

Algorithm-Aided Design Explorations in Wood

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Geometria Architecture Ltd

Forum Wood Building Nordic 2019
26.9.2019

Geometria Architecture Ltd

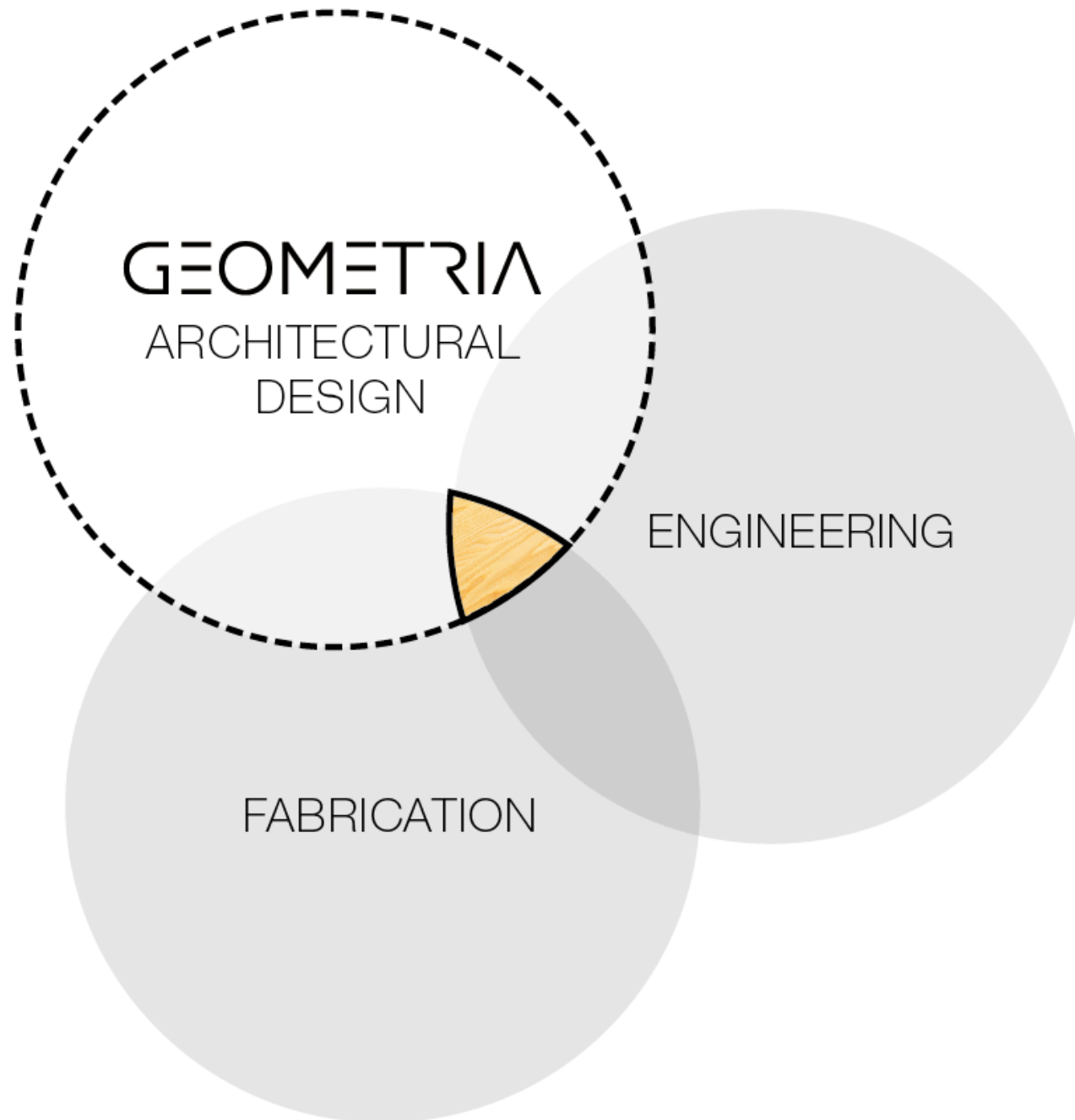
GEOMETRIA is a Finnish architectural design office and a consultancy partner dedicated to solving complexity in the field of construction industry.



ARCHITECTURAL
DESIGN



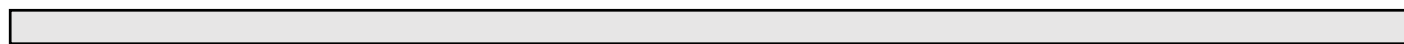
DESIGN
CONSULTING



Where & how algorithms can be utilised?



PROJECT PLANNING



DESIGN



FABRICATION



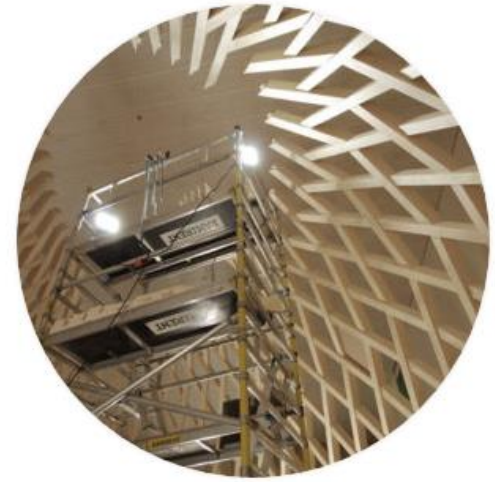
DIGITAL DESIGN

- Design space exploration
- Parametric design tools
- Data-driven design



DIGITAL PLANNING

- Automated precision modeling
- Adaptive parametric systems
- Optimisation
- Simulation



DIGITAL FABRICATION

- Automated fabrication modeling
- Data export ("file-to-factory")

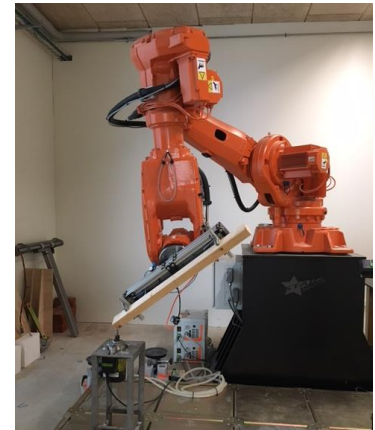




PROJECT PLANNING

DESIGN

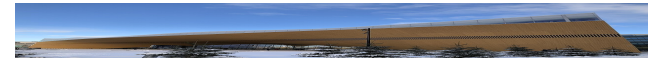
FABRICATION



PROJECT PLANNING

DESIGN

FABRICATION

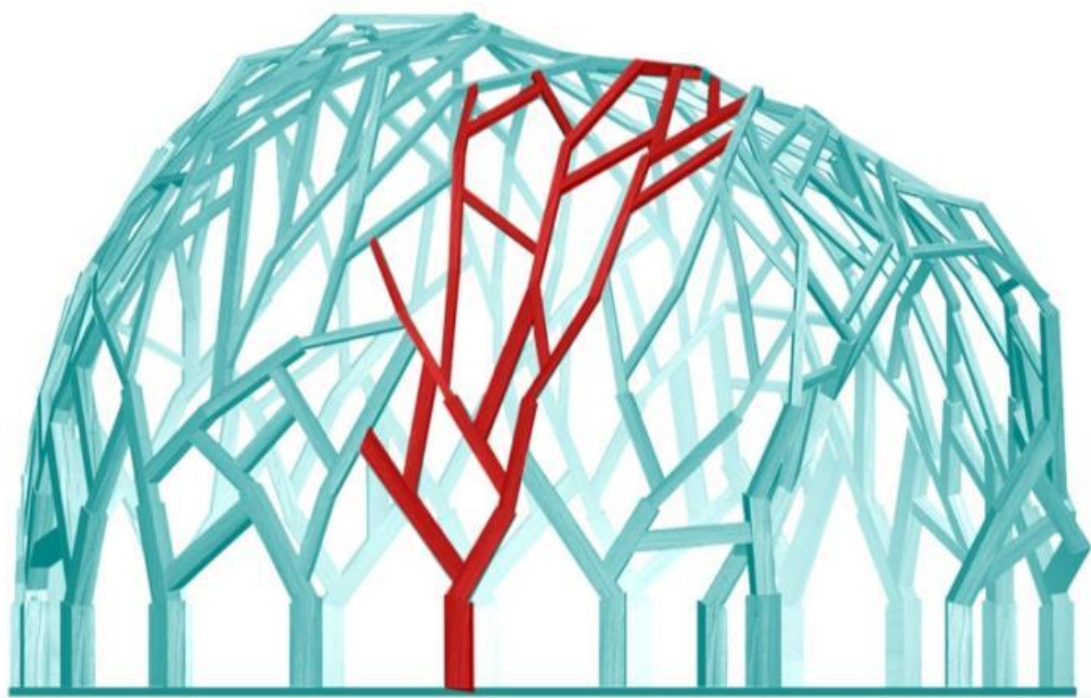


PROJECT PLANNING

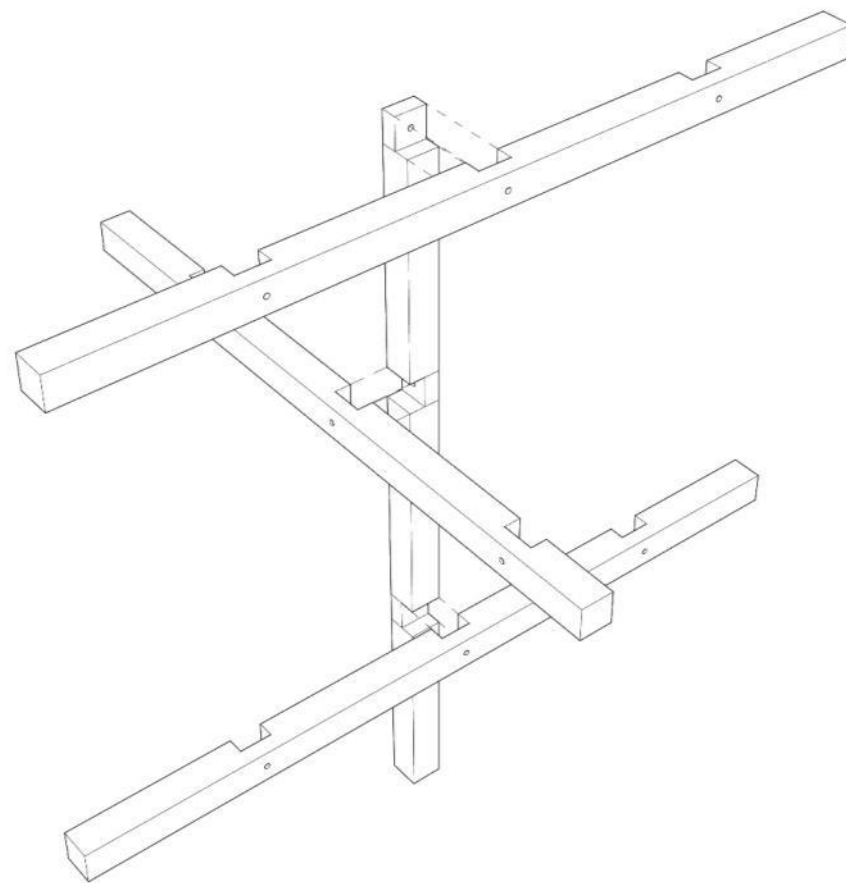
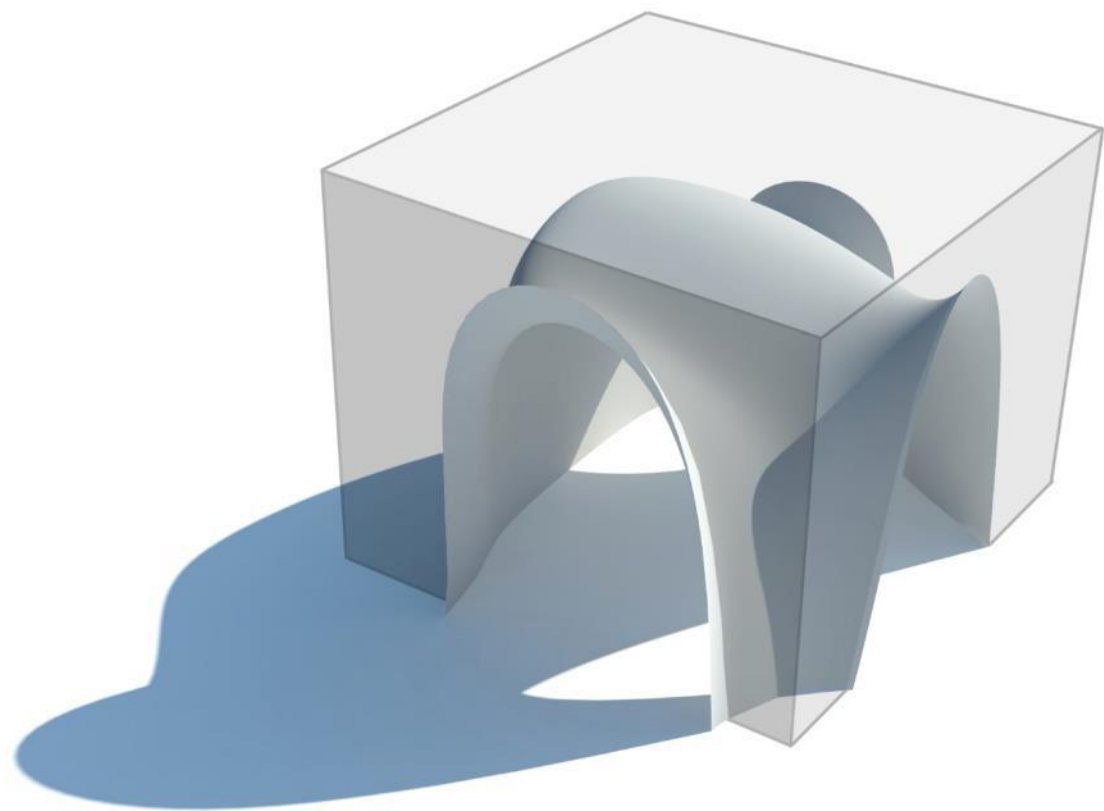
DESIGN

FABRICATION





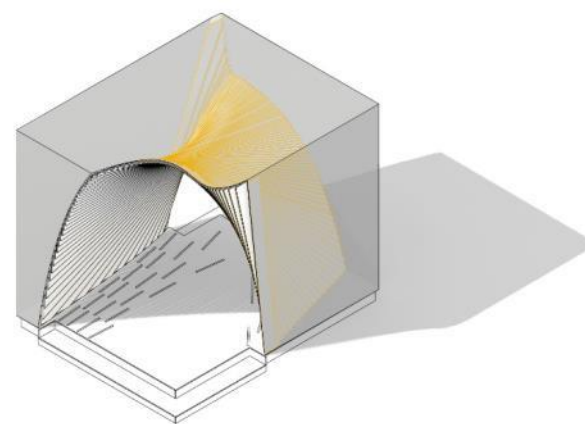
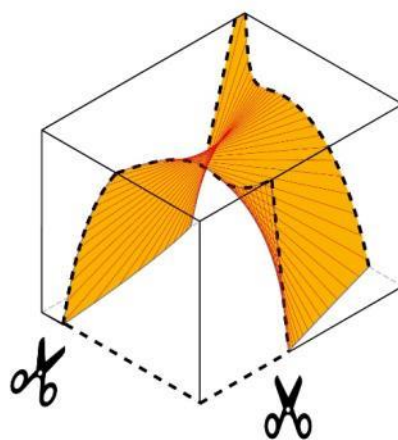
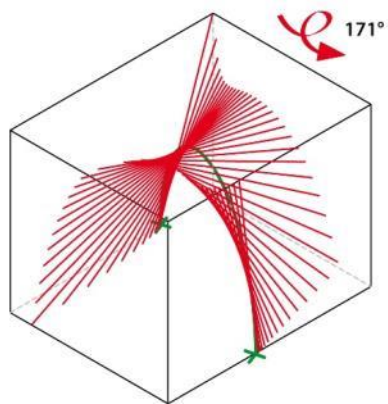
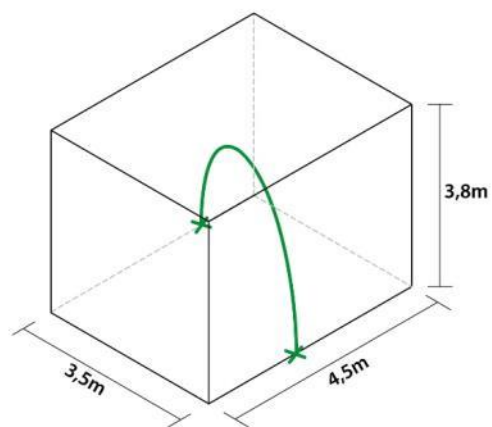






GEOMETRIA







HÄMEEN-
KATU
ELÄÄ!





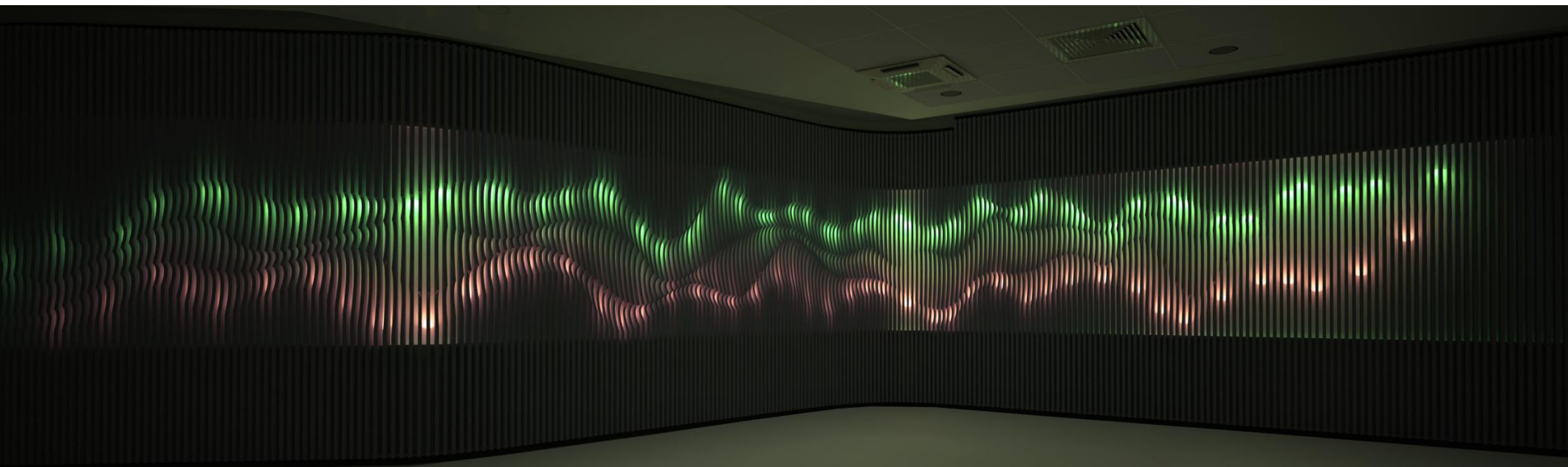
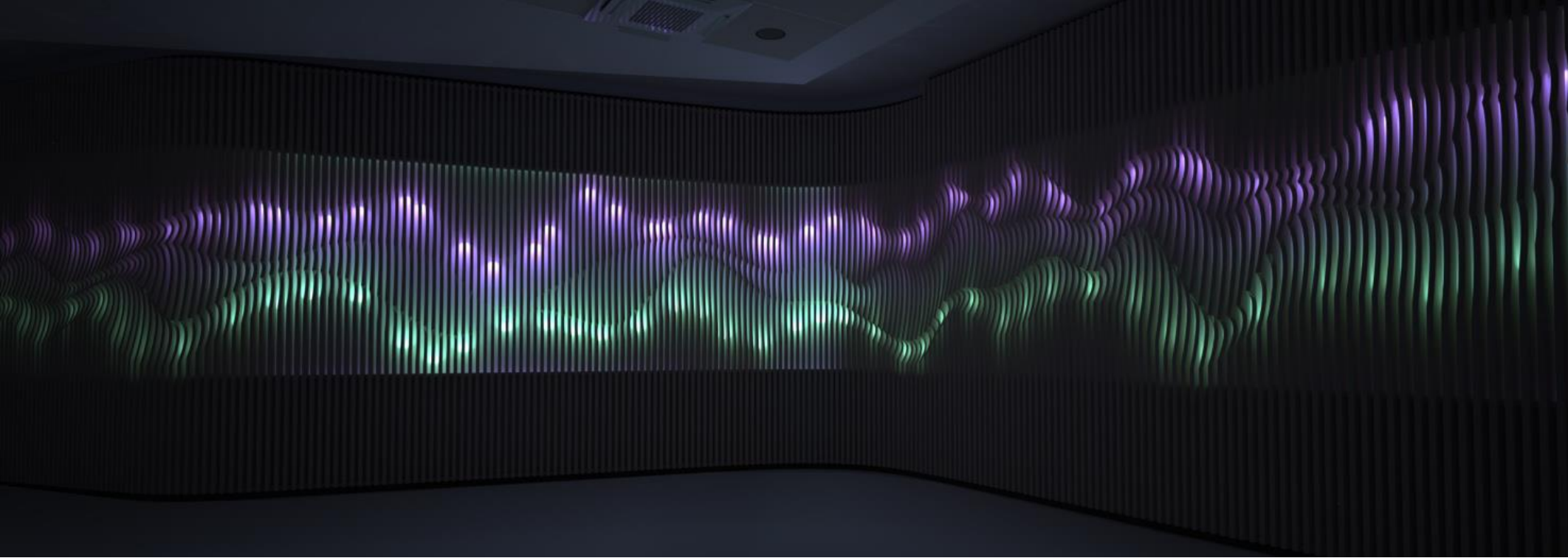


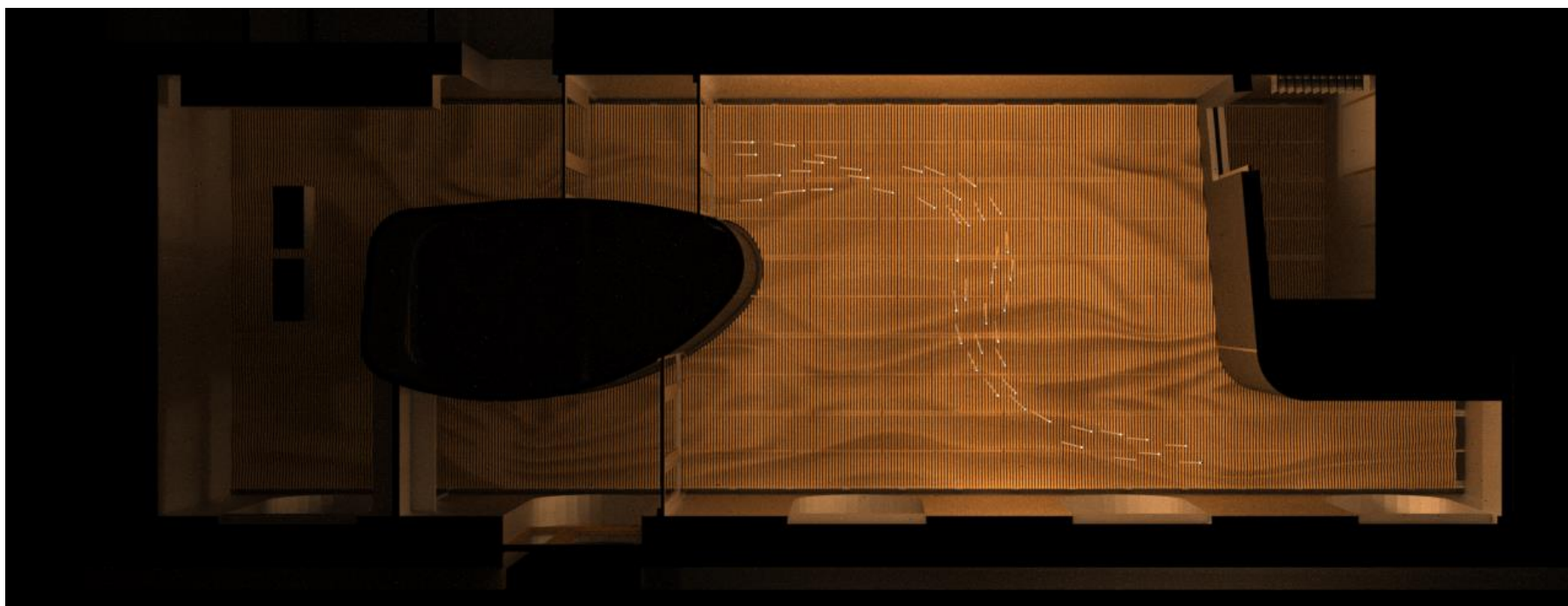
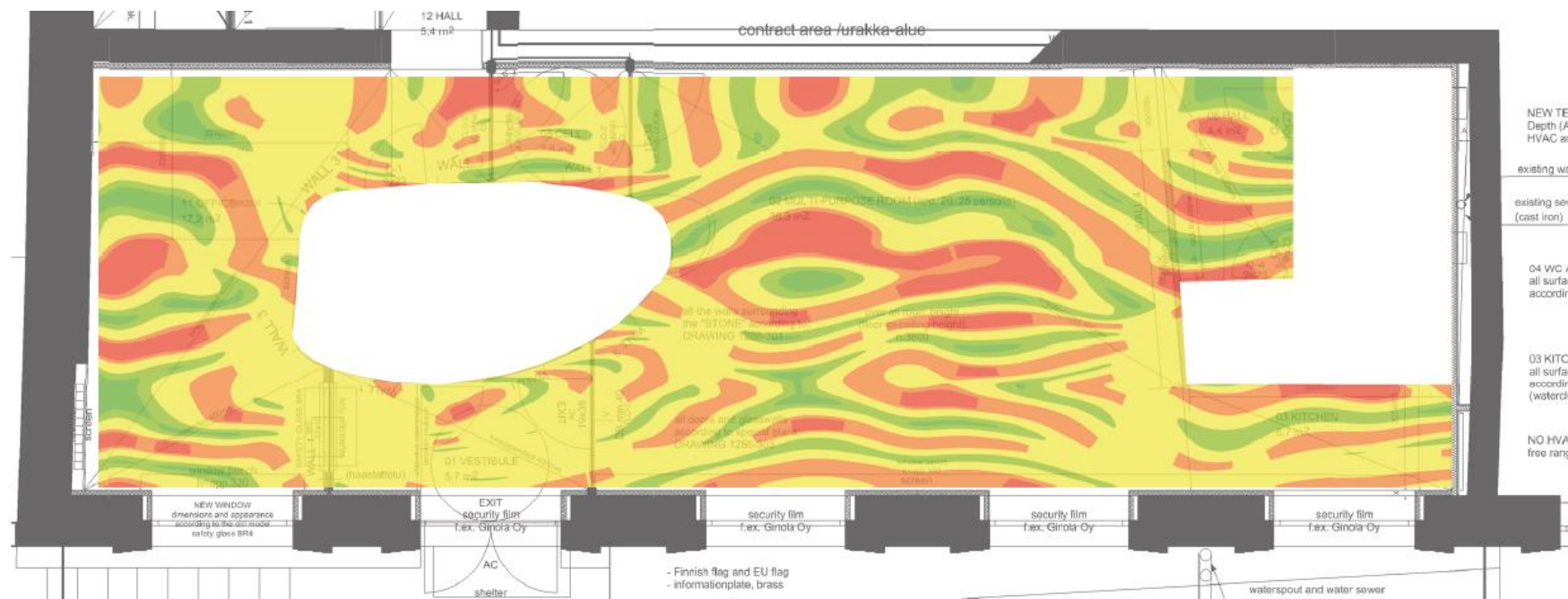
GEOMETRIA







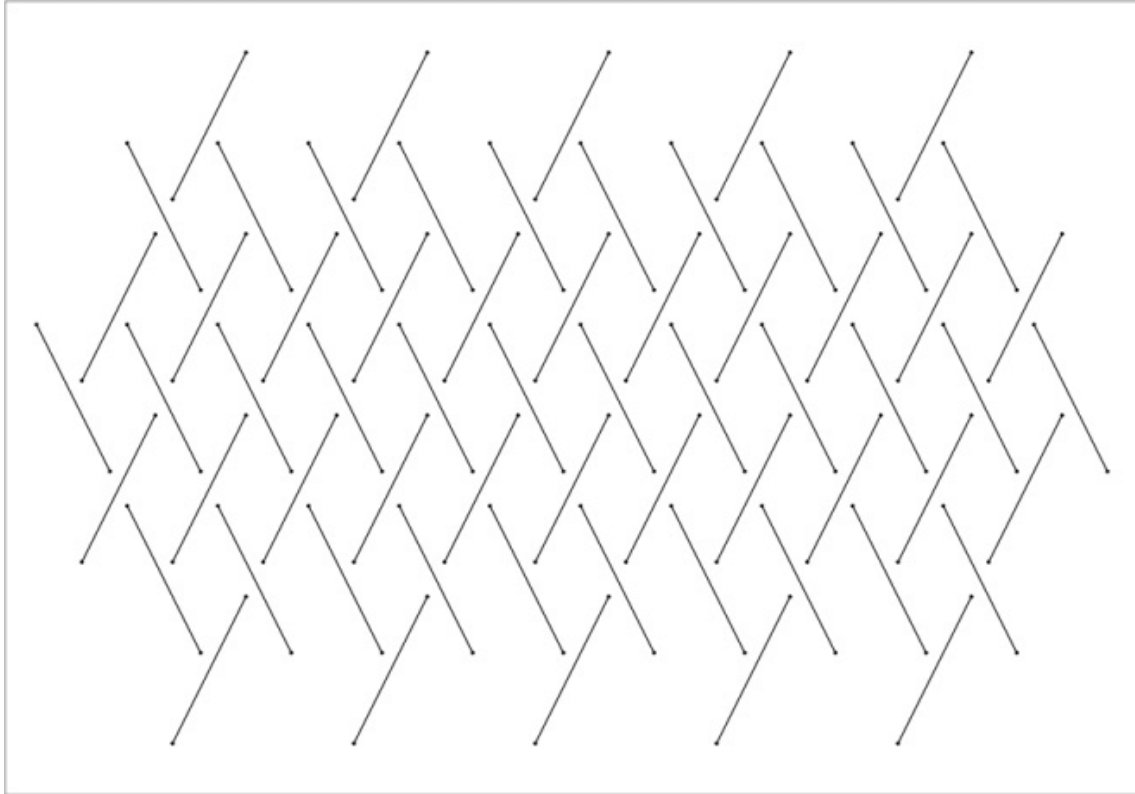






GEOMETRIA



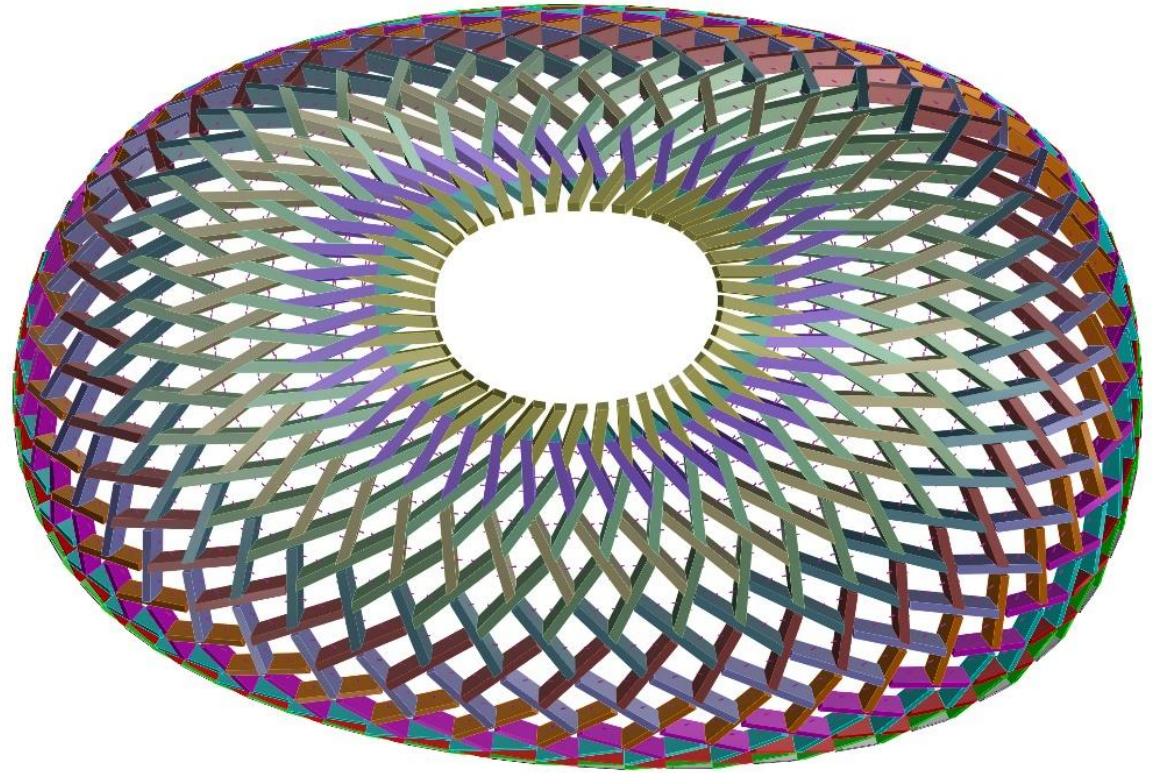
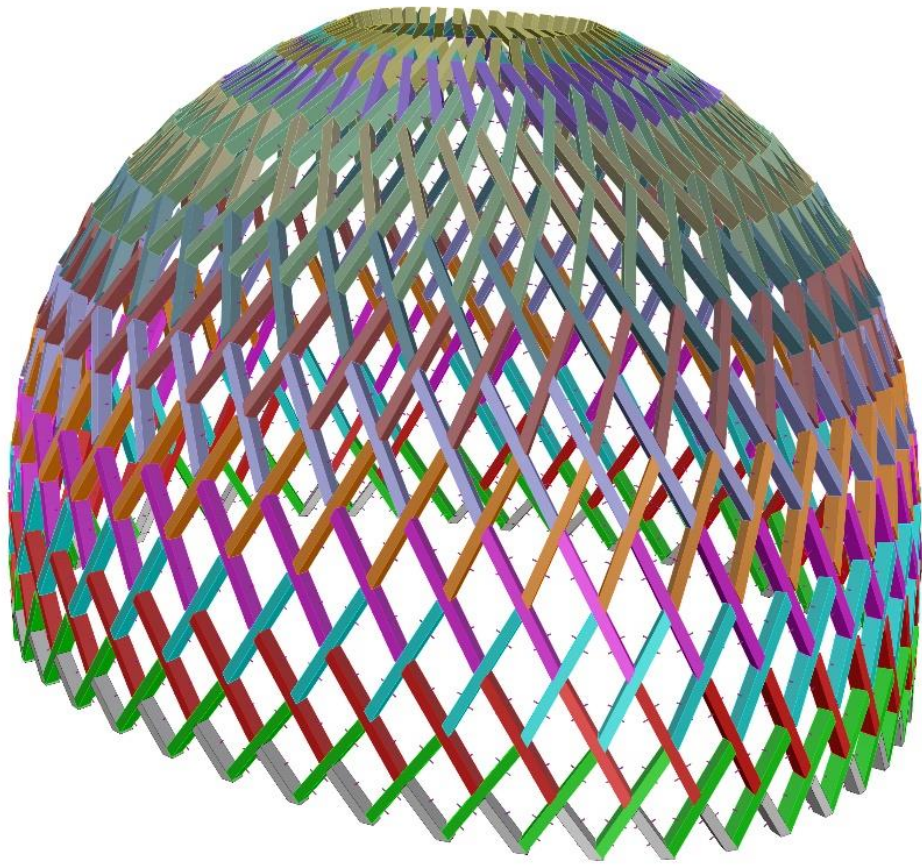


sotkanmuna











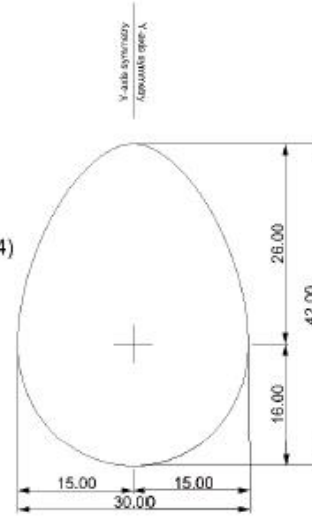




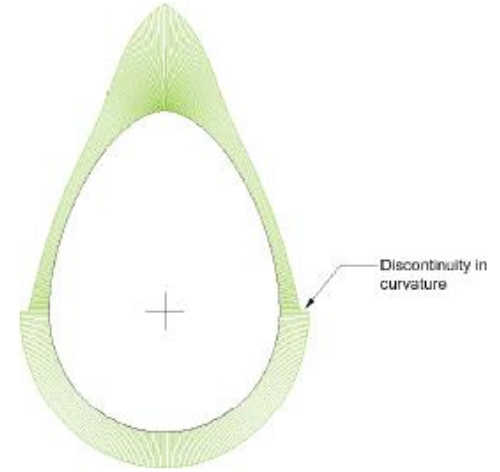


UPPER PART:
hyperbola
(conic;
tan, tan, rho=0.34)

LOWER PART:
half ellipse
(15,16)

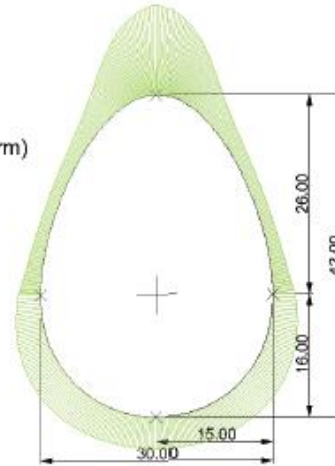


2. SHAPE GENERATION



3. SECTION
CURVATURE GRAPH

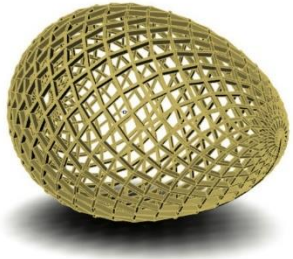
REDRAW
interpolated curve
(deg=3, knots=uniform)



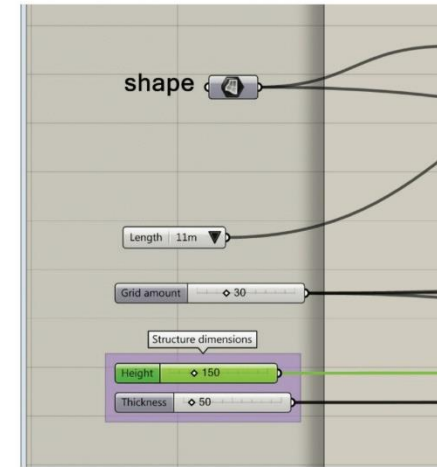
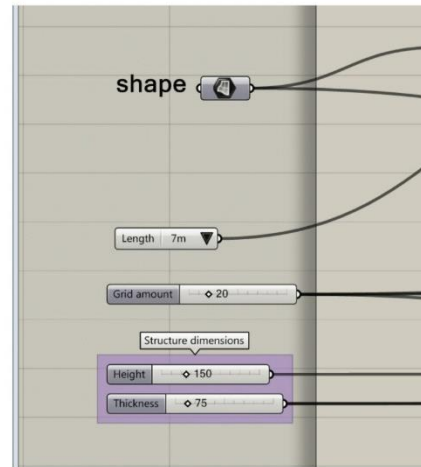
4. SECTION
CURVATURE GRAPH



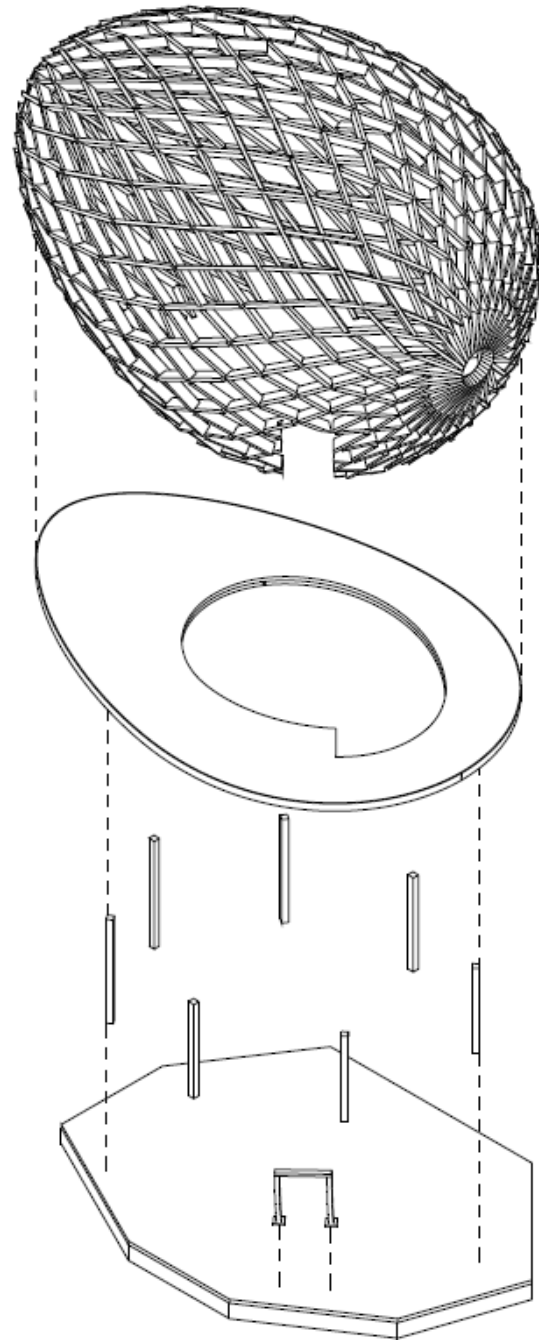
5. REVOLVED 3D-SHAPE



3D representation of the shape and the structure.
Contains necessary information for structural analysis
and fabrication.



Parameters can be adjusted in order to find a perfect balance between structural efficiency, visual aesthetics and cost efficiency.



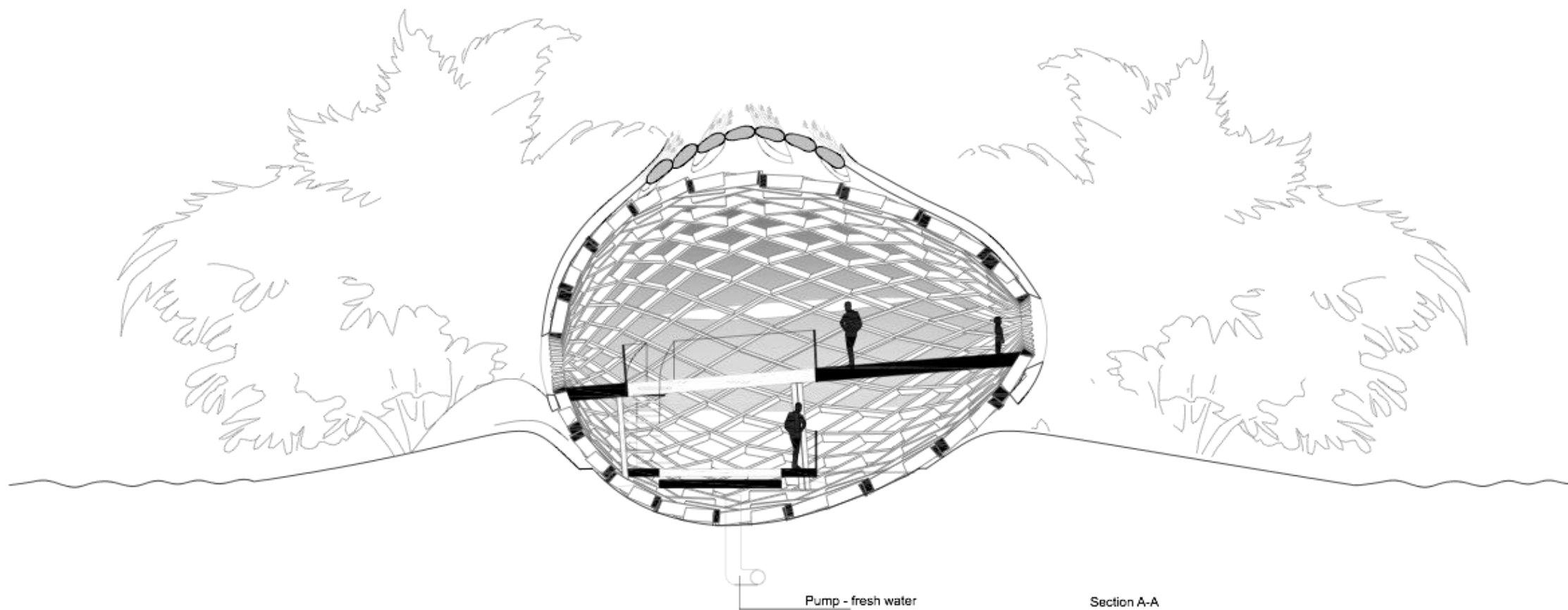
Zollinger timber structure

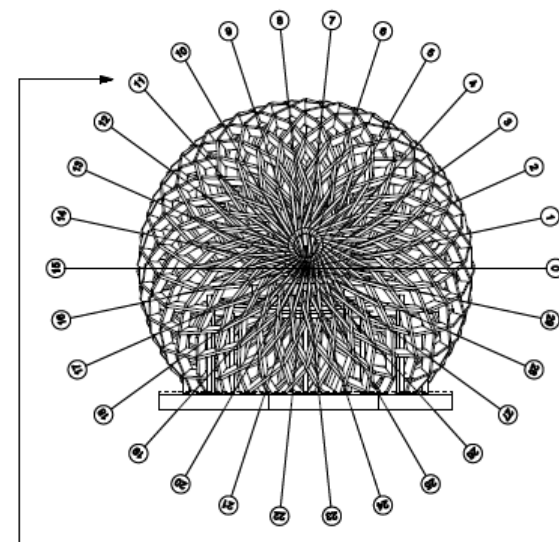
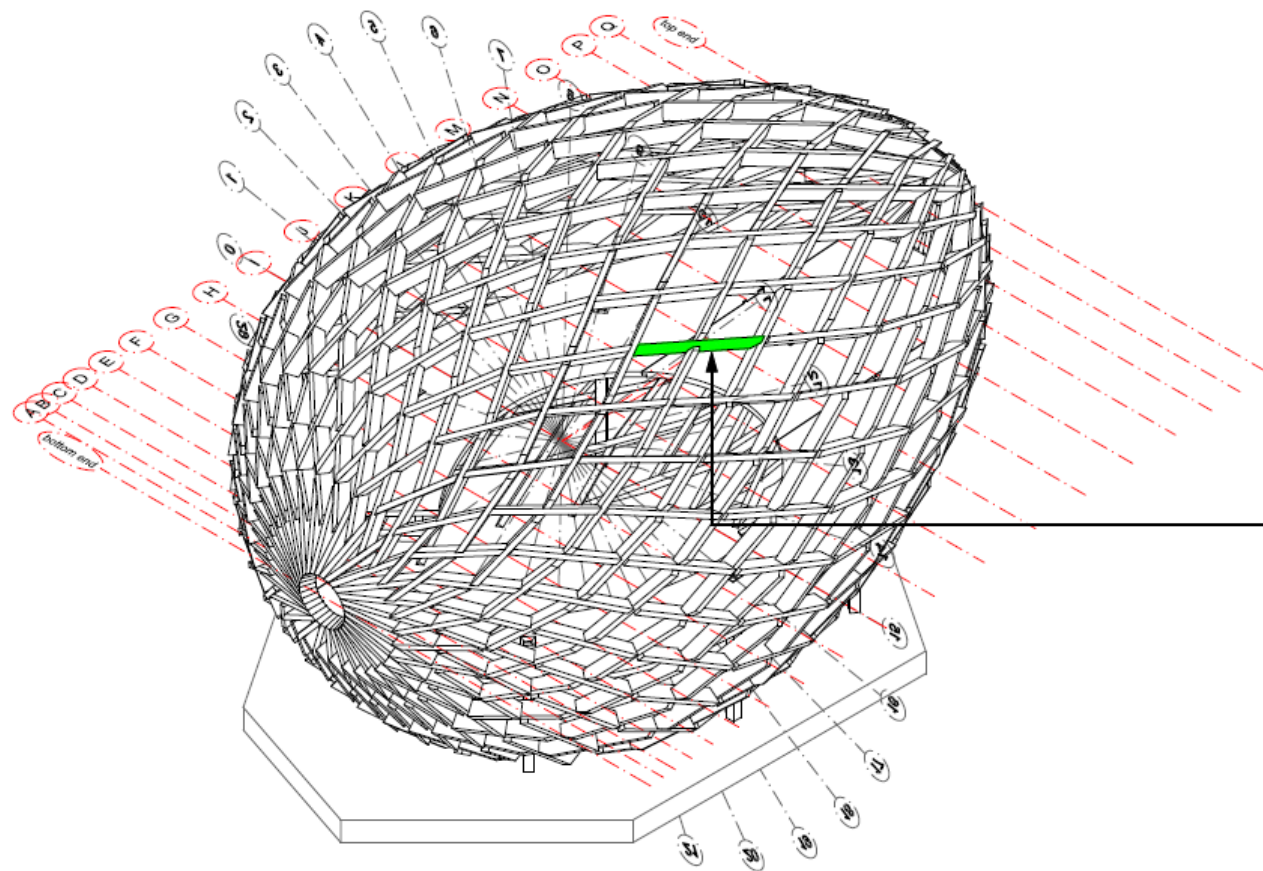
Platform
CLT-Concrete composite

Timber columns

Steel door frame

Foundation



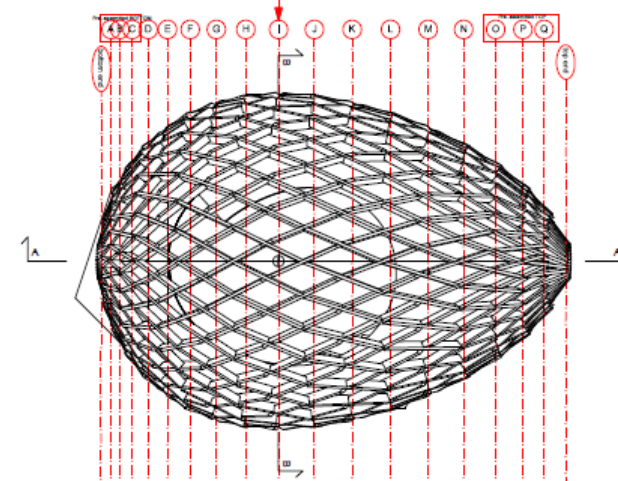


Longitudinal
module

Polar
module

Material
definition

I	11	_	PINE
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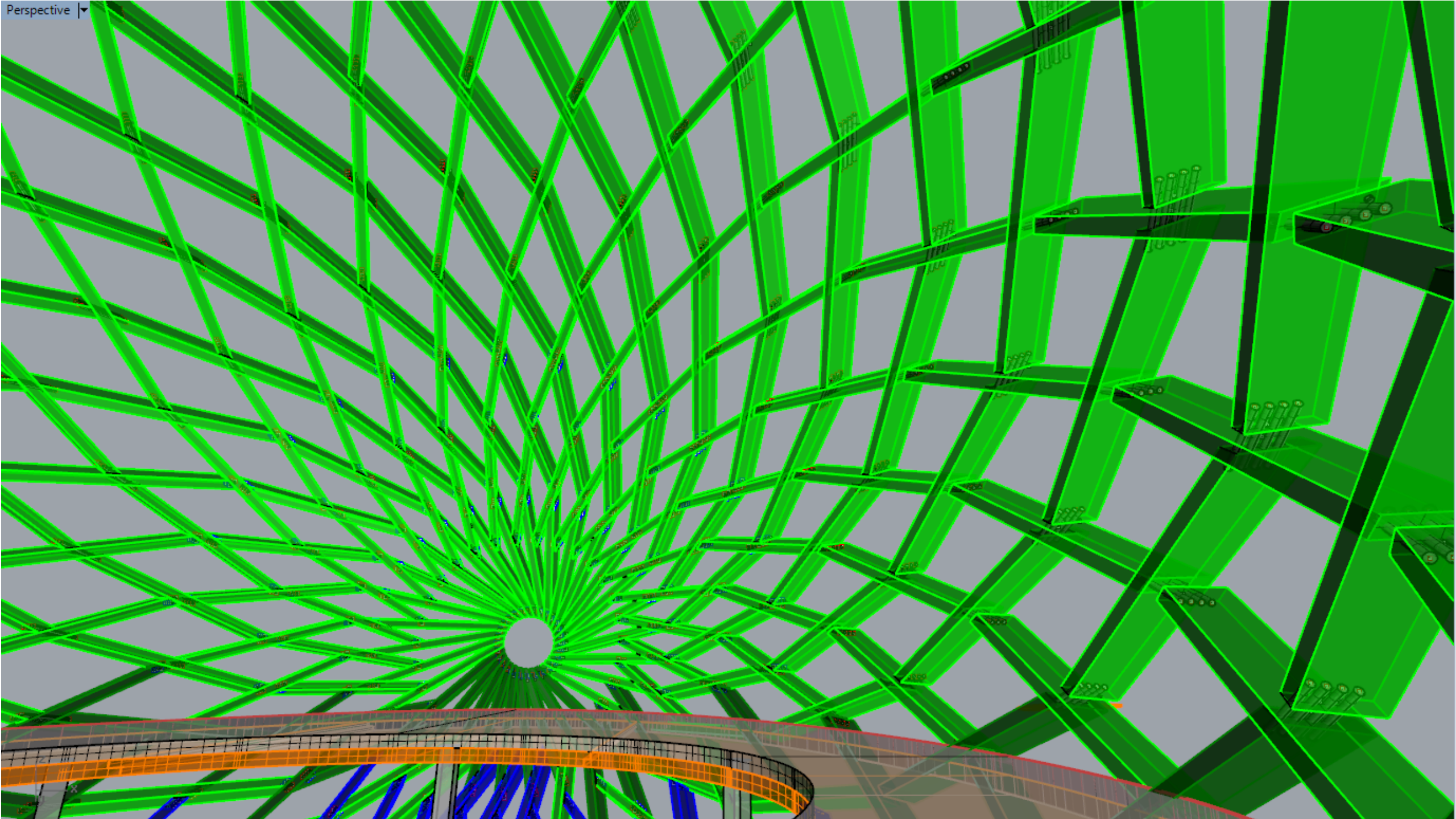


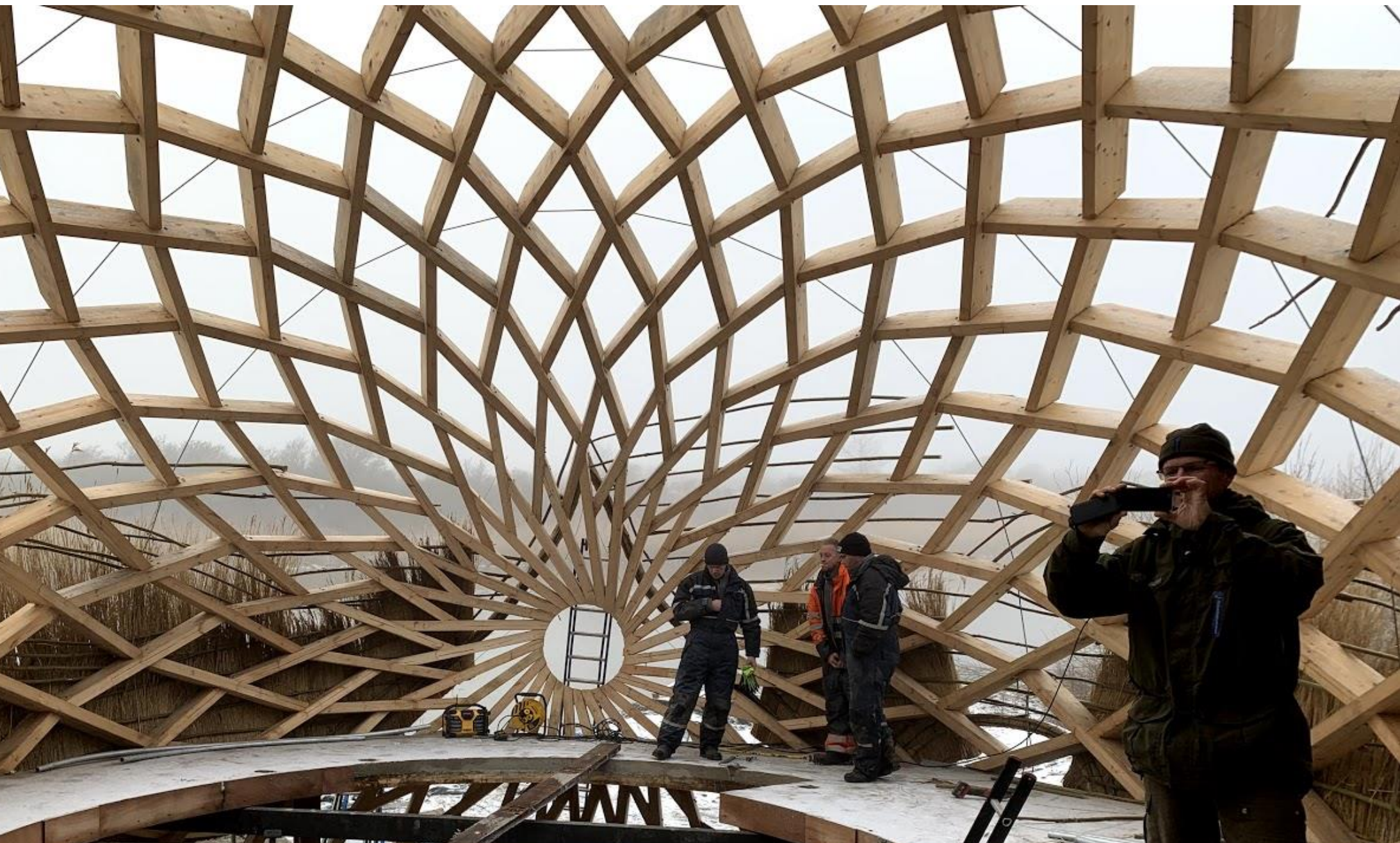
TOYOTA

HAWKER
perfect Hx









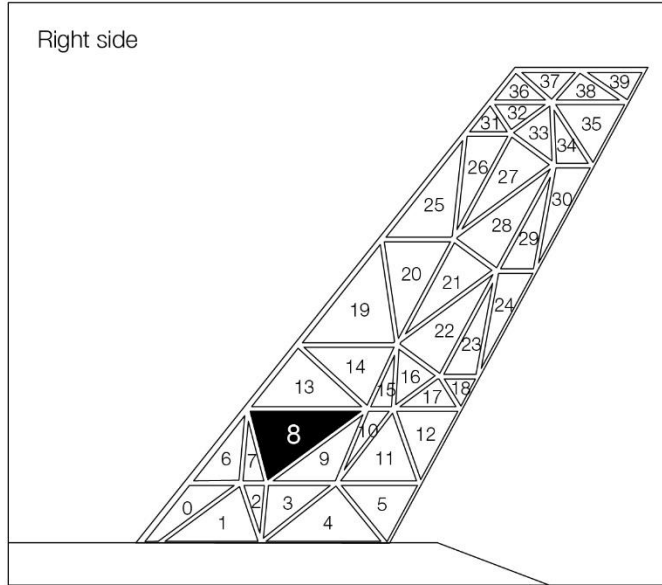












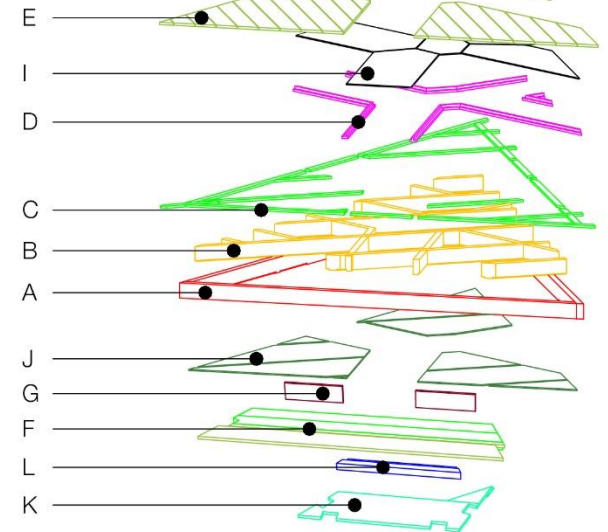
PART CODING CONVENTION

Facade element	Facade side	Unique element number	Layer code	Unique member index
F	R	8	A	1

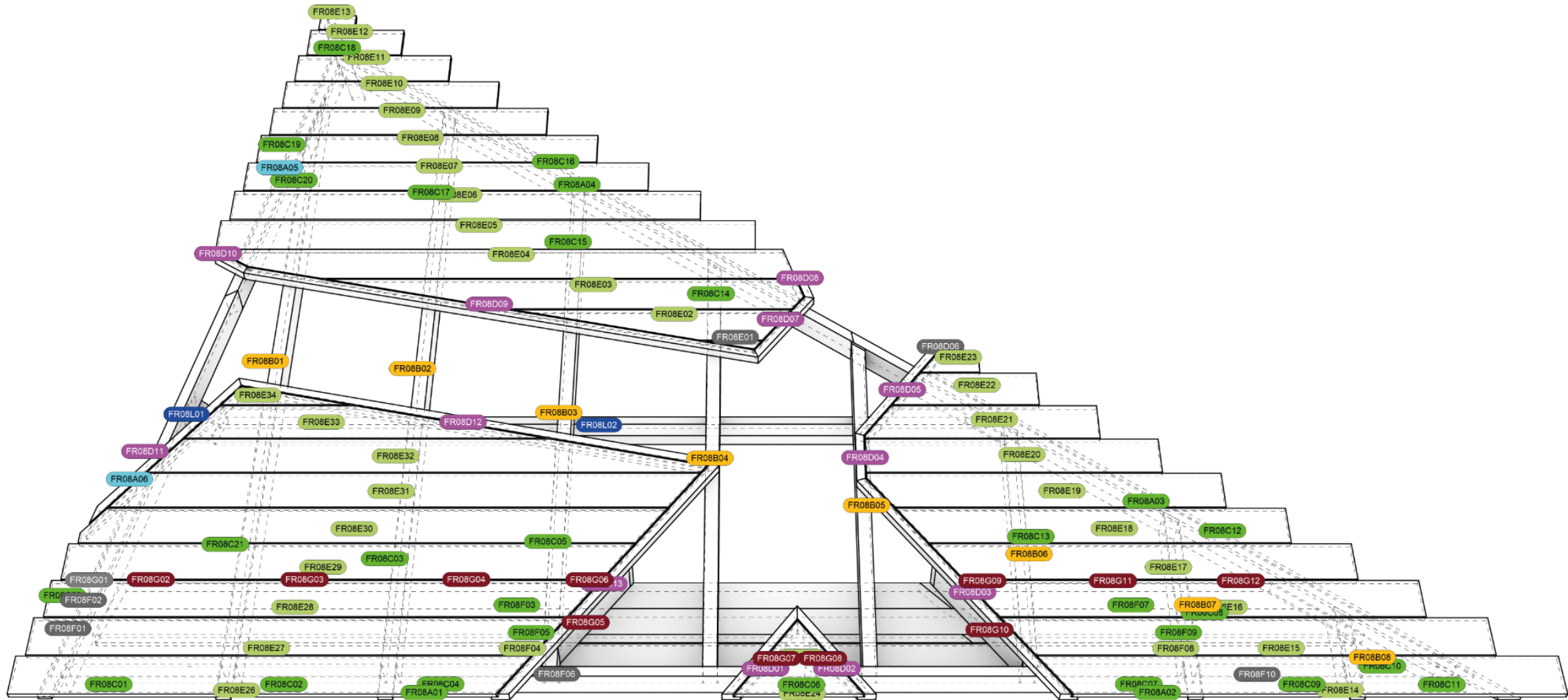
R = Right side
L = Left side

A = Main frame
B = Sub frame
C = Sub frame slats
D = Voronoi frame
E = Facade cladding
F = Stairbeam
G = Stairbeam cover
I = Glass
J = Multiplex cladding
K = Platform fixation
L = Railing

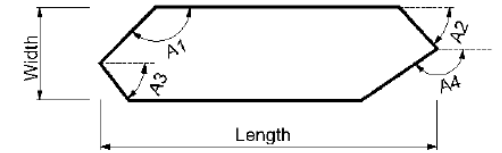
Element layers



categorical coding of every piece



fabrication data extraction of every piece



C - Sub frame slats

Layer	Code	Width	Height	Length	A1	A2	A3	A4
C	FR01C01	40	22	2147	-	-	90	144
C	FR01C02	65	22	384	126	-	-	90
C	FR01C03	40	22	855	-	90	90	-
C	FR01C04	65	22	304	-	-	62	90
C	FR01C05	40	22	2423	-	90	62	-
C	FR01C06	65	22	728	-	-	62	90
C	FR01C07	65	22	1166	118	-	-	115
C	FR01C08	65	22	1162	115	28	-	-
C	FR01C09	65	22	800	-	41	28	-
C	FR01C10	65	22	750	139	-	41	90
C	FR01C11	65	22	1383	139	-	-	126
C	FR01C12	65	22	1345	-	62	54	-
C	FR01C13	65	22	977	126	-	-	126
C	FR01C14	65	22	808	-	72	72	-
C	FR01C15	65	22	843	-	-	54	90
C	FR01C16	65	22	1658	-	36	72	-
C	FR01C17	65	22	246	-	-	54	90

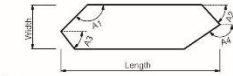
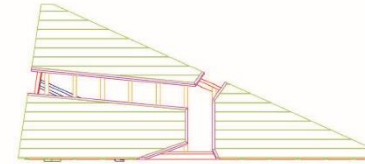
fabrication data directly for the cutting machine

[illegible]

Uitkijk toren "Fort de Roovere"
Ro&Ad Architects

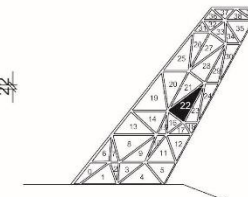
Facade assembly plans, Right side
Date / Phase: 03.07.2017 / Phase 2
Revision: C - 16.08.2017
Page no: 113

Front view



D - Voronoi cladding

Layer	Code	Width	Height	Length	A1	A2	A3	A4
D	FR22D01	65	48	946		57	24	
D	FR22D02	65	48	209	101	-	-	111
D	FR22D03	65	48	757	123	48	-	-
D	FR22D04	65	48	1092	105	79	-	-
D	FR22D05	65	48	446	90	75	-	-
D	FR22D06	65	48	308	124			90
D	FR22D07	65	48	2843	90	56		
D	FR22D08	65	48	2780	132	-	-	90



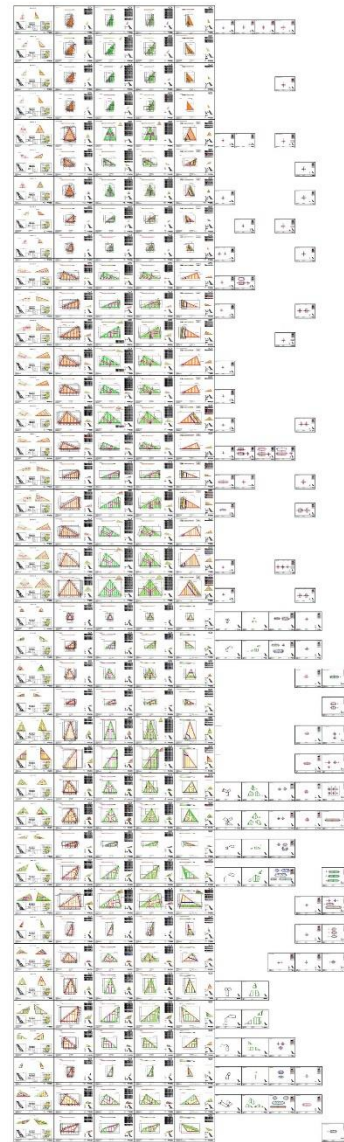
Layer: C - Sub frame slats
D - Voronoi frame
Scale: 1:30

GEOMETRIA
architecture & geometry

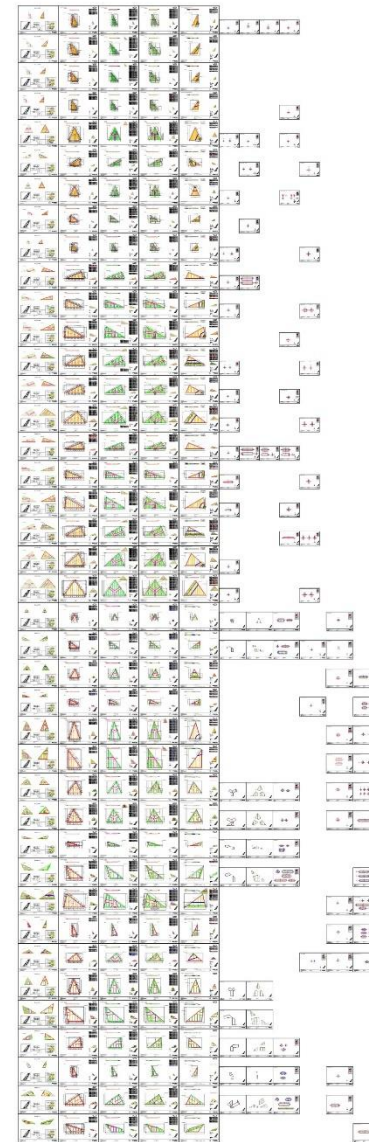
Ceiling elements



Facade elements
Left side



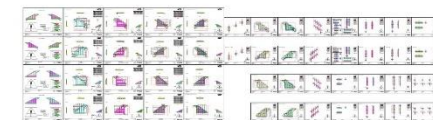
Facade elements
Right side



Facade-edge elements



Wall elements

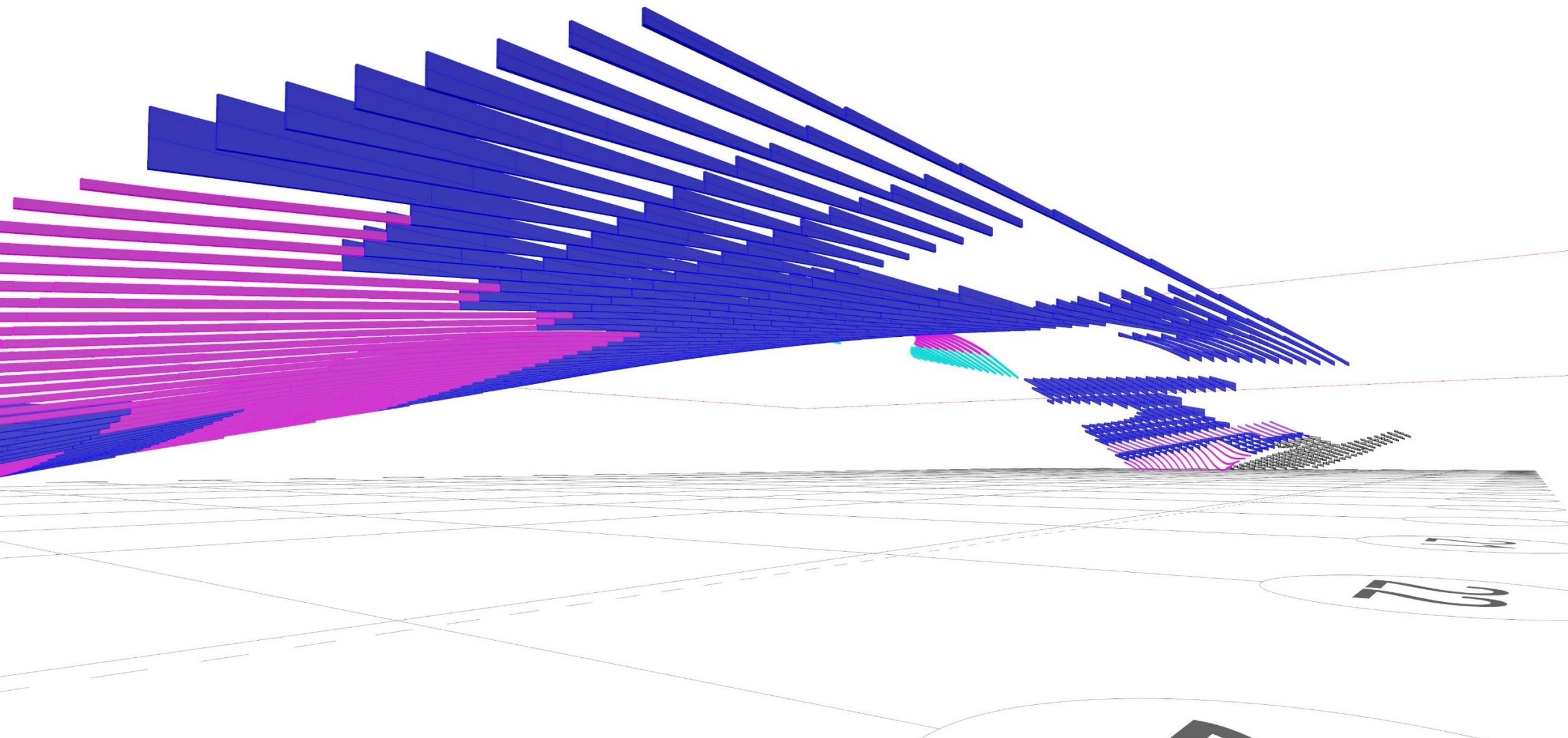


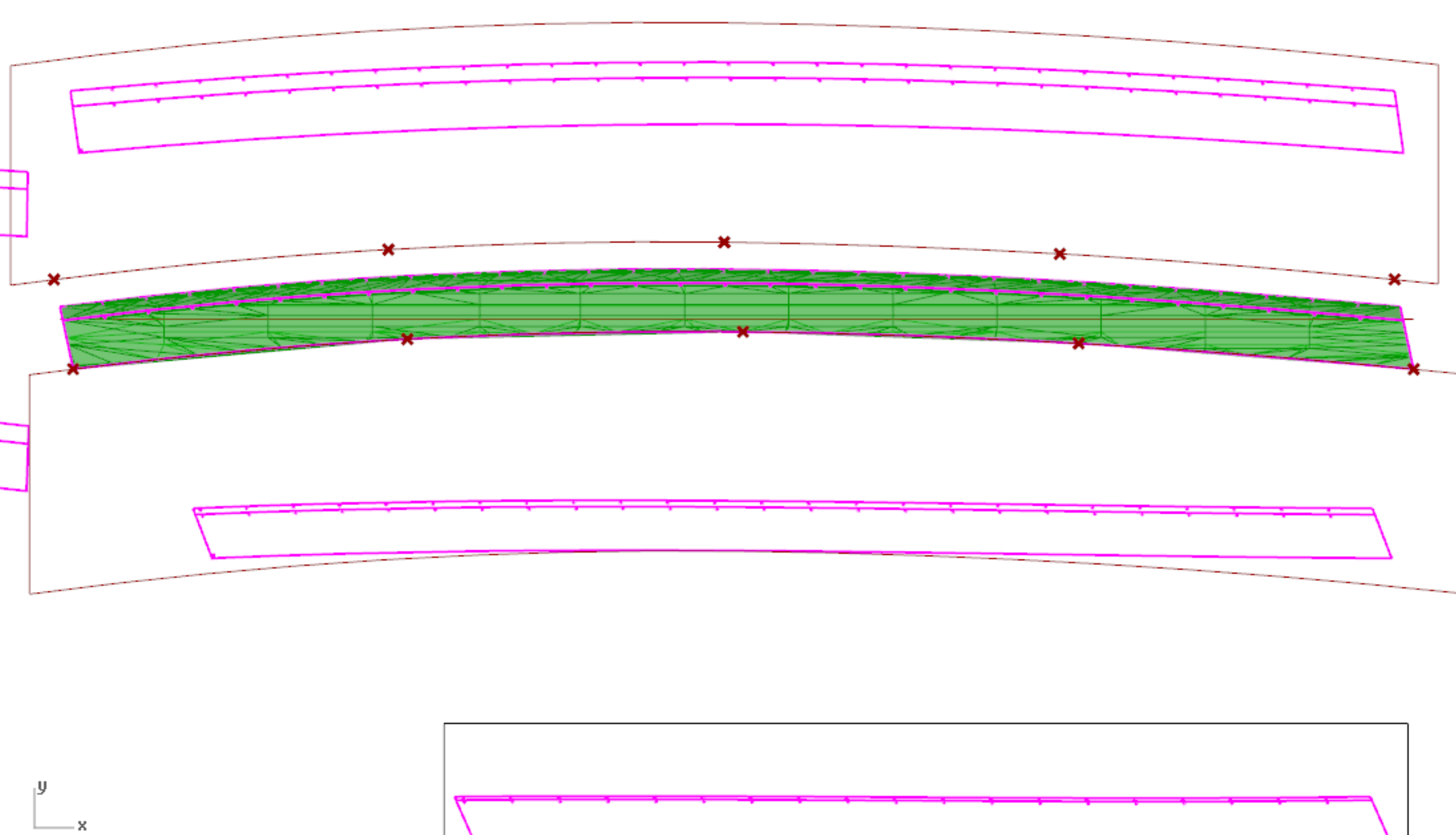










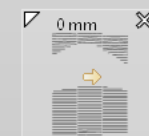


Search

MODEL TREE	
▼ ML15-17_kaarevat	
▼ Building.b.1	
▼ Beam	
Beam.b.1	
Beam.b.2	
Beam.b.3	
Beam.b.4	
Beam.b.5	
Beam.b.6	
Beam.b.7	
Beam.b.8	
Beam.b.9	
Beam.b.10	
Beam.b.11	
Beam.b.12	
Beam.b.13	
Beam.b.14	
Beam.b.15	
Beam.b.16	
Beam.b.17	

3D

INFO	
Beam.b.8	
Identification	Location
Quantities	Material
Profile	Relations
Classification	Hyperlinks
Tekla Common	
Property	Value
Model	ML15-17_kaarevat
Discipline	Architectural
Name	M17-41-K
Type	63.0*159.248098
Type Name	63.0*159.248098
Description	
Material	UNKNOWN MATERIAL
Layer	
System	
Profile Type	Rectangular
Geometry	Solid





Hundegger

DERRICK

PowerPressLab
PBA





Thank you!

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toni.osterlund@geometria.fi

www.geometria.fi

