

Algorithm-Aided Design Explorations in Wood

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Geometria Architecture Ltd

Forum Wood Building Nordic 2019
26.9.2019

Geometria Architecture Ltd

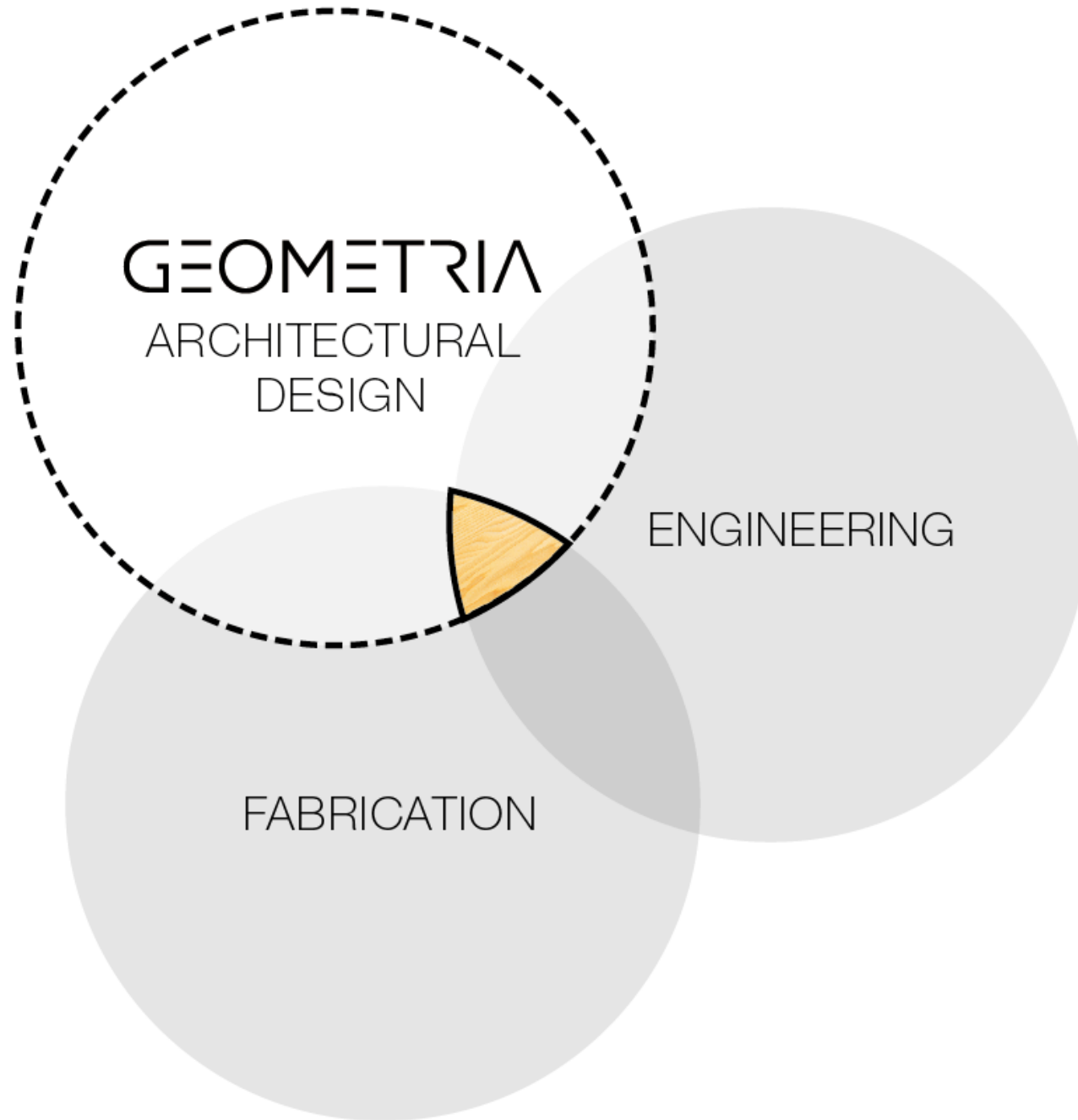
GEOMETRIA is a Finnish architectural design office and a consultancy partner dedicated to solving complexity in the field of construction industry.



ARCHITECTURAL
DESIGN



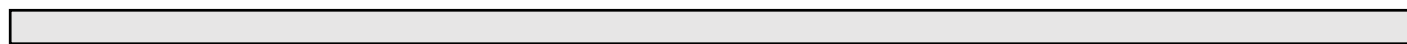
DESIGN
CONSULTING



Where & how algorithms can be utilised?



PROJECT PLANNING



DESIGN



FABRICATION



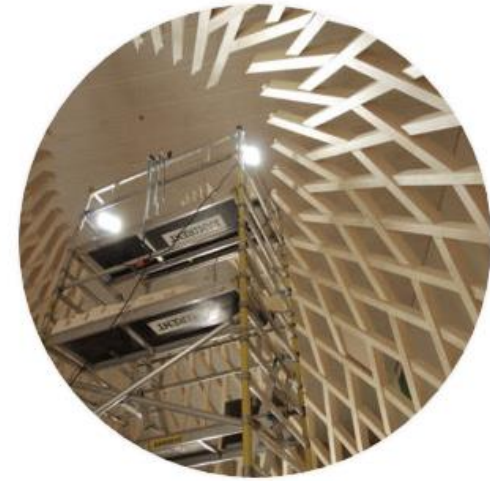
DIGITAL DESIGN

- 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

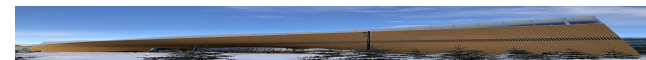
FABRICATION



PROJECT PLANNING

DESIGN

FABRICATION



PROJECT PLANNING

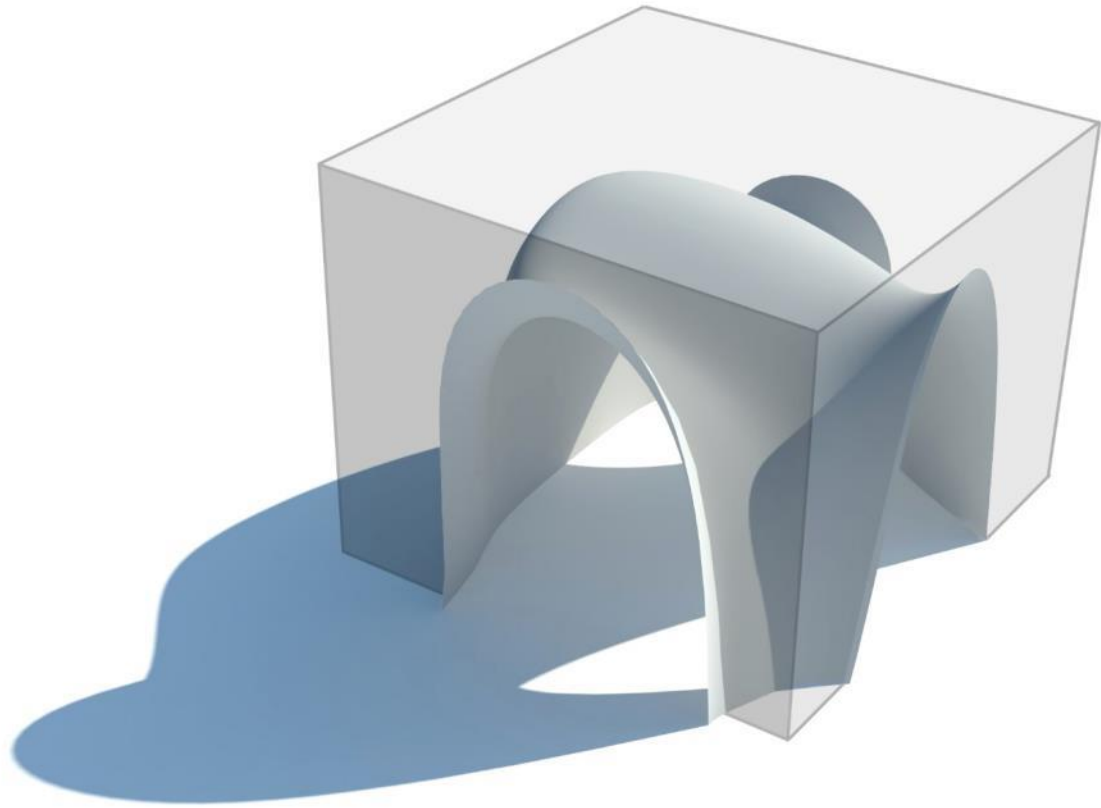
DESIGN

FABRICATION

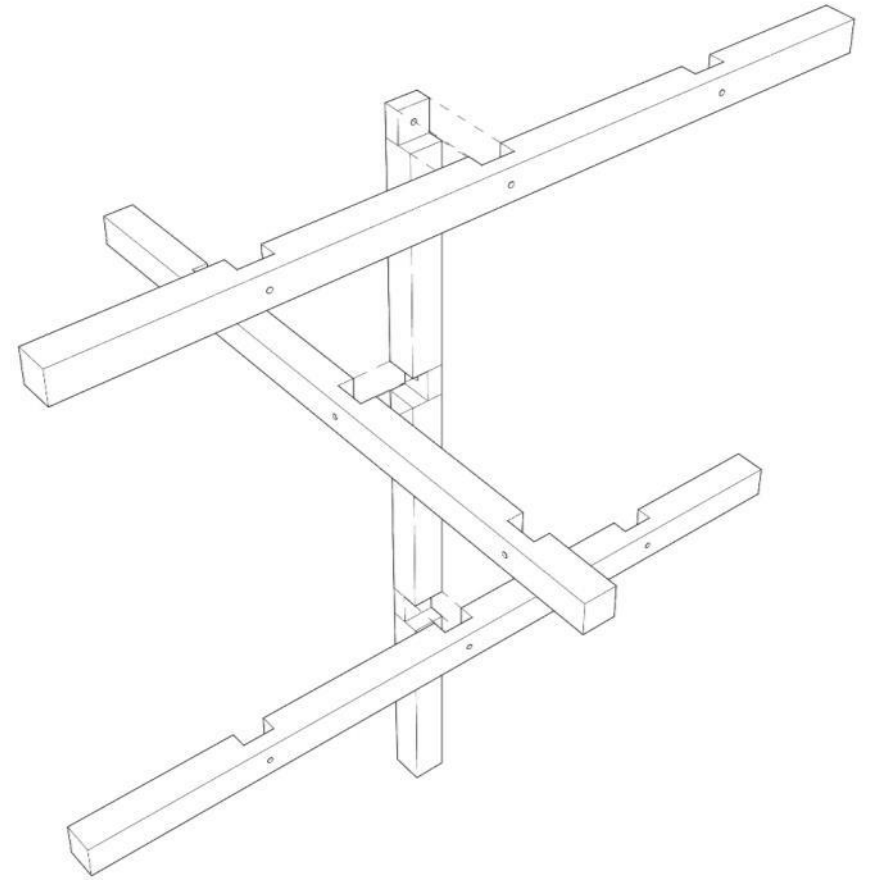








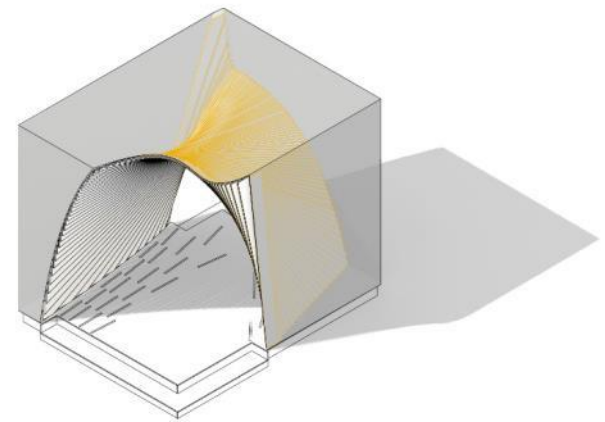
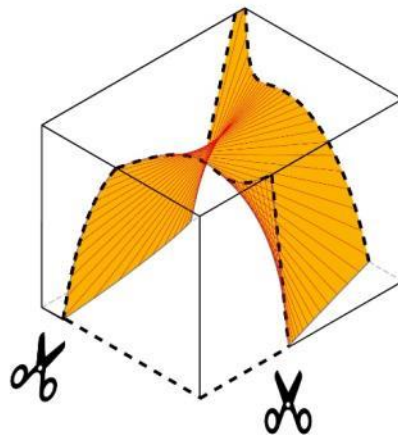
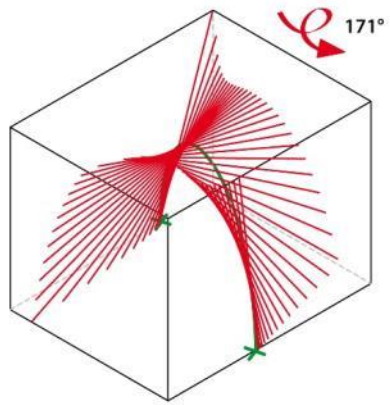
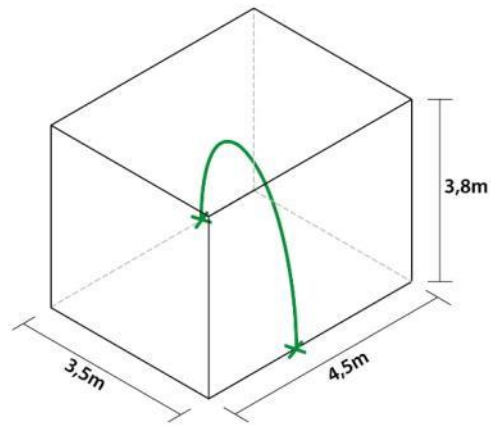
+





GEOMETRIA







HÄMEEN-
KATU
ELÄÄ!





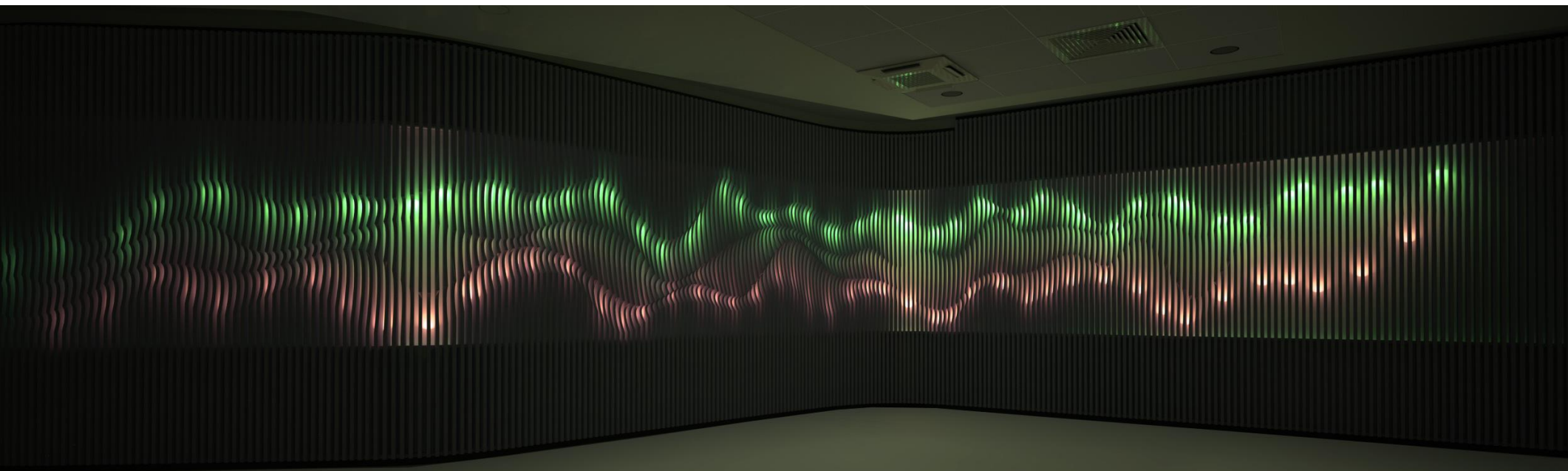
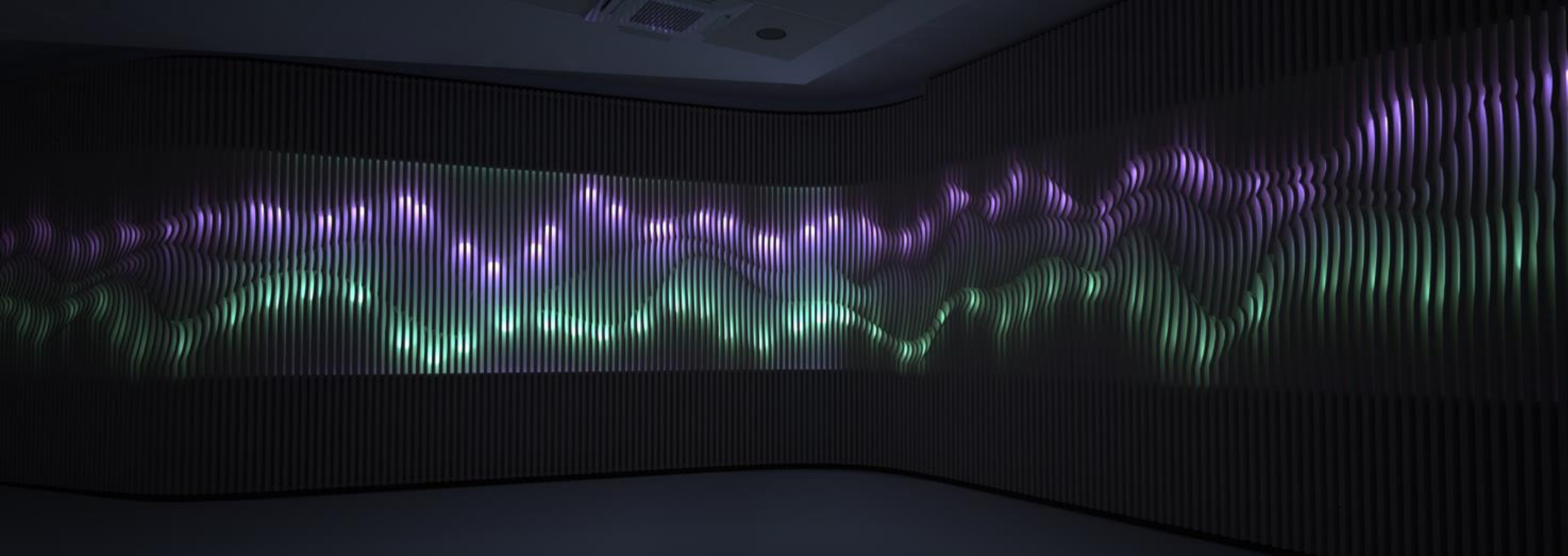


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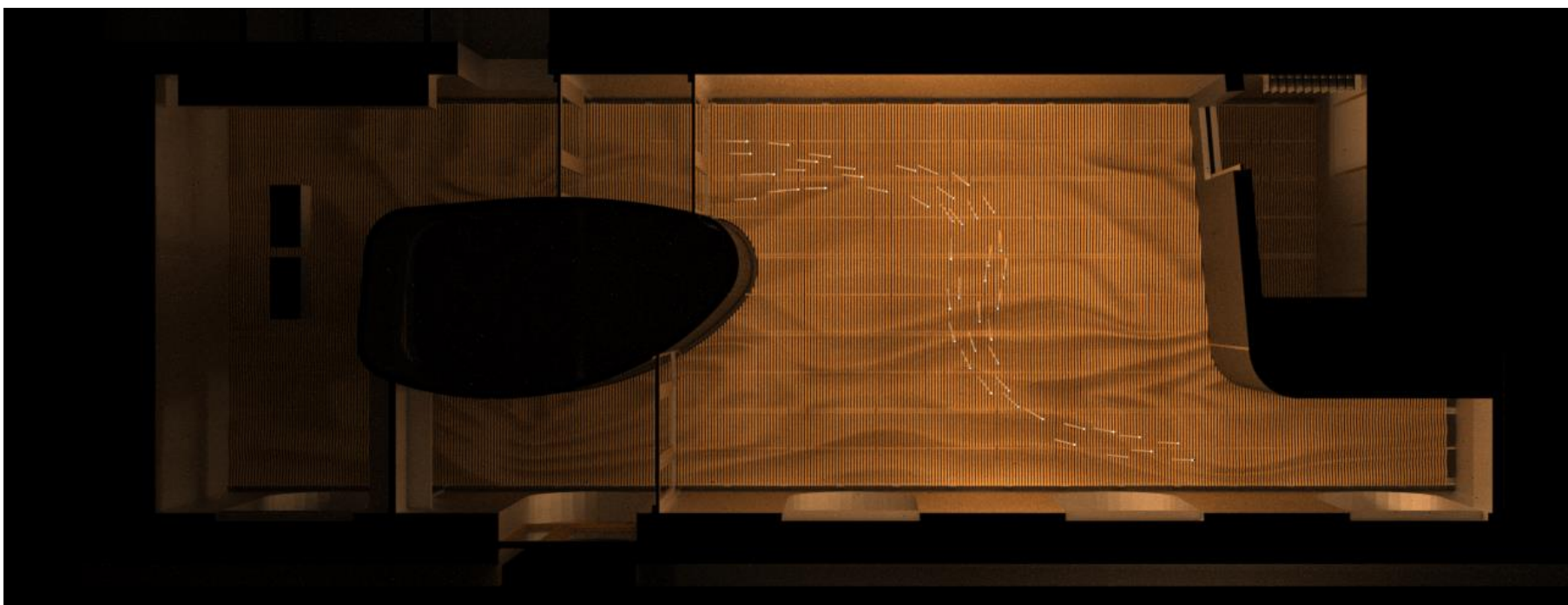
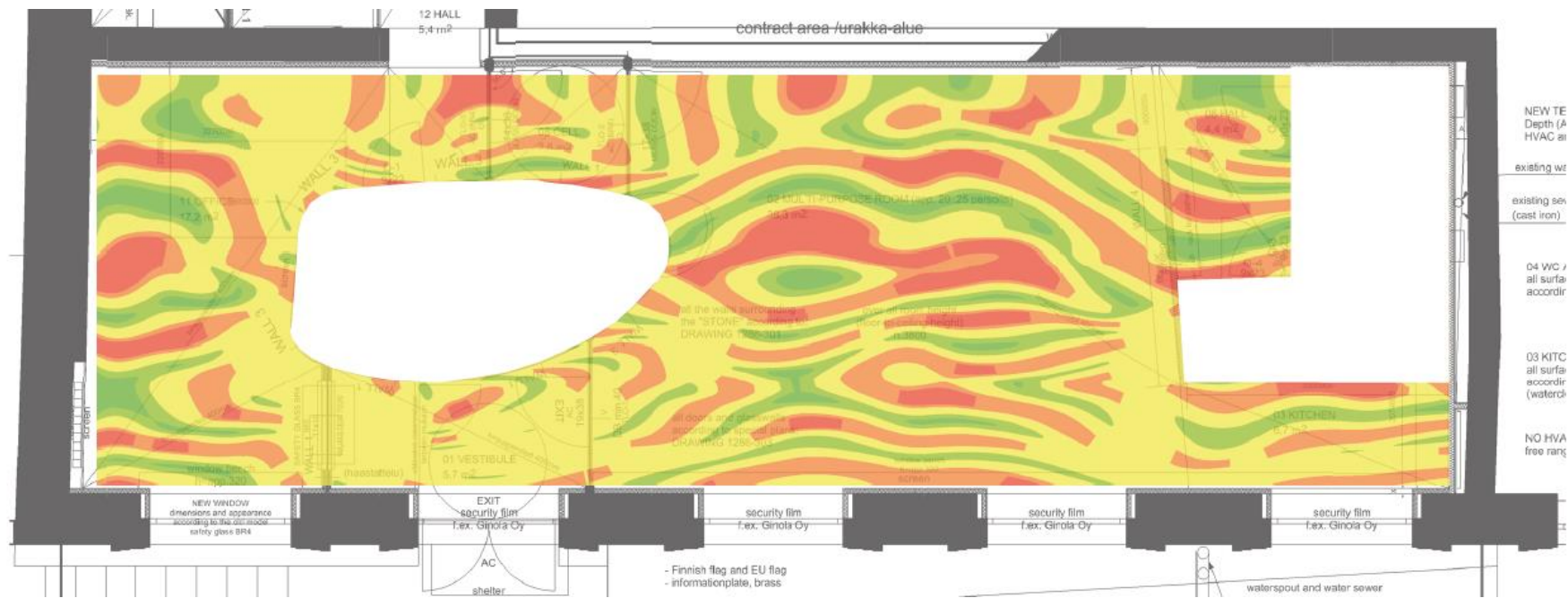








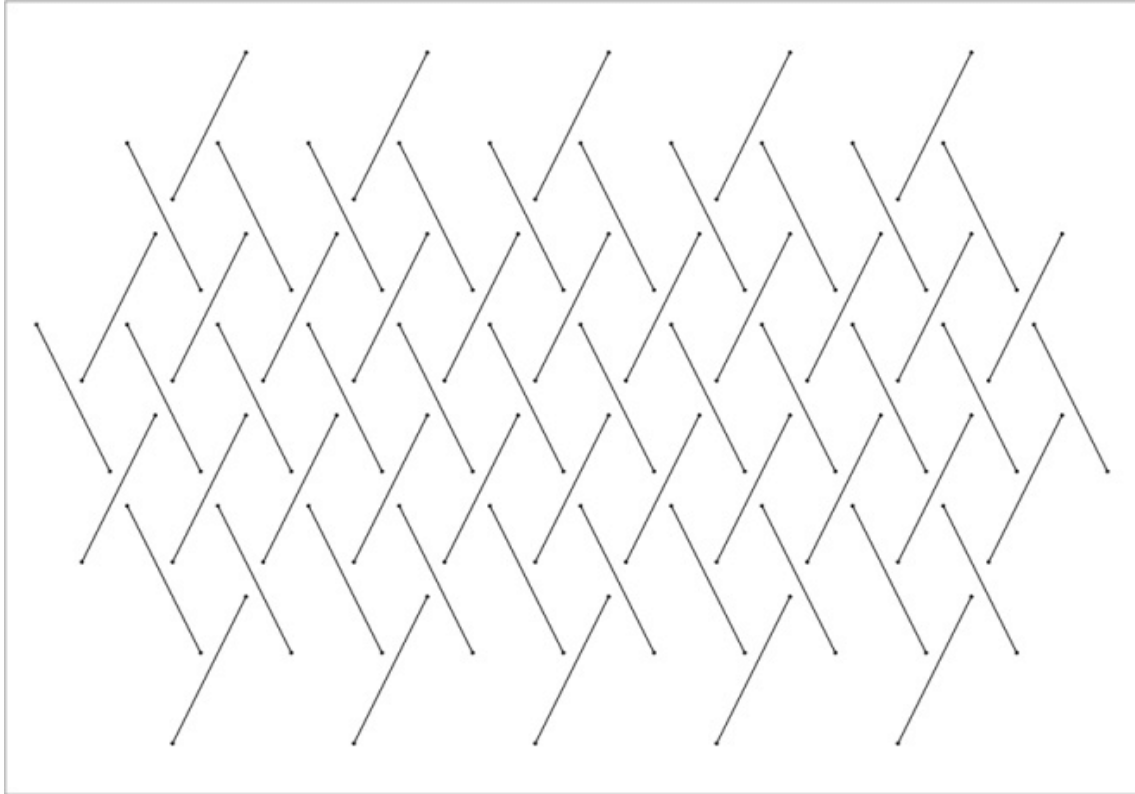
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sotkanmuna



382

248

525

185

437

129

125

256

527

251

180

378

120

381

019

117

182

579

522

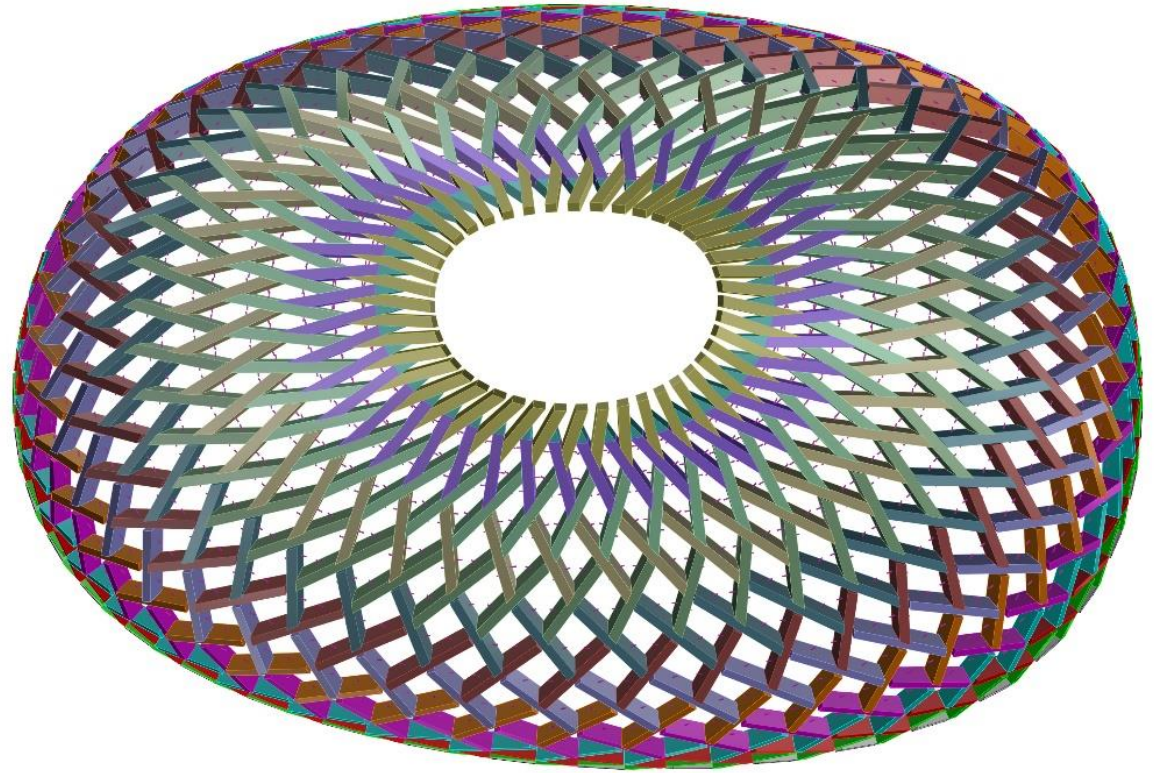
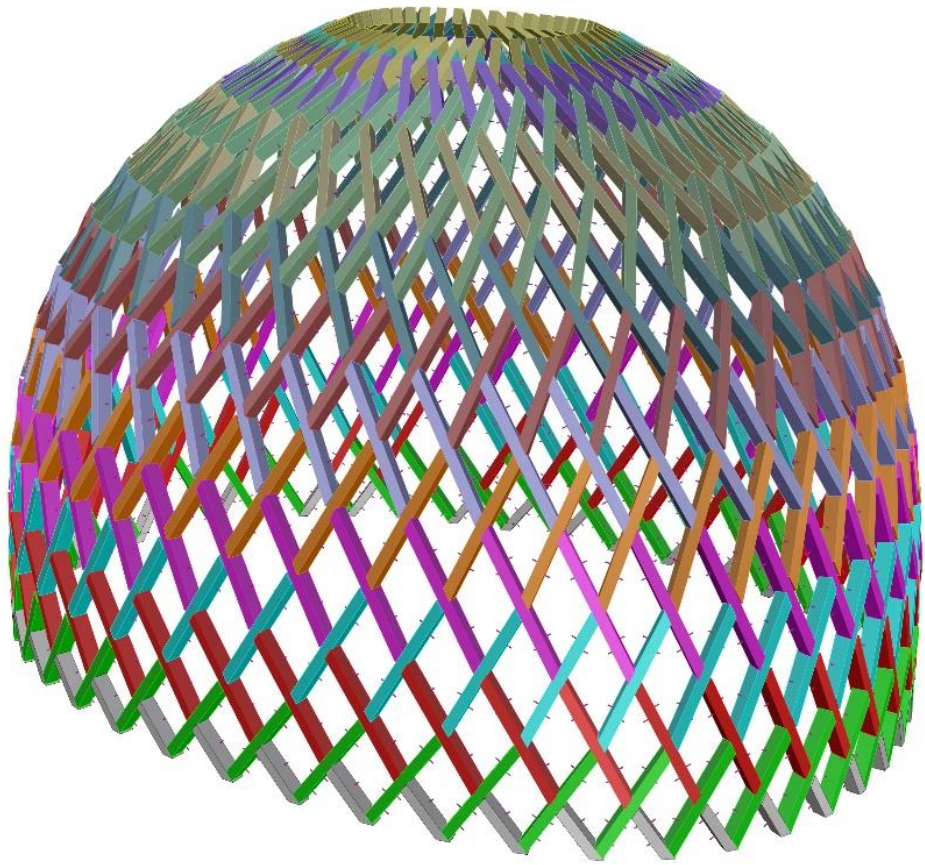
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52

13-91411
HT:0,0 DB









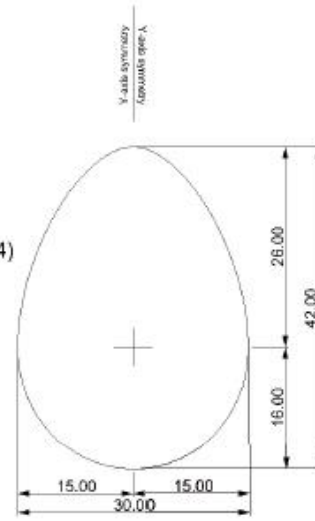




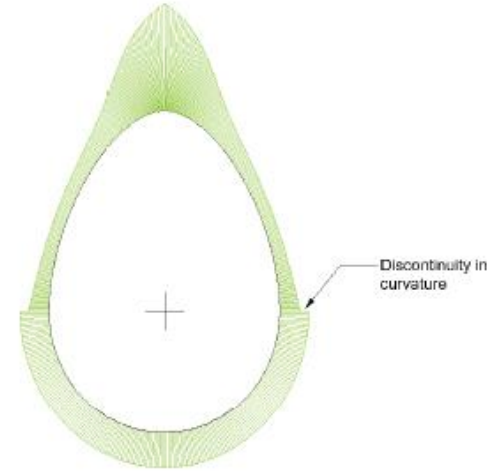


UPPER PART:
hyperbola
(conic;
tan, tan, rho=0.34)

LOWER PART:
half ellipse
(15,16)

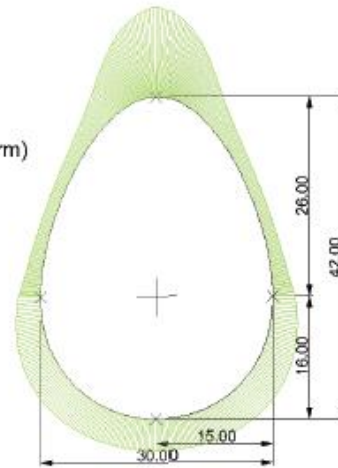


2. SHAPE GENERATION



3. SECTION
CURVATURE GRAPH

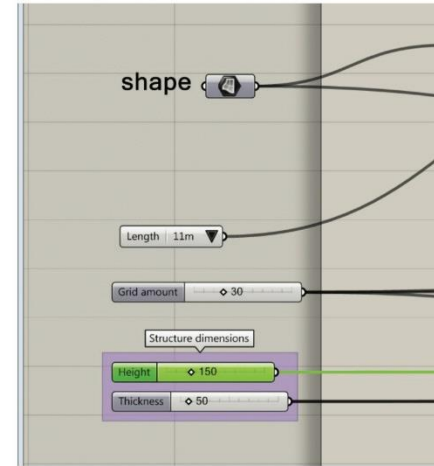
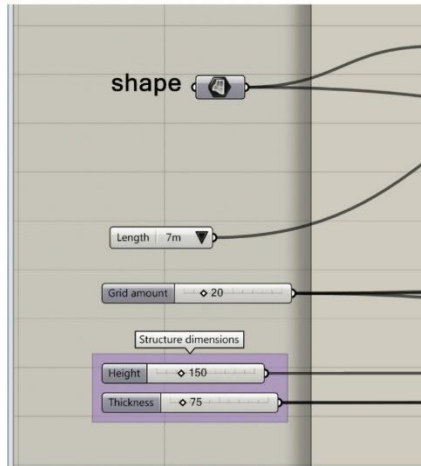
REDRAW
interpolated curve
(deg=3, knots=uniform)



4. SECTION
CURVATURE GRAPH



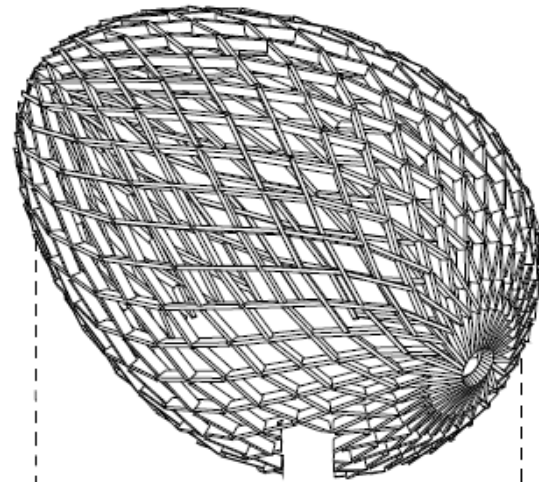
5. REVOLVED 3D-SHAPE



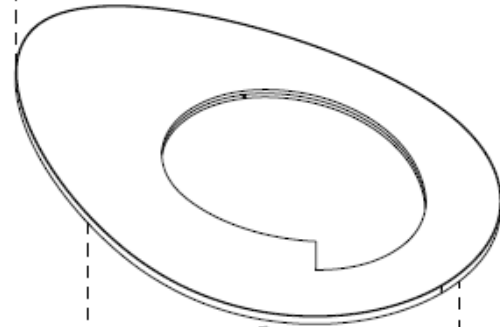
3D representation of the shape and the structure.
Contains necessary information for structural analysis
and fabrication.



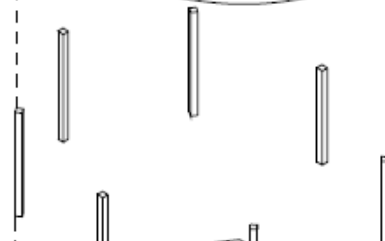
Parameters can be adjusted in order to find a perfect balance between structural efficiency, visual aesthetics and cost efficiency.



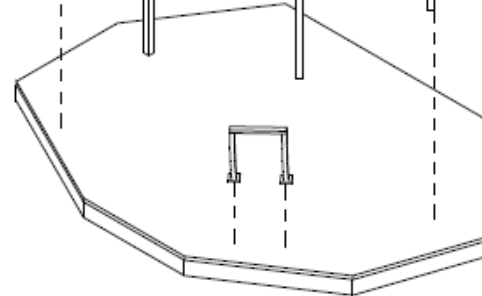
Zollinger timber structure



Platform
CLT-Concrete composite

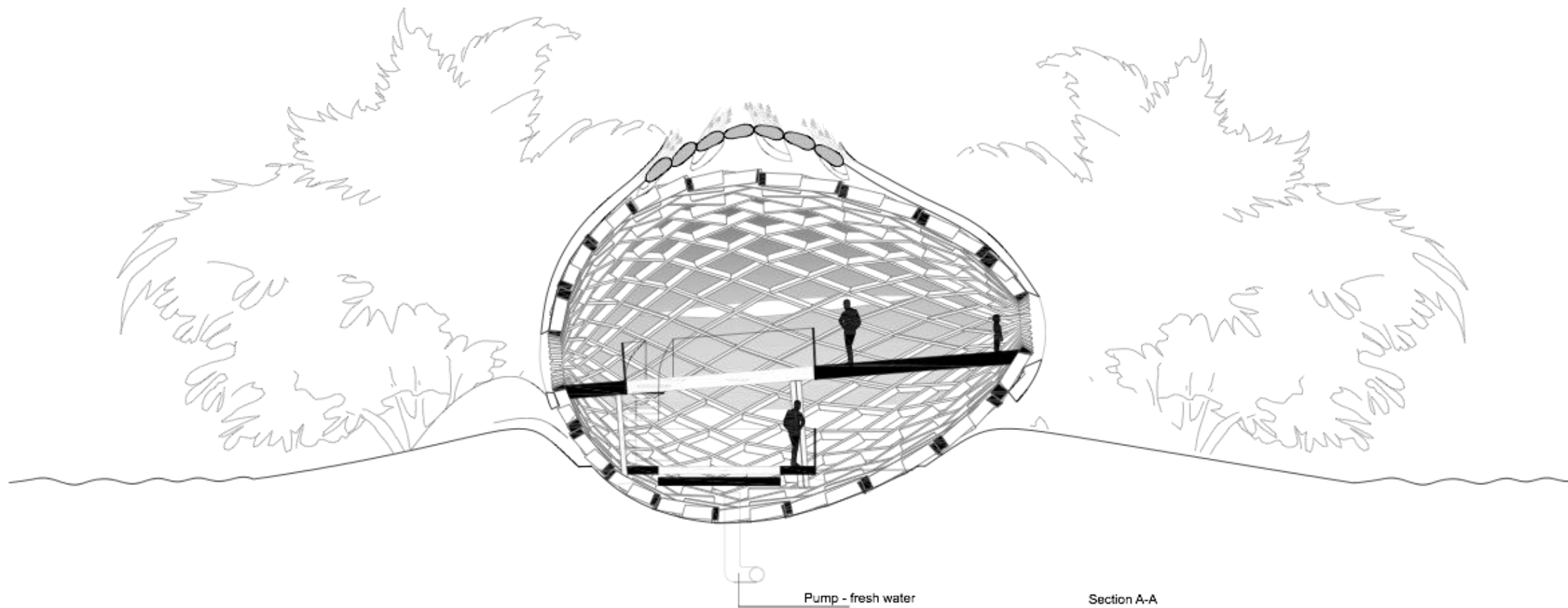


Timber columns



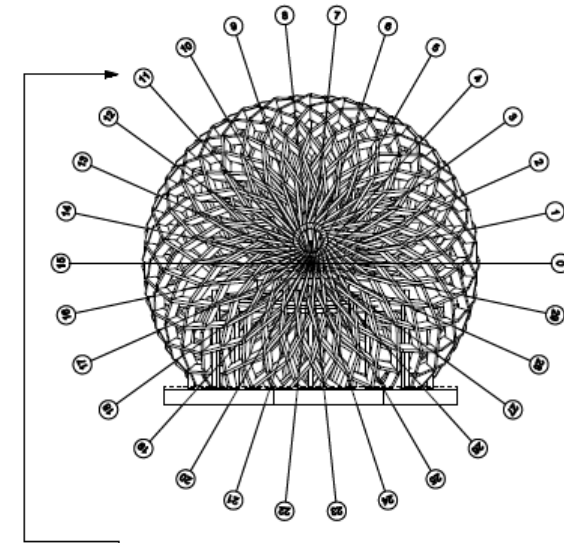
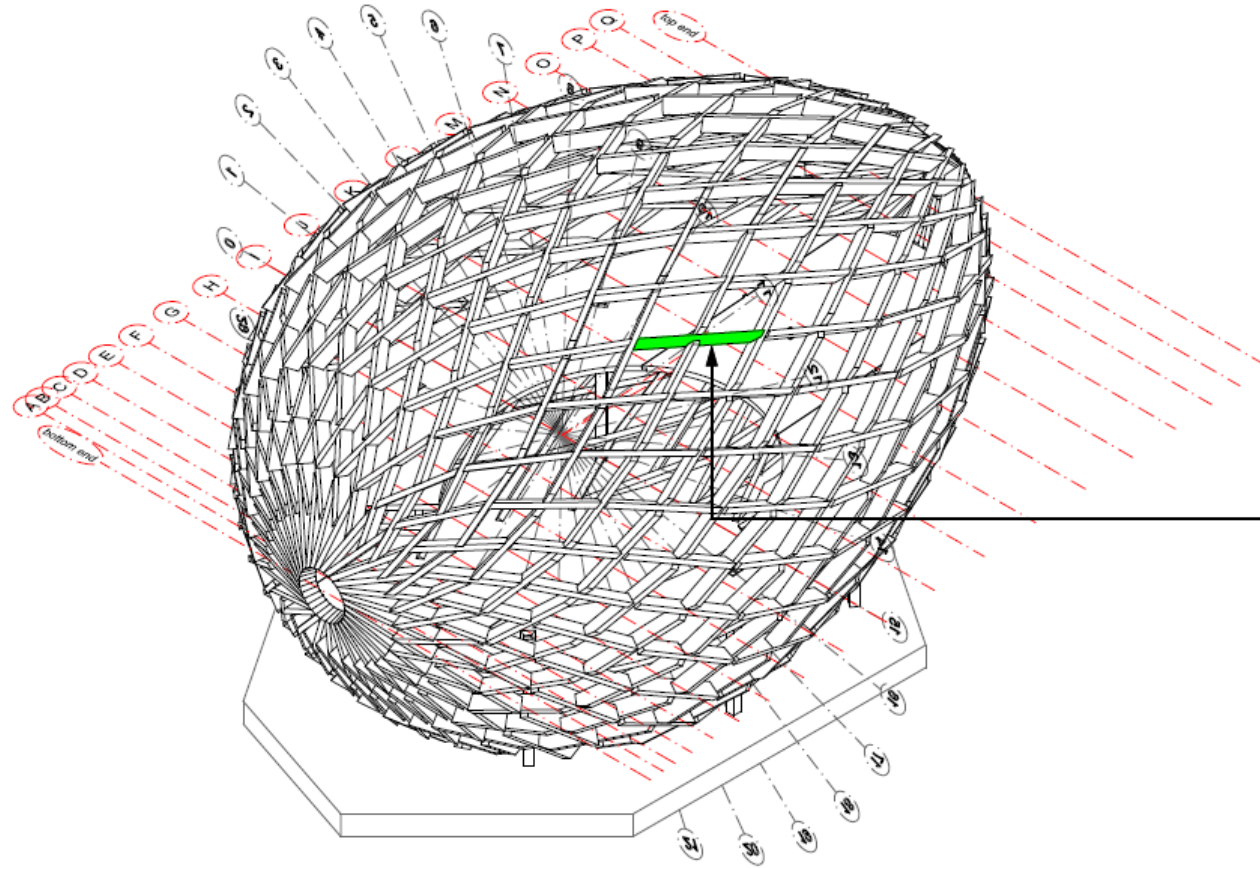
Steel door frame

Foundation

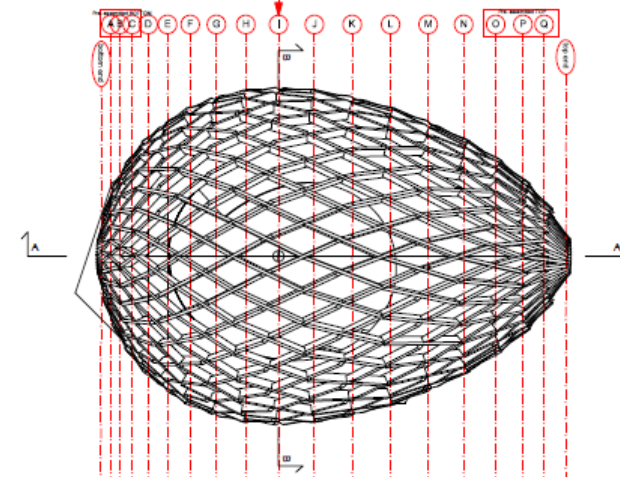


Pump - fresh water

Section A-A



Longitudinal module	Polar module	Material definition
I	11	PINE





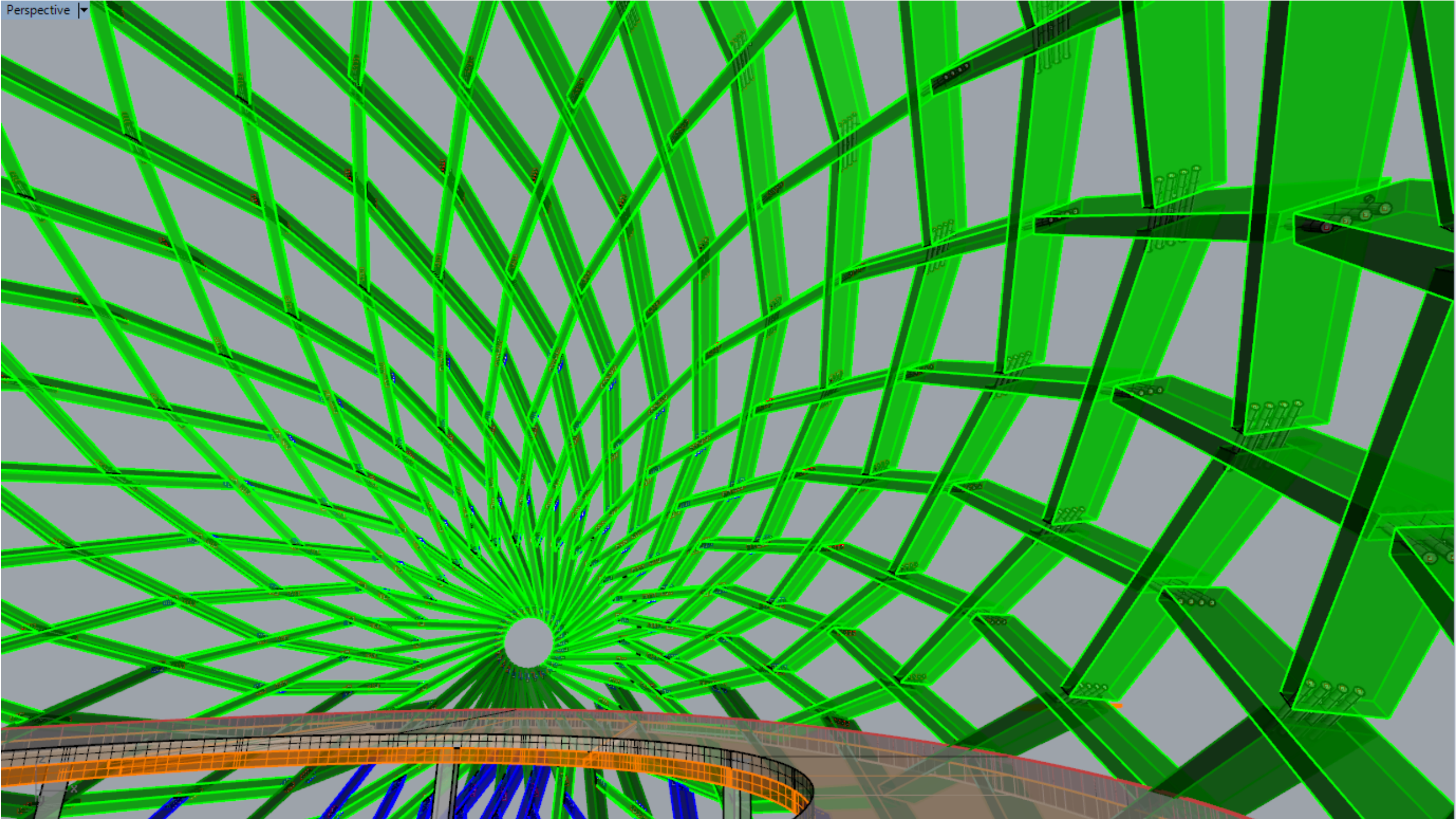
TOYOTA

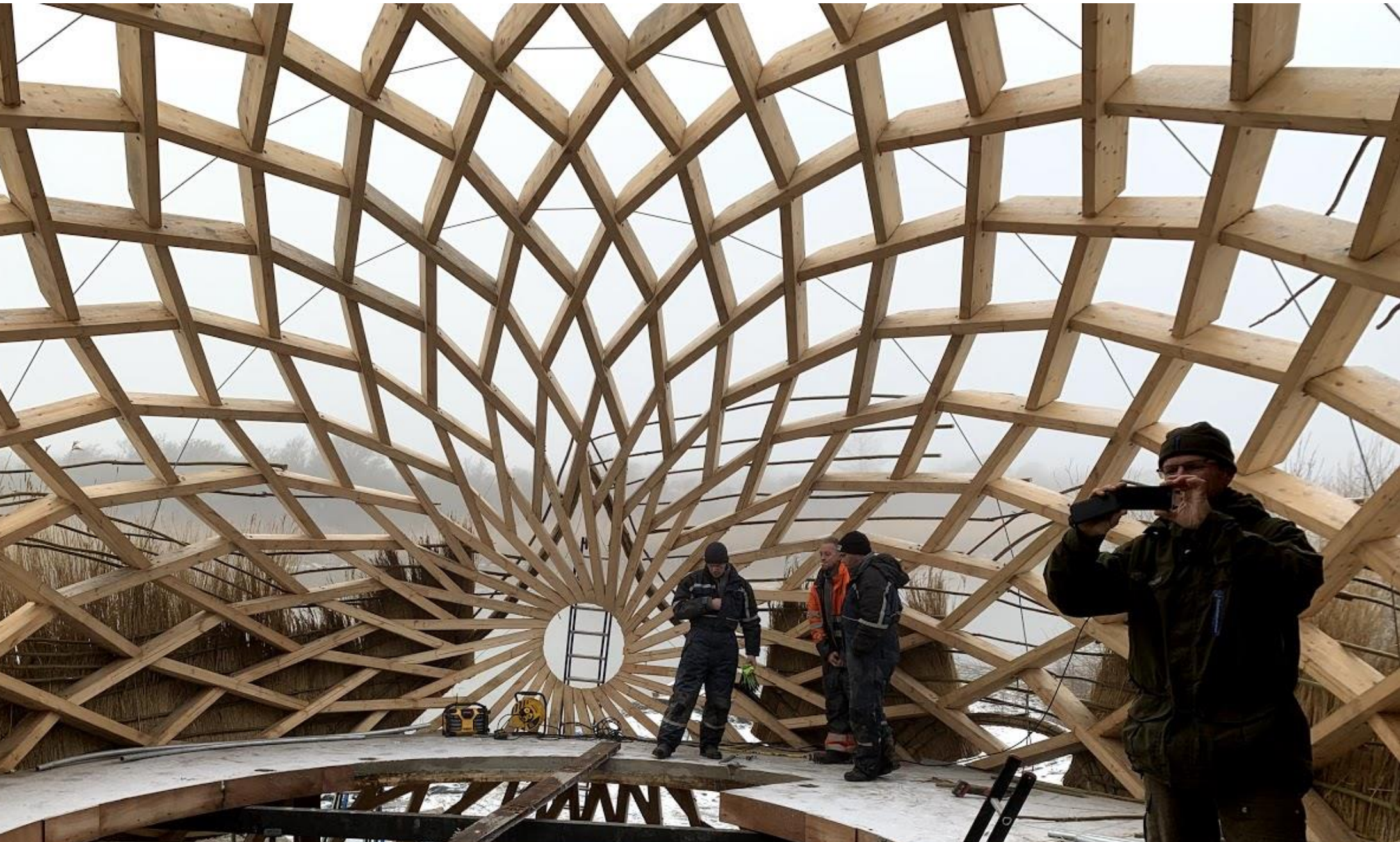
HAWKER
perfect Hx

SIAKKA
DRAPEL









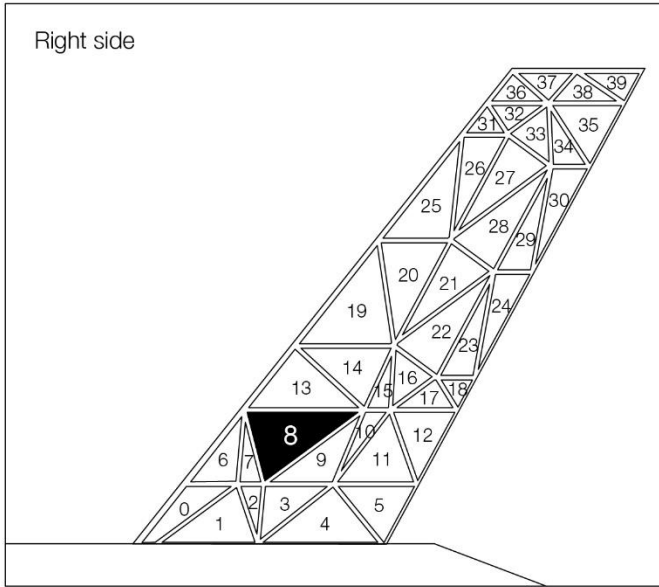




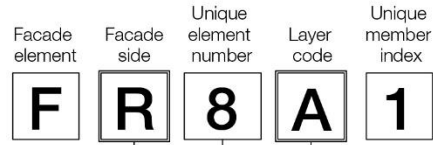






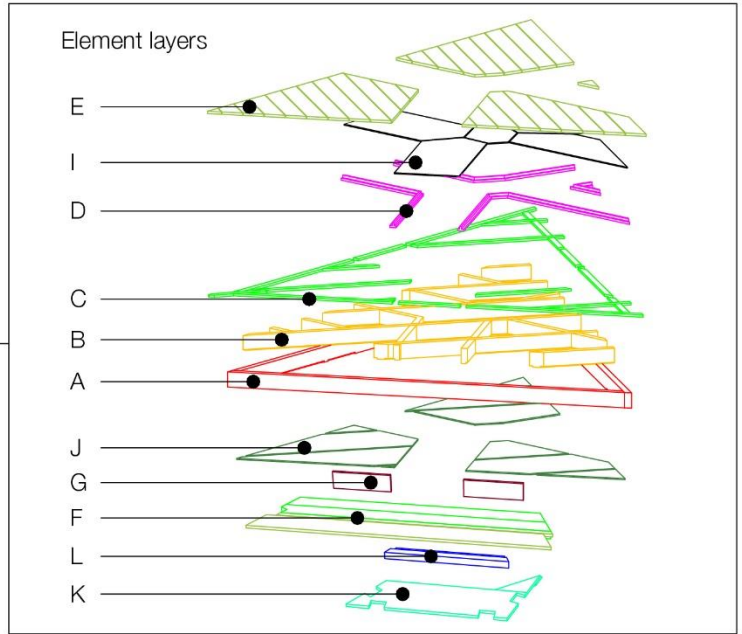


PART CODING CONVENTION

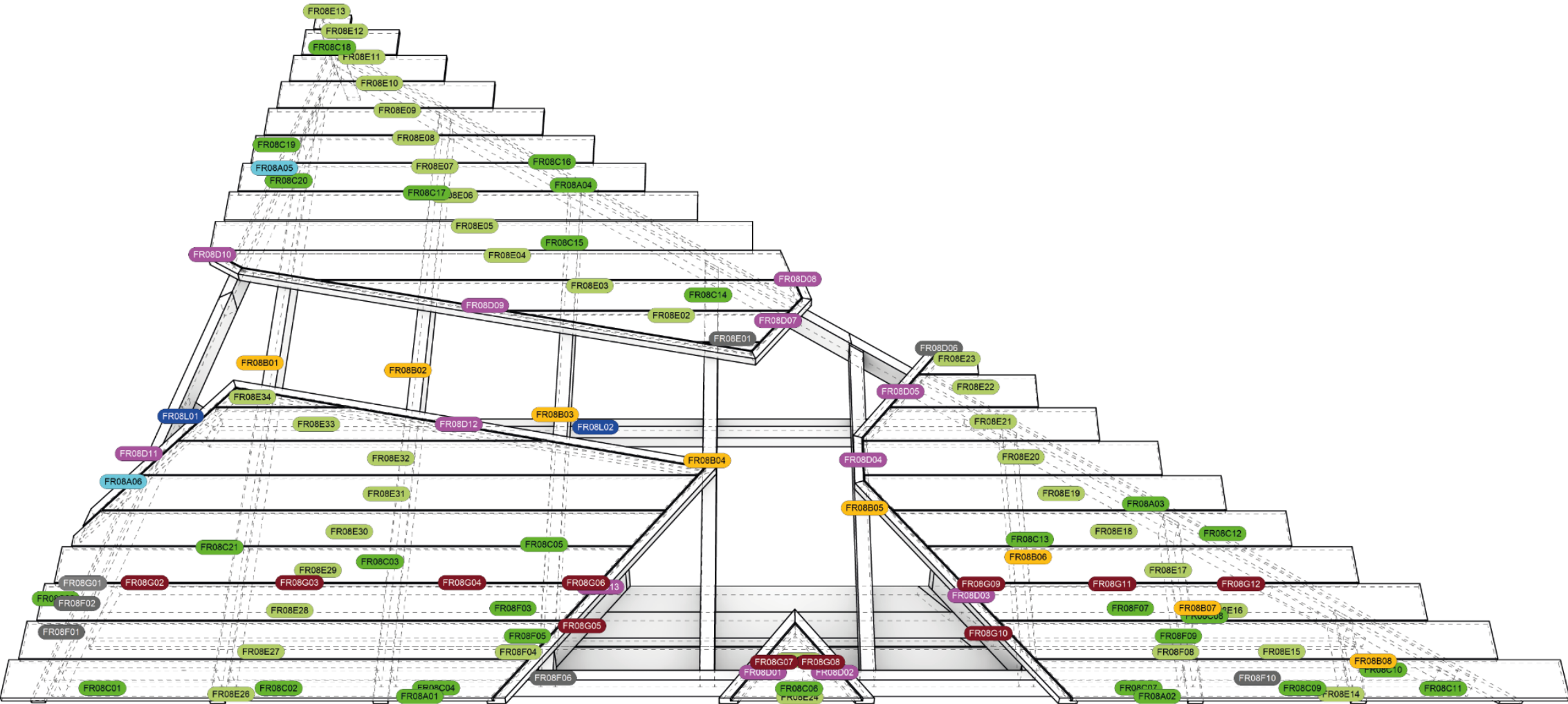


R = Right side
L = Left side

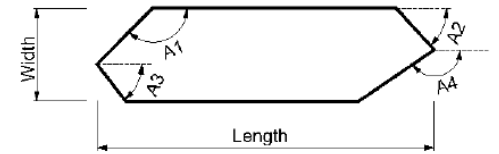
- A = Main frame
- B = Sub frame
- C = Sub frame slats
- D = Voronoi frame
- E = Facade cladding
- F = Stairbeam
- G = Stairbeam cover
- I = Glass
- J = Multiplex cladding
- K = Platform fixation
- L = Railing



categorical coding of every piece

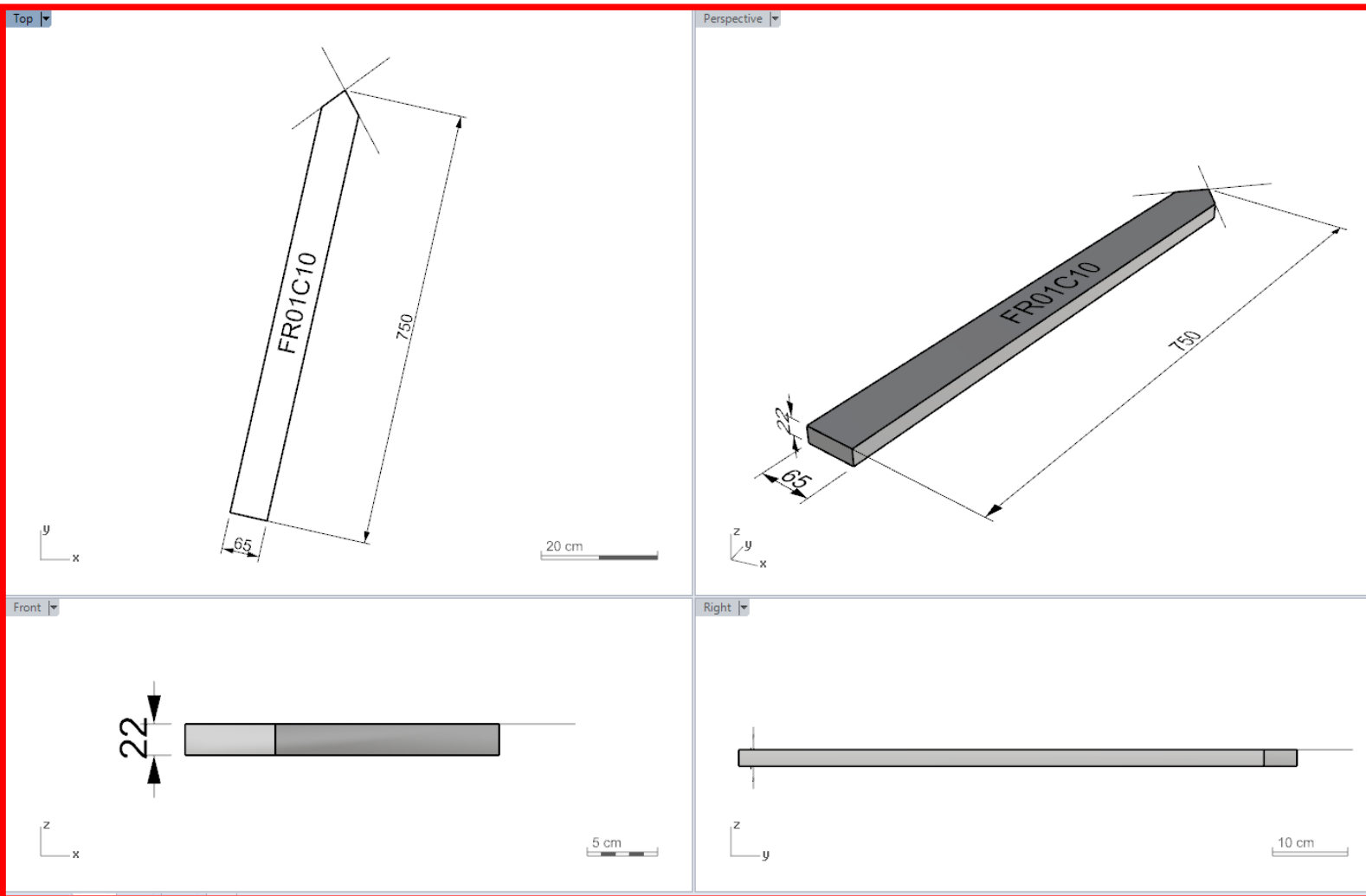


fabrication data extraction of every piece



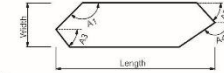
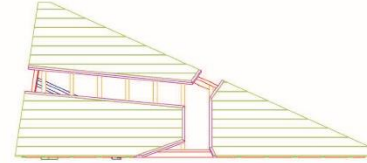
C - Sub frame slats

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	1385	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

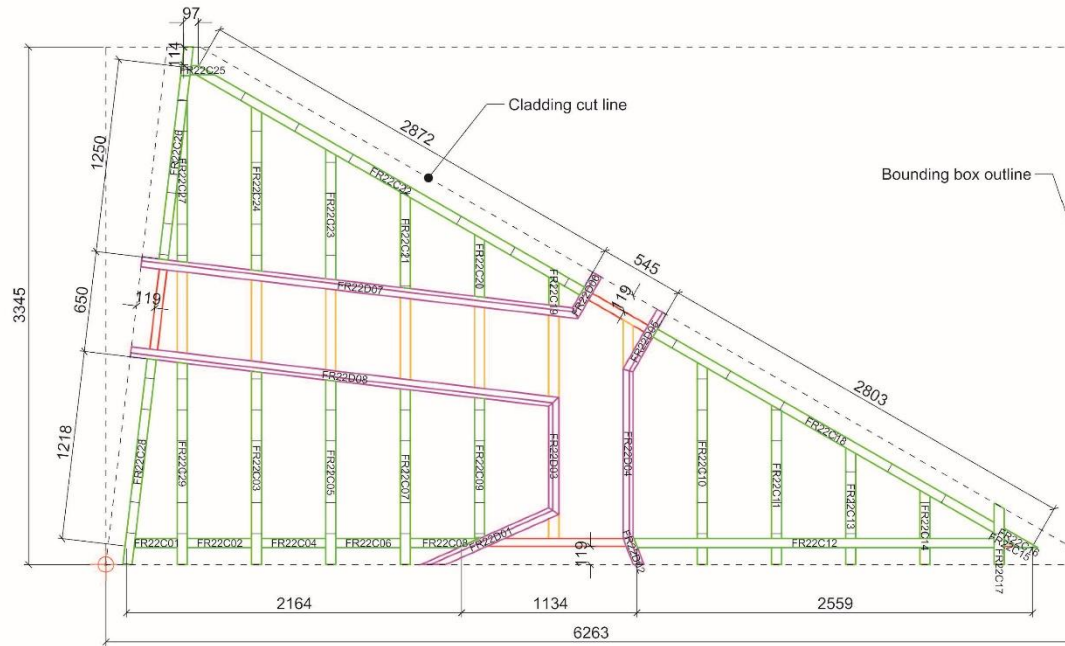


Element FR22:Layer C & D

Schematic section



Front view



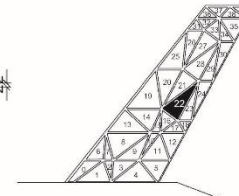
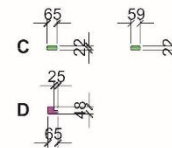
C - Sub frame slats

Layer	Code	Width	Height	Length	A1	A2	A3	A4
C	FR22C01	59	22	279	90	-	-	97
C	FR22C02	59	22	415	90	-	-	90
C	FR22C03	65	22	1250	90	-	-	97
C	FR22C04	59	22	415	90	-	-	90
C	FR22C05	65	22	1194	90	-	-	97
C	FR22C06	59	22	415	90	-	-	90
C	FR22C07	65	22	1137	90	-	-	97
C	FR22C08	59	22	444	156	-	-	90
C	FR22C09	65	22	905	90	-	66	97
C	FR22C10	65	22	1307	90	-	-	120
C	FR22C11	65	22	1031	90	-	-	120
C	FR22C12	59	22	2330	90	69	-	-
C	FR22C13	65	22	755	90	-	-	120
C	FR22C14	65	22	480	90	-	-	120
C	FR22C15	ERR	ERR	ERR	-	-	-	-
C	FR22C16	65	22	251	150	60	-	-
C	FR22C17	65	22	394	90	90	-	120
C	FR22C18	59	22	2545	-	90	60	-
C	FR22C19	65	22	188	97	-	-	120
C	FR22C20	65	22	407	97	-	-	120
C	FR22C21	65	22	625	97	-	-	120
C	FR22C22	59	22	2889	-	-	90	150
C	FR22C23	65	22	844	97	-	-	120
C	FR22C24	65	22	1063	97	-	-	120
C	FR22C25	59	22	158	-	-	30	97
C	FR22C26	59	22	1386	-	-	83	90
C	FR22C27	65	22	1055	97	7	-	-
C	FR22C28	59	22	1339	90	83	-	-
C	FR22C29	65	22	1307	90	-	-	97

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

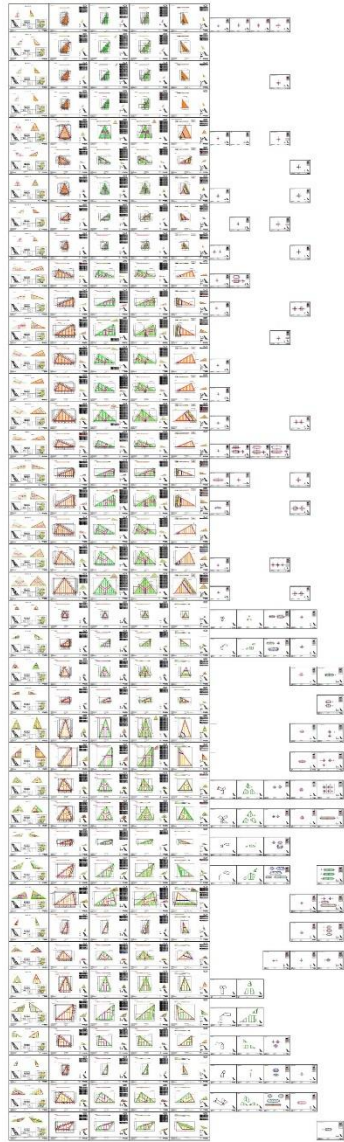
Profile:



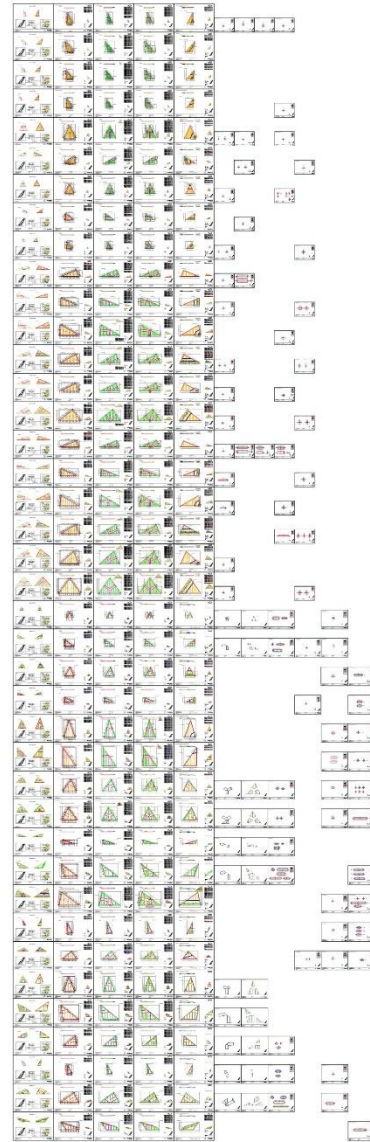
Ceiling elements



Facade elements
Left side



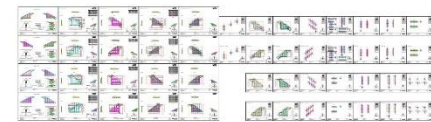
Facade elements
Right side



Facade-edge elements



Wall elements



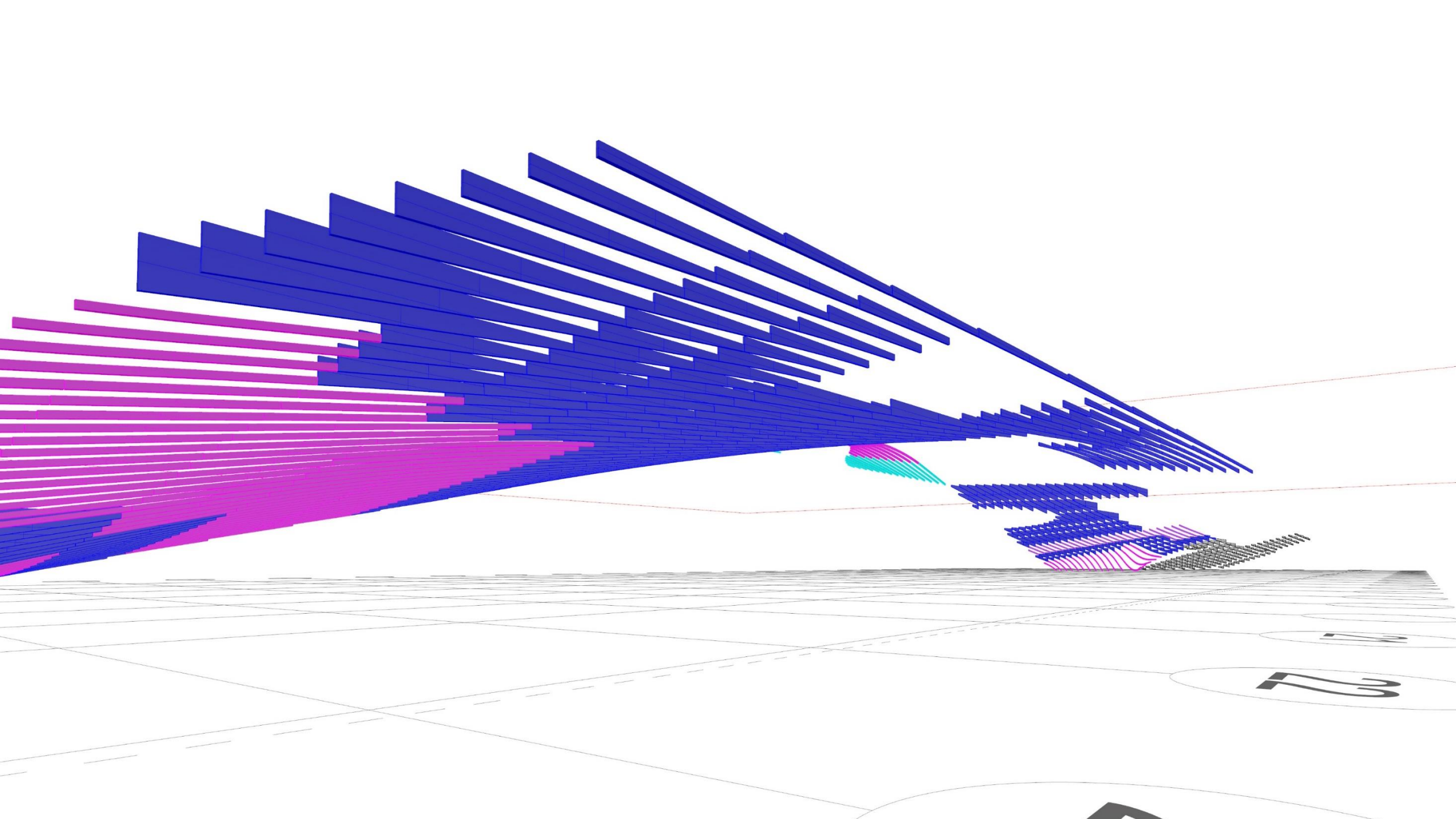


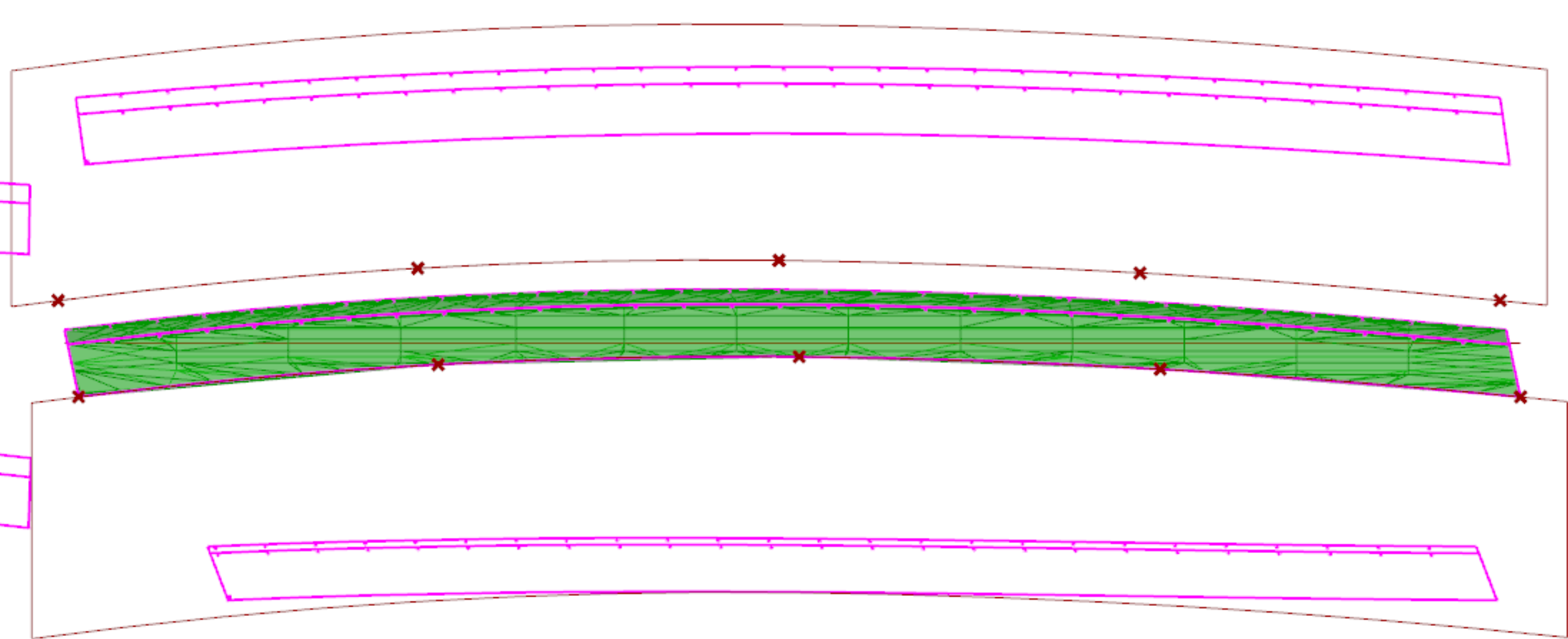


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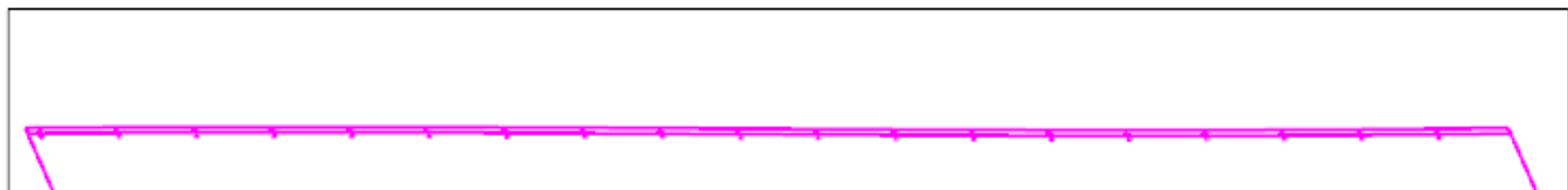








y
x





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

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

Personenwaagen
PBA







Thank you!

Toni Österlund

toni.osterlund@geometria.fi

www.geometria.fi

