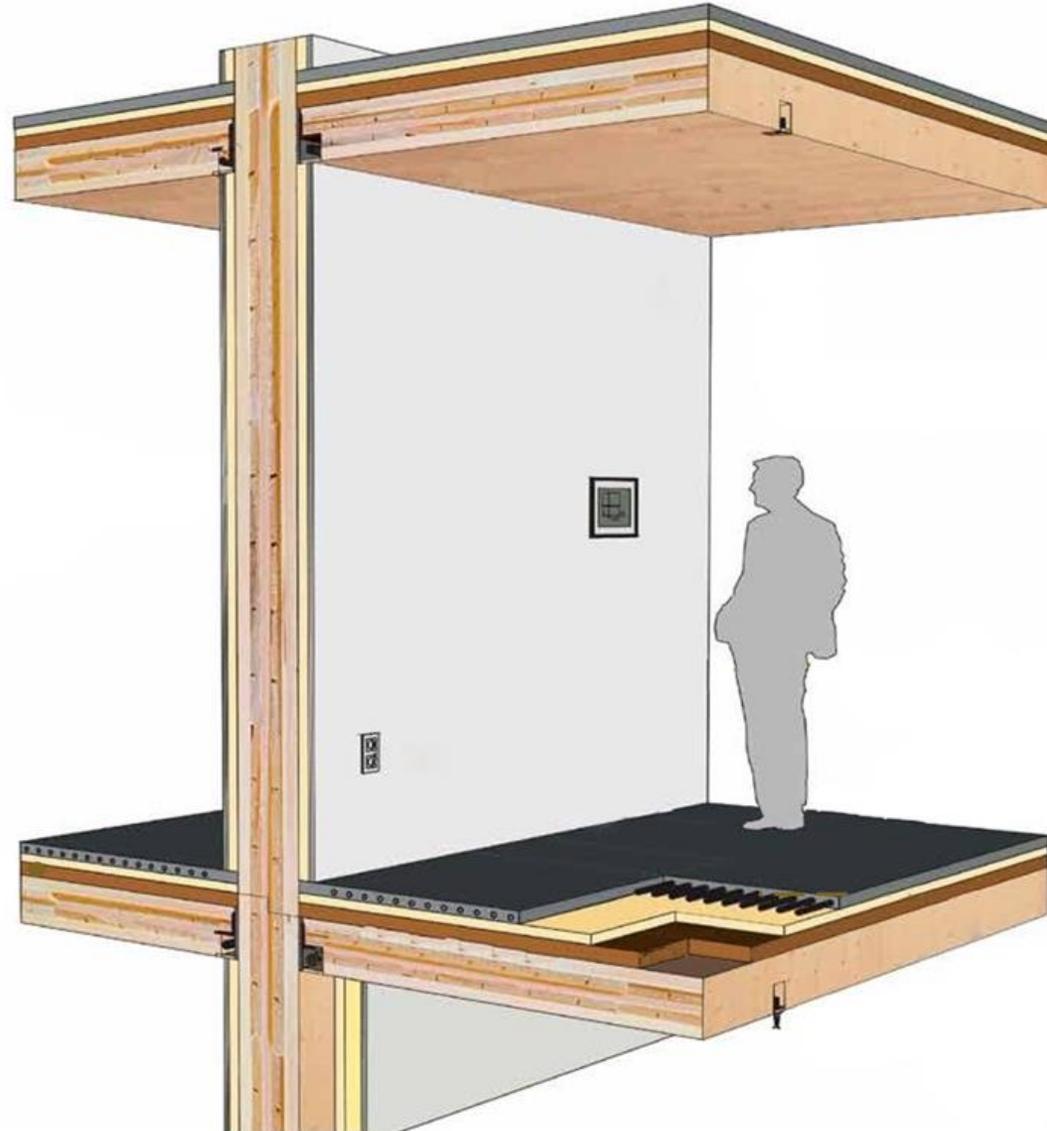
Structural Integrity



Acoustics



Construction



Architectural Quality



Fire

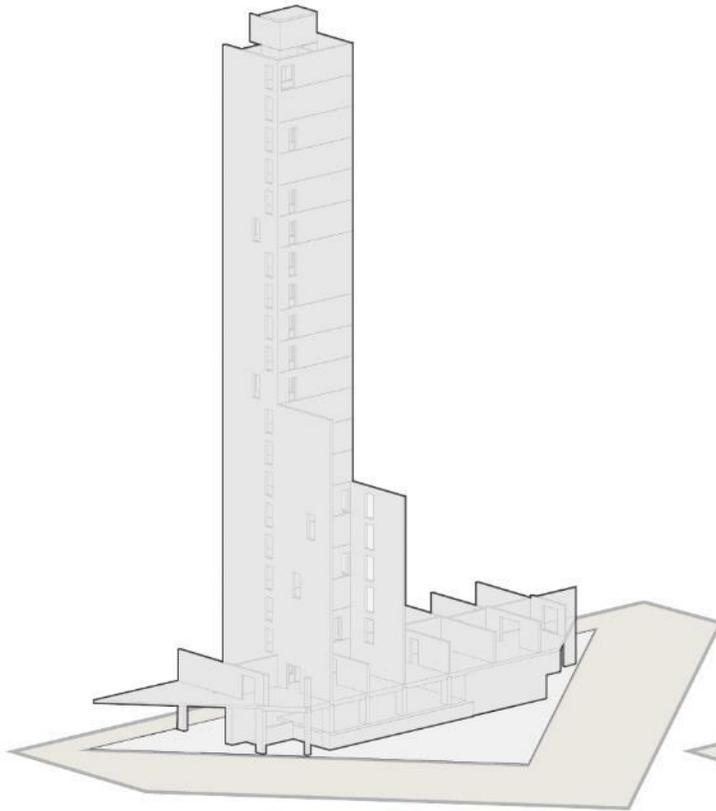


Building Services

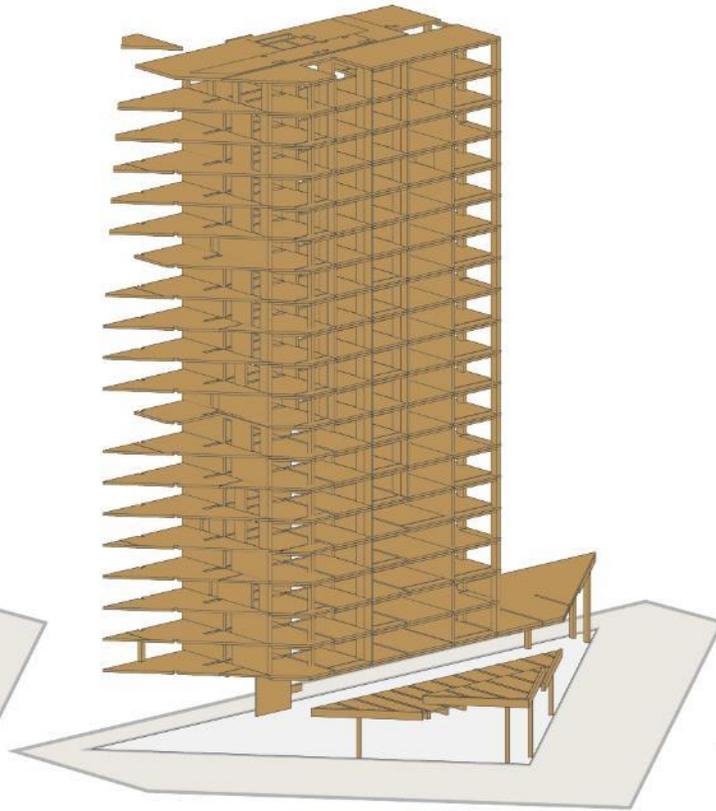
# Hybrid structure

ARUP

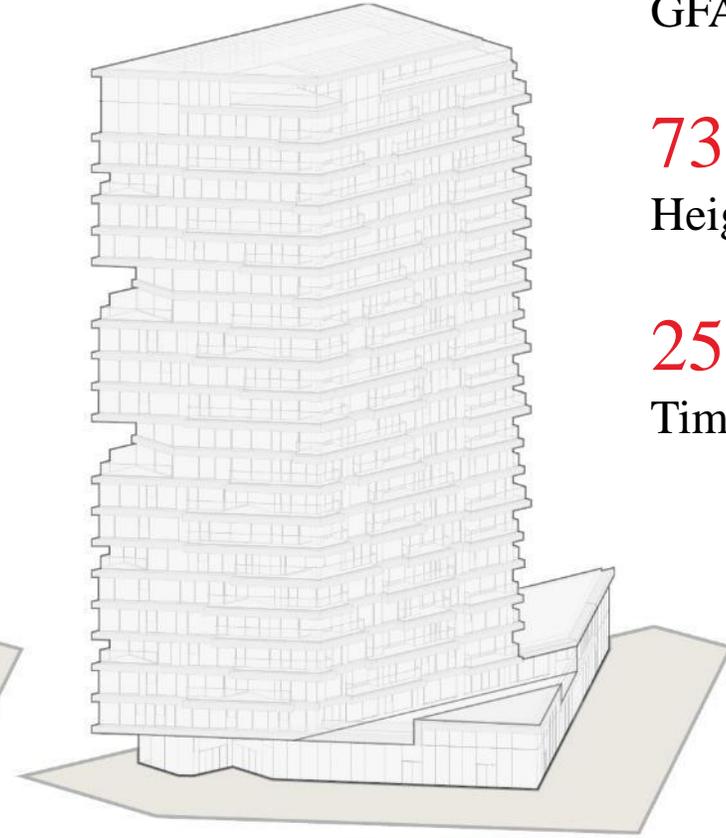
Concrete



Timber



Glass



14.500m<sup>2</sup>  
GFA

73 m  
Height

2500m<sup>3</sup>  
Timber





# #6 Data driven, generative design

Elements, Amsterdam



Developer: **Kondor Wessels Vastgoed**

Architect: **Koschuch**

Landschape architect: **Boom**

Tendermanagement: **Tenderboost**

# #6 Data driven, generative design

Elements, Amsterdam



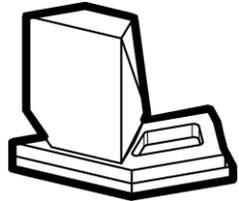
Developer: **Kondor Wessels Vastgoed**

Architect: **Koschuch**

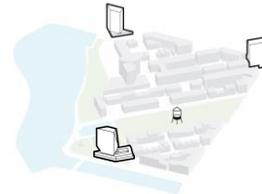
Landschape architect: **Boom**

Tendermanagement: **Tenderboost**

# Sustainability, 6 KPI's



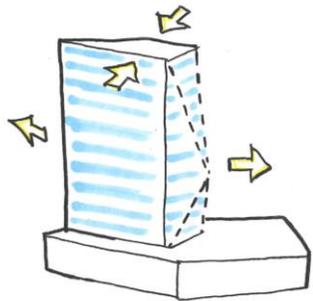
Building



Neighborhood

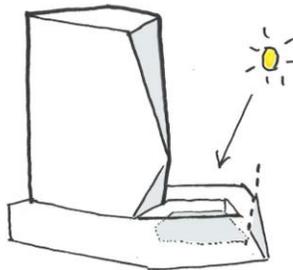


Planet



daylight

*Dutch 'lichte TNO norm'*



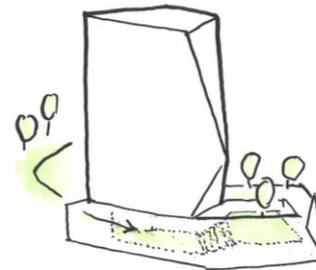
Sun

*Optimal  
sun conditions*



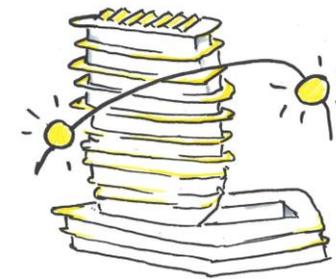
wind

*Windcomfort*



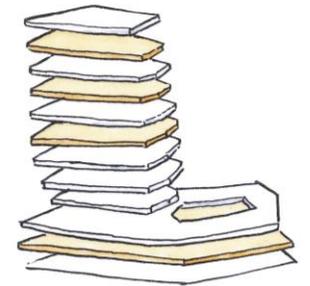
green

*20% green*



energie

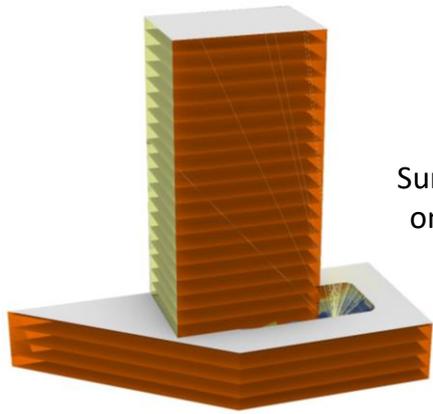
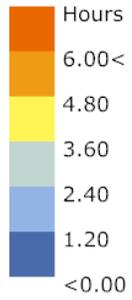
*Energieneutral*



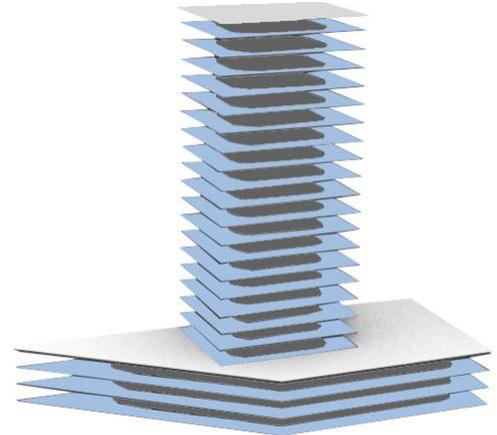
material

*51% Carbon reduction*

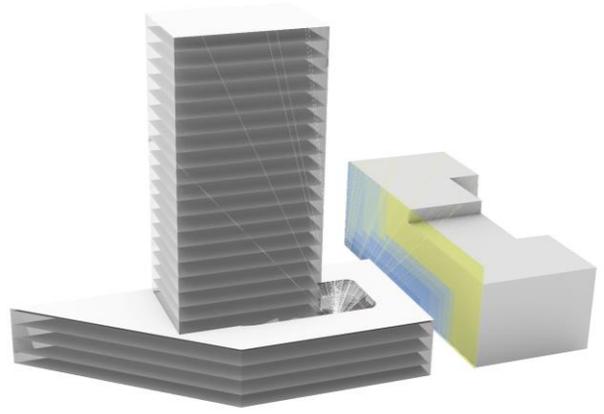
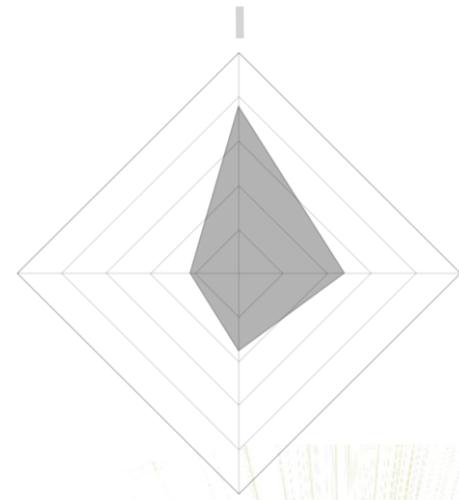
# Dominant shaping parameters



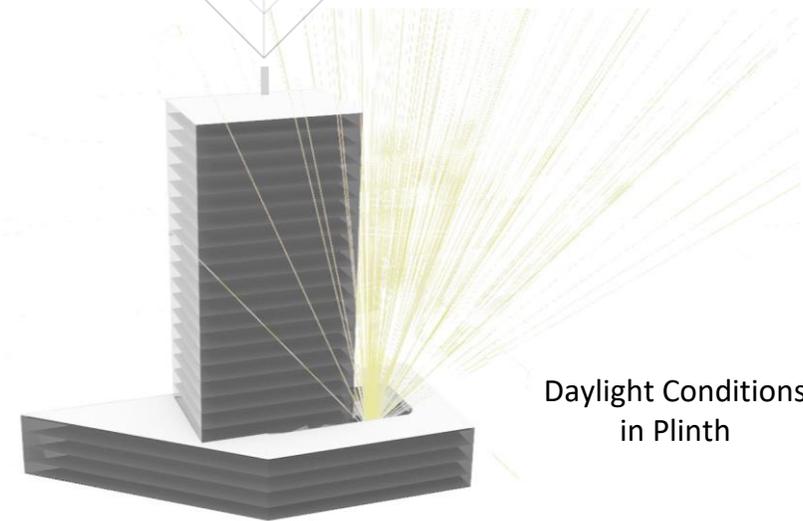
Sunlight conditions on facades tower



Daylight conditions in apartments

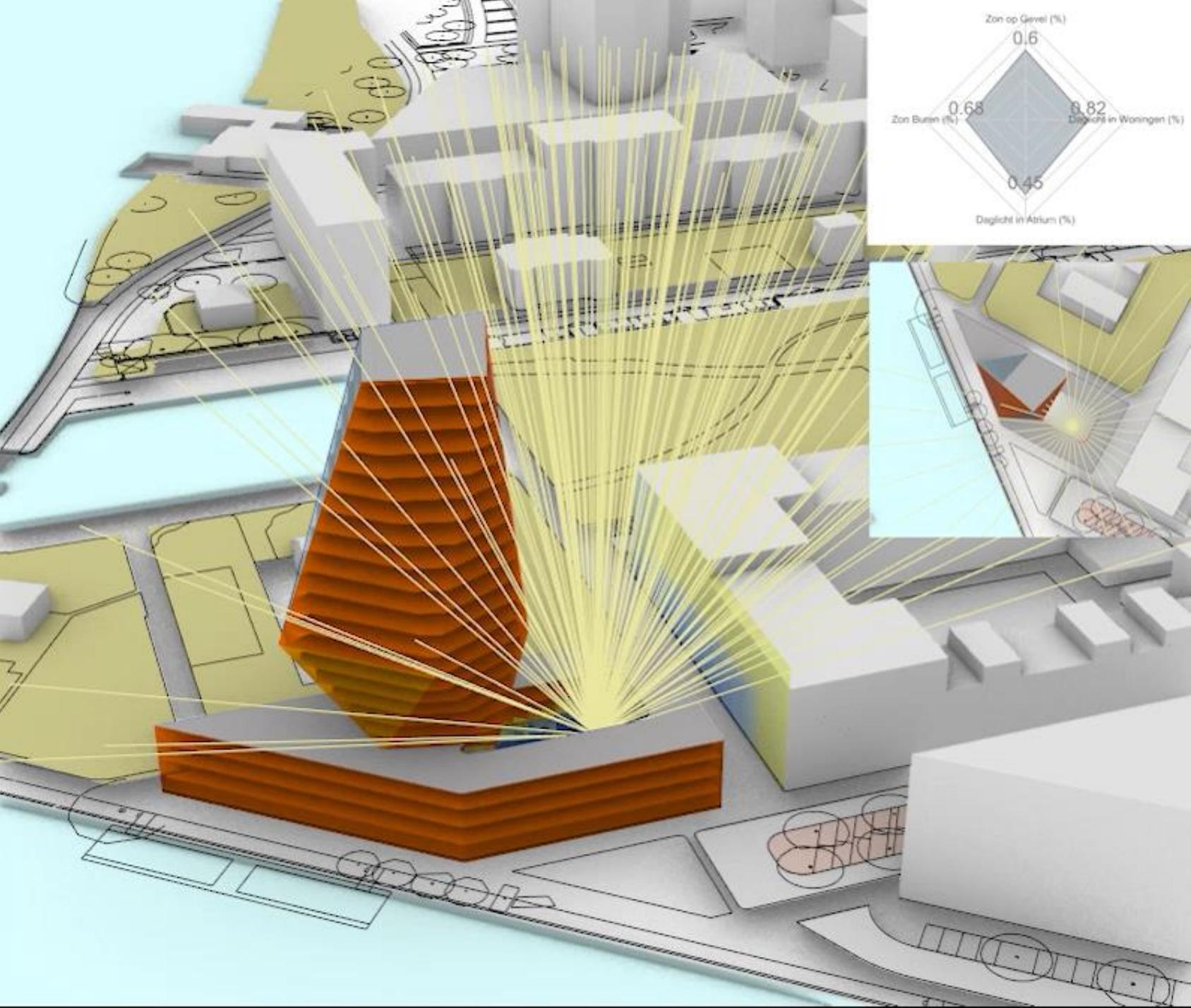


Sunlight conditions on neighboring facade

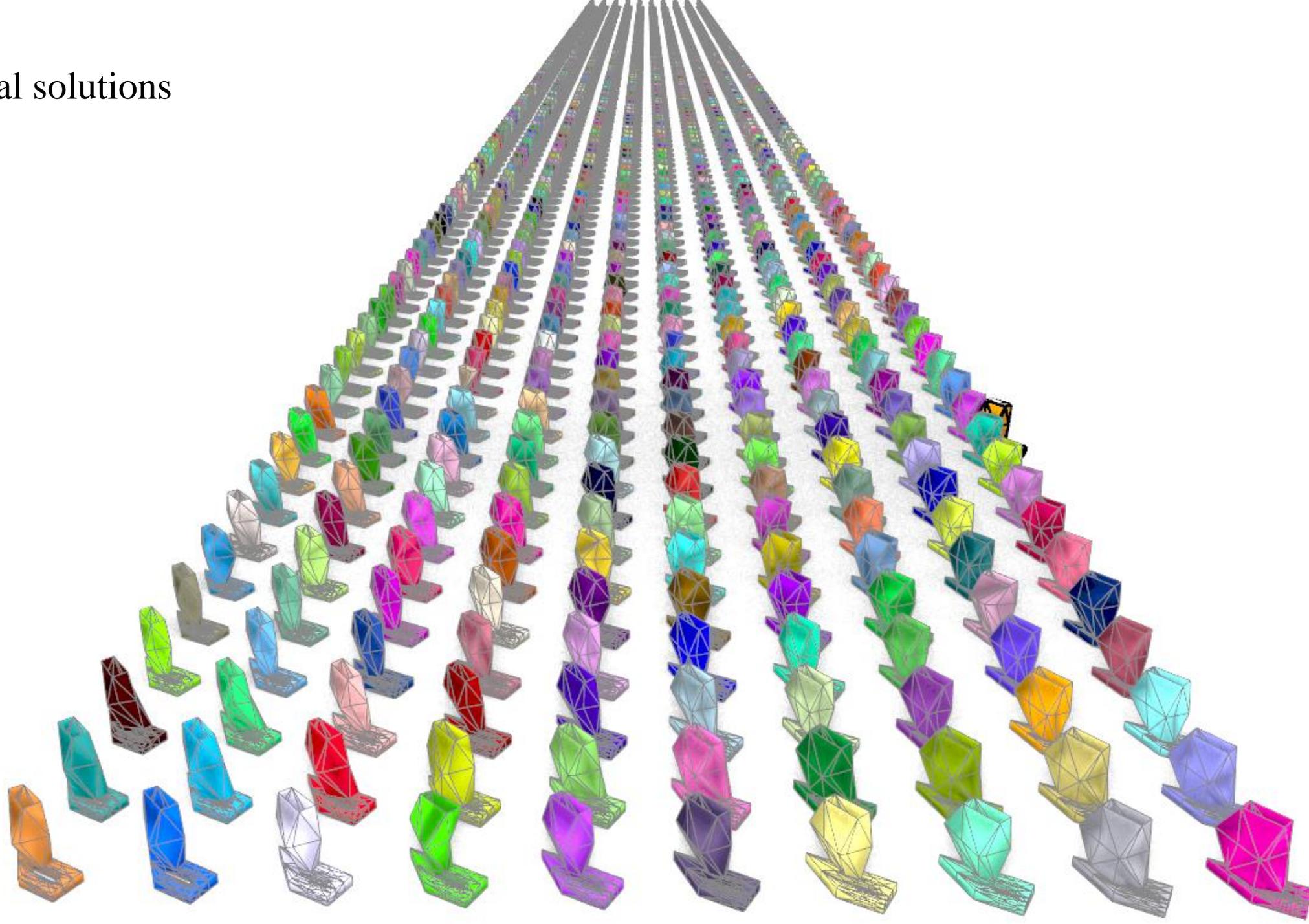


Daylight Conditions in Plinth

# Final algorithm



Potential solutions

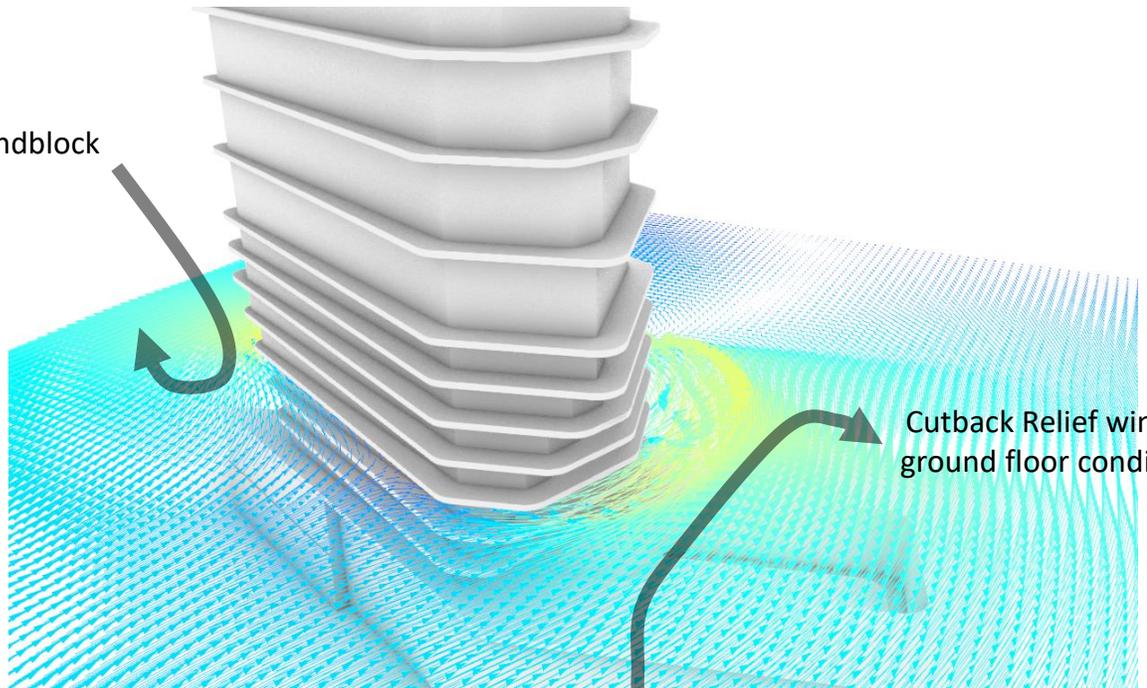


# Wind



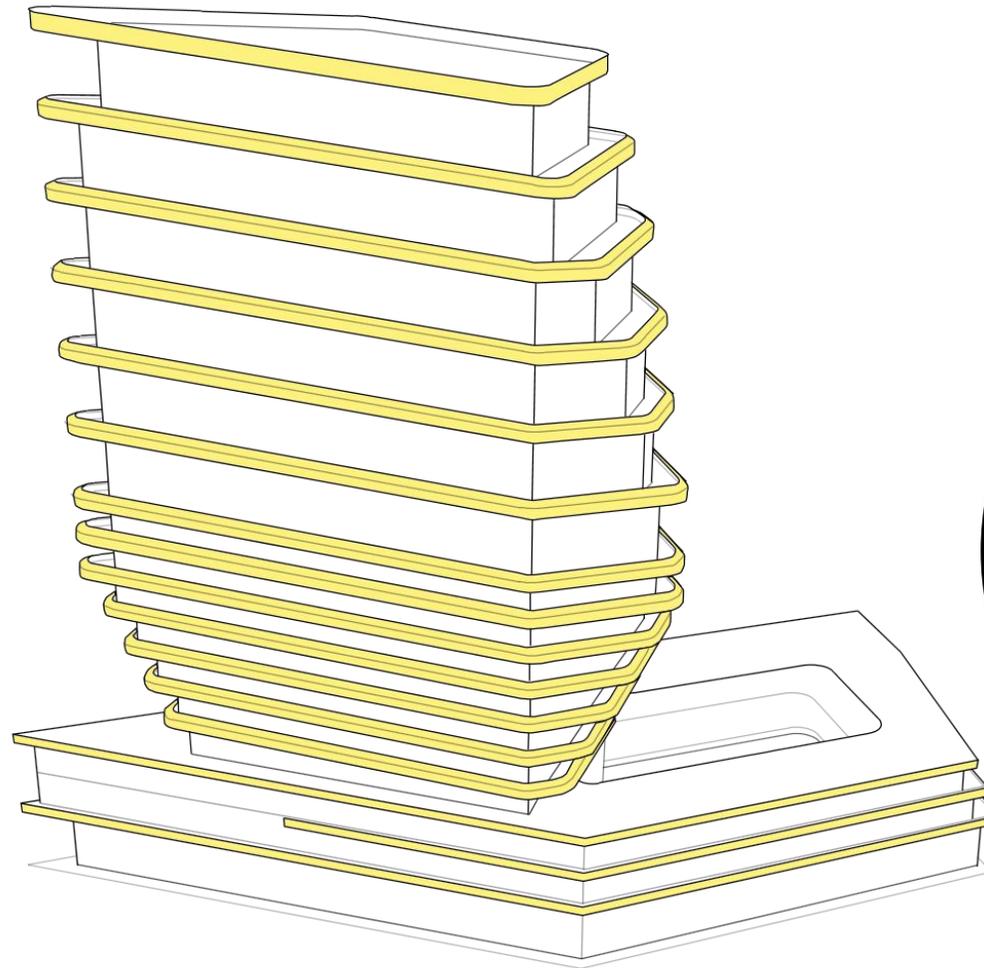
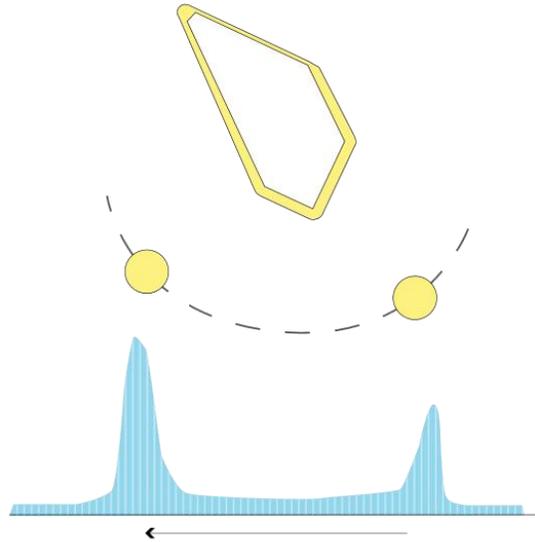
Optimal wind conditions at Ground floor level

Setback as windblock



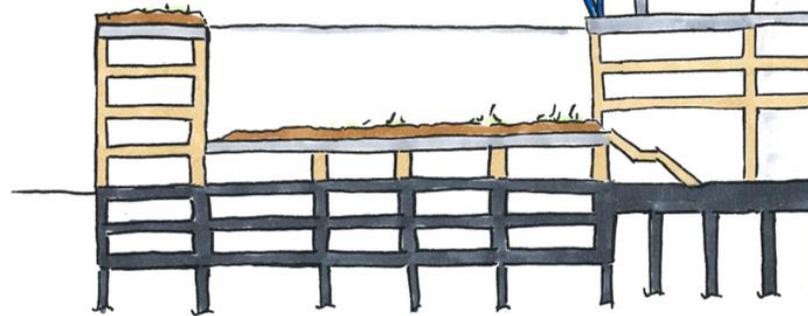
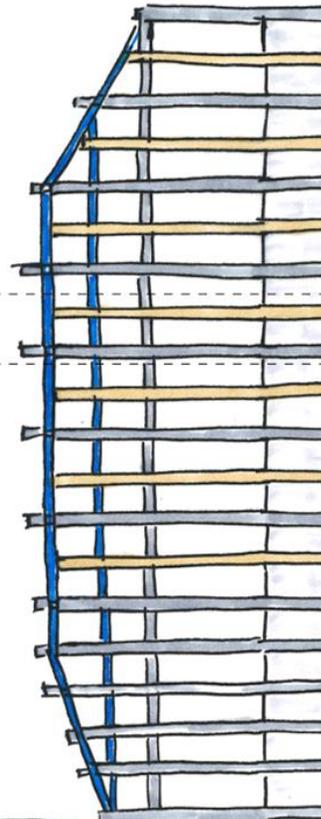
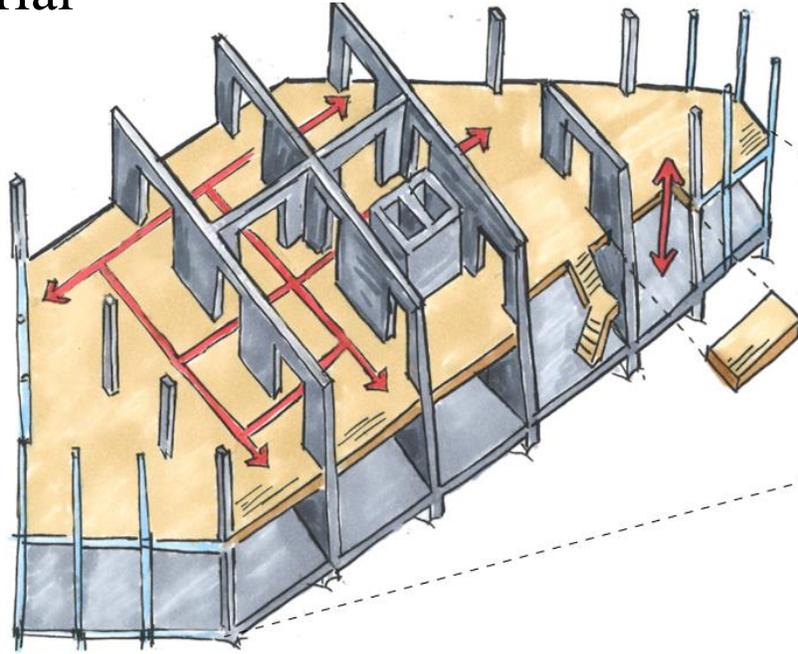
Cutback Relief wind at ground floor conditions

Energie



Optimal energy performance at the right time of day

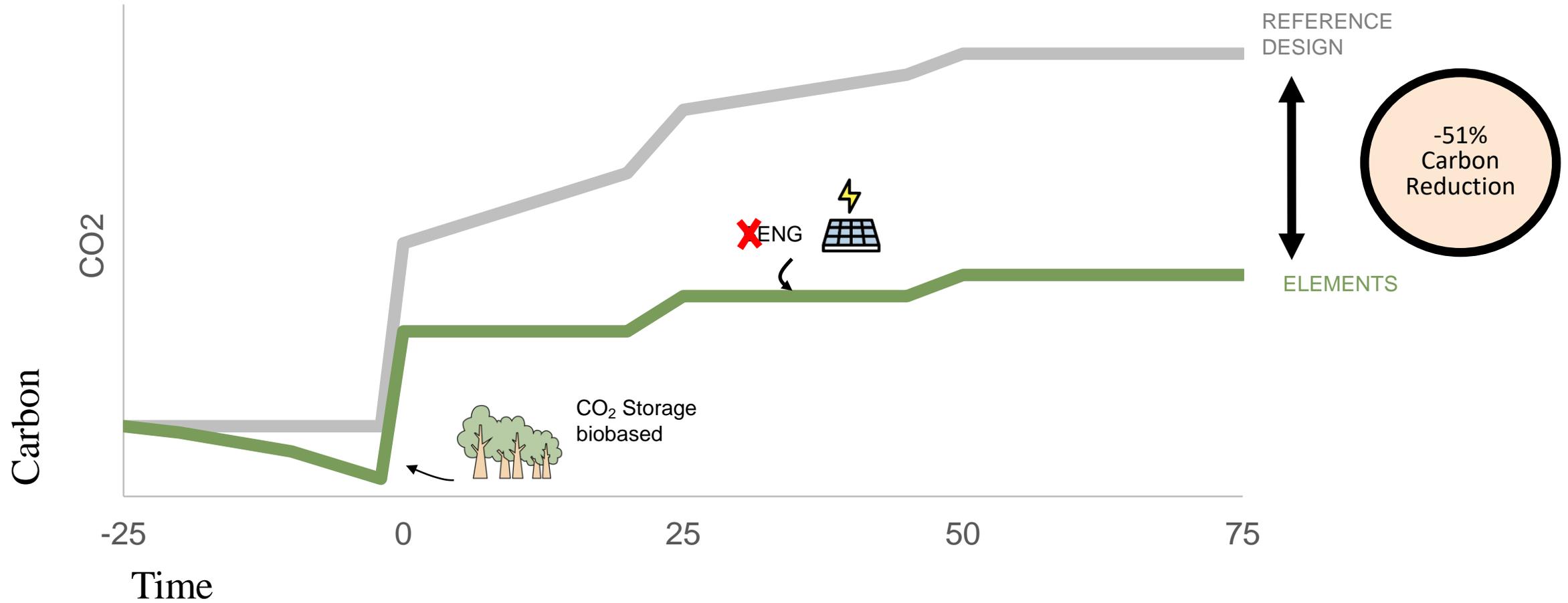
# Material



50% Carbon reduction by smart use of Timber



# Embodied and Operational Carbon performance





# Time for a new paradigm

Reframing Violet Le Duc and Louis Sullivan

*A sustainable structure may not necessarily be functional,  
but no building can be functional that does not have a  
sustainably designed structure.*

#Form follows sustainability

# Conclusion

## Whats in a name

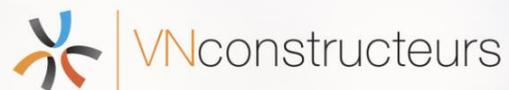
*Wikipedia:*

Een **constructeur** is een bouwmeester (projectleider of architect) en is de eindverantwoordelijke voor het productieproces van constructies (bruggen en huizen).

Voorstel:

Een constructeur is de verantwoordelijke professional voor het ontwerp, uitvoering en demontage van duurzame draagconstructies van gebouwen en civiele werken.

ARUP



powered by



# Dag van de constructeur

Mede mogelijk gemaakt door:

