ARK-C005
PERUSTEET: VOIMA

KANTAVAT RAKENTEET 2

Aalto University

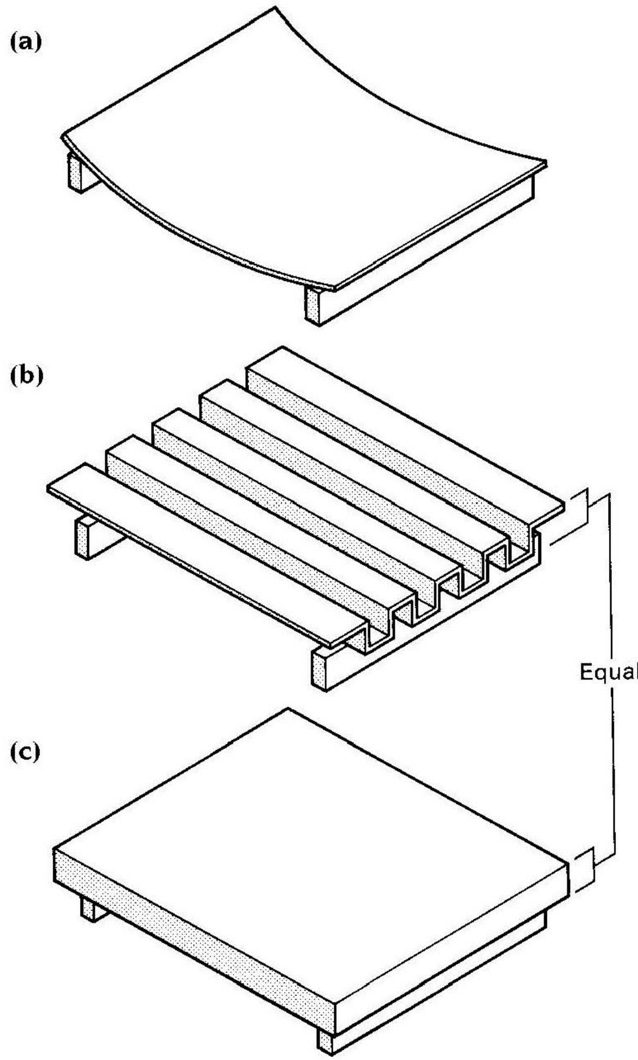


Fig. 4.7 The effect of cross-sectional shape on the efficiency with which bending-type load is resisted. (a) Thin card which has an inefficient rectangular cross-section. (b) Thin card folded to give an efficient 'improved' cross-section. (c) Thick card with inefficient rectangular cross-section and having equivalent strength and stiffness to the folded thin card.

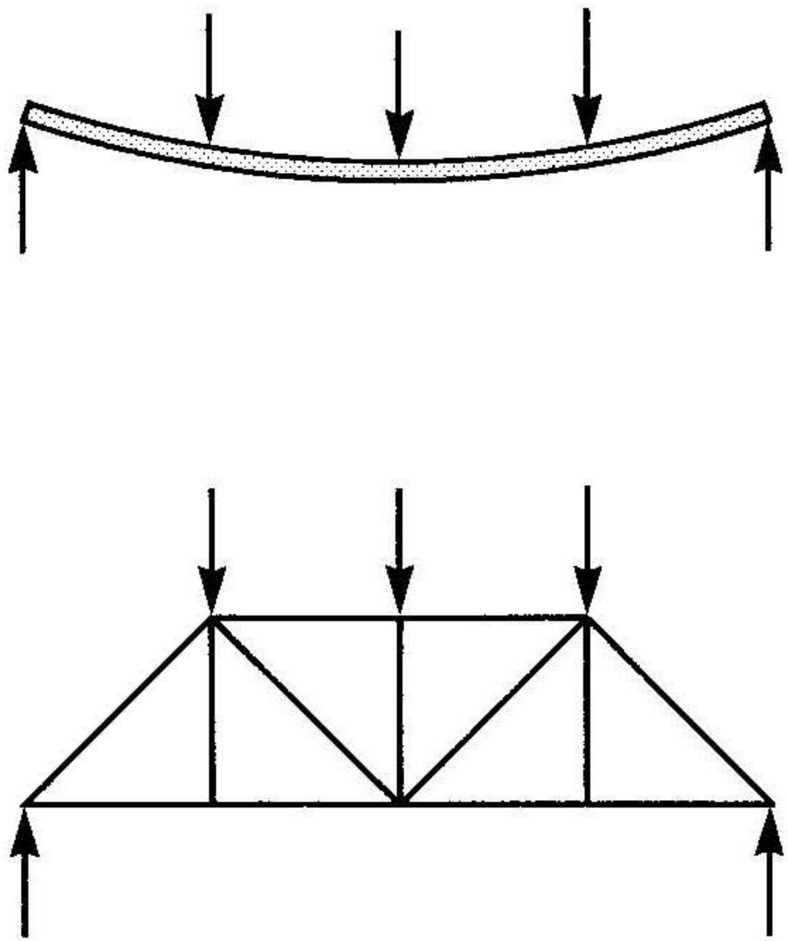
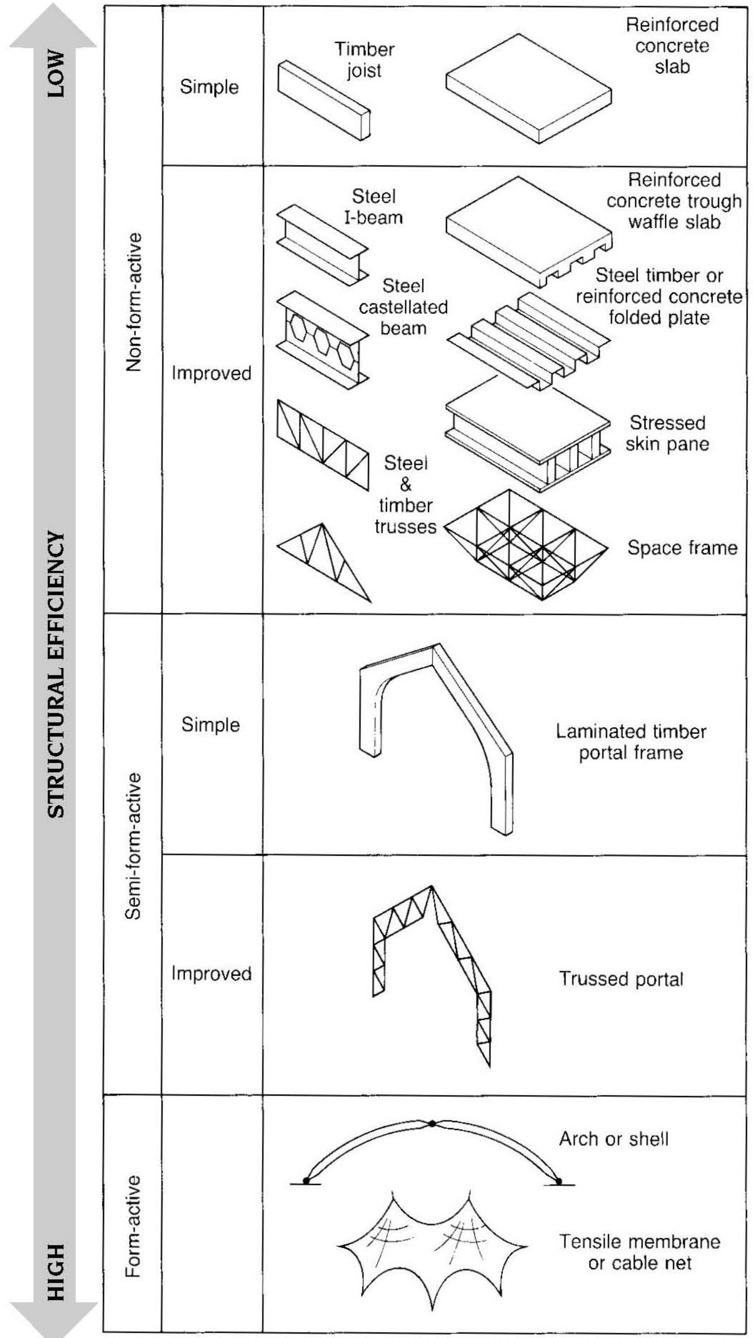
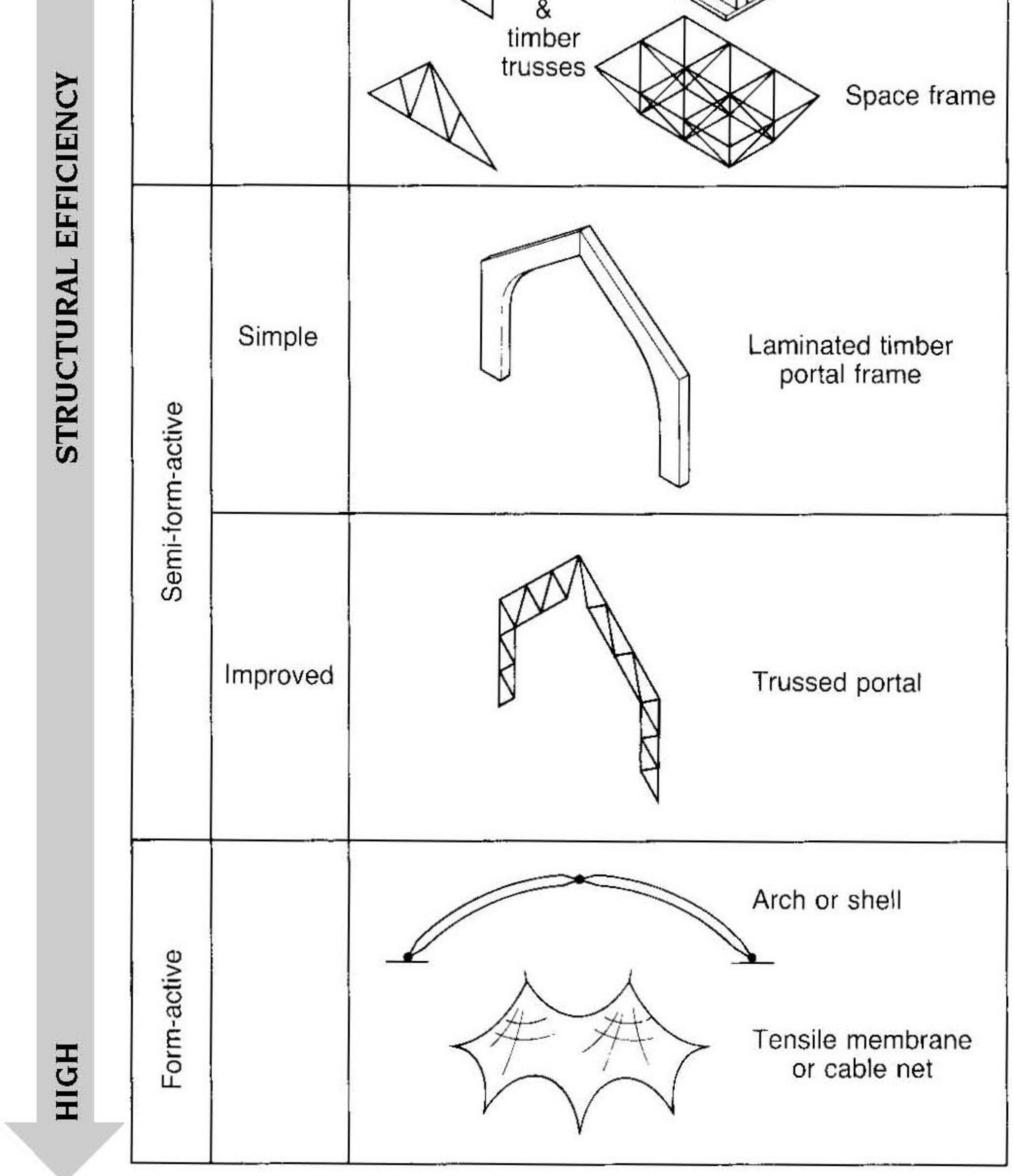
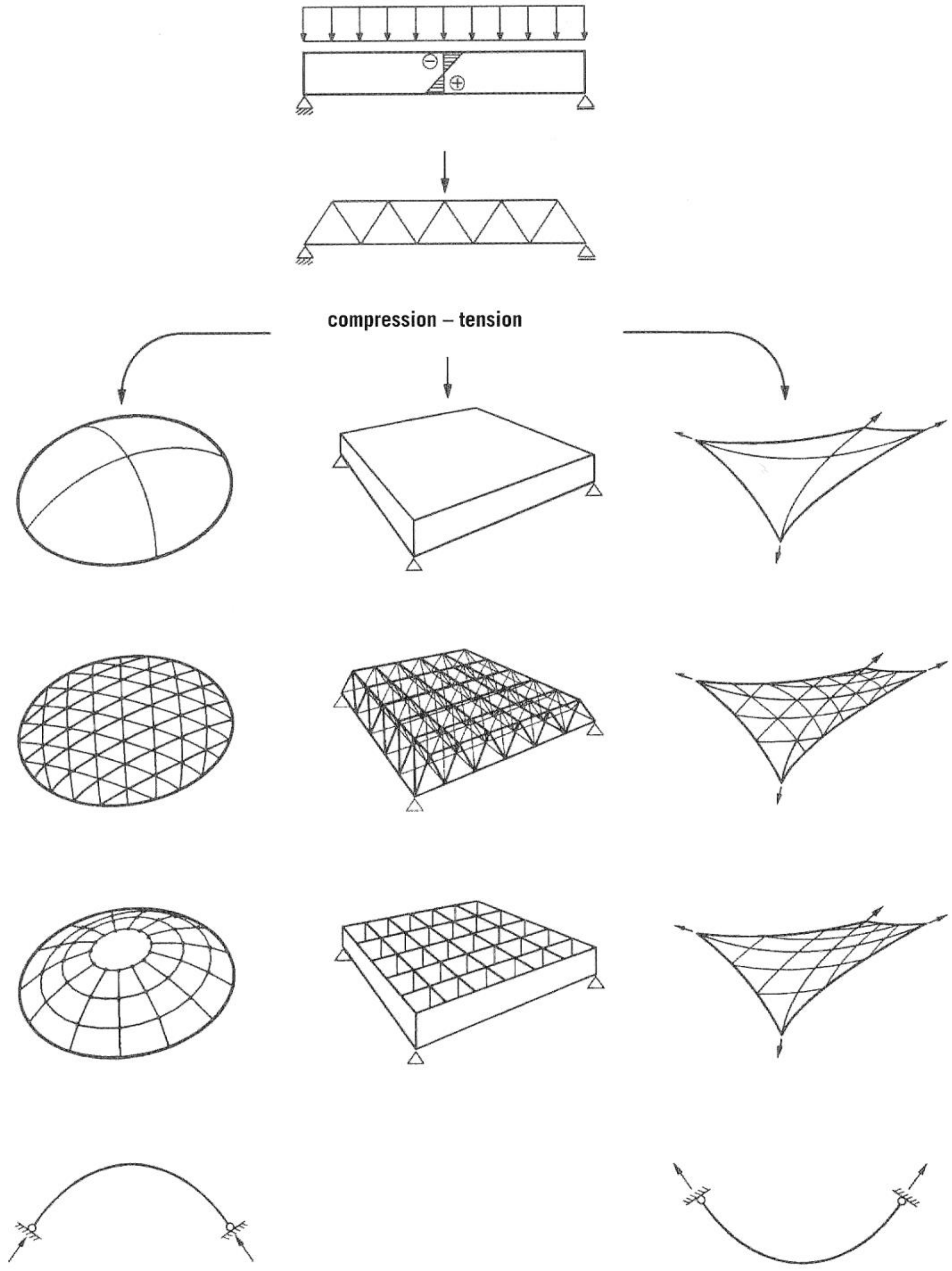


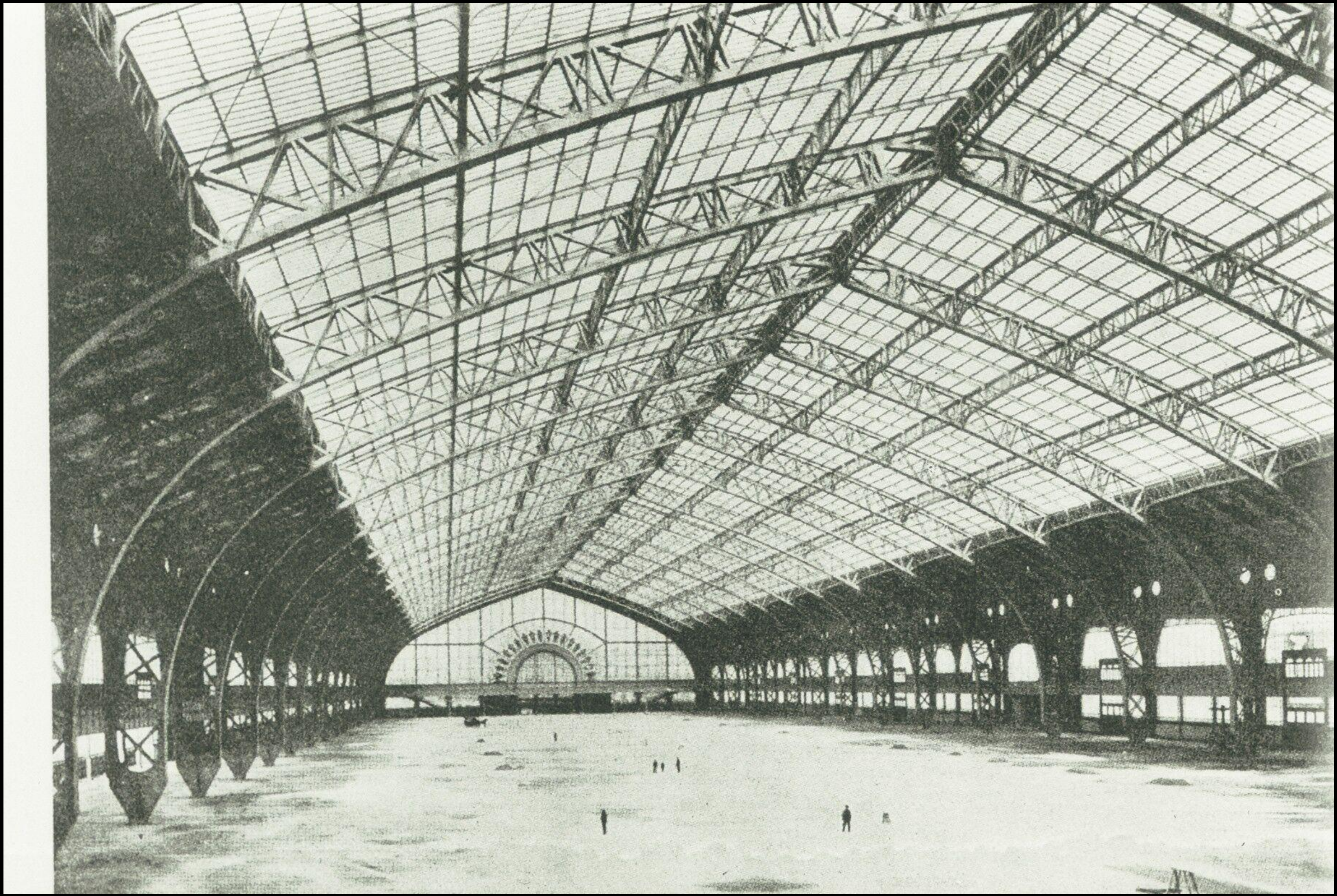
Fig. 4.10 A solid beam is less strong and rigid than a triangulated structure of equivalent weight.


LOW
STRUCTURAL EFFICIENCY
HIGH
Non-form-active
Simple
Timber joist
Reinforced concrete slab
Improved
Steel I-beam
Reinforced concrete trough waffle slab
Steel castellated beam
Steel timber or reinforced concrete folded plate
Stressed skin pane
Steel & timber trusses
Space frame
Semi-form-active
Simple
Laminated timber portal frame
Improved
Trussed portal
Form-active
Arch or shell
Tensile membrane or cable net


STRUCTURAL EFFICIENCY
HIGH
&
timber
trusses
Space frame
Semi-form-active
Simple
Laminated timber
portal frame
Improved
Trussed portal
Form-active
Arch or shell
Tensile membrane
or cable net

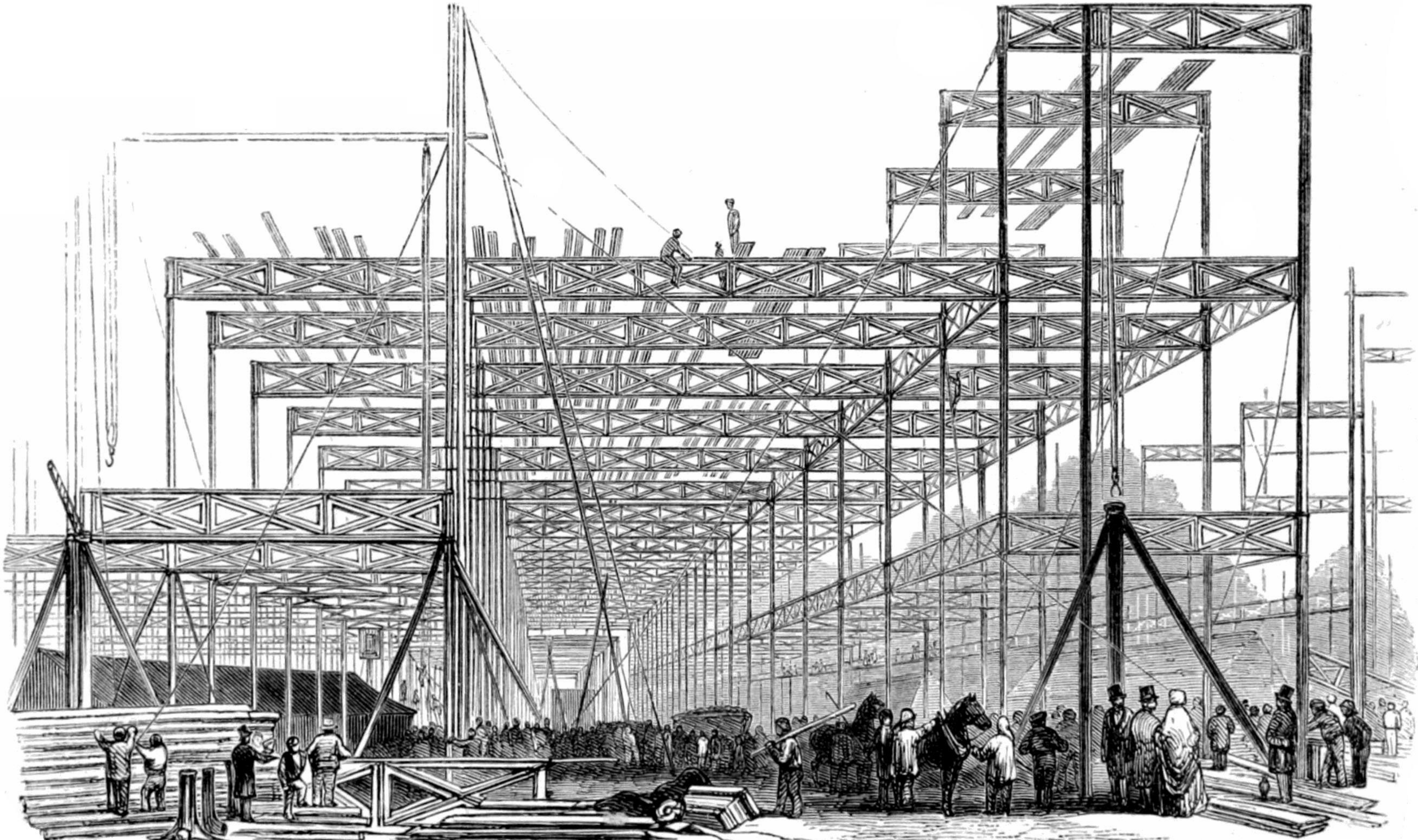

compression – tension

RISTIKKORAKENTEET



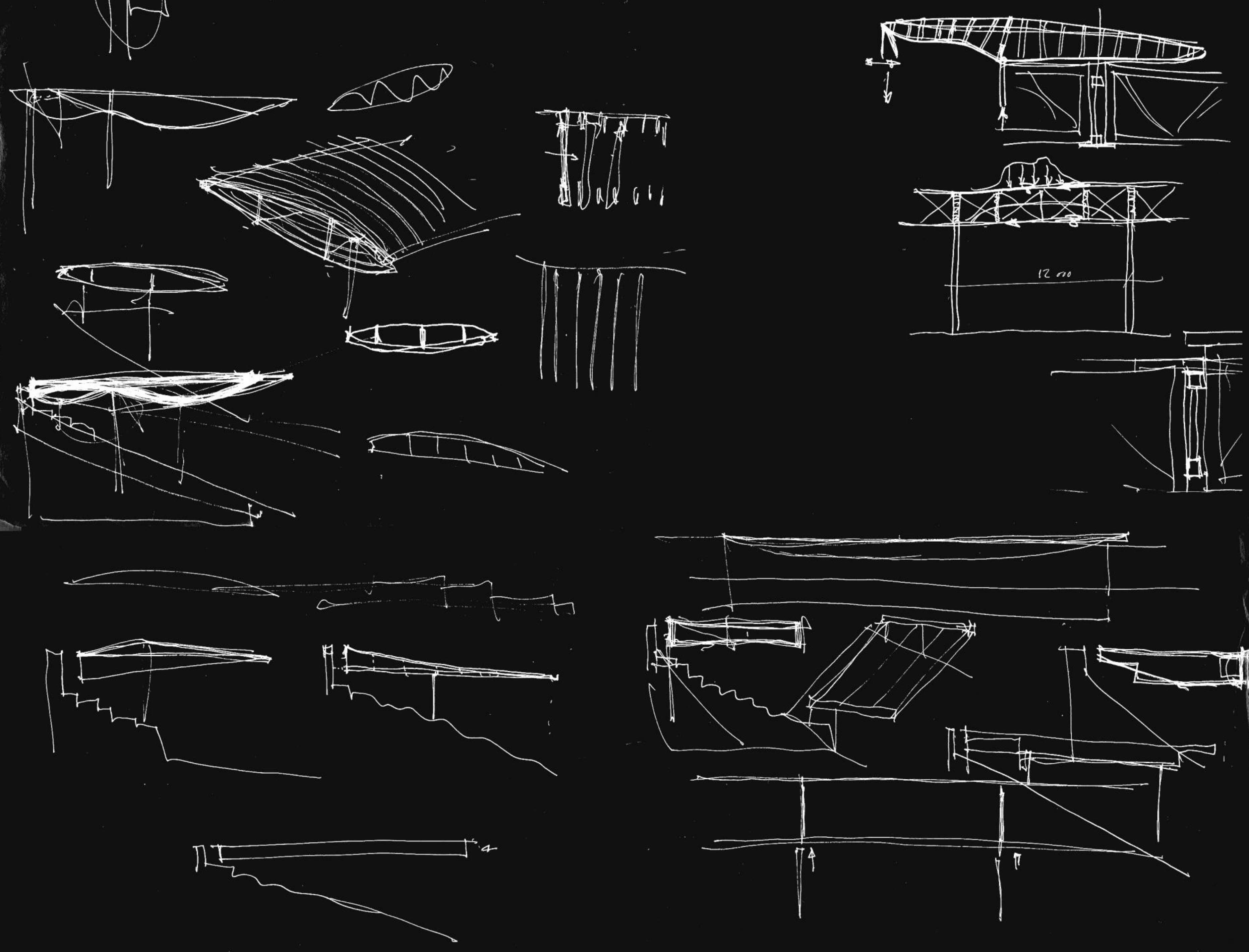
Galerie des Maschines 1889

Crystal Palace, HydePark,
Joseph Paxton, 1851



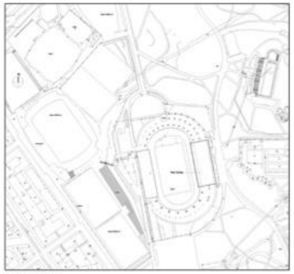
Leutschenbach school – Christian Kerez 2009

Helsingin Olympiastadionin katokset 2005/2020 –
Arkkitehtitoimisto K2S



Olympia stadion / Itäkatsomo
Arkkitehtitoimisto K2S Oy 2003


Fortum
OULUX
Helsingin Energia
VOITH



site plan 1:5000

The new canopy for the Helsinki Olympic Stadium

The new canopy of the stadium covers the east-side bleachers, roughly one fourth of the stadium. The roof has two characters. It is almost invisible from the stadium exterior respecting the pure functionalistic architecture of the stadium. On the other hand it has a strong contemporary character in the stadium interior.

The steel construction is optimized by the section form of a double sinus curve which gives an undulating, smooth geometry to the underside surface of the roof. The underside surface is wood which gives a warm feeling of material and also relates well to the previous extensions of the stadium.

The structural planning was extended into careful studies with both static and aeroelastic wind tunnel experiments. The elementation of the structure as well as the re-inforcement of the old concrete structure proposed great challenges.

The stadium itself was completed in 1938 for the Olympic Games in Helsinki. It was originally designed by Yrjö Lindegren and Toivo Jäntti.

The project was completed for the 2005 IAAF World Championships in Athletics.

Time of Completion:
05/2005

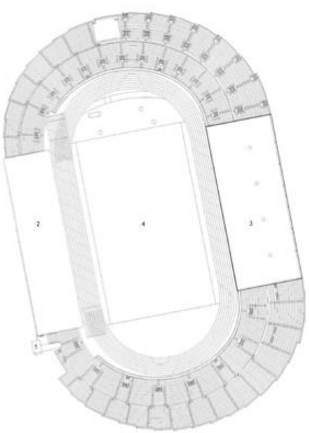
Area:
4000 m2

Address:
Olympiastadion
00250 Helsinki
Finland

Architect:
K2S Architects Ltd.

Designteam:
Kimmo Lintula, Niko Sirola and Mikko Summanen

Assistants:
Tuukka Vuori, Matias Manninen, Laura Vara

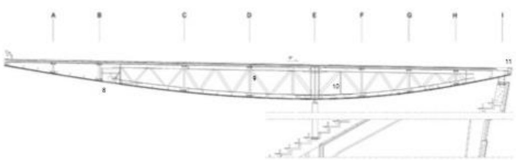


plan 1:1500

eastern elevation 1: 1500

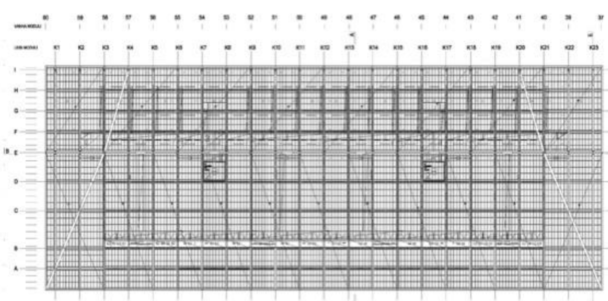
1. tower
2. old canopy
3. new canopy
4. field
5. training rooms
6. marathon gateway
7. entrance

section 1: 1500

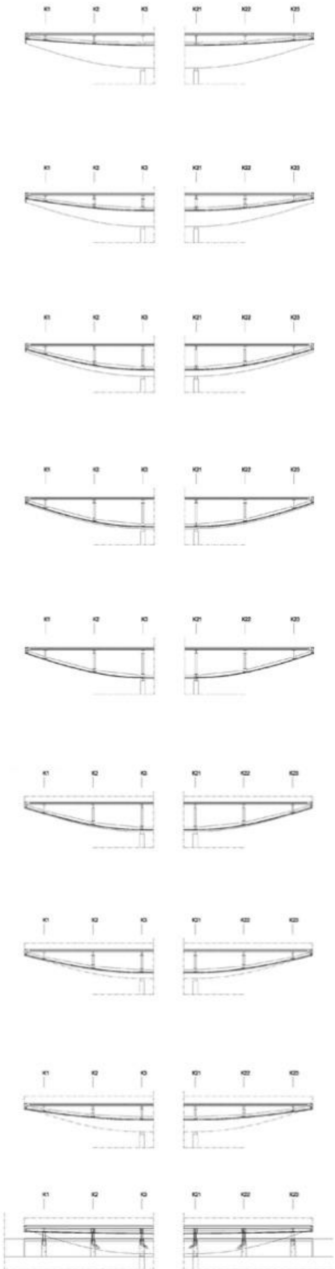


section A-A 1:200

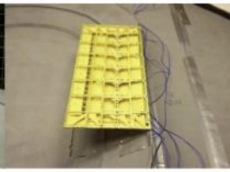
8. audio-visual equipment
9. technical area
10. maintenance passage
11. heating, ventilation, sanitation and electrical installations

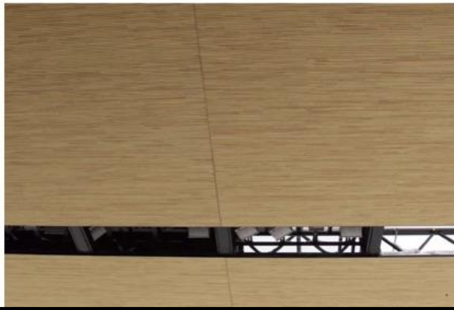


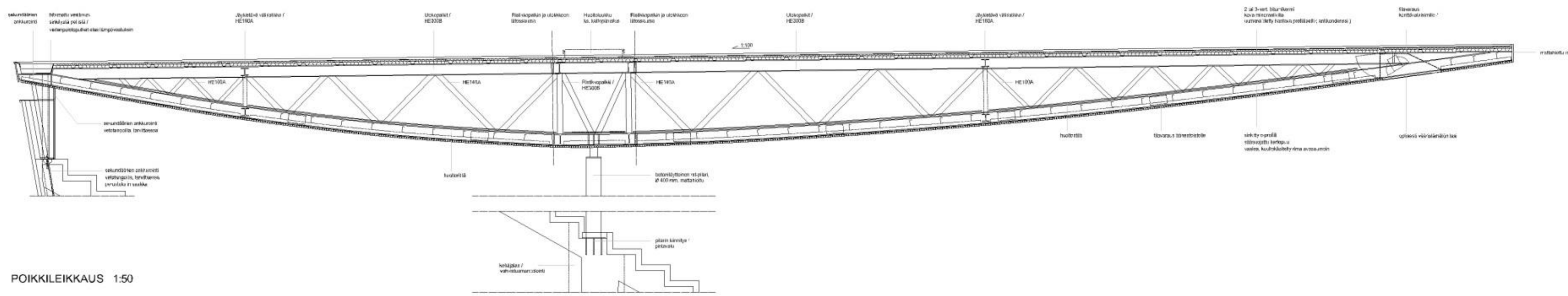
roof plan 1:400



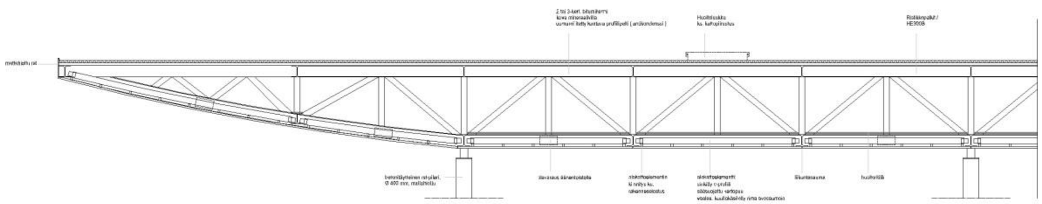
sections A-I 1: 200







POIKKILEIKKAUS 1:50



PITUUSLEIKKAUSOTE 1:50

JULKISIVUOTE 1:50

Olympiastadion perusparannus ja laajennus
Arkkitehtitoimisto K2S Oy ja NRT 2020

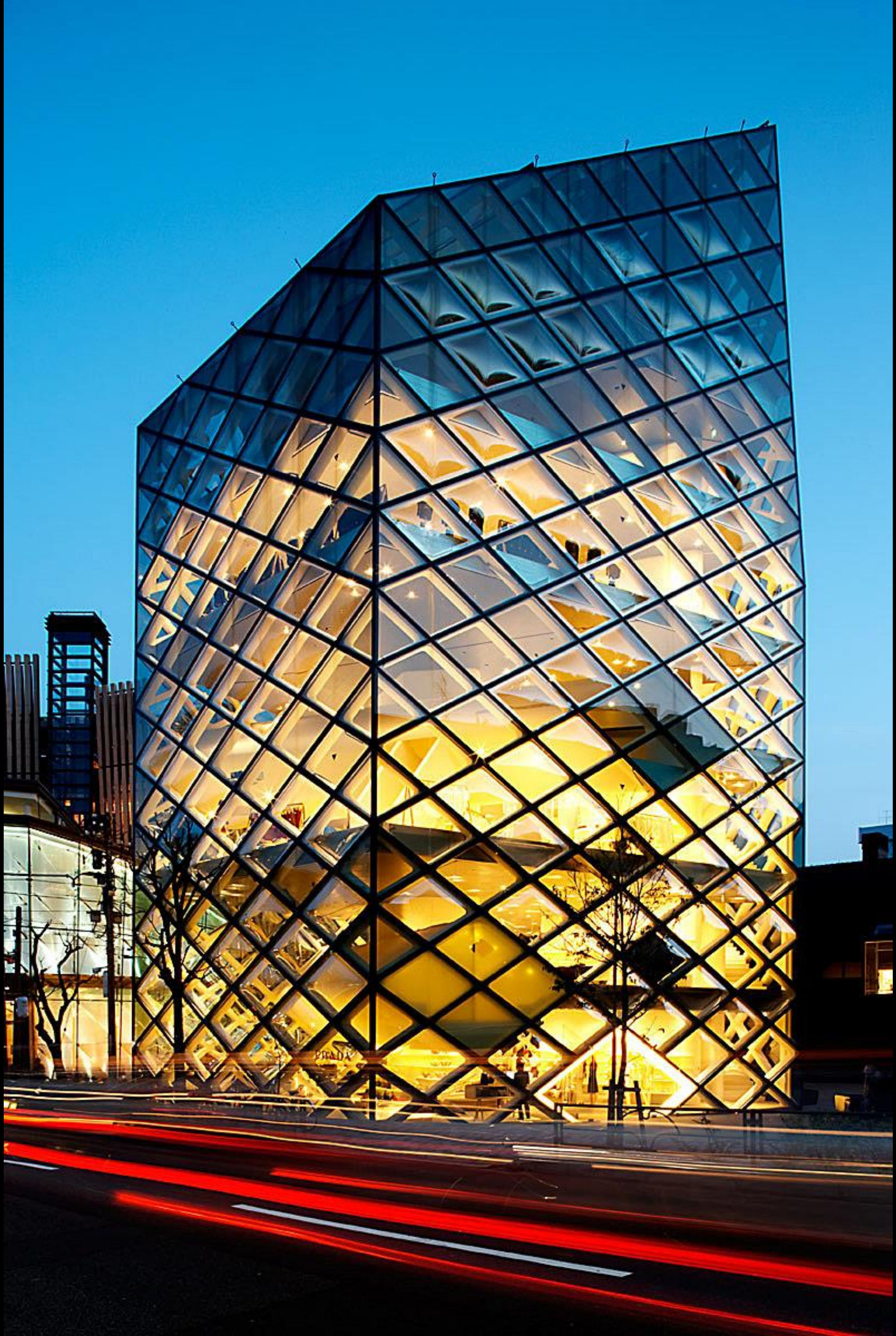
Olympiastadion perusparannus ja laajennus
Arkkitehtitoimisto K2S Oy ja NRT 2020

Olympiastadion perusparannus ja laajennus
Arkkitehtitoimisto K2S Oy ja NRT 2020

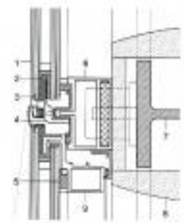

Olympiastadion perusparannus ja laajennus
Arkkitehtitoimisto K2S Oy 2020


YHDESSÄ ILON PUOLELLA
VEIKKAUS
YHDESSÄ ILON PUOLELLA
VEIKKAUS
YHDESSÄ ILON PUOLELLA
VEIKKAUS

VERKKOMAISET RAKENTEET

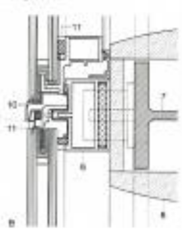


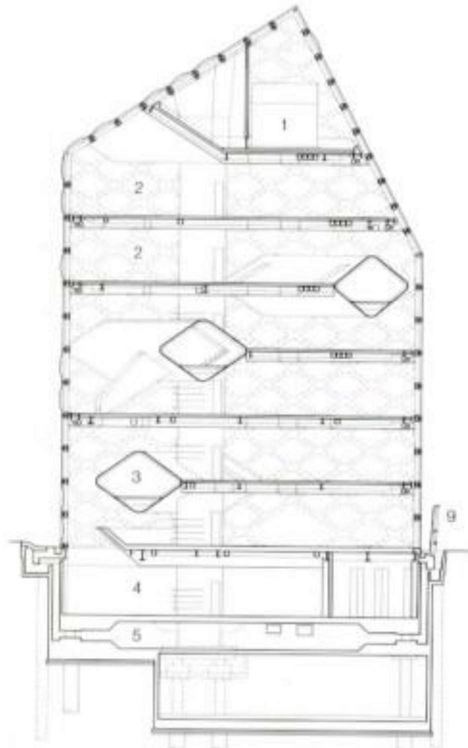
Prada Tokyo – Herzog de Meuron 2003



1 rautenförmige Glaselemente eben, konvex oder konkav gebogen 3200/2000 mm:
Float 12 mm Rand punktuell mit diamantgefräster Nut + SZR 16 mm Luftfüllung + VSG 2× 6 mm mit einlaminierter UV-Filterfolie U = 2,6 W/m²K
2 Gleitschiene Edelstahl U-Profil
3 mechanische Sicherung der äußeren Scheibe Halteklammer Edelstahl
4 Halteklammer Verglasung Aluminium l = 34 mm
5 Anpressprofil Silikon
6 diagonale Pfosten-Riegelkonstruktion Aluminium
7 tragende Fassade Stahlprofile HEA 250/180 mm
8 Brandschutzverkleidung Calciumsilikat cremefarben matt lackiert mind. 25 mm
9 RWA-Flügel/Notausstieg Aluminium
10 Fugenprofil Silikon
11 Nassversiegelung Silikon
12 Kantenprofil Silikon
13 Klemmprofil Aluminium
14 Unterkonstruktion Schweißprofil Stahlblech 8–20 mm
15 Aluminiumgleitschiene

1 3.20/2.00 m rhomboid glazing elements, flat, convex and concave: 12 mm float glass with diamond-cut grooves in edges for fixing + 16 mm air-filled cavity + 2× 6 mm lam. safety glass with UV-filter film between laminations (U = 2.6 W/m²K)
2 stainless-steel sliding track
3 stainless-steel mechanical fixing of outer pane
4 aluminium fixing clamp 34 mm long
5 silicone compression strip
6 aluminium diagonal post-and-rail facade
7 180/250 mm steel I-section structural facade member
8 25 mm (min.) calcium silicate fire-resisting cladding
9 aluminium smoke-extract flap/emergency exit
10 silicone jointing strip
11 silicone wet seal
12 silicone arris strip
13 aluminium fixing piece
14 8–20 mm welded sheet-steel supporting sections
15 aluminium guide track





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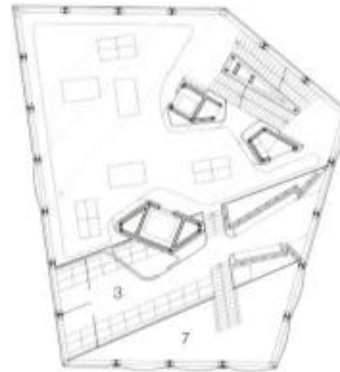
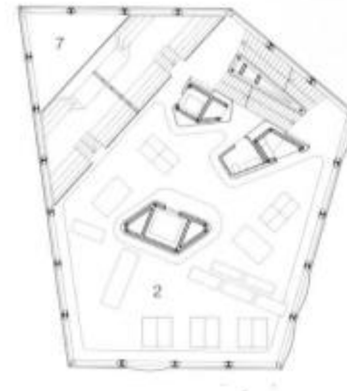
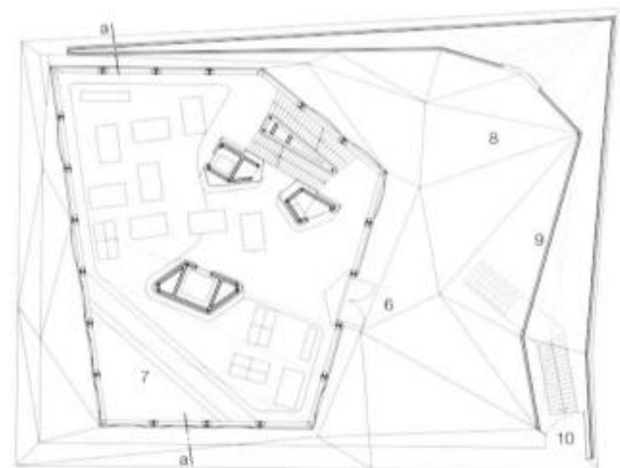






Herzog & deMeuron

Although the structure penetrates everything, its effect is neither intrusive, nor immediately comprehensible. The single structural elements have not been left naked, as seen on the pictures of the construction site. The photographs show that everything is made of steel, as in a ship.

On these pages and on the following ones: construction site, Tokyo, July-December 2002

The structure could not have remained unclad in any case due to fire safety regulations, although, more importantly, we felt its raw materiality was inappropriate for a place where looking, presenting and ultimately touching are central issues.

We chose to follow a radically different path and turned the structure into its almost diametric opposite by cladding it. To be more precise, this is a kind of layering rather than cladding, somewhat like the layers of plant matter that cover rock surfaces in natural surroundings. Similarly, we have placed an organic layer on the structural components.

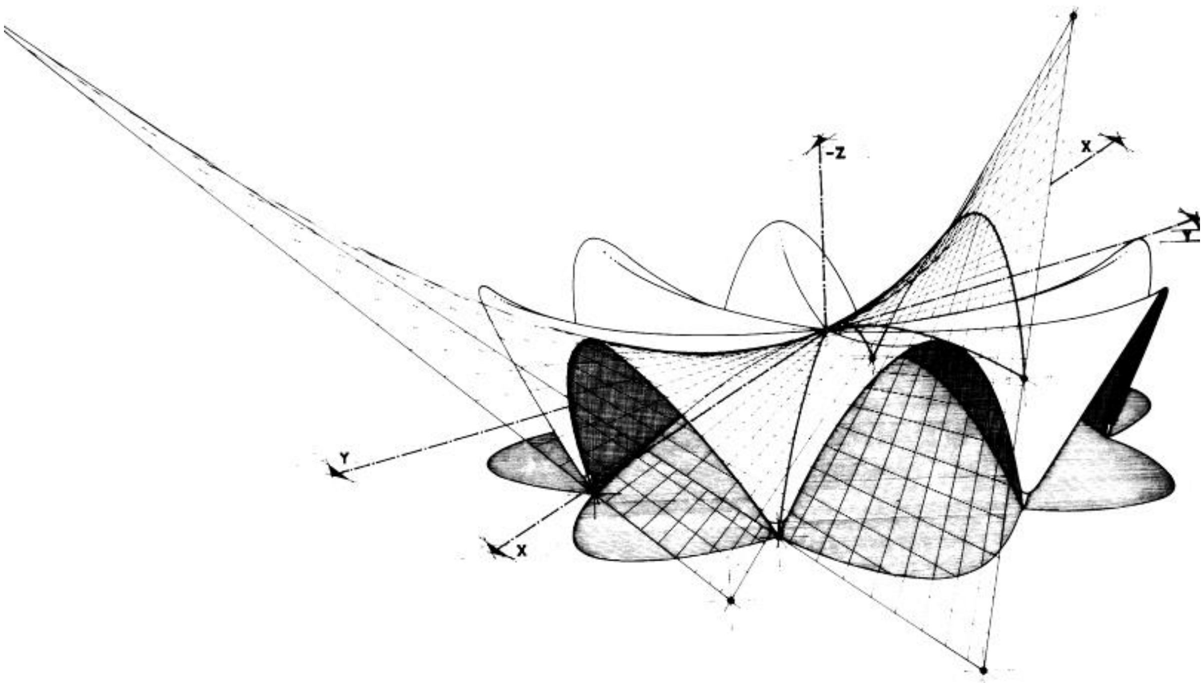
Construction site, Tokyo, August 2002


D&G

Court of British museum in London – Norman Foster 2000

Montreal Biosphere – Buckminster Fuller 1967

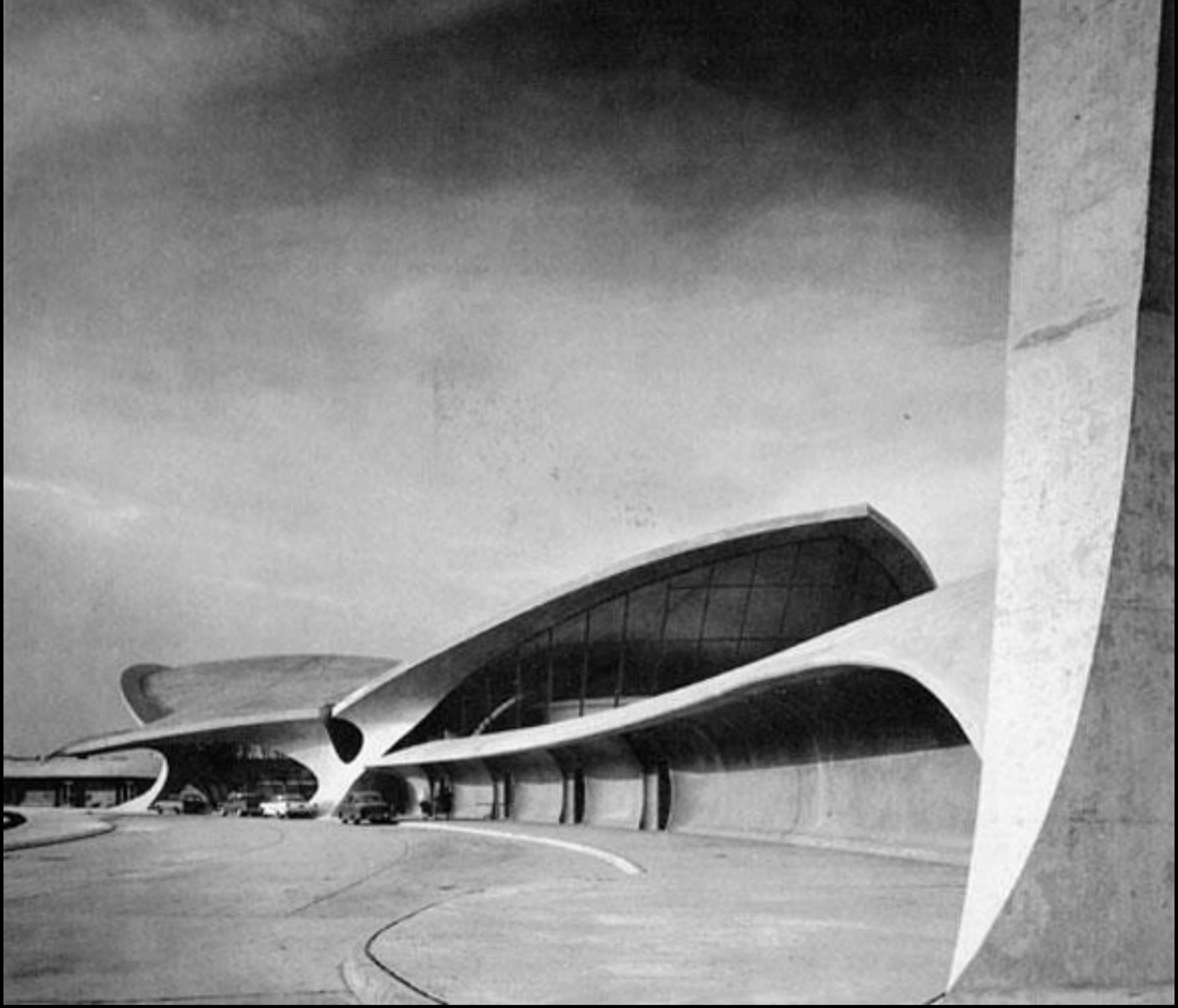
KUORIRAKENTEET



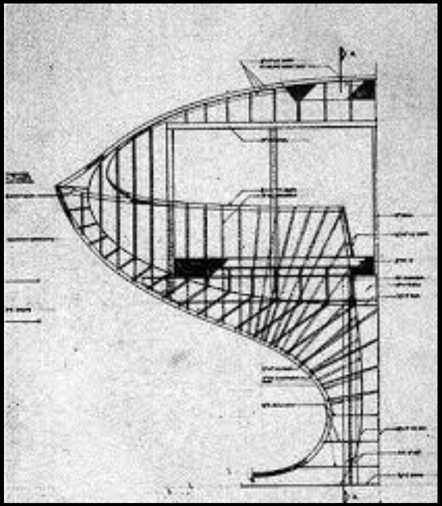
-Z
X
Y
Y
X

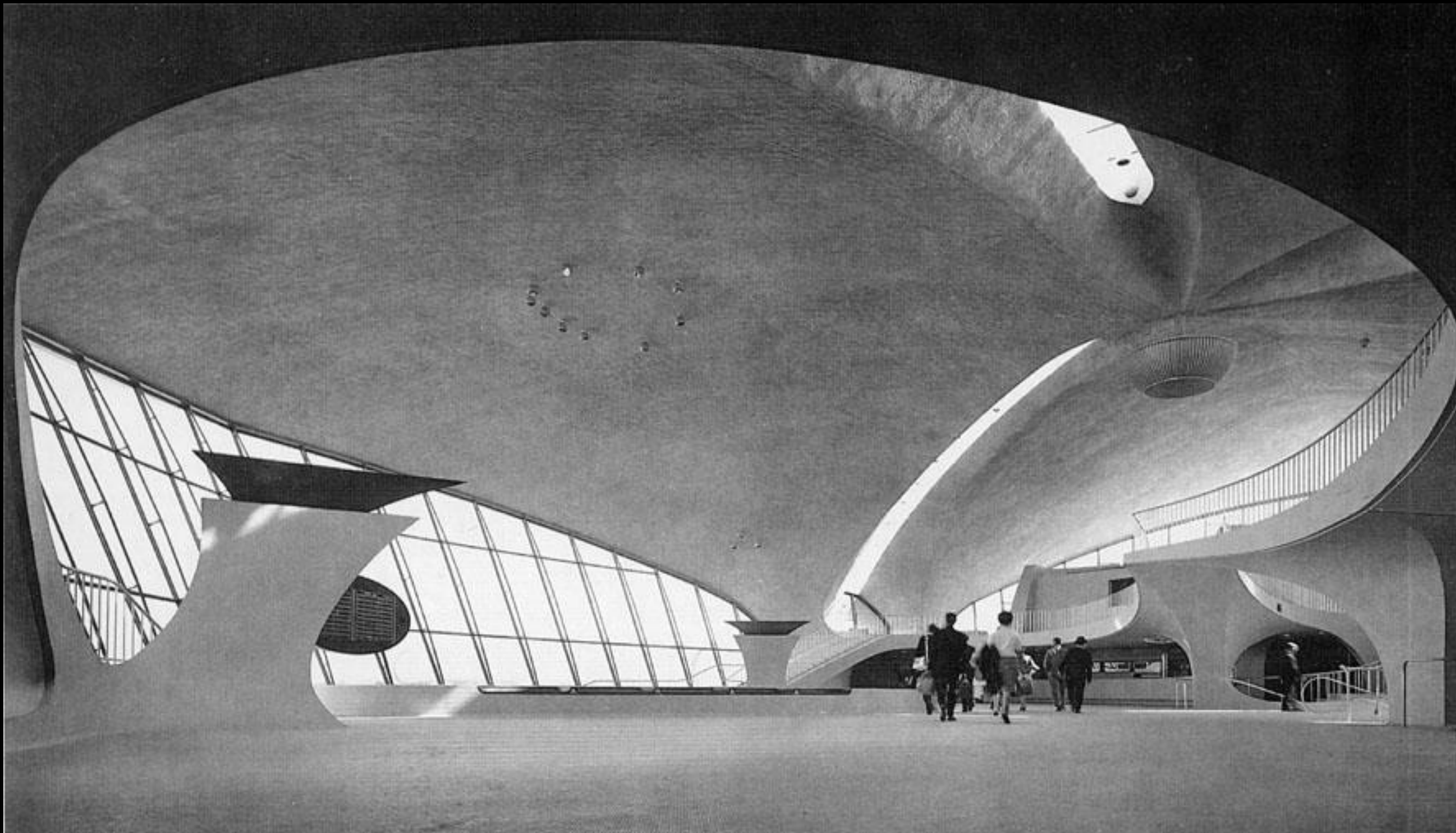
L’Oceanogràfic Valencia – Félix Candela 2002


PANTHEON, ROME



TWA, JFK New York – Eero Saarinen 1962

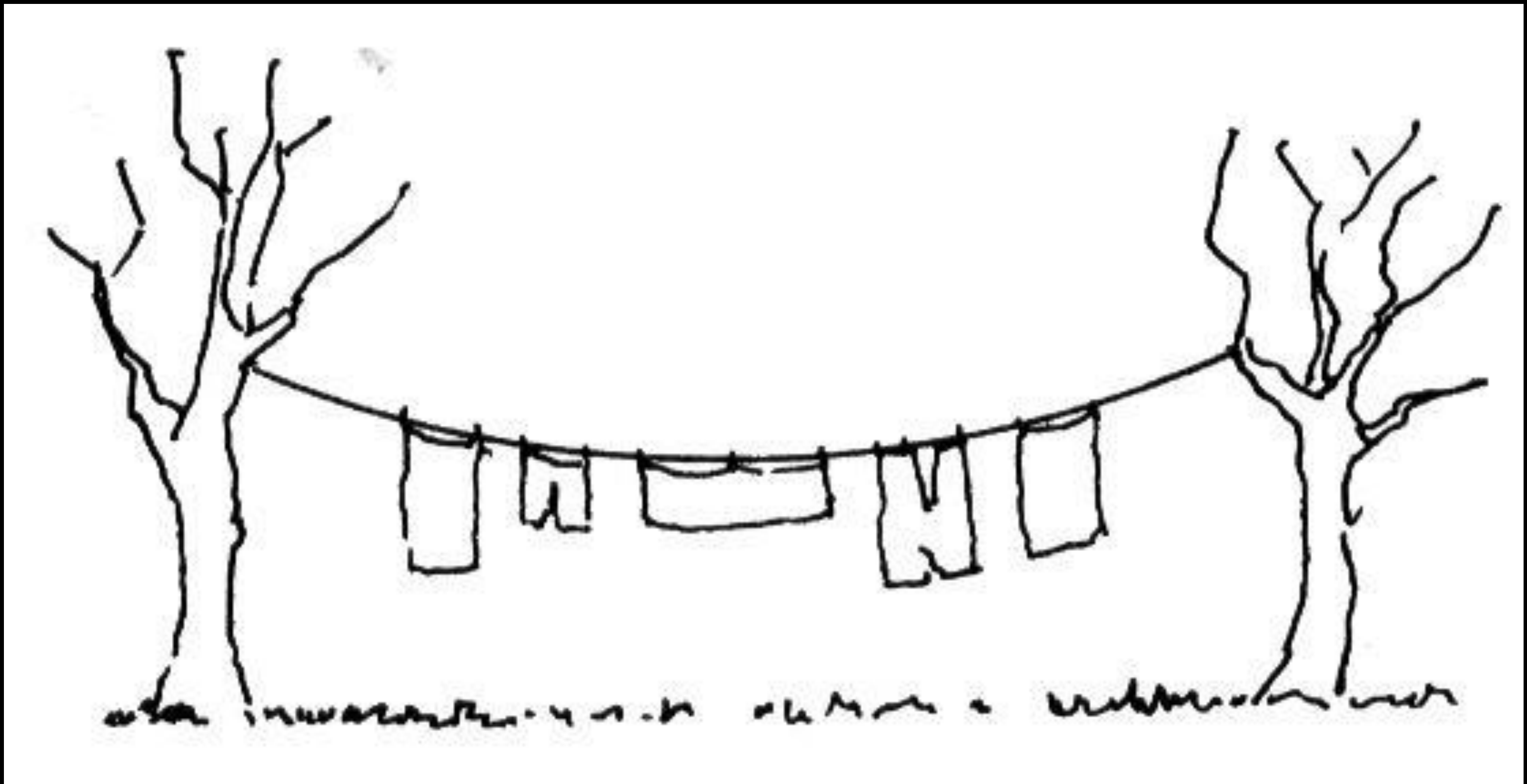
Kresge Auditorium, MIT – Eero Saarinen 1955

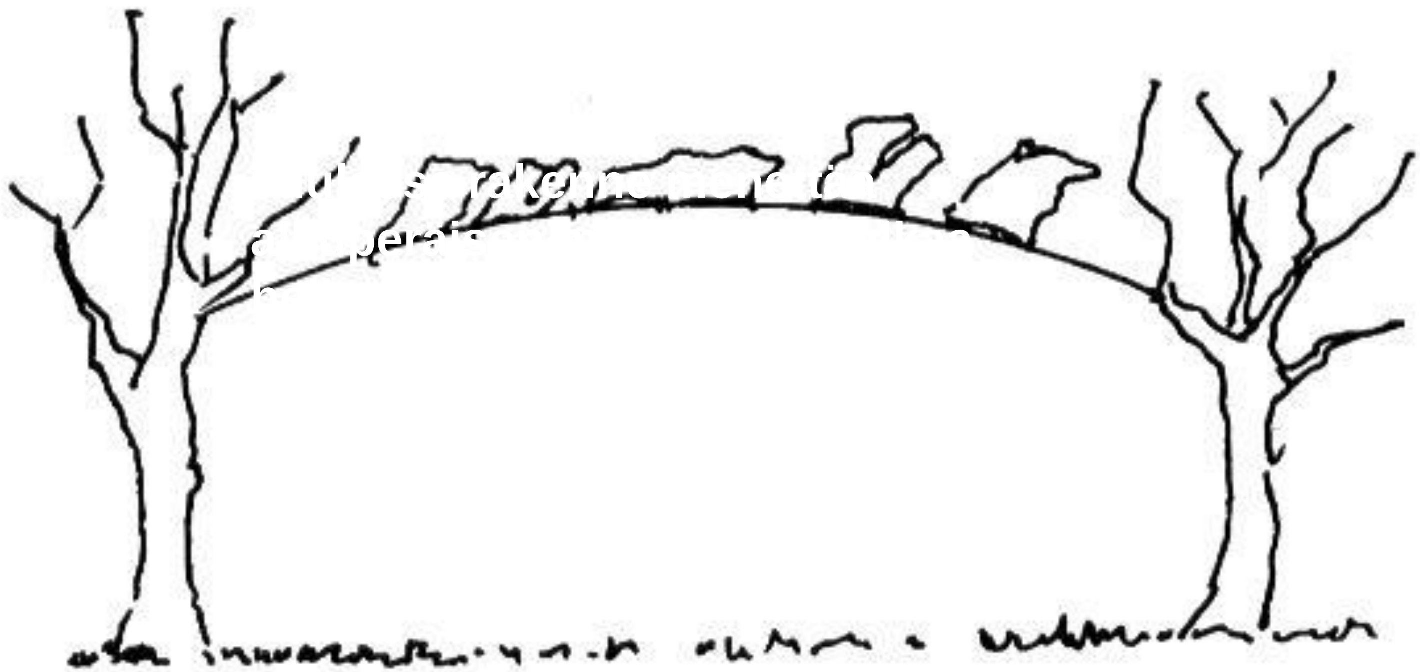
Palazzetto dello sport, Rooma – Pier Luigi Nervi 1957

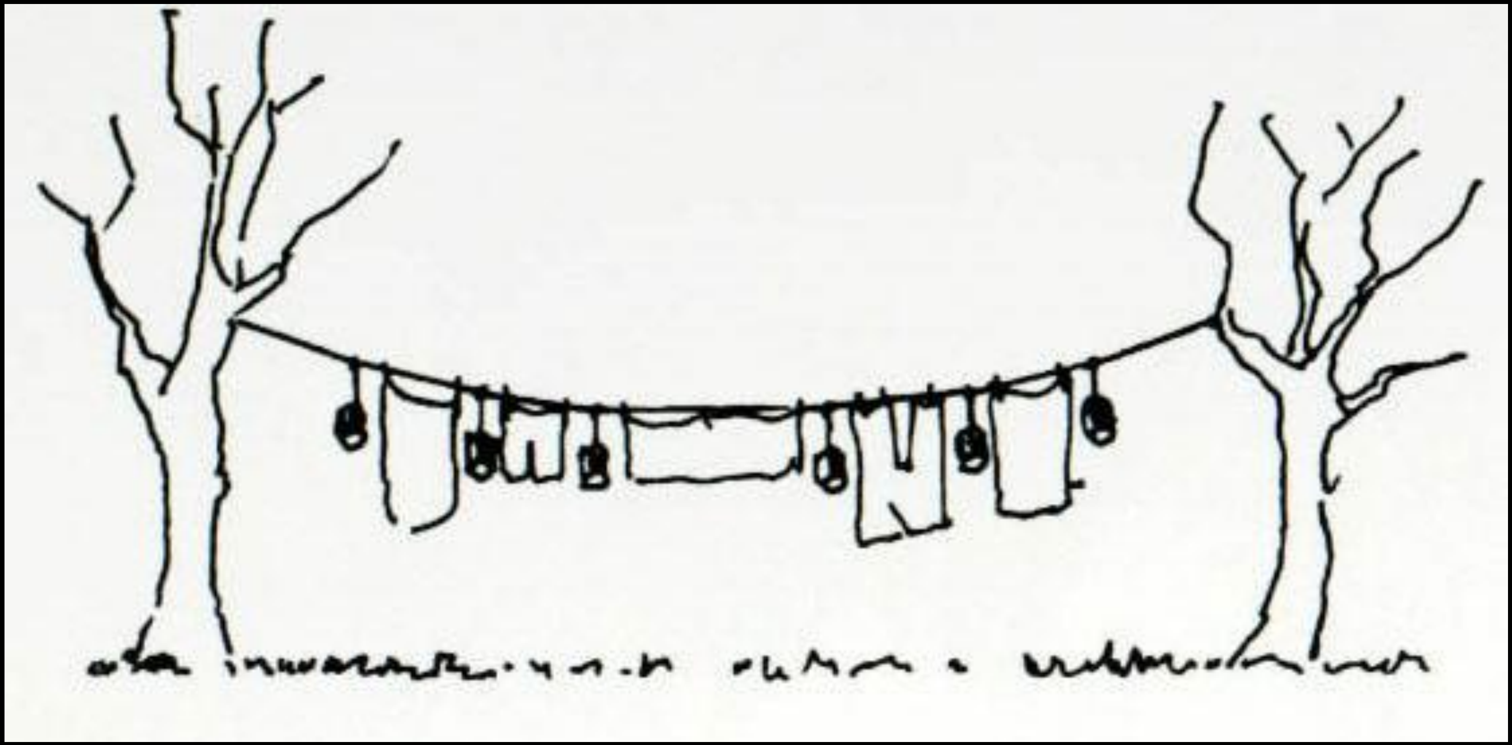
Meiso no Mori, Gifu – Toyo Ito 2006

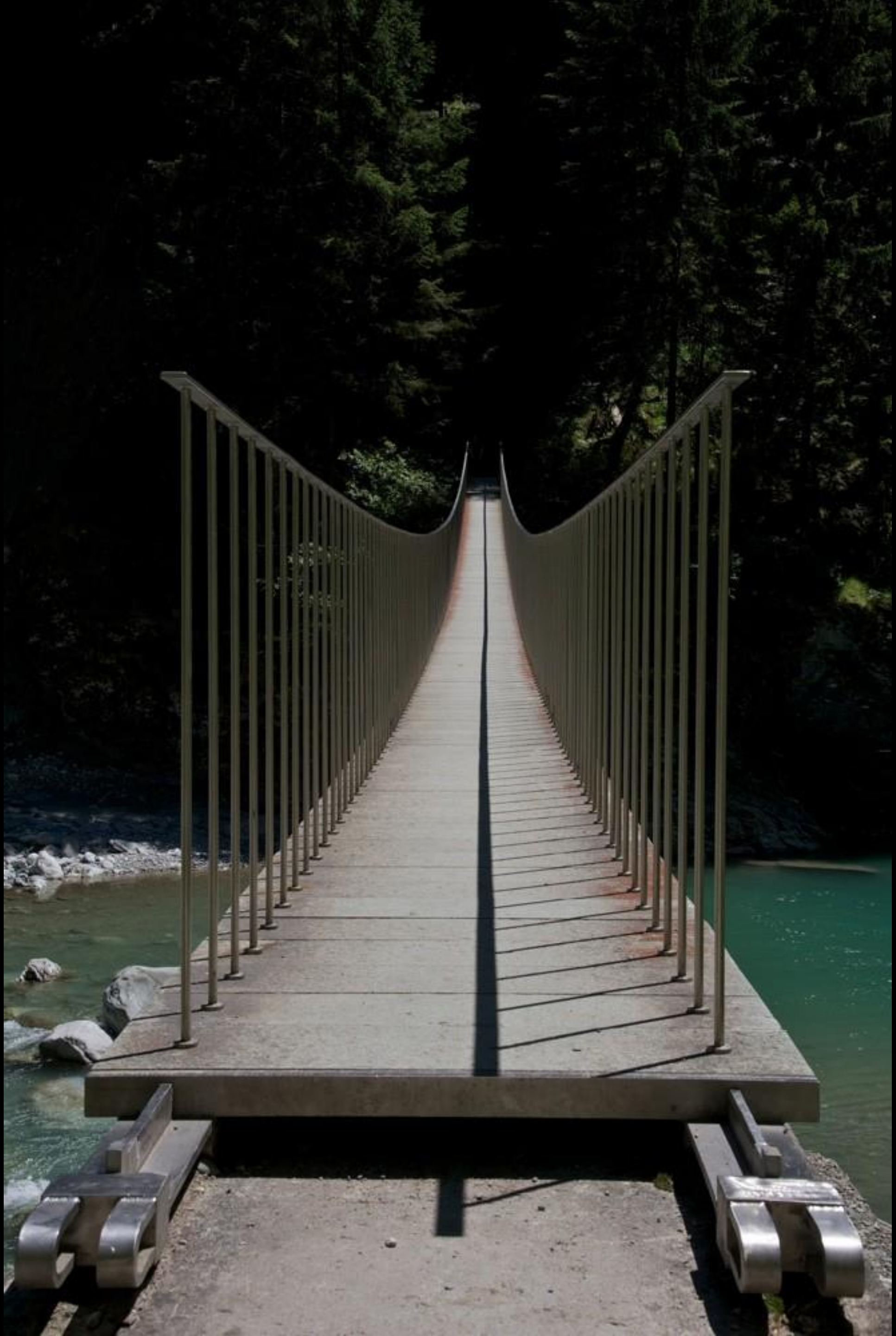
Teshima Art Museum, Kagawa – Ryue Nishizawa 2010

JÄNNITETYT RAKENTEET

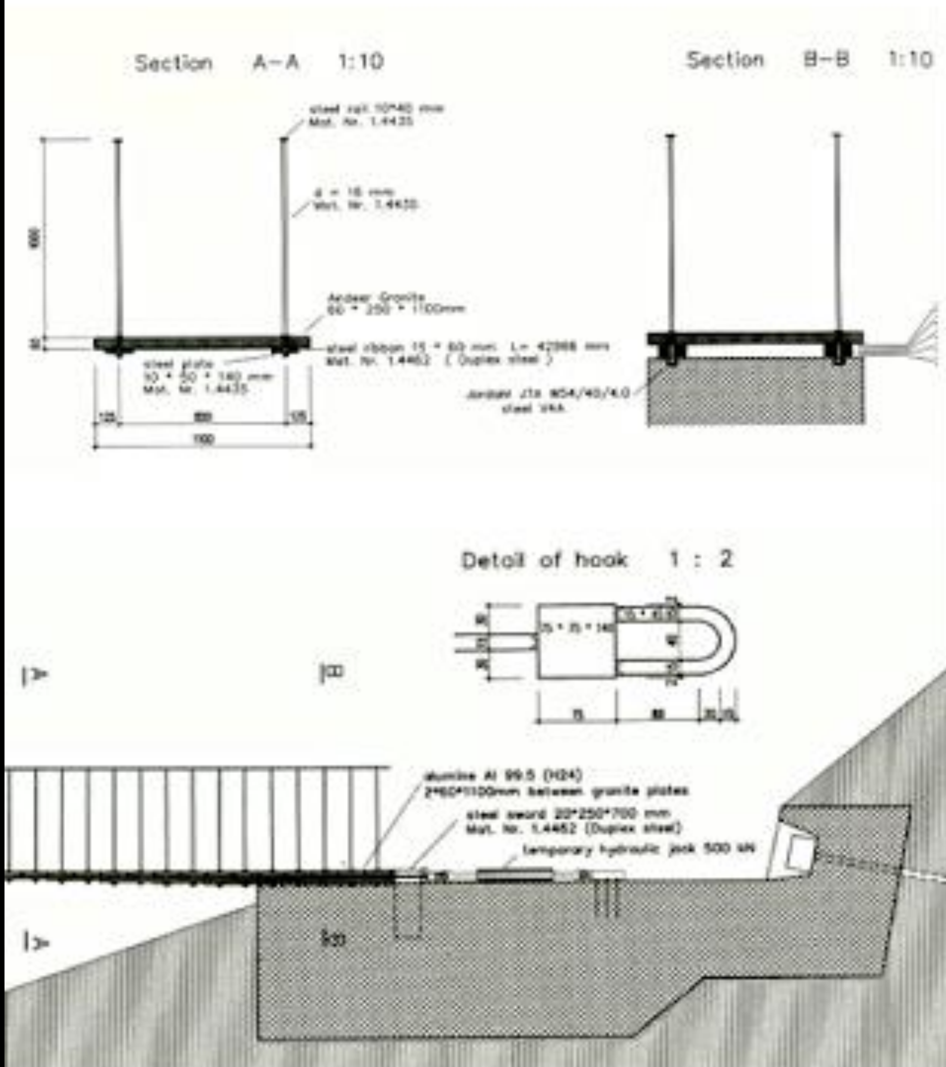


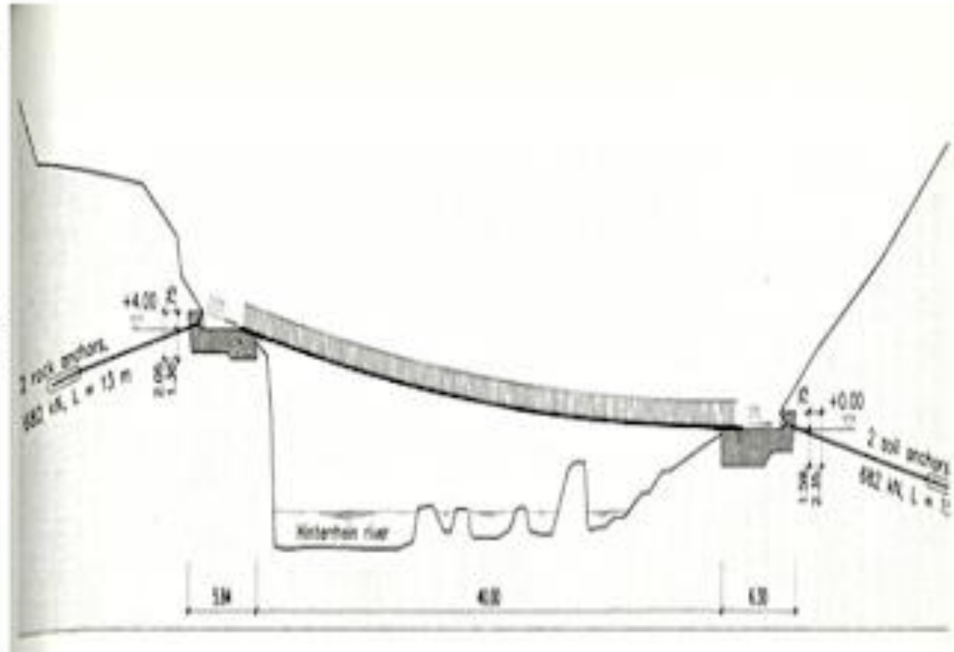






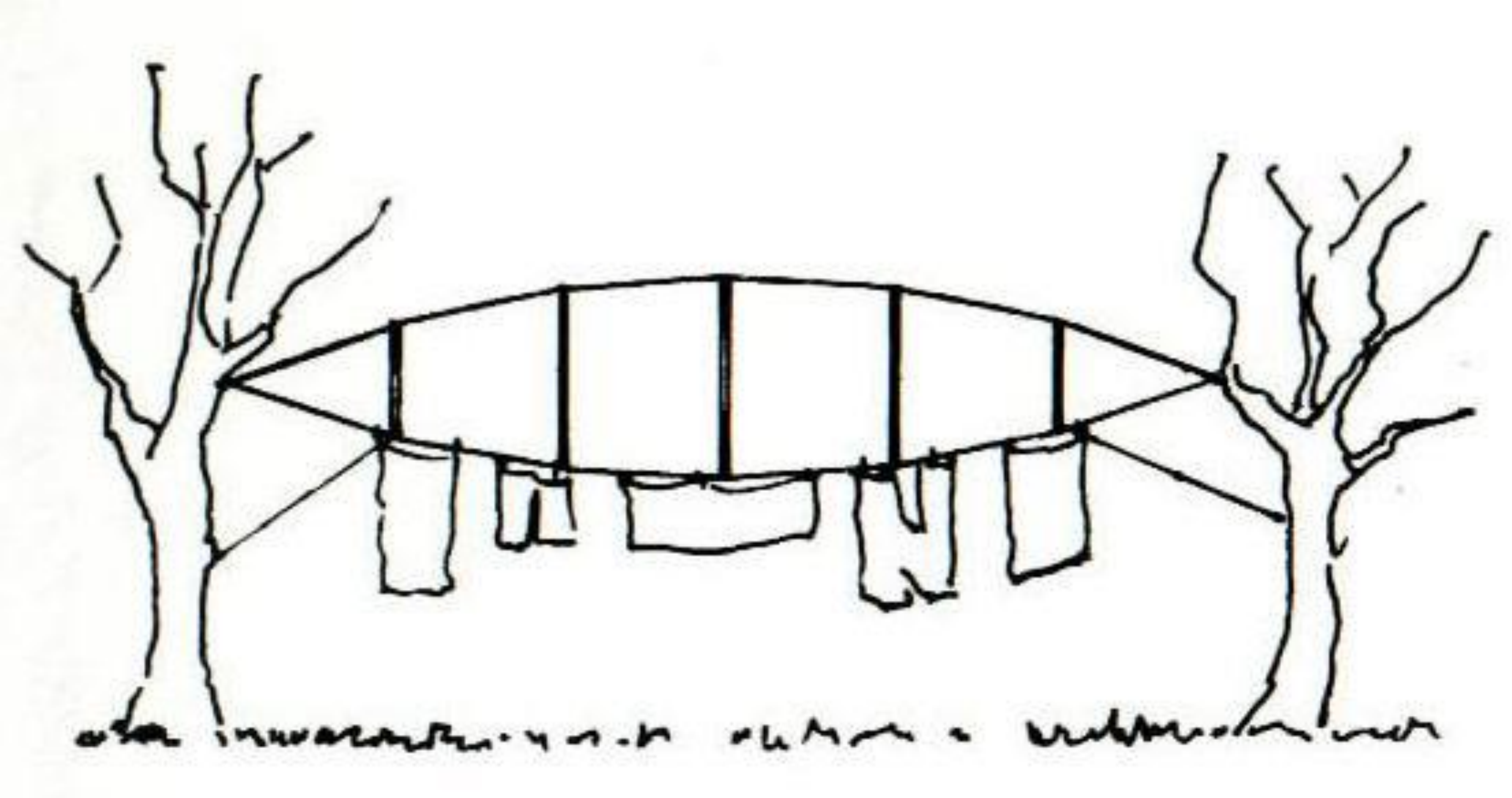
Punt de sarasuns – Conzett, Bronzini, Gartmann AG



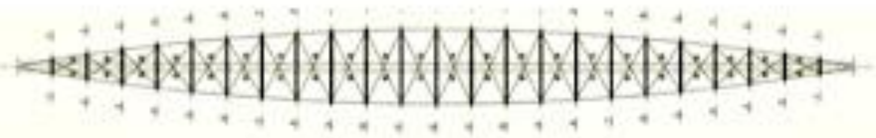


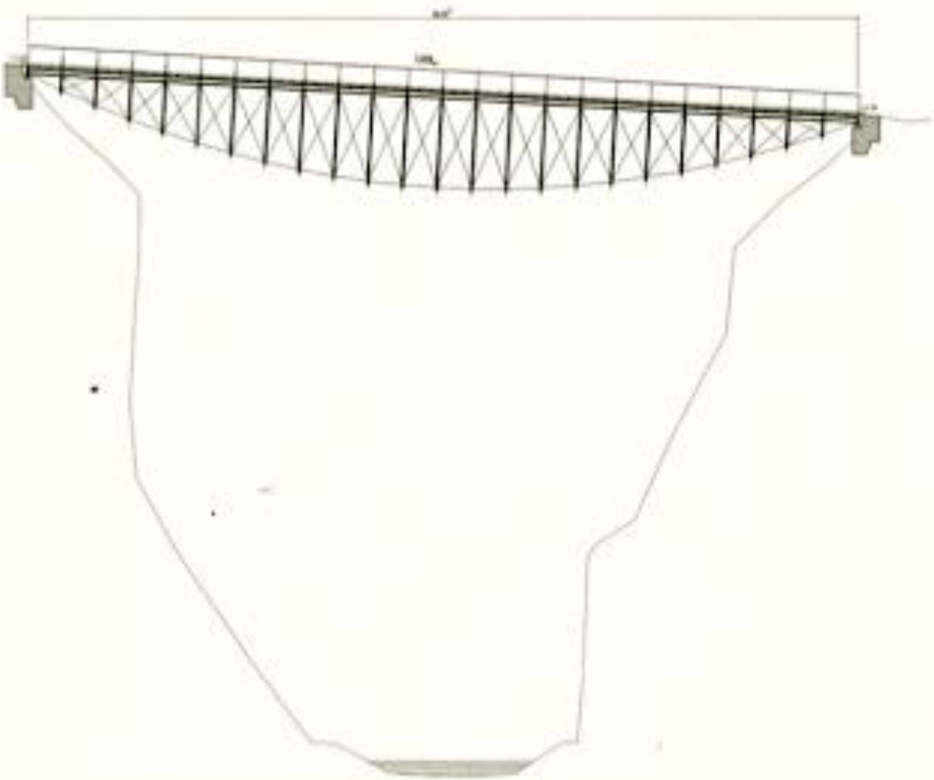
The structural behaviour of the stress-ribbon is a combination of supporting cable and stiffening beam. The actual flexural stiffness of the stone slabs when pressed together was measured in a test rig made up of five stone slabes.

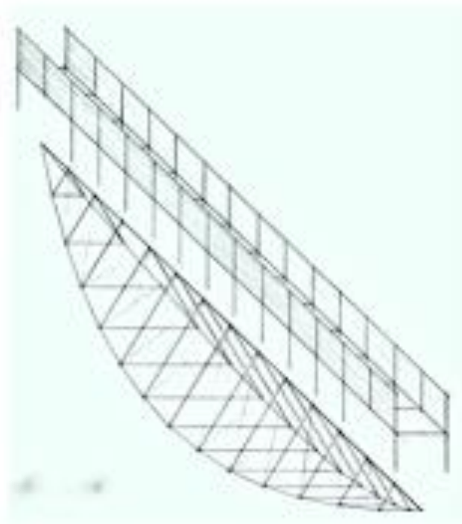
Pavilhao de Portugal, Lisbon – Alvaro Siza



Traversina bridge – Jurg Conztt

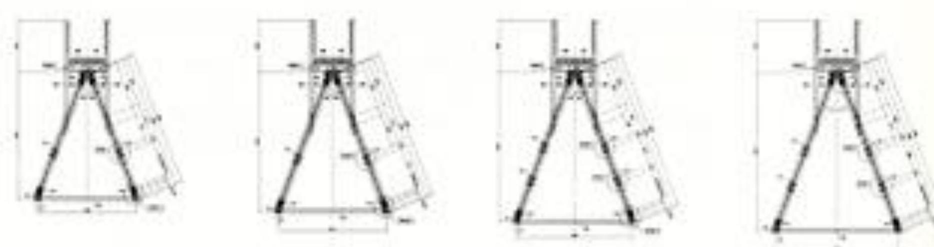


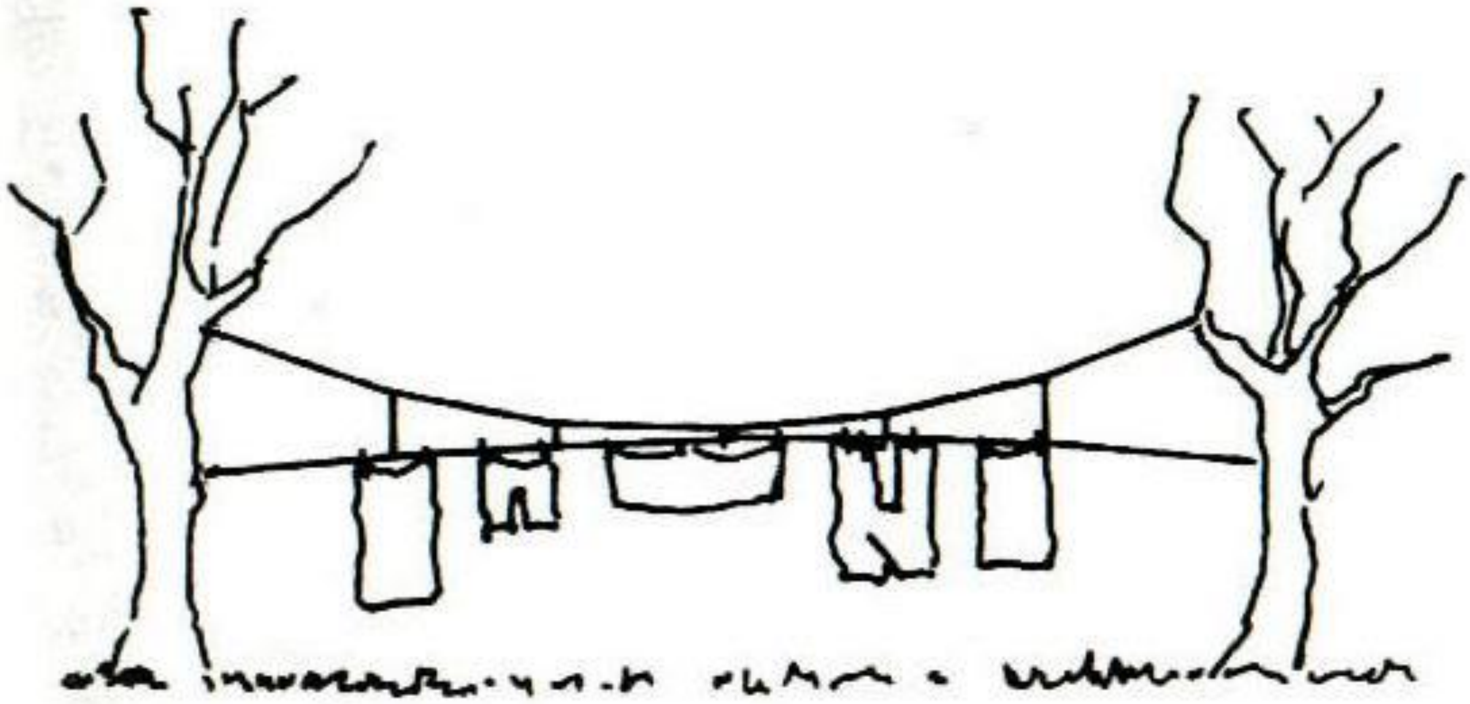




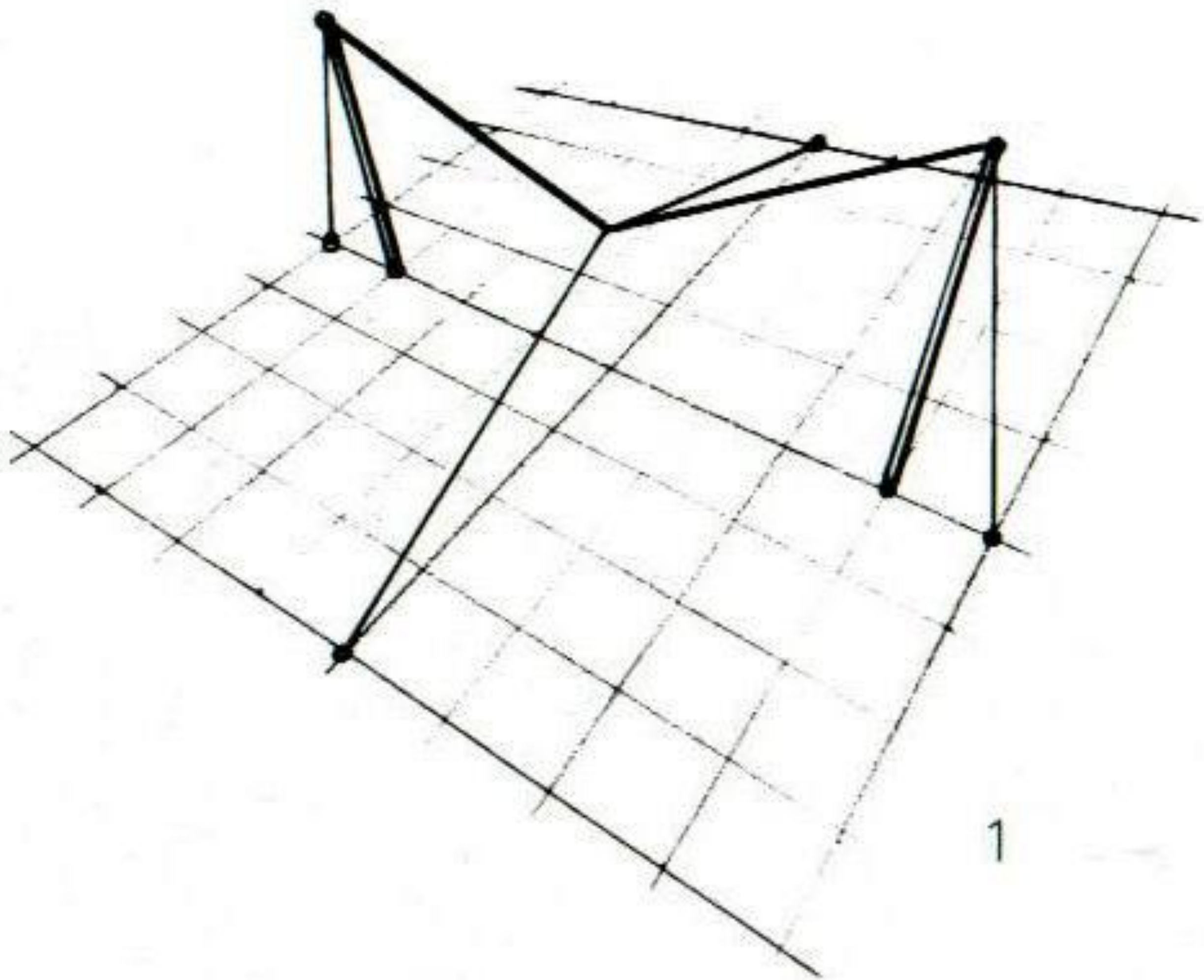
The bridge was made of only larch wood and non-corrosive steel cables. The structure of the bridge consists of a prabolic trus system where the triangular trusses get smaller on the ends, causing the two cables at each of the bottom vertices of the triangle to curve in a parabola.

There are a total of 23 struts created by theses triangles. The triangular trusses are connectd to the girder where each are pinned down by five cables: two that come down from the top vertices and goes up to the top of the next truss, and two cables that criss-cross on the bottom of the bridge. where the parabolic cables are found.





Bridge Sementina & Monte Carasso



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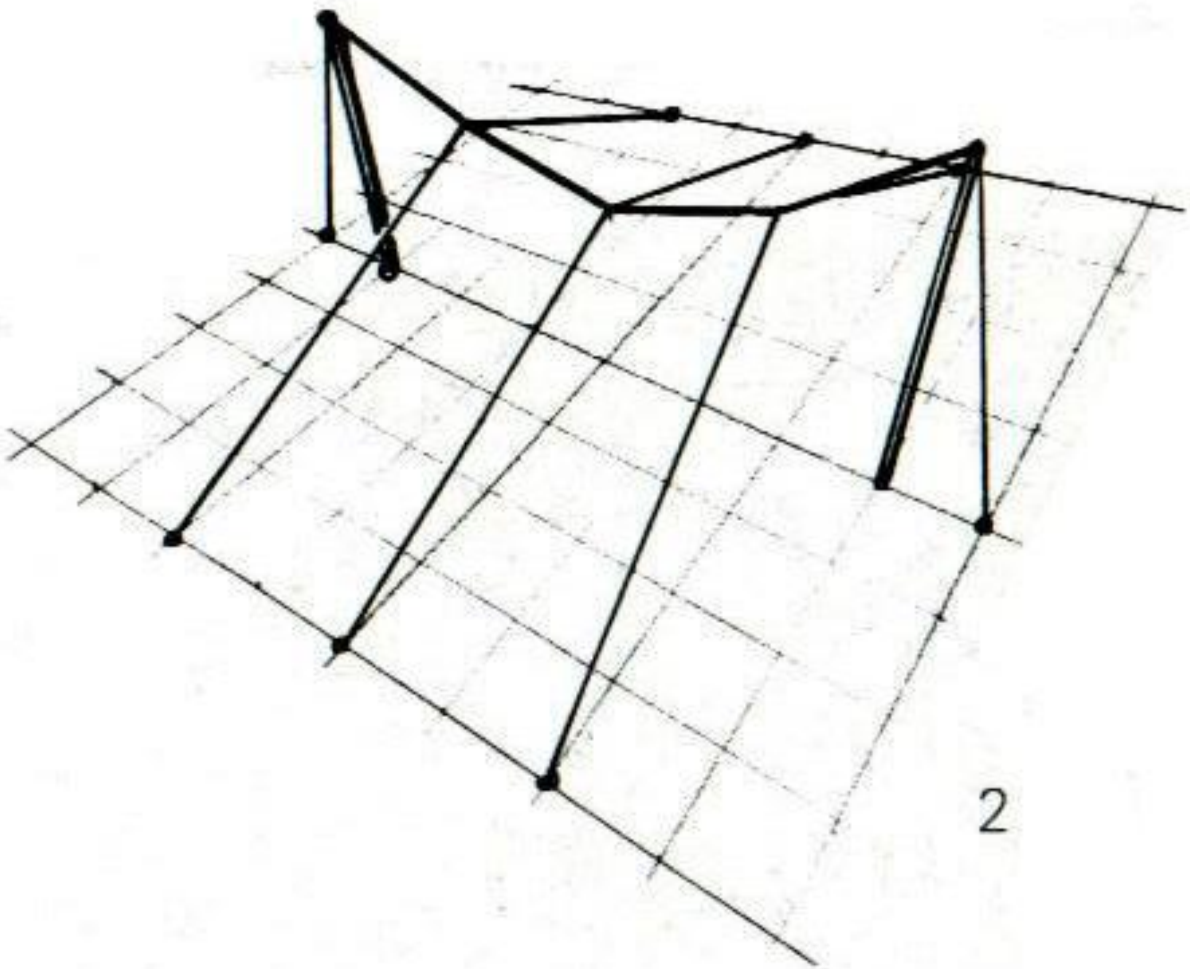

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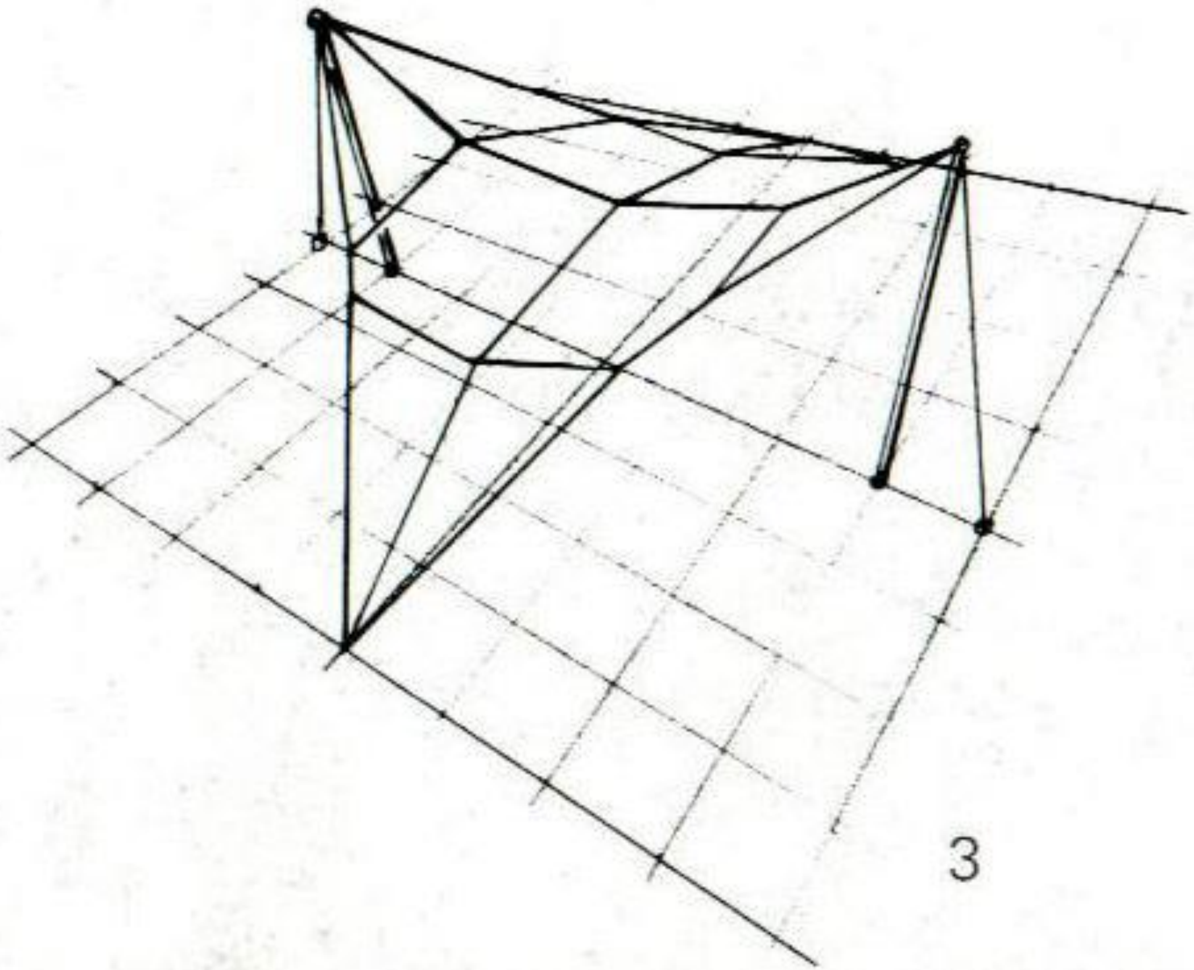

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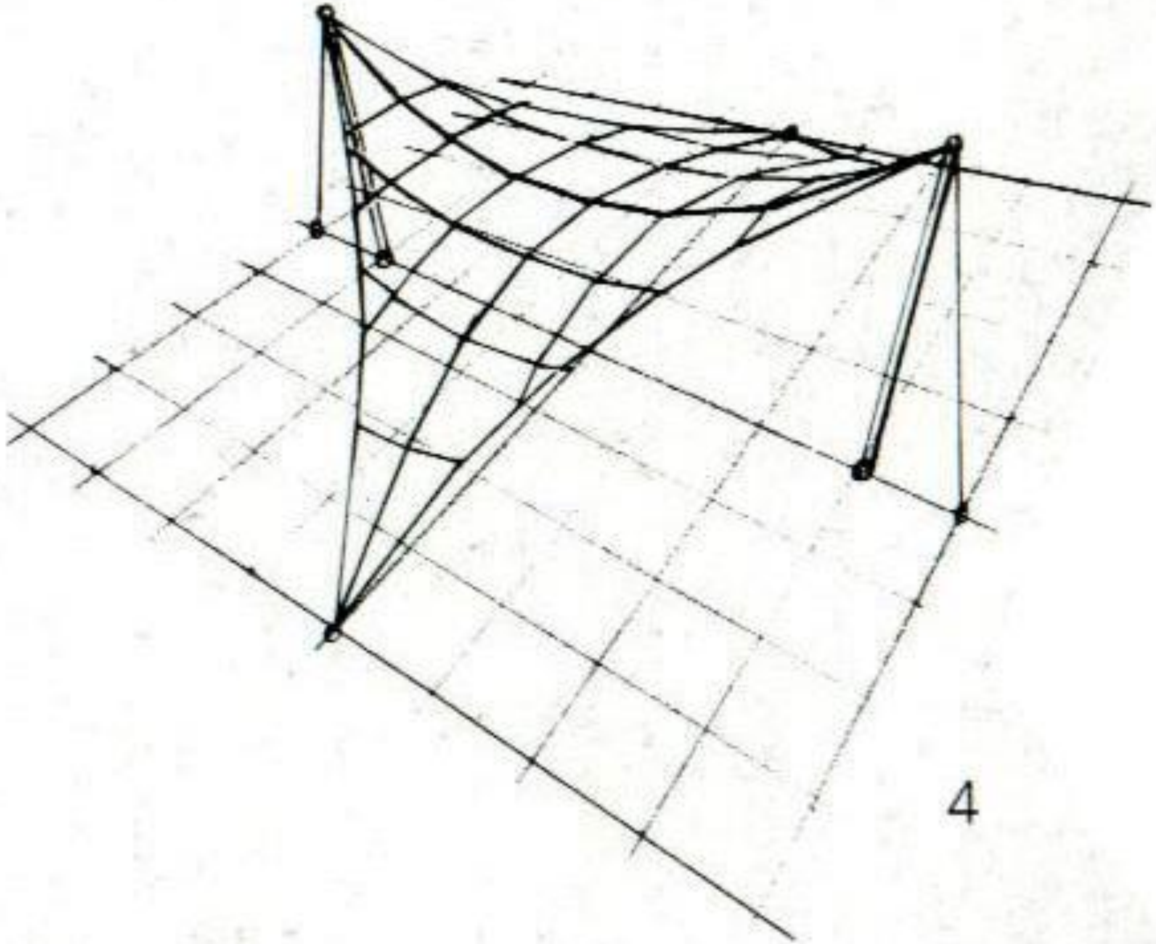

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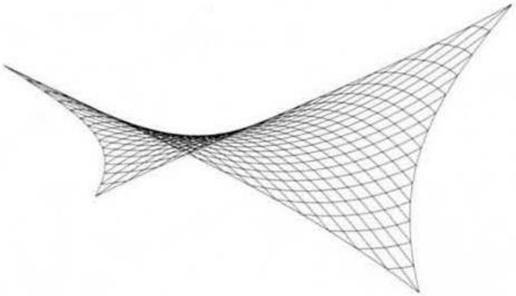
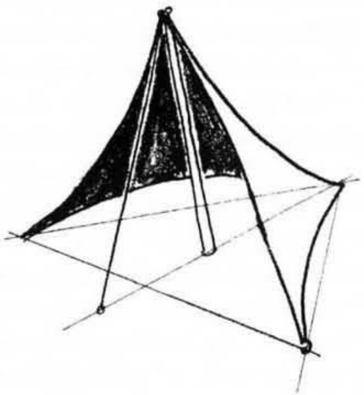


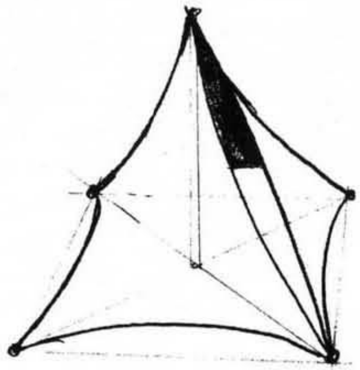
Stress line diagram of a four point structure. [4.13]

Four point structure designed by Frei Otto, Kassel, 1955. [4.14]

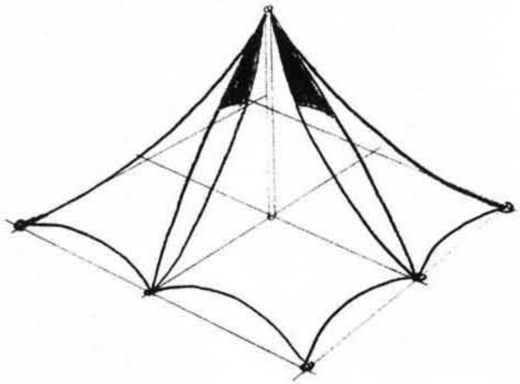
Kassel – Frei Otto 1955



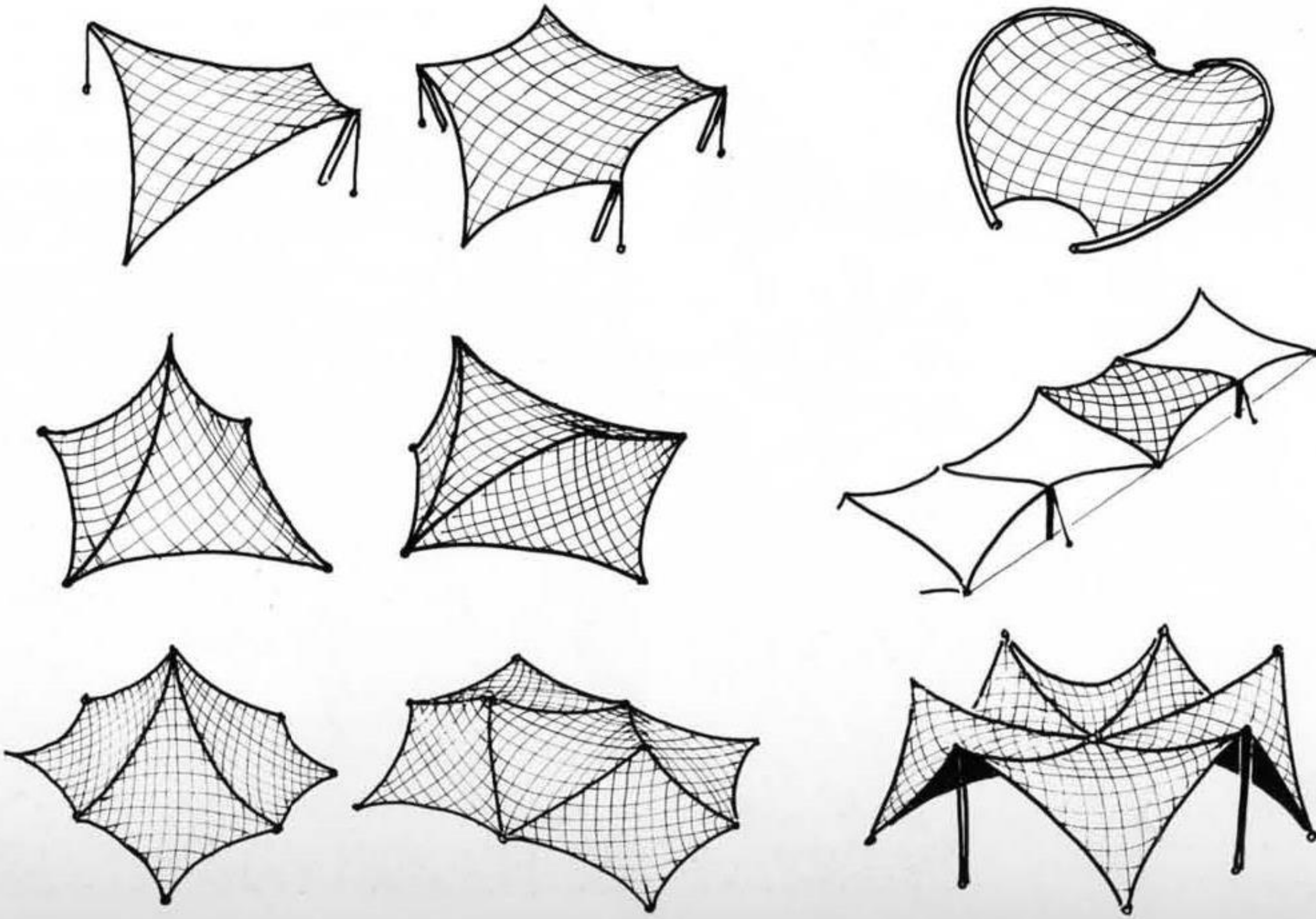
Single four-point structure. Three points share the ground as a common plane. The fourth is created by the pole. [4.17]

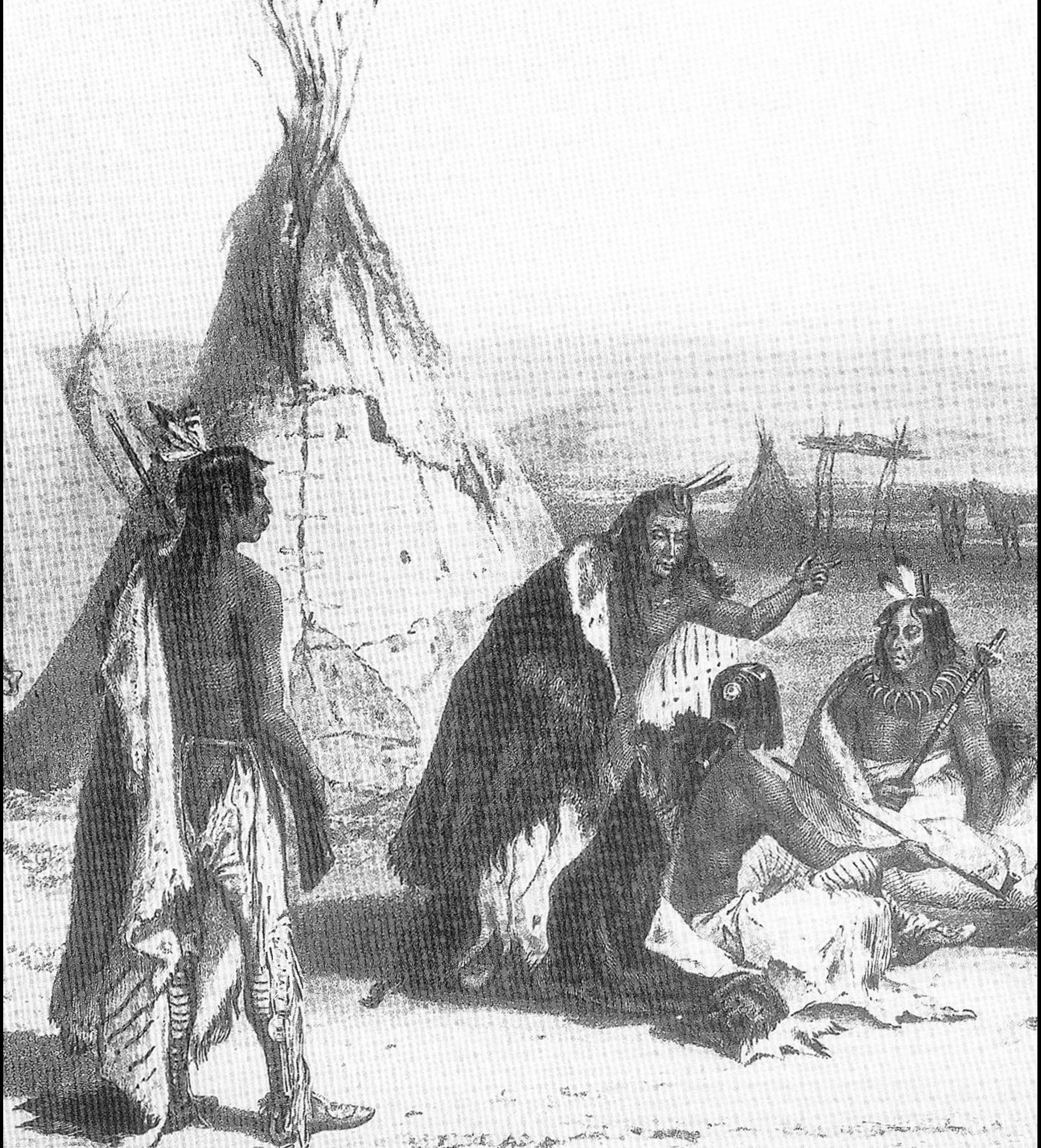


Two four-point structures, held by a single pole, cover a square. [4.18]

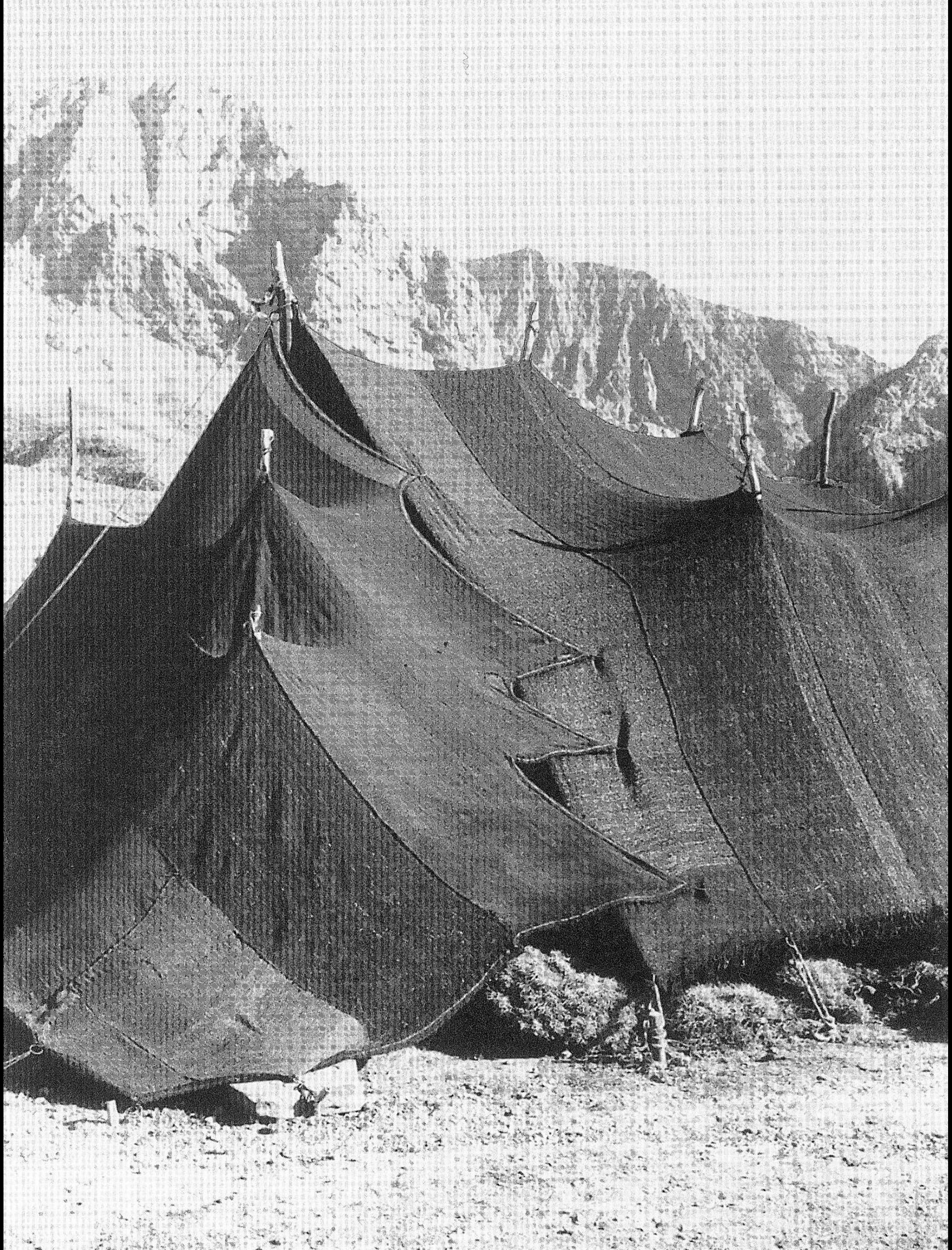


Four four-point structures cover a larger square. One radial cable could replace each pair of adjacent edge catenaries in the slope of the structure. [4.19]

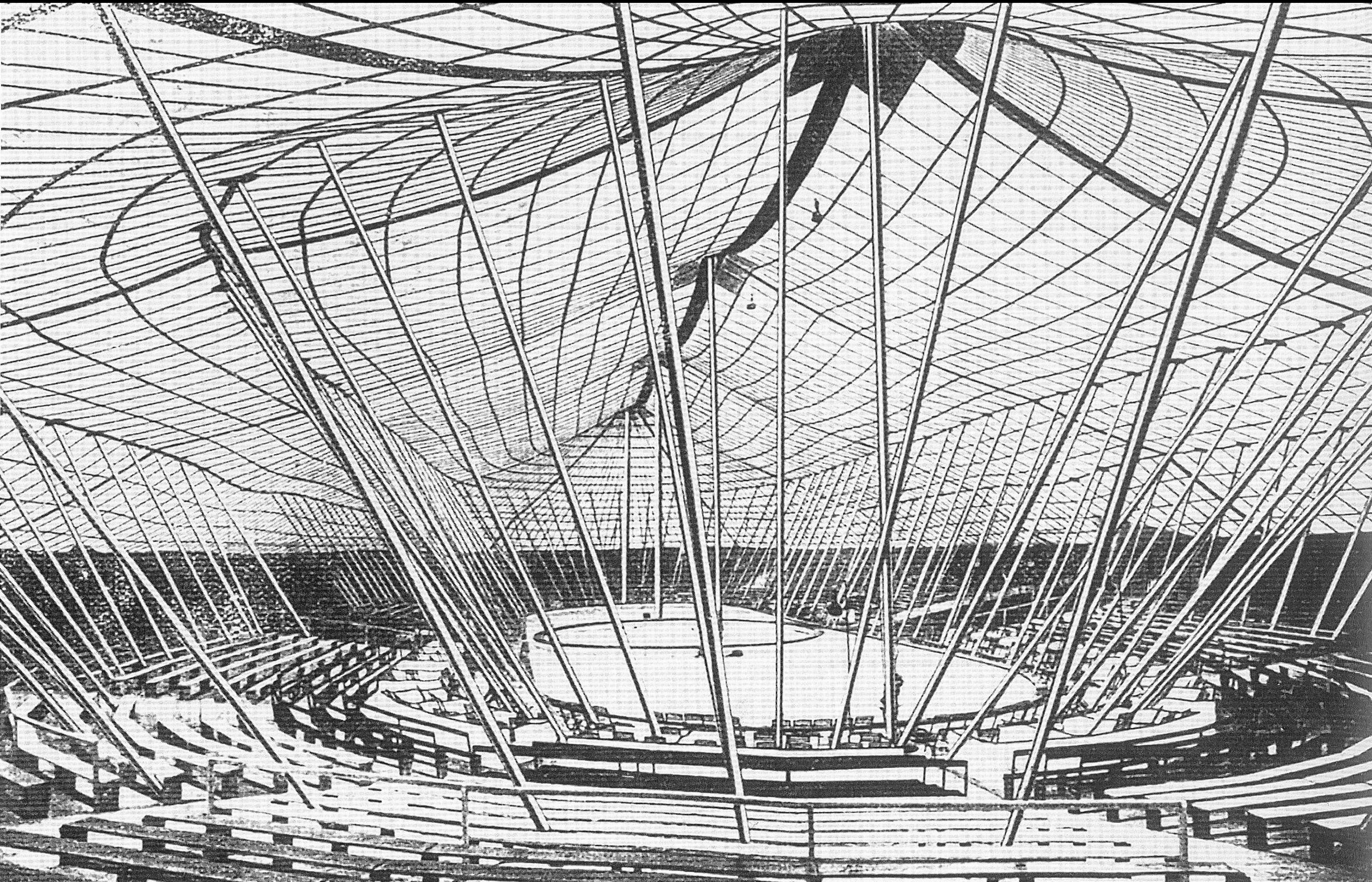




Dakota-intiaaniteltta 1800-luku

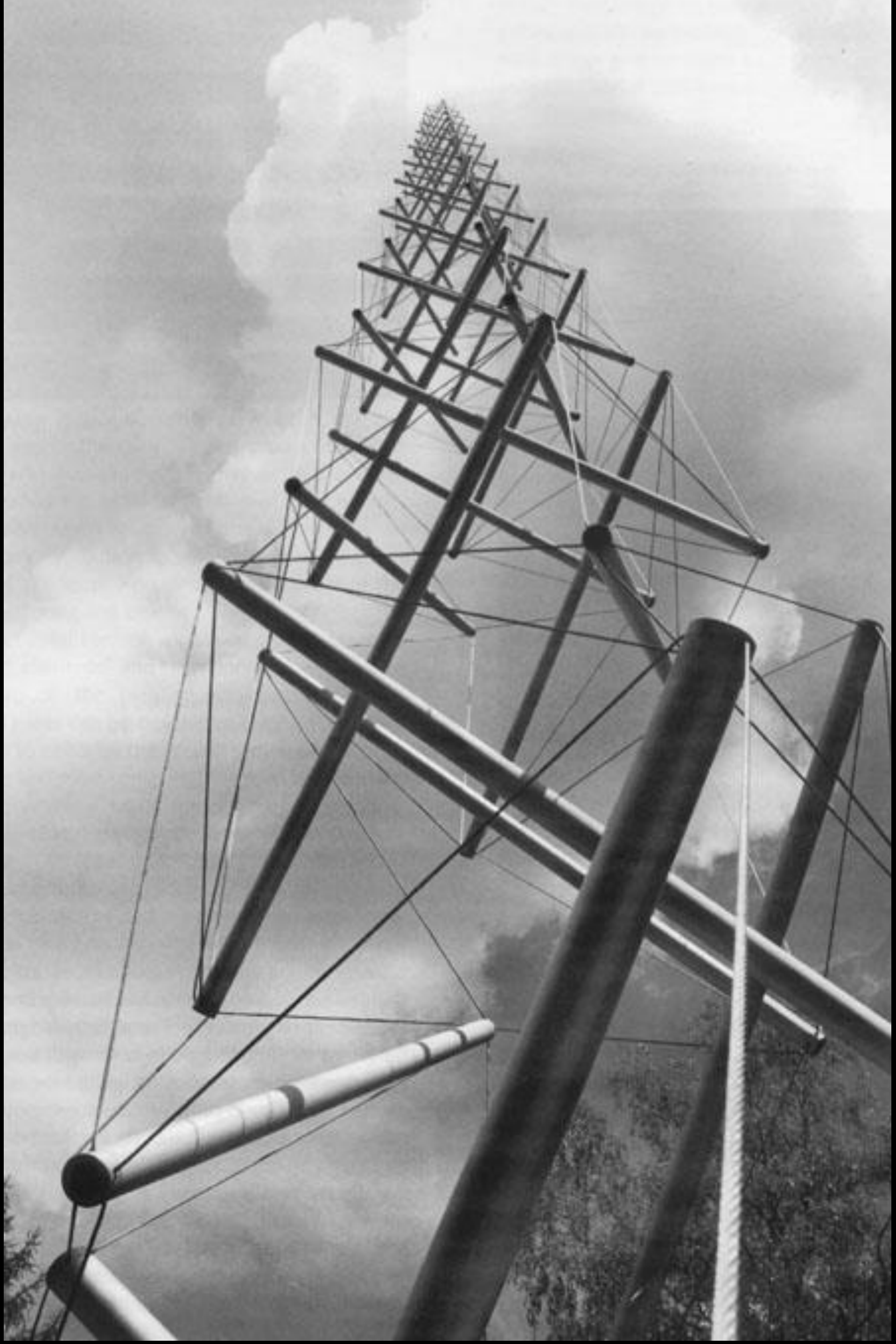


Sangesari-teltta – Pohjois-Iran 1970-luku



Richard Buckminster Fuller 1895 - 1983

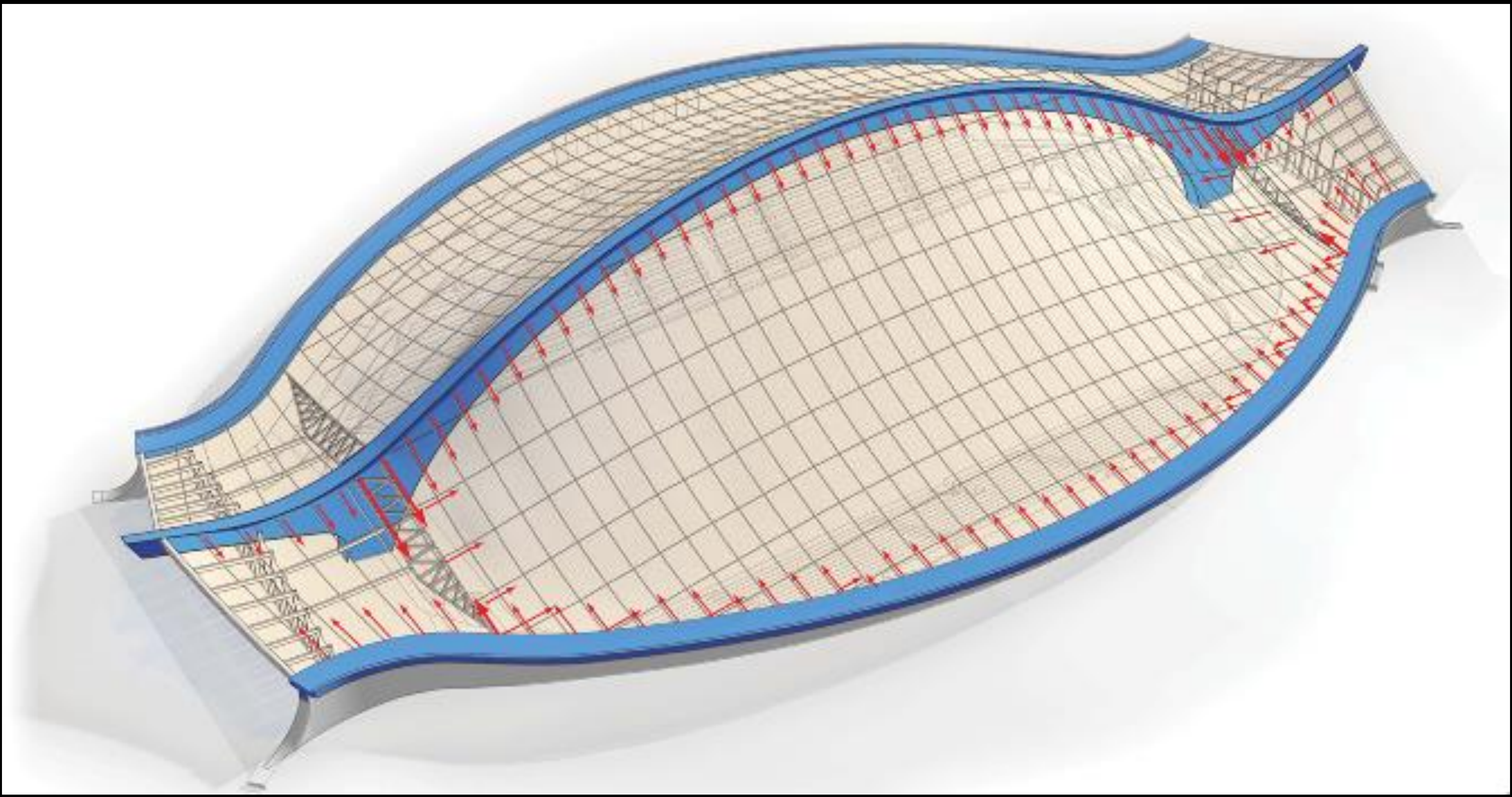
Richard Buckminster Fuller – ”Tensegriteetti”

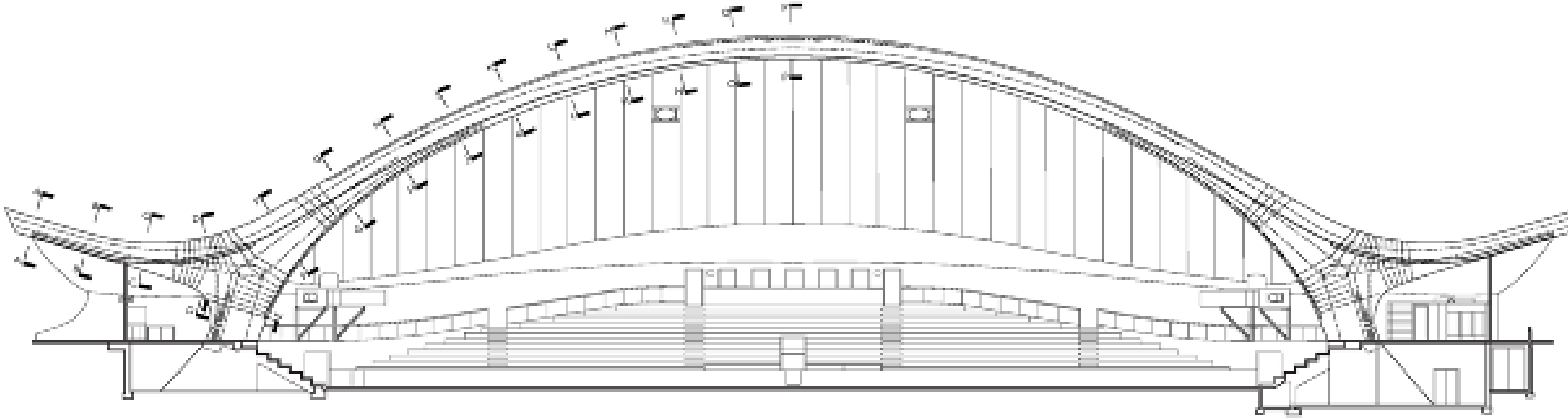


Richard Buckminster Fuller - Manhattan dome

David S. Ingalls Skating Rink, Yale – Eero Saarinen 1958

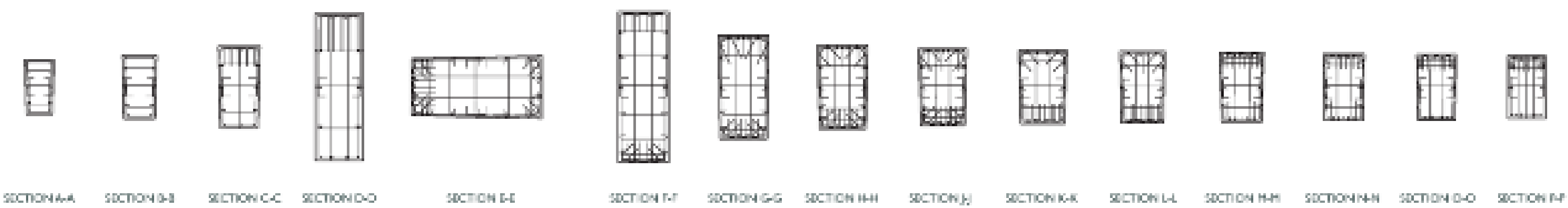

BROWN





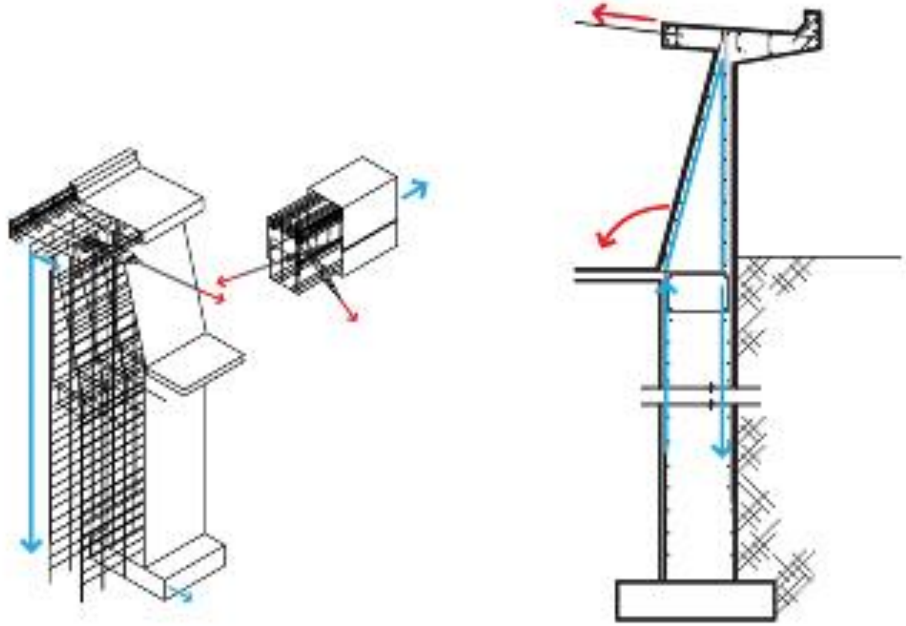
LONGITUDINAL SECTION A-A

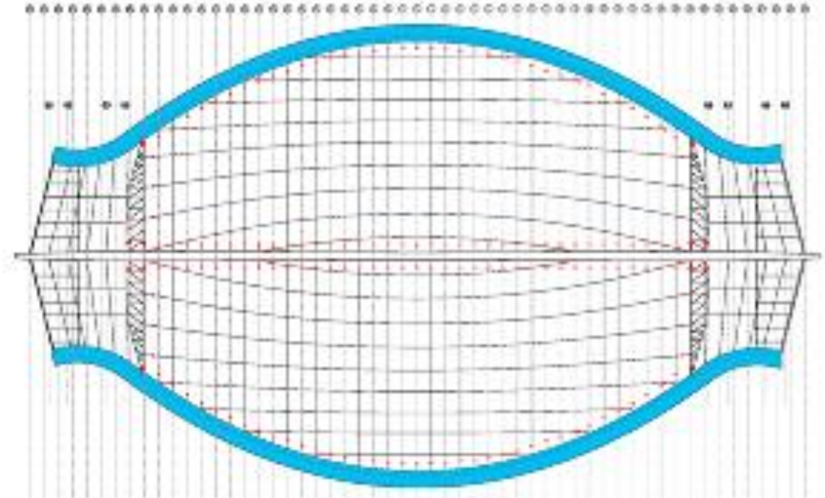
1/16" = 1'-0"



SECTION DETAILS OF ARCH

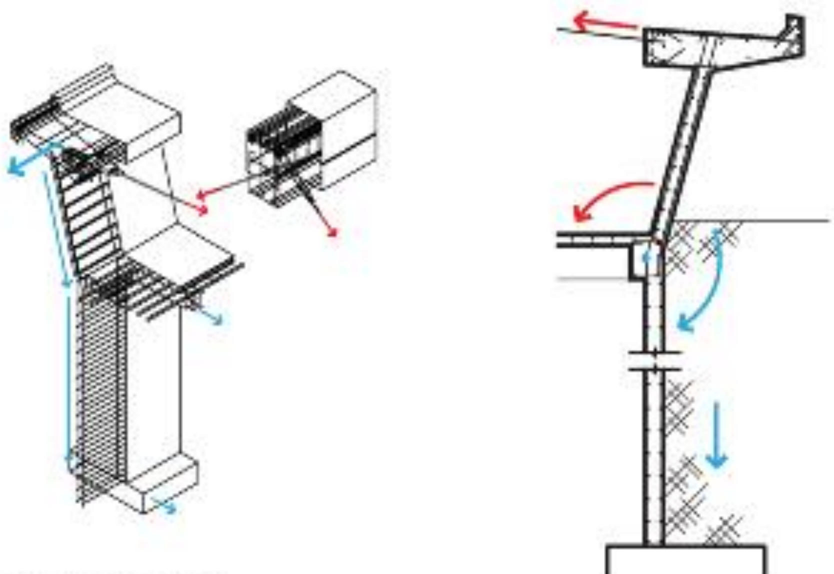
3/8" = 1'-0"

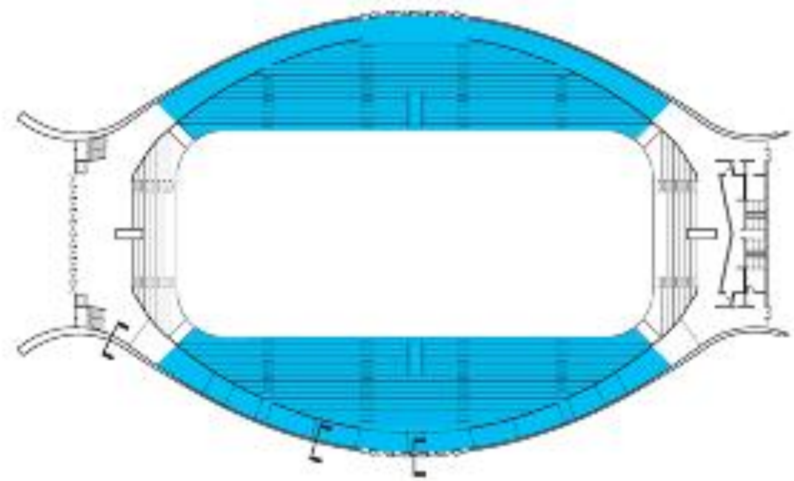




ROOF PLAN

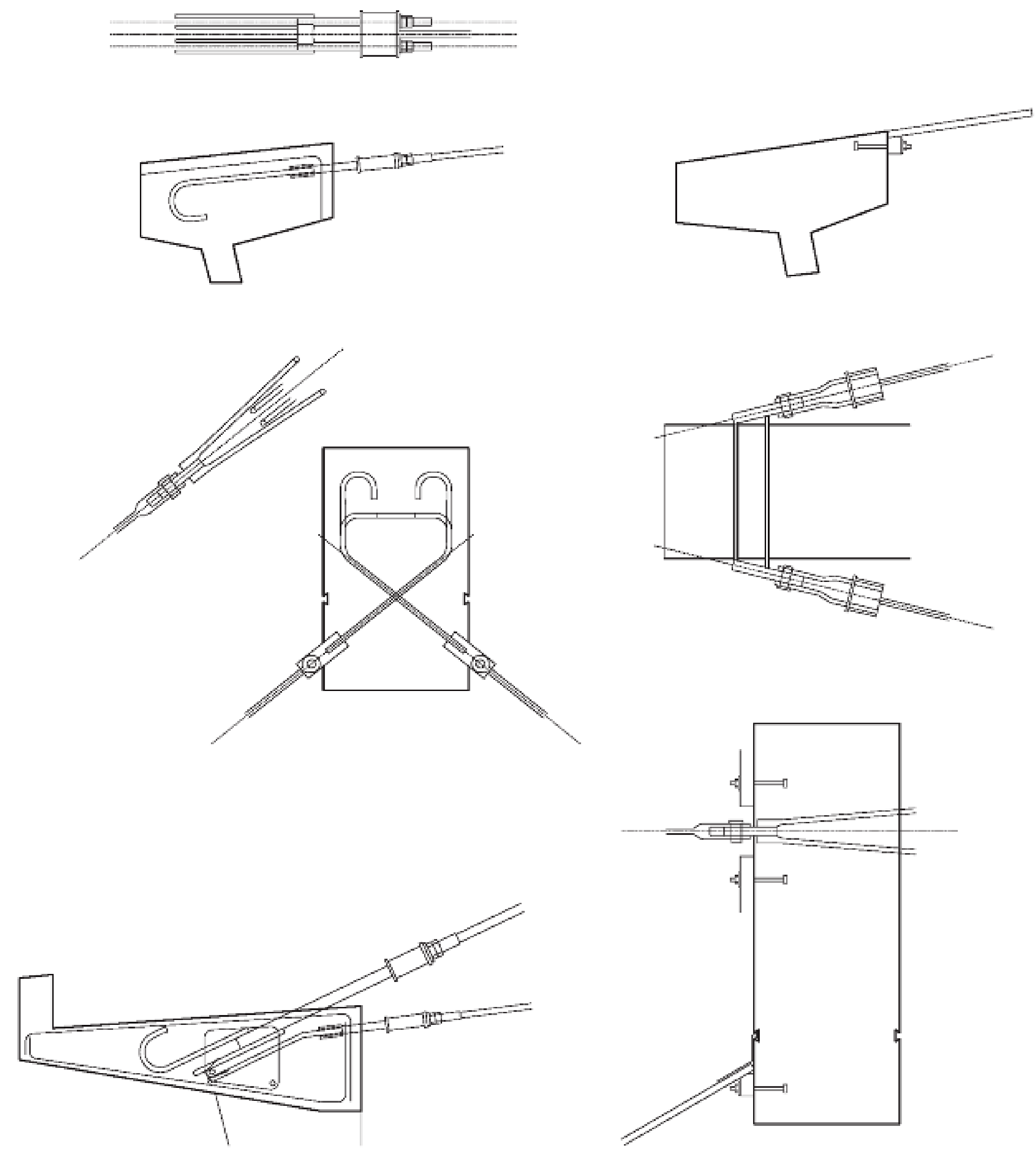
LOAD PATH AT END





LOAD PATH AT ARCH

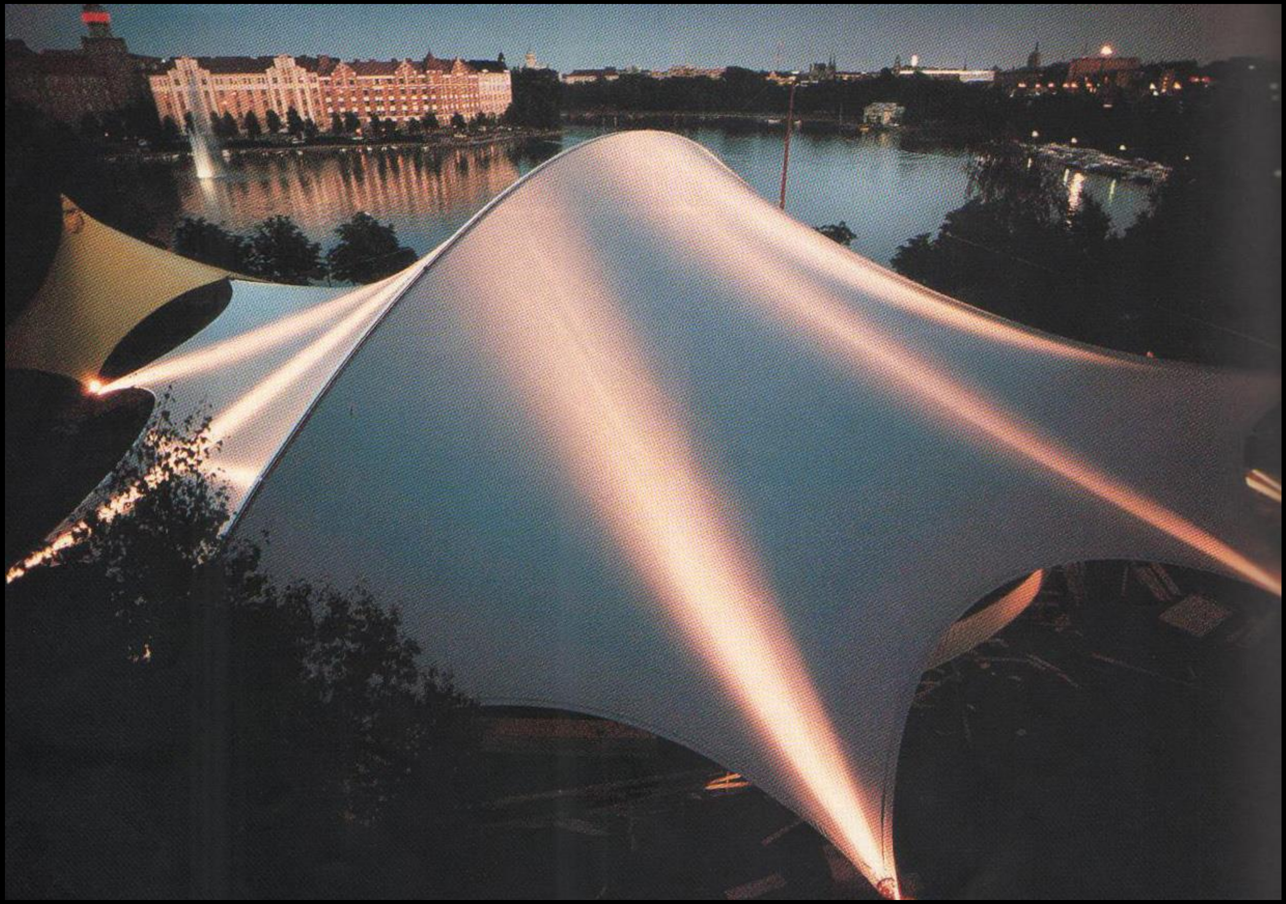
GROUND FLOOR PLAN



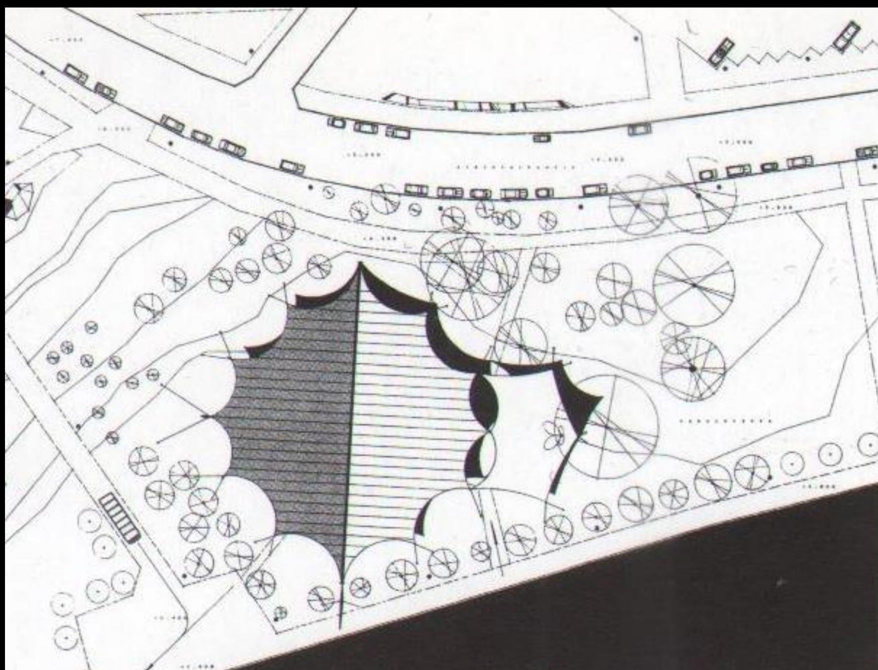
CABLE CONNECTION DETAILS

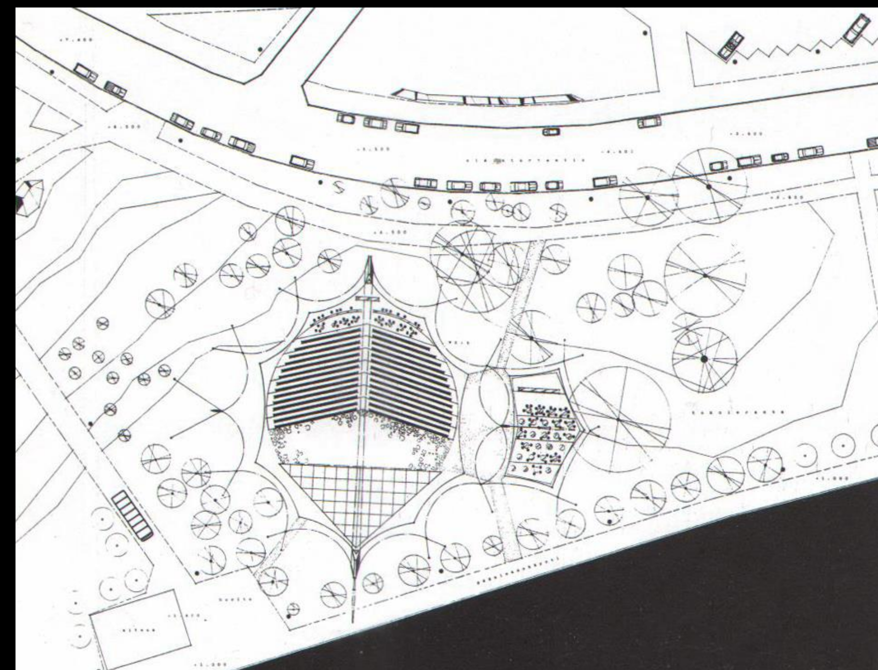
München Olympic Stadium – Otto & Behnisch 1972

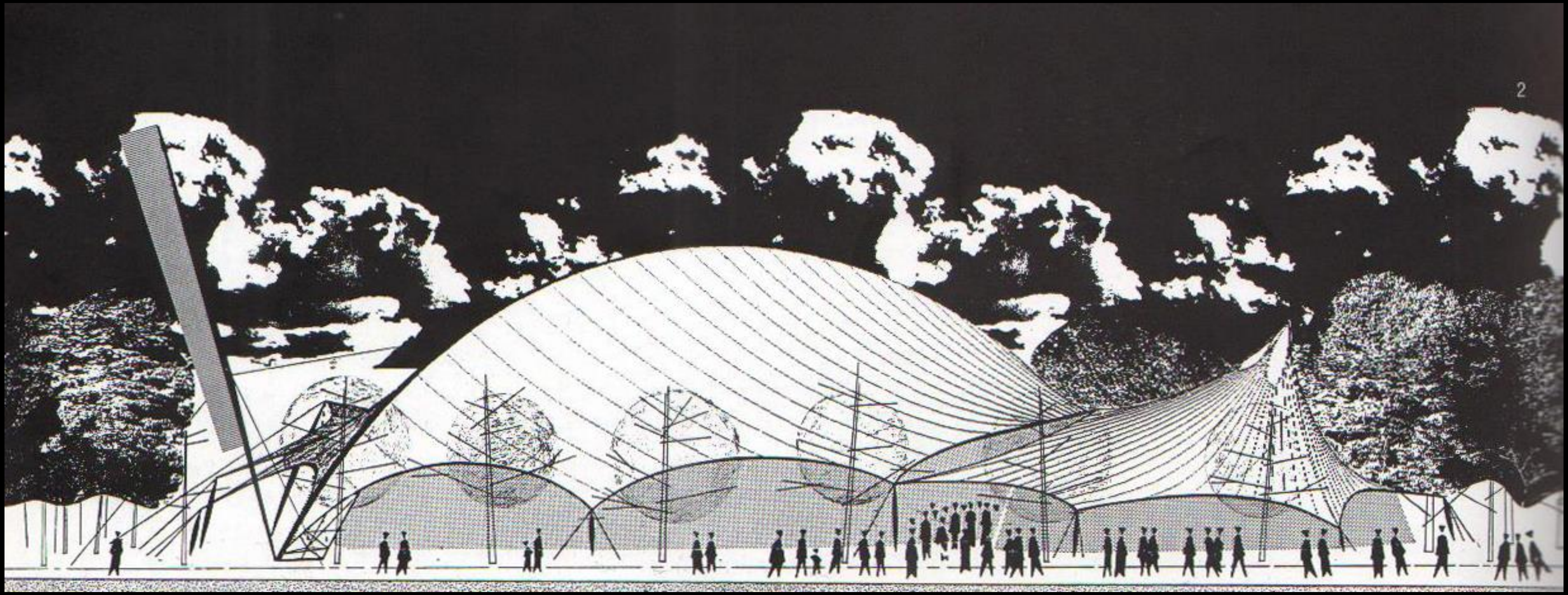
FREI OTTO: MÜNCHENIN OLYMPIASTADION



Huvilateltta – Roy Mänttäri 1995







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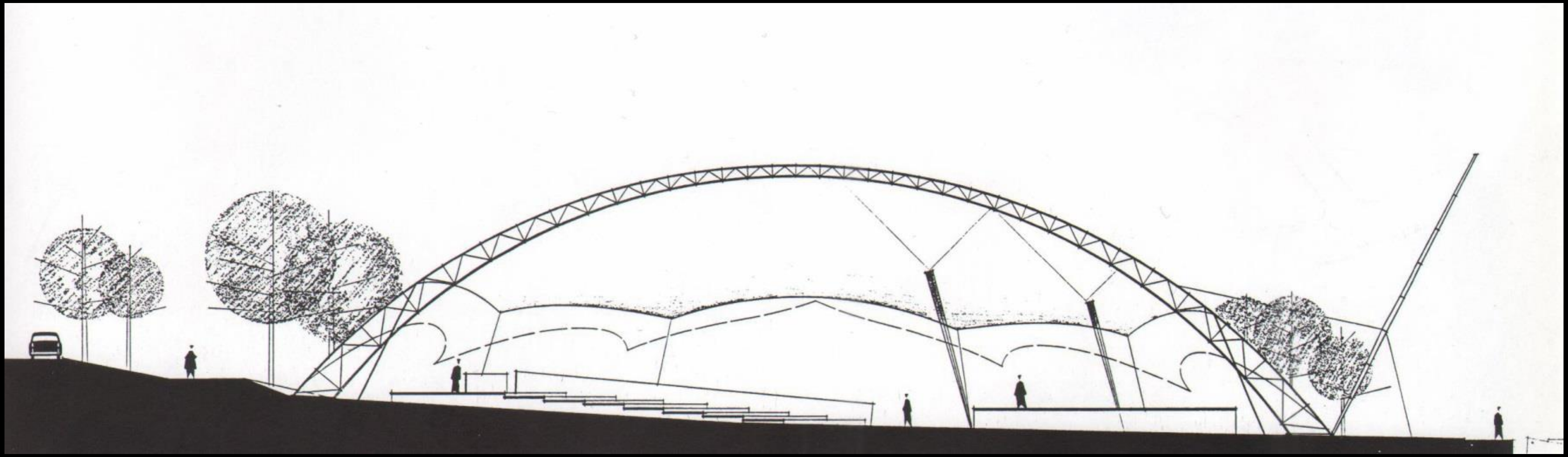
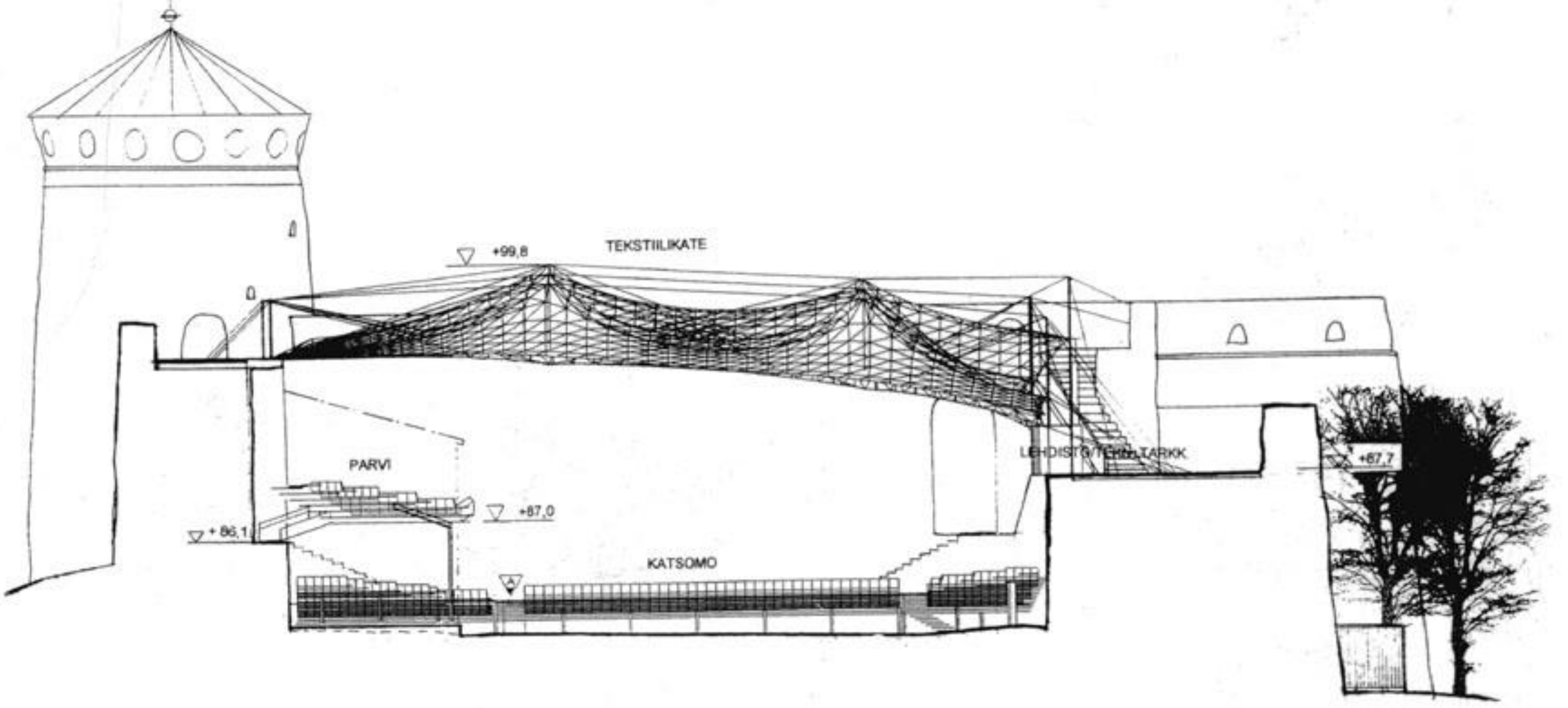
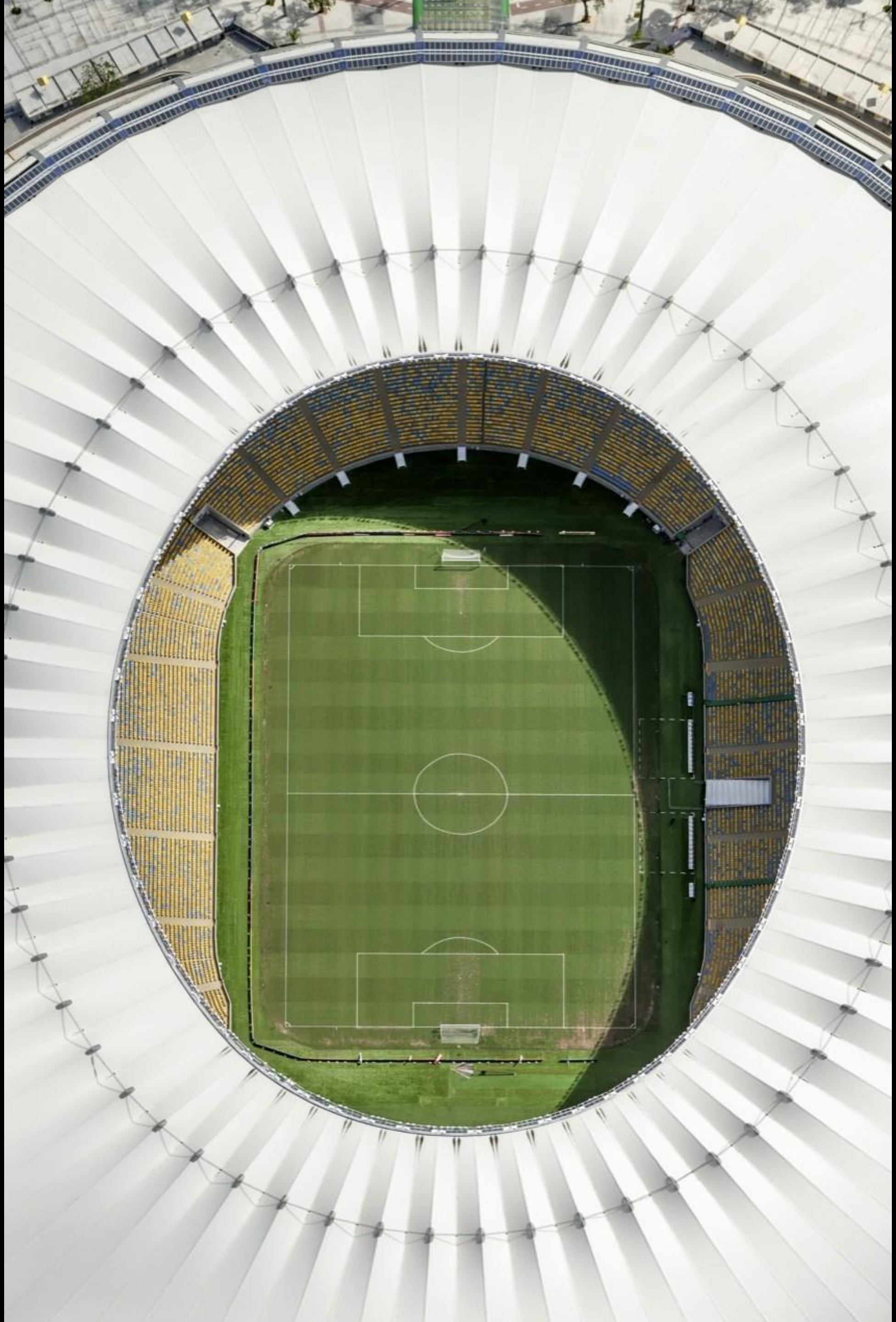


Olavilinnan katos . Markku Erholz, Heikki Paakkinen ja
Matti Ollila 2000

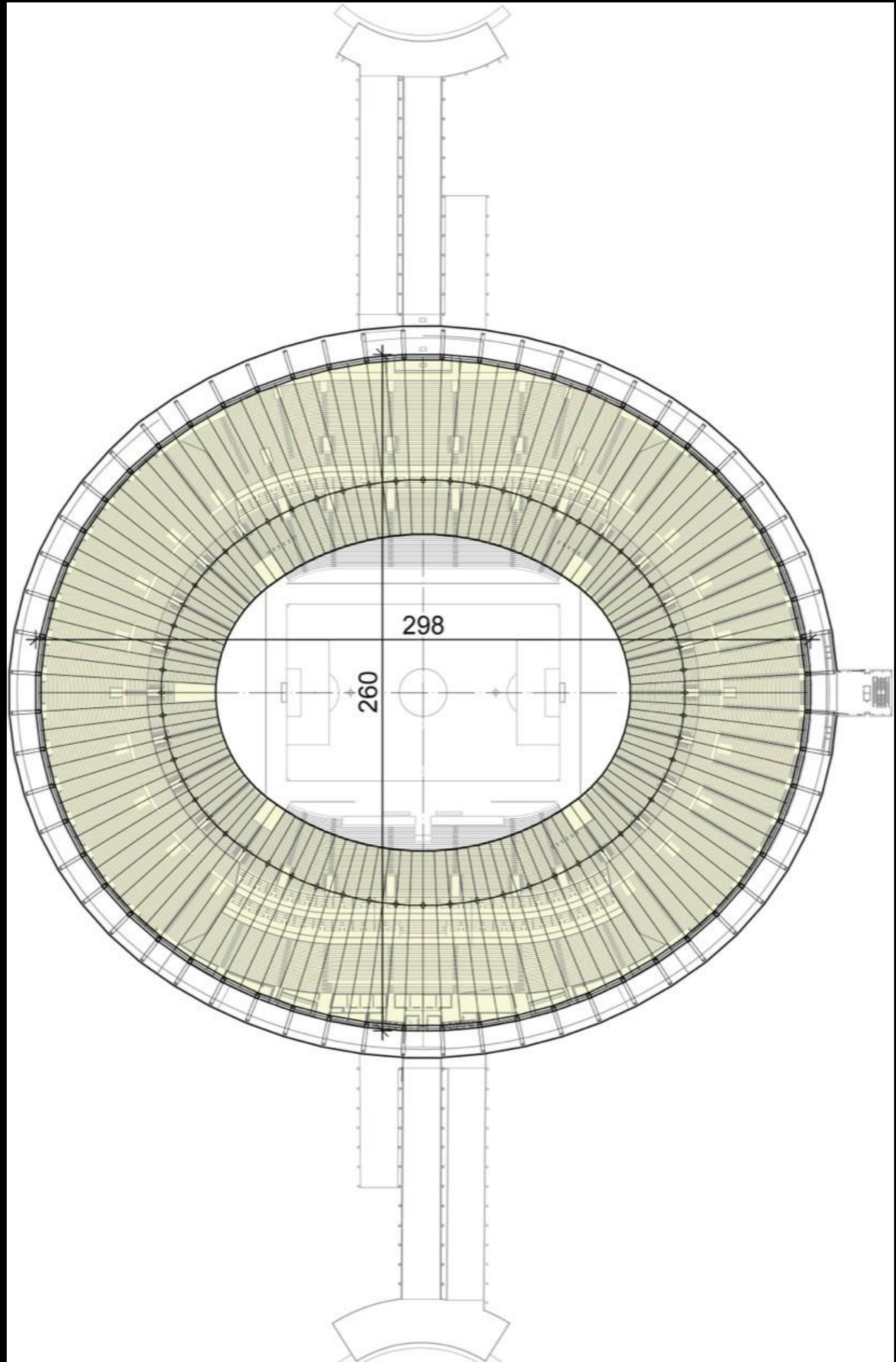


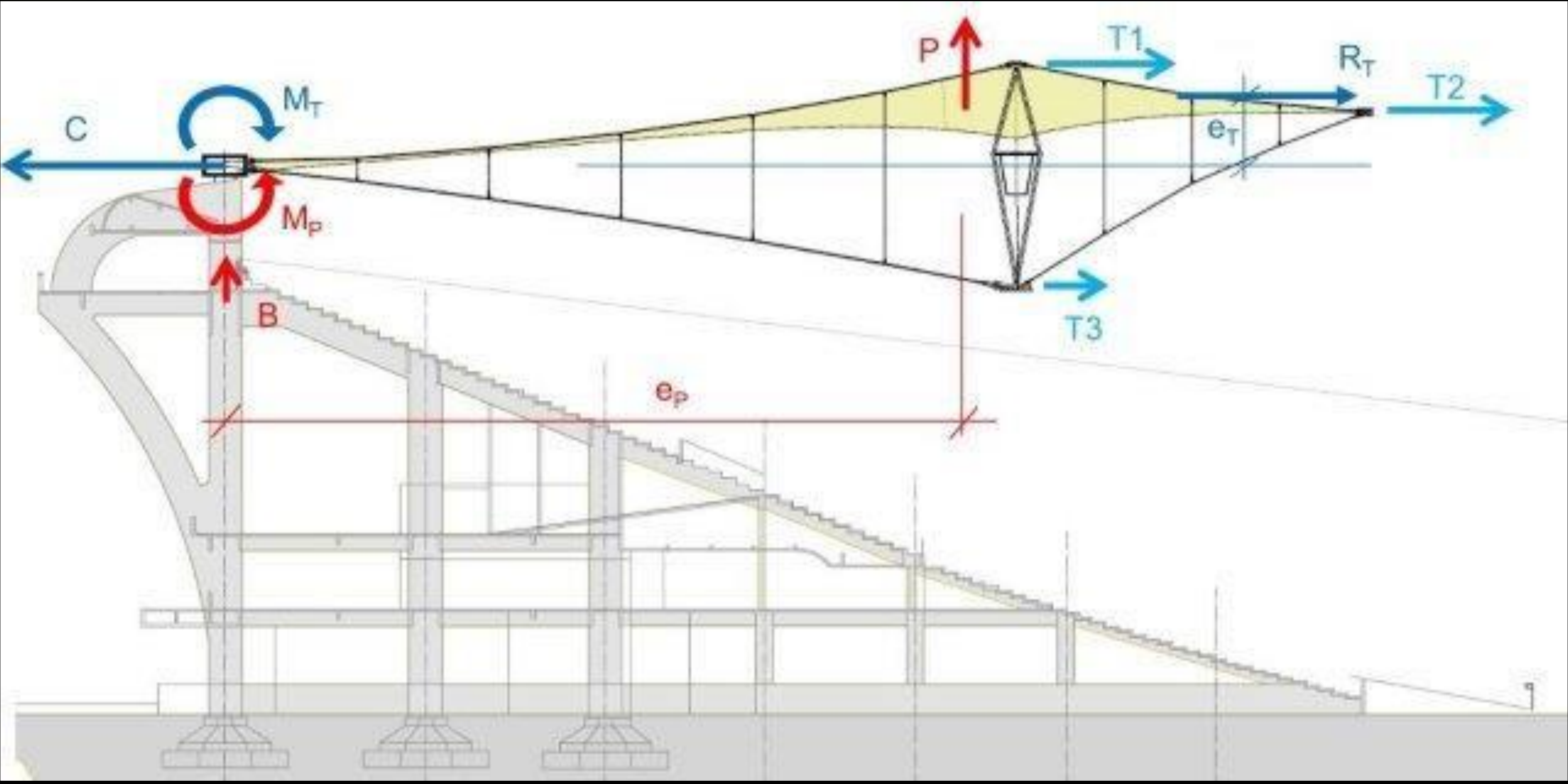
TEKSTIILIKATE
+99,8
PARVI
+87,0
+ 86,1
KATSOMO
+87,7

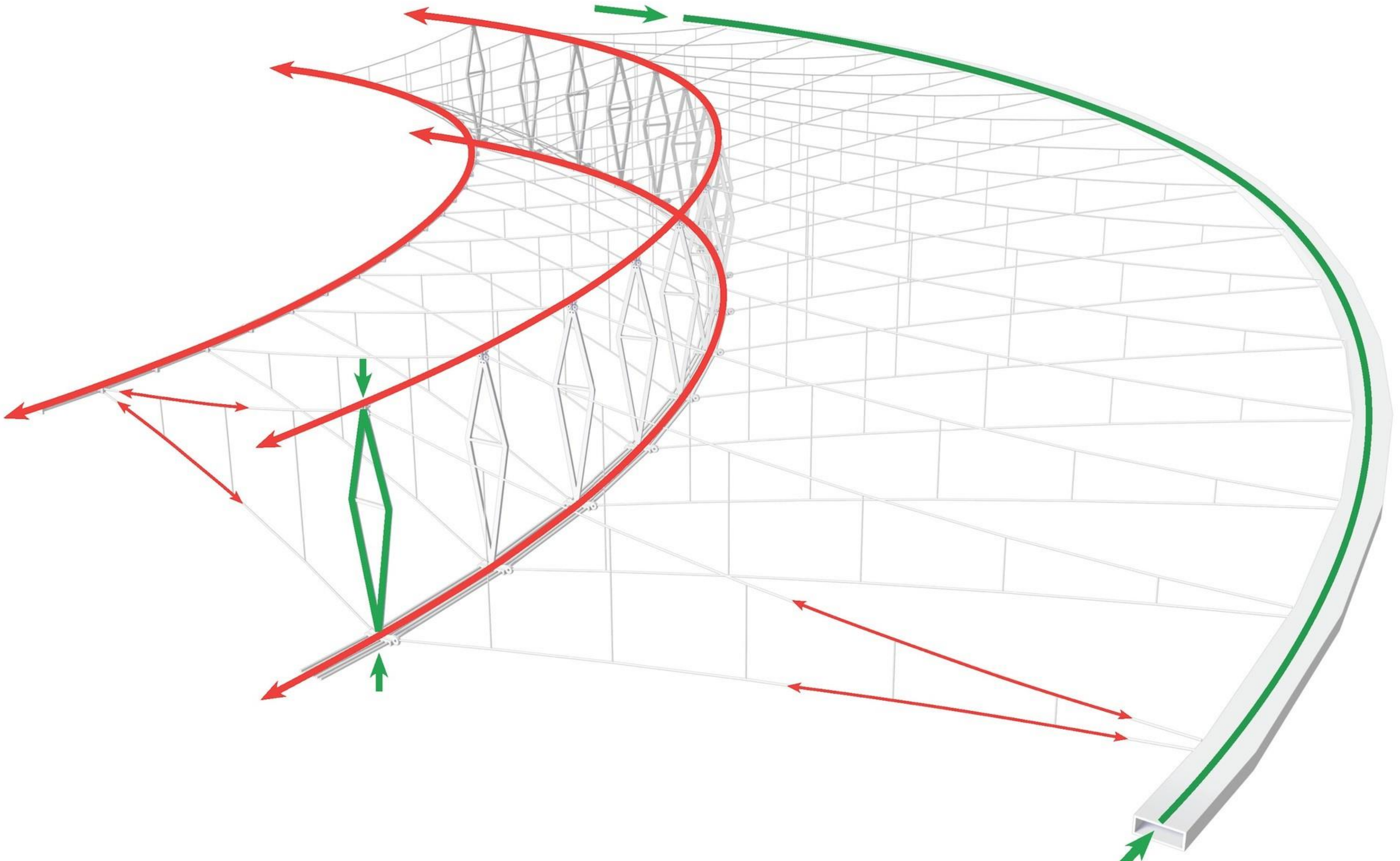
Millenium dome, London – Richard Rogers 2000

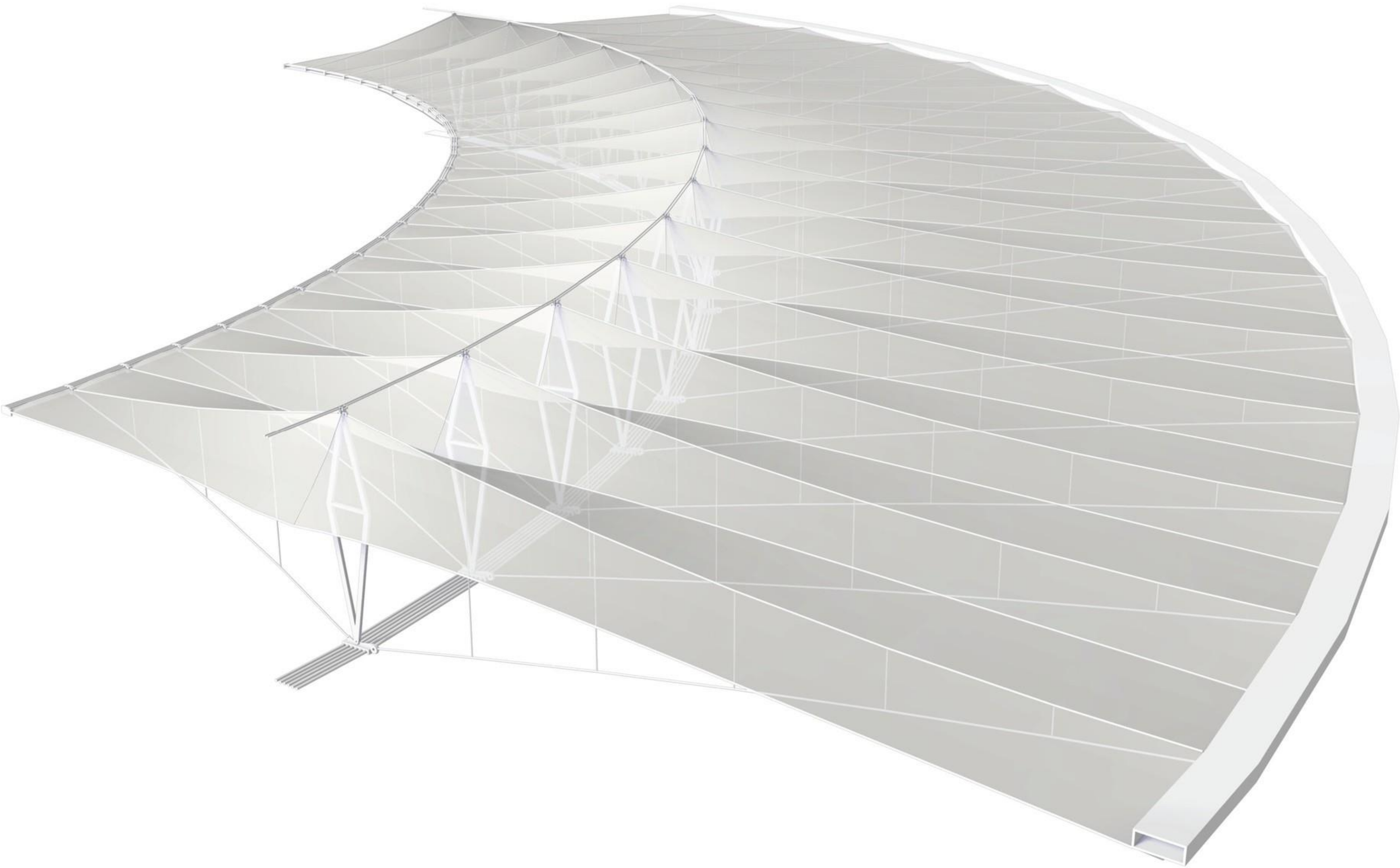


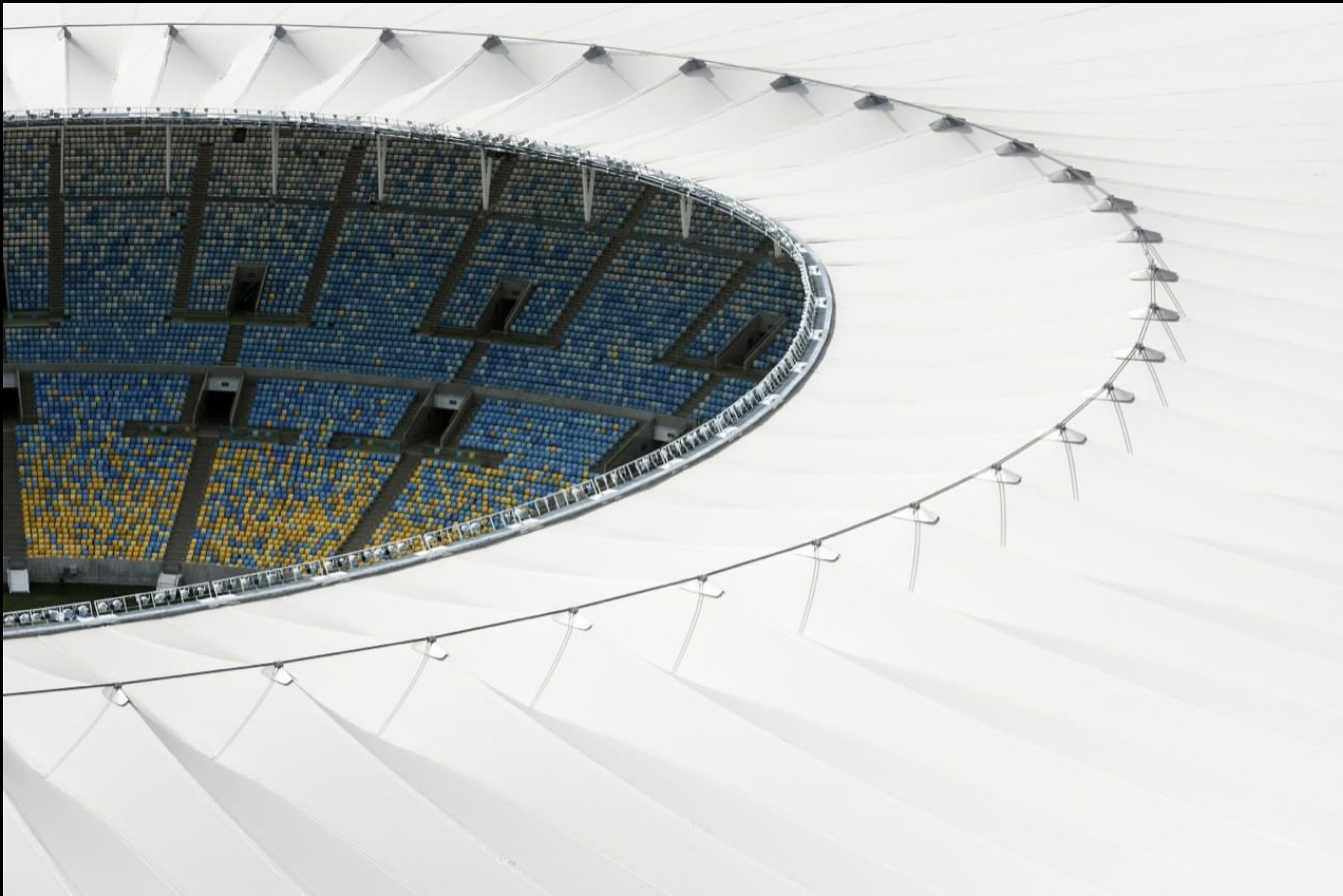
Maracaña stadium
Schlaich, Bergermann und partner


298
260

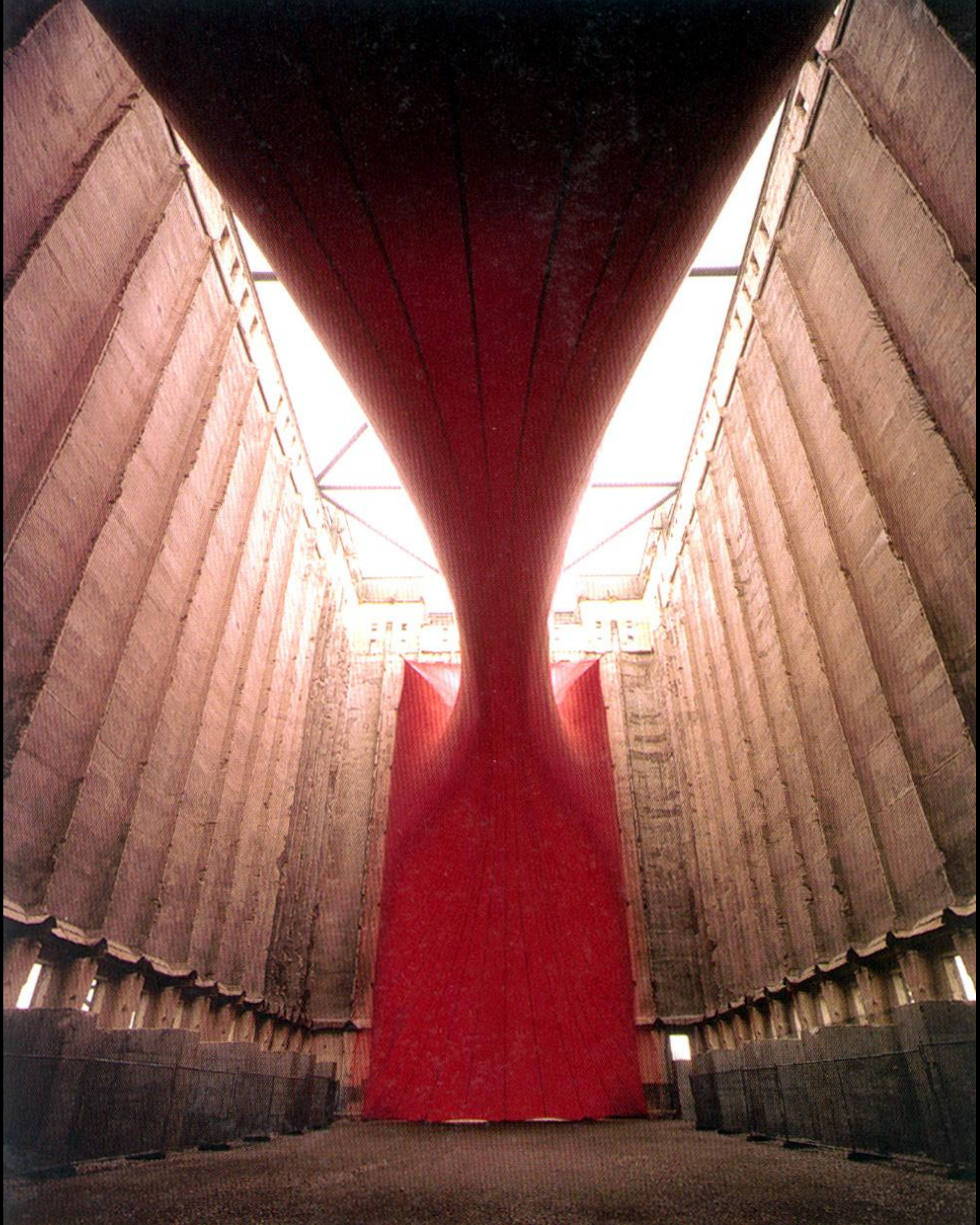

P
T1
RT
T2
MT
C
eT
MP
B
T3
eP



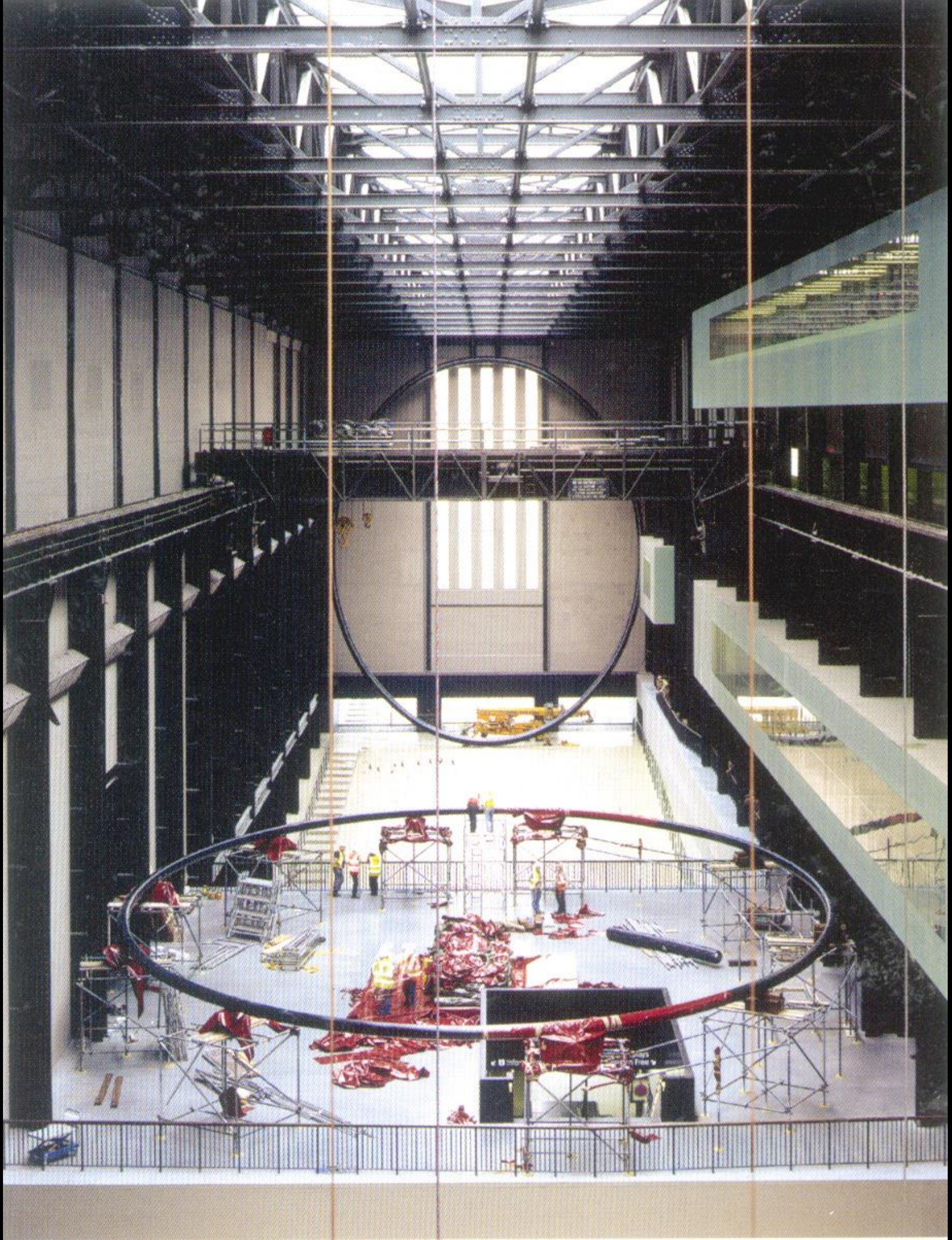


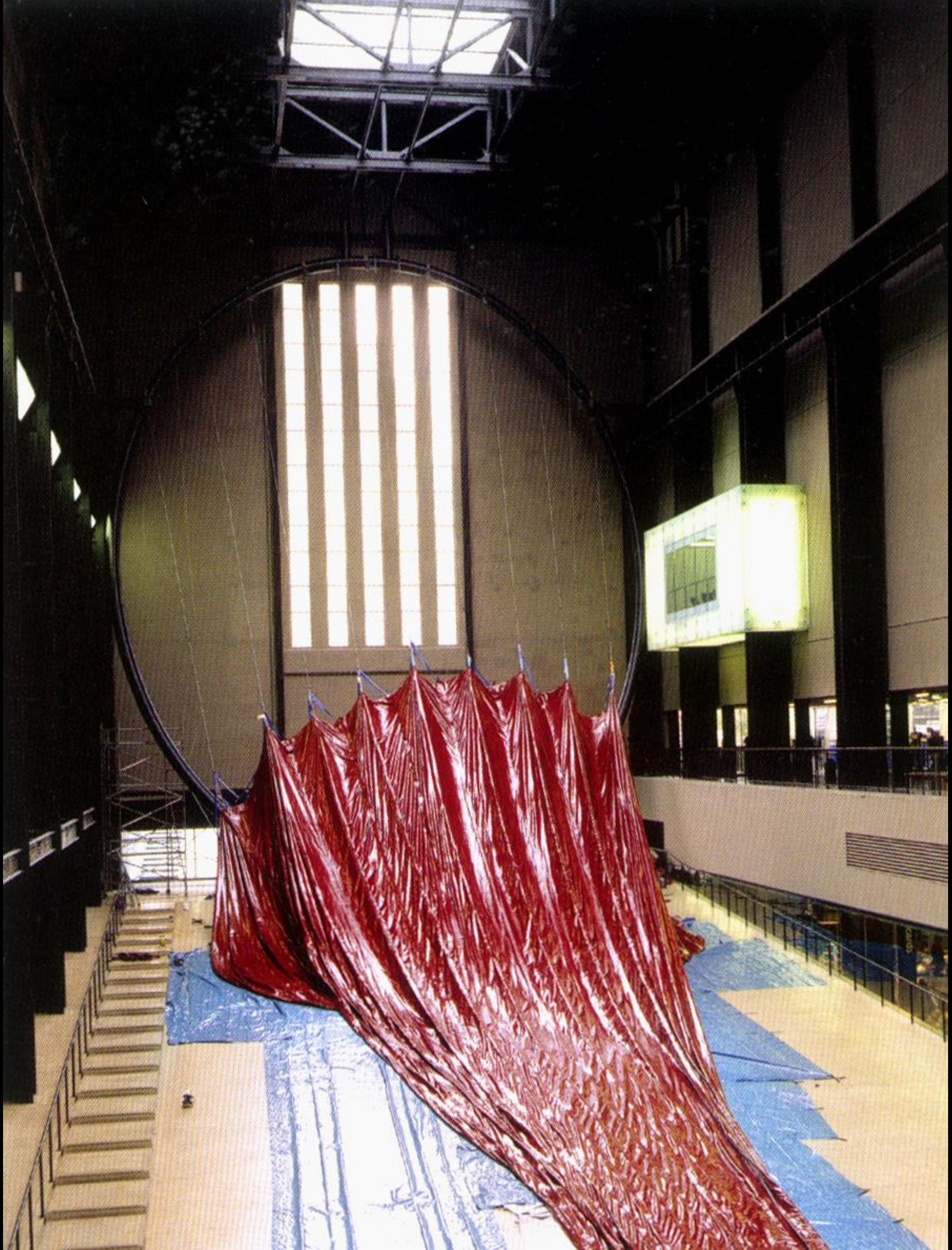


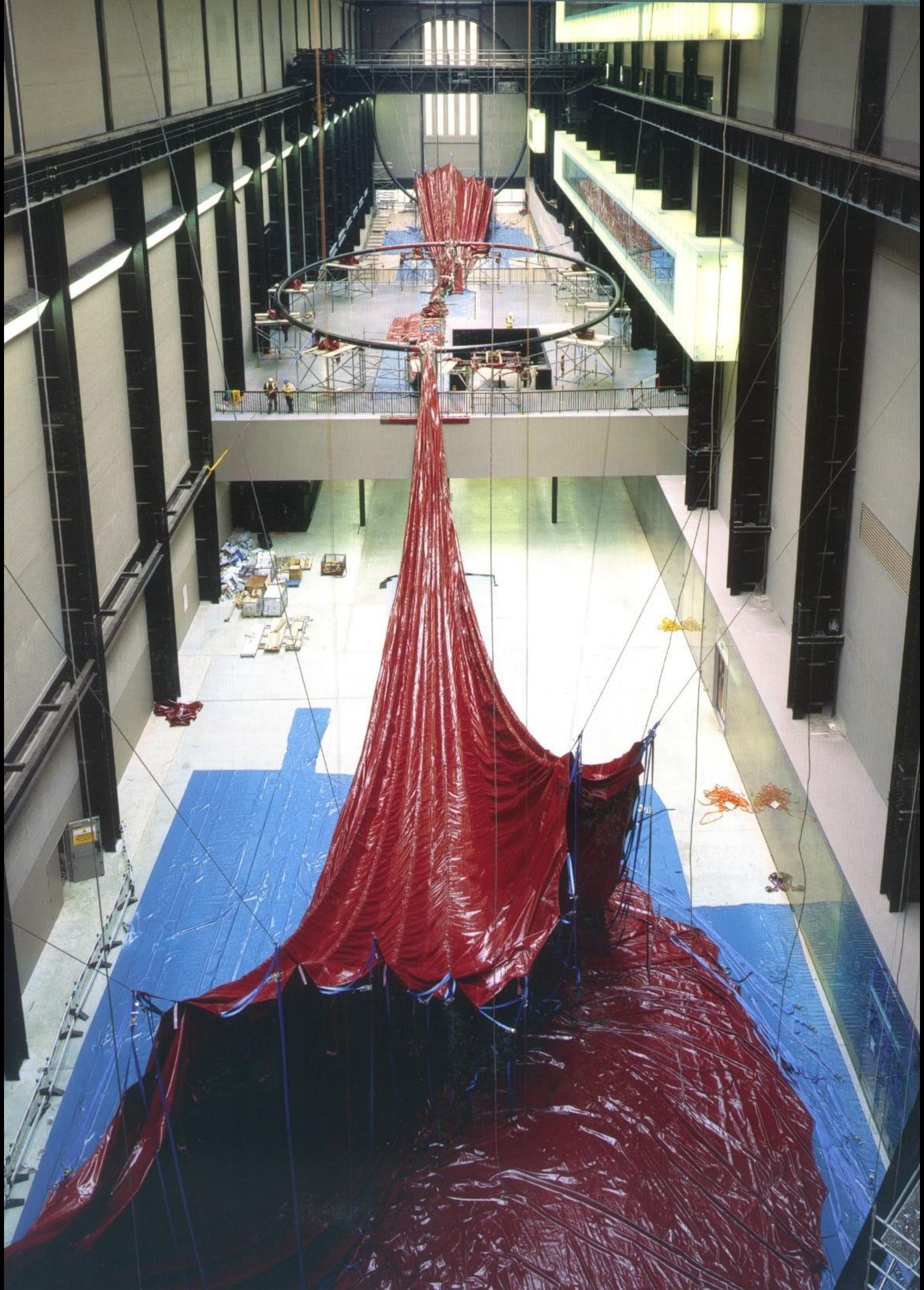

14
13
12
11
10
09

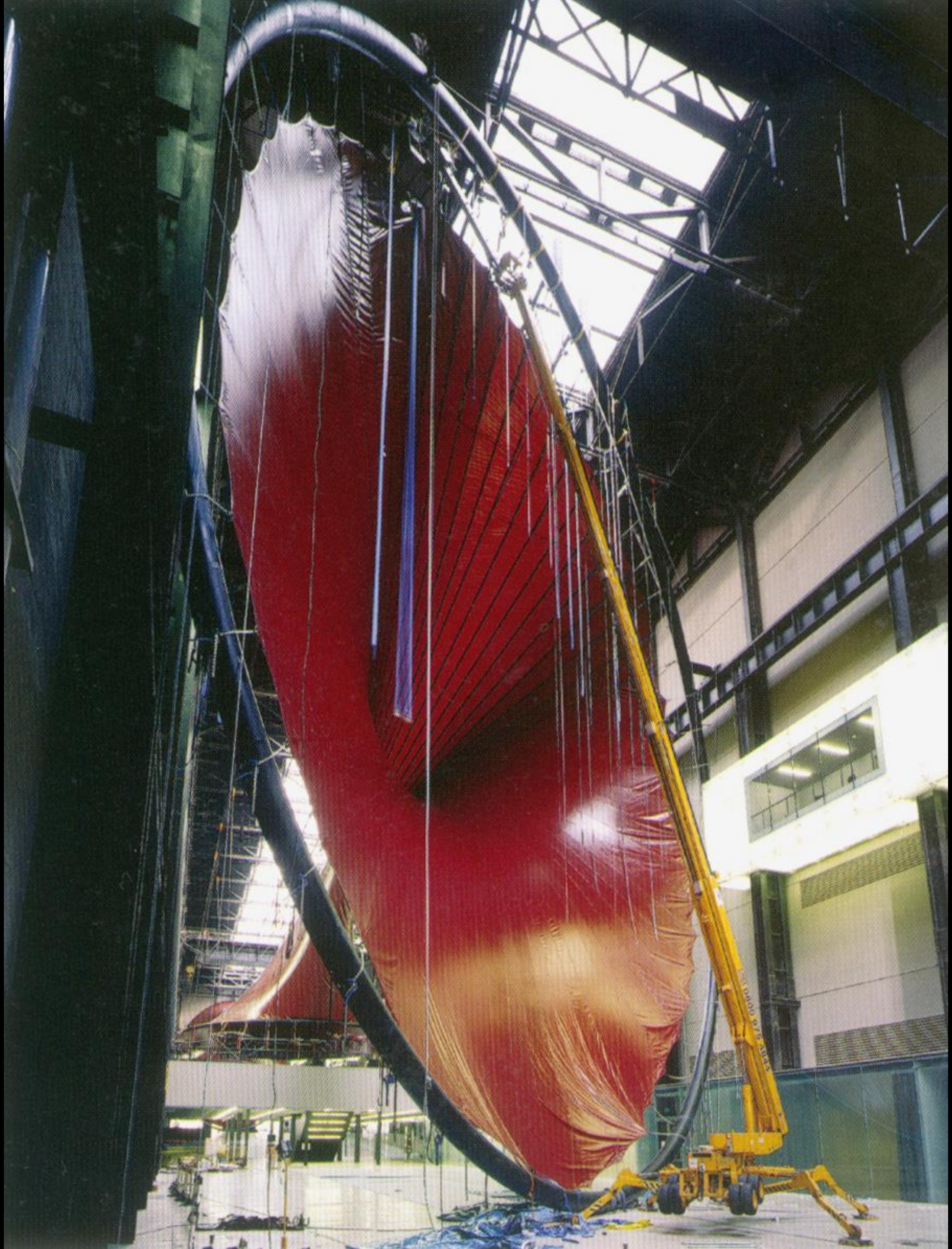


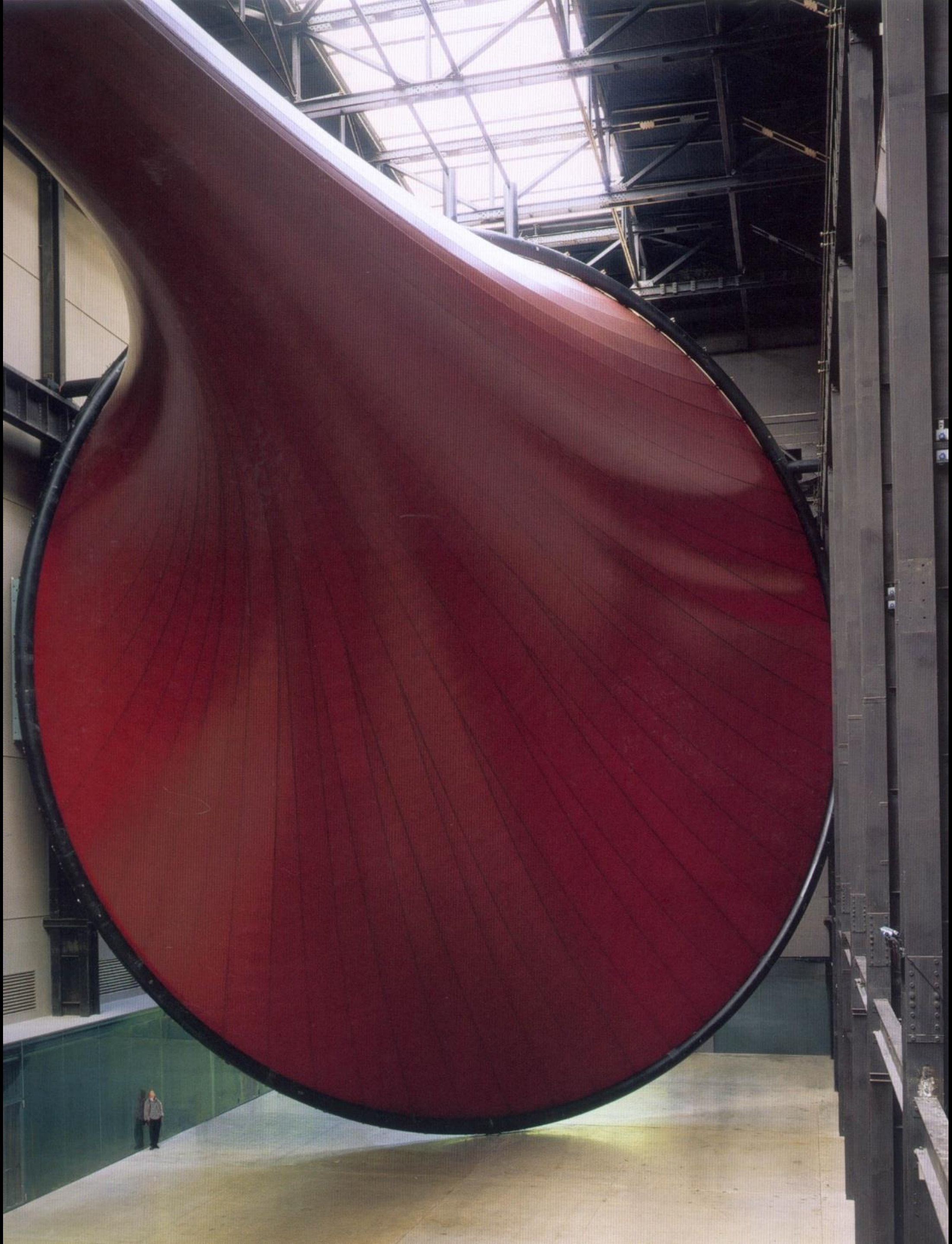
Taratantara - Anish Kapoor 1999

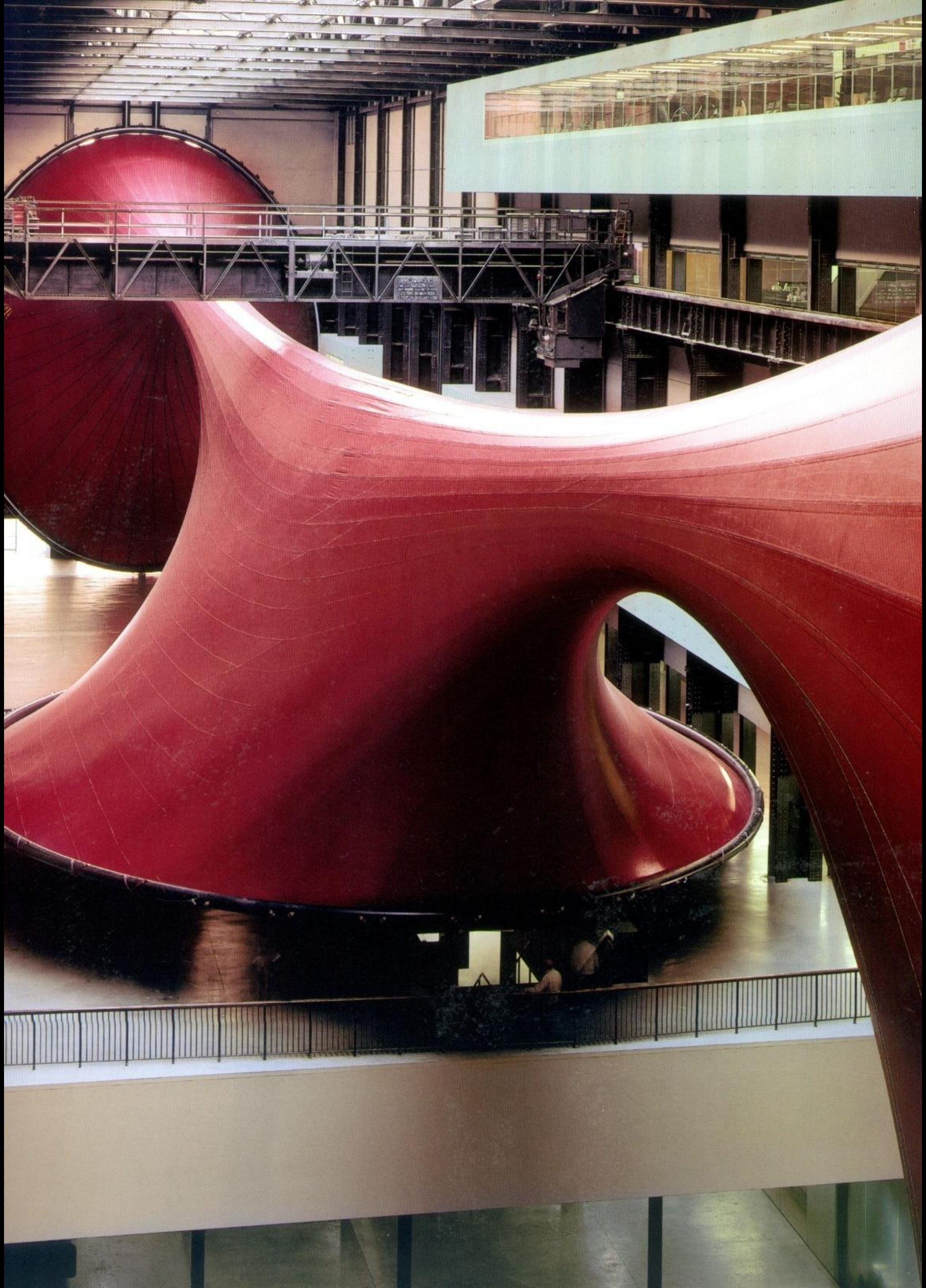


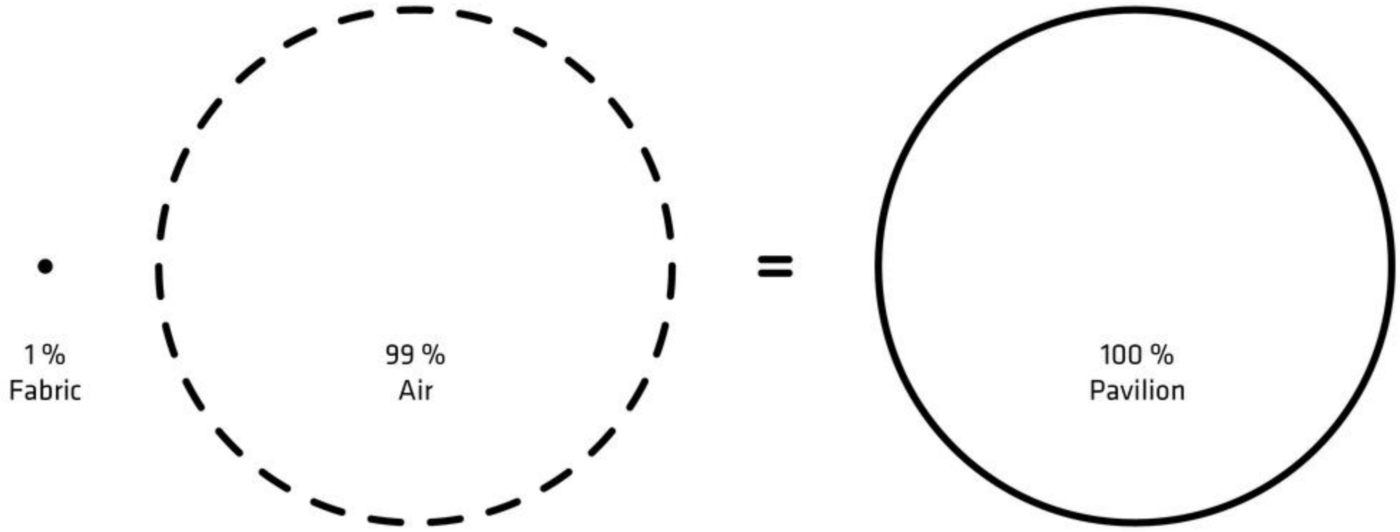








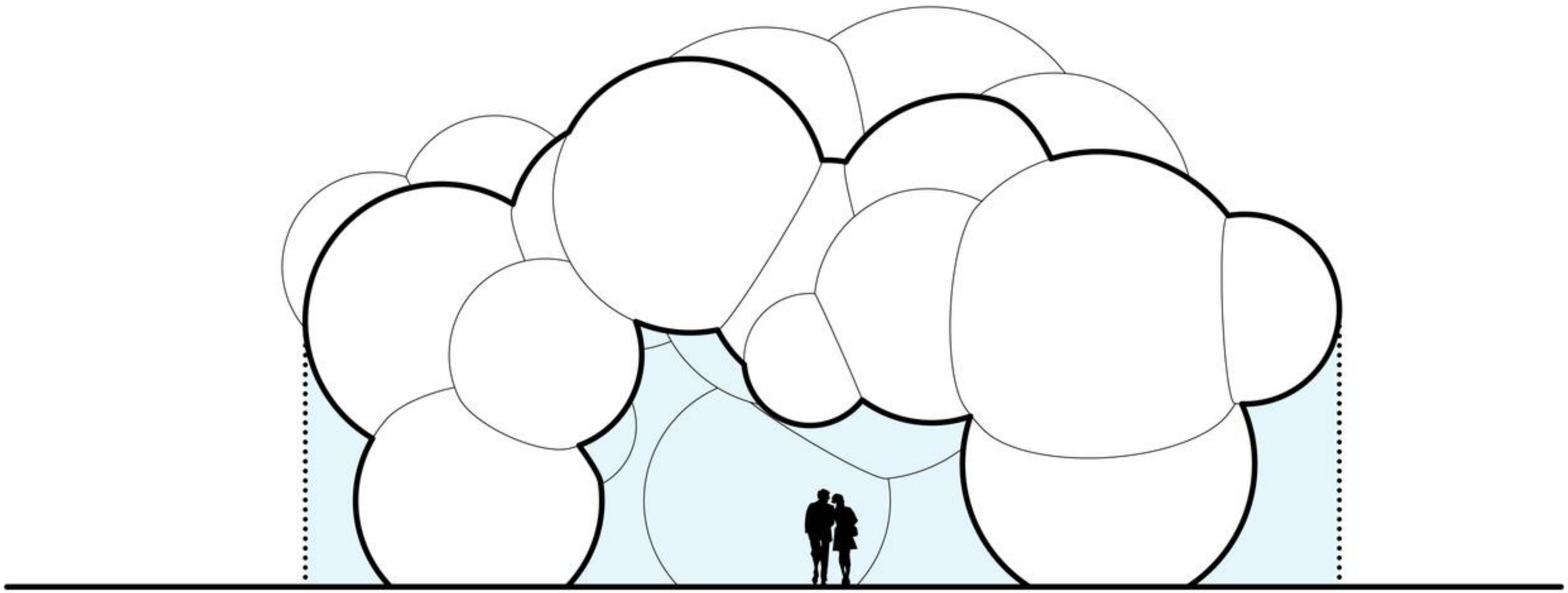




Paradox

Can we create a temporary structure that provides maximum visibility, yet minimum amount of environmental footprint?
Is it possible to produce a landmark that is impermanent, removable and fashionable?

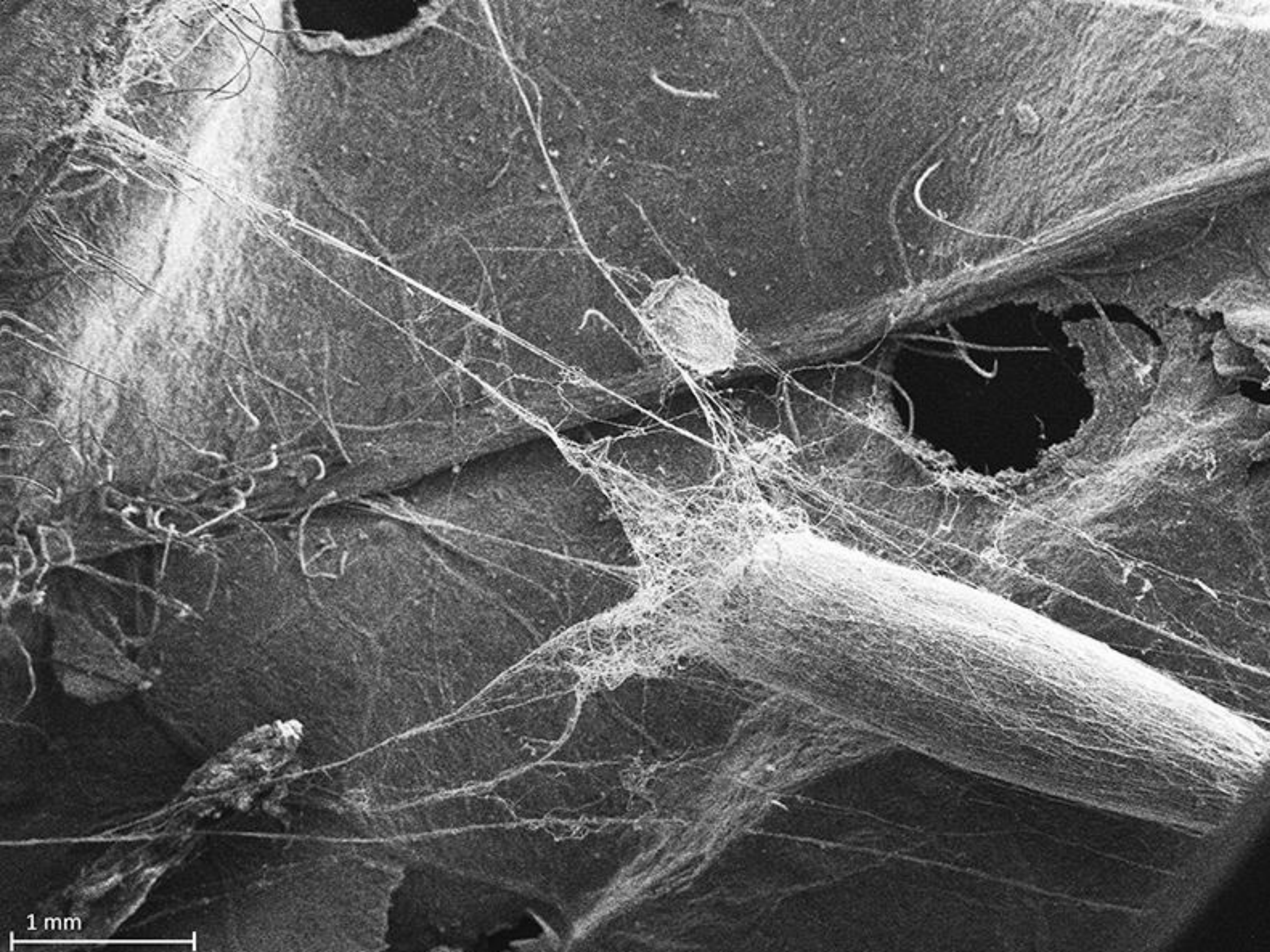
Mobile pavillion Roskilde – BIG 2016



Usable Covered Area
The pavilion provides usable covered area of 120m2, and is capable to accommodate 170 guests.

BIOMIMEETTISET RAKENTEET

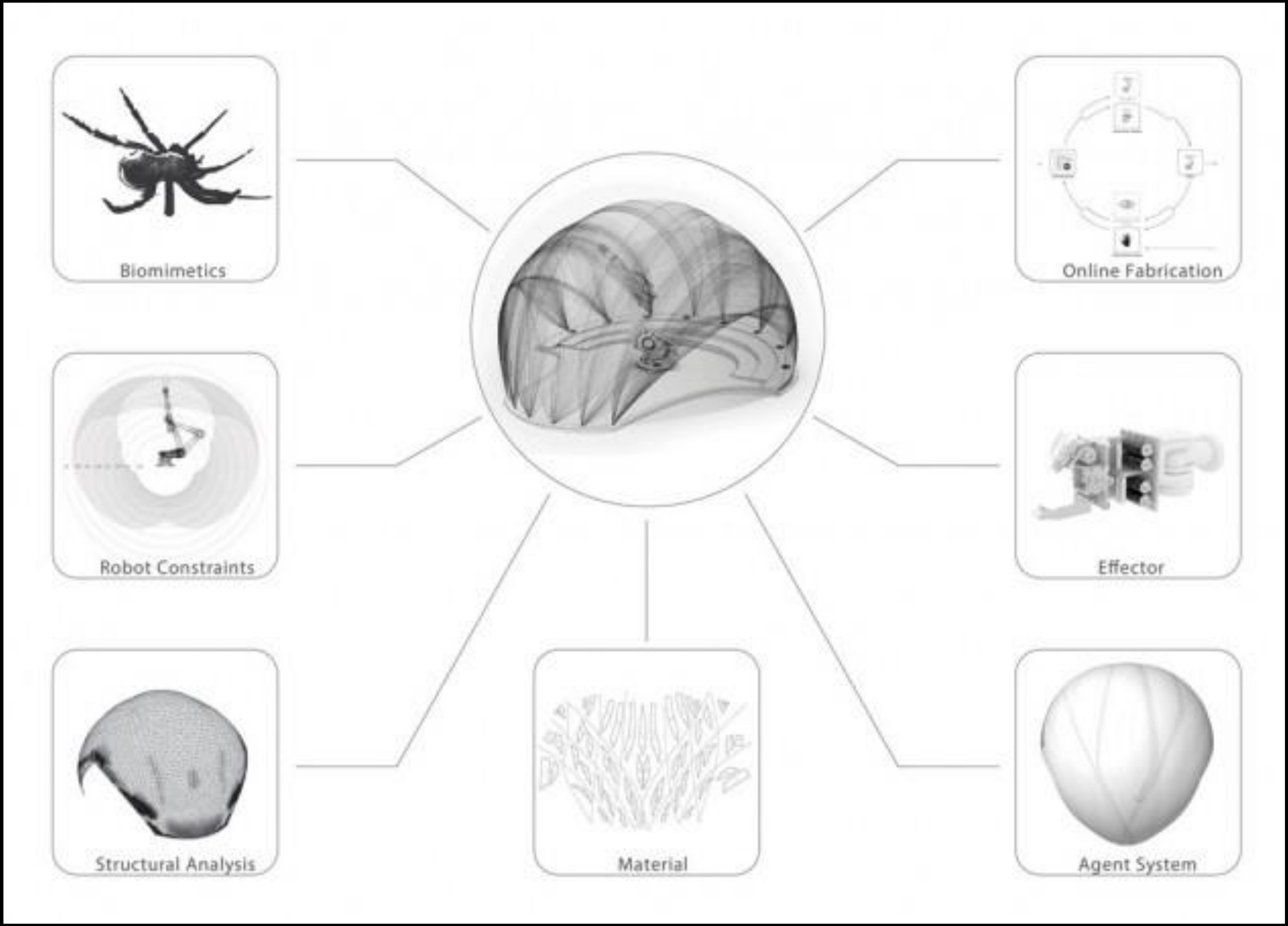
ICD-ITKE Research Pavillion – University of Stuttgart 2017


1 mm

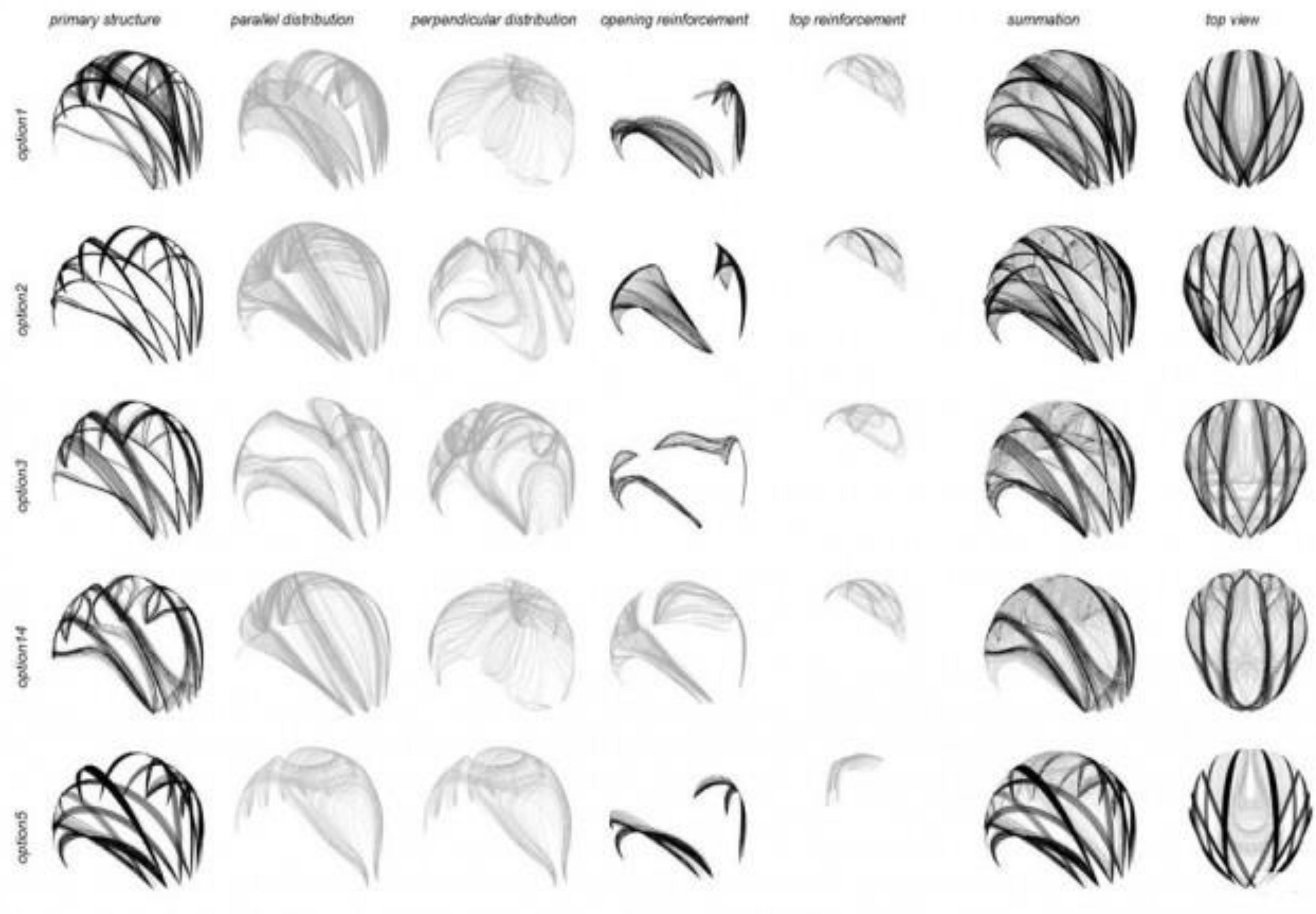

KUKA

ICD / ITKE Research pavillion

ICD-ITKE Water spider Pavillion – University of Stuttgart

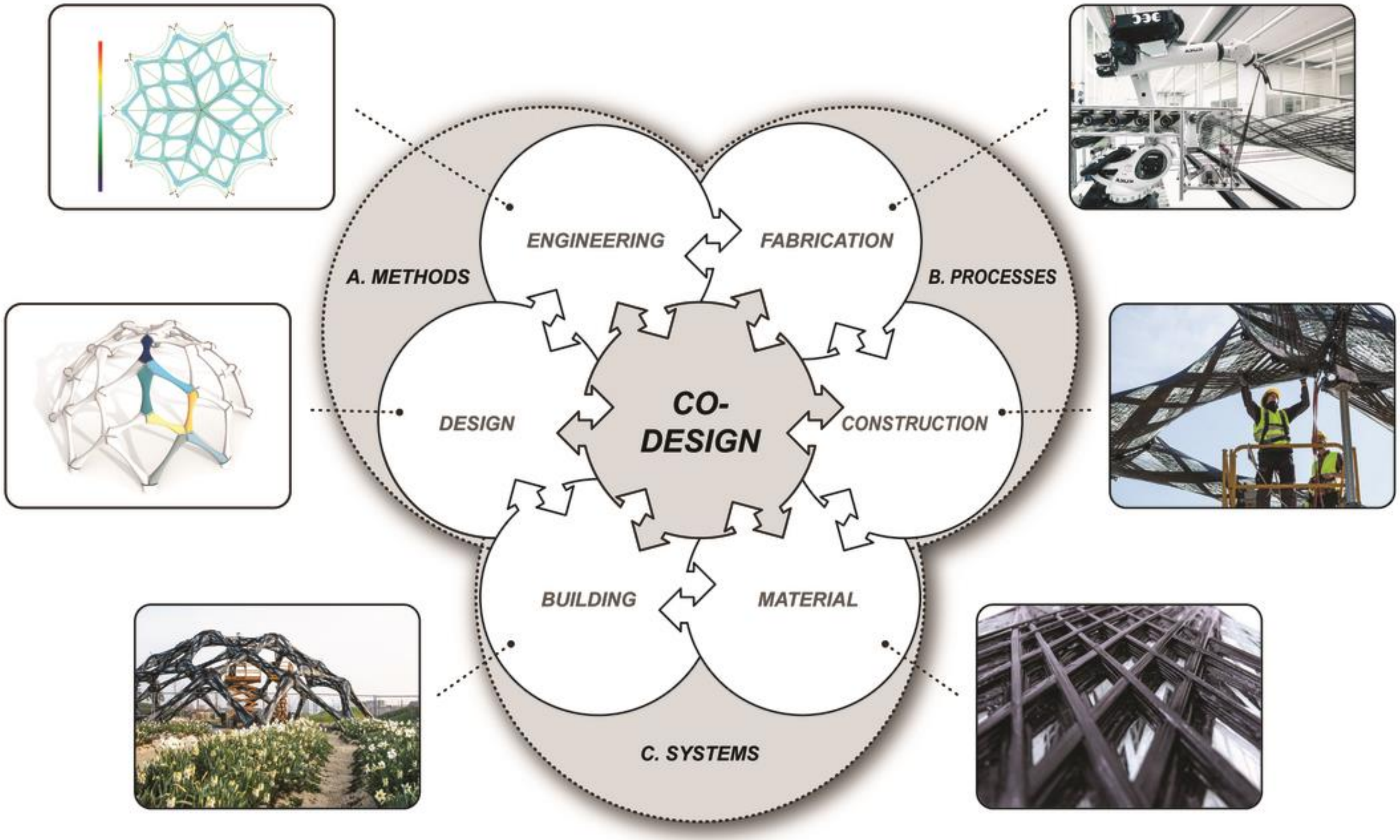


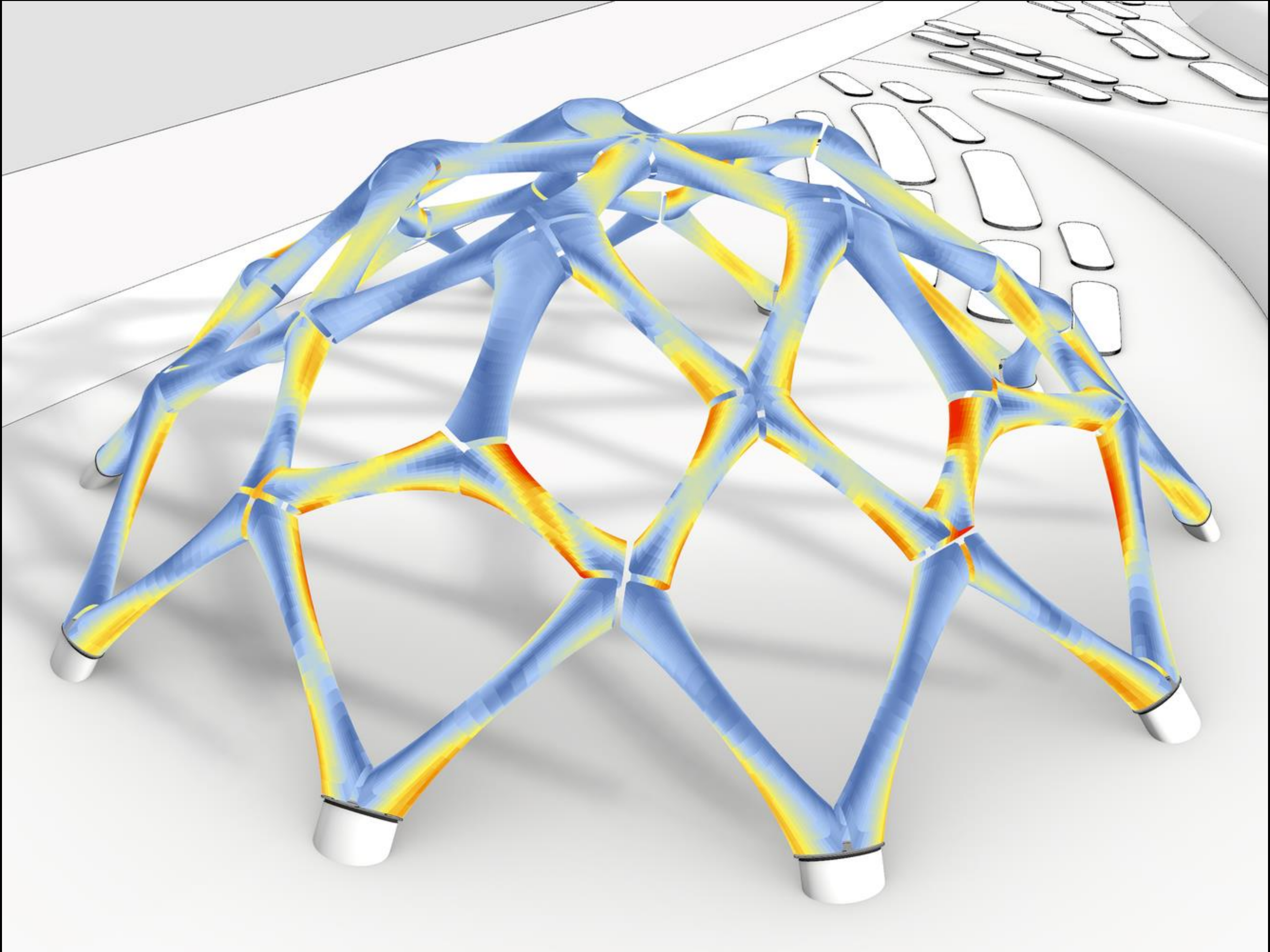
Biomimetics
Online Fabrication
Robot Constraints
Effector
Structural Analysis
Material
Agent System

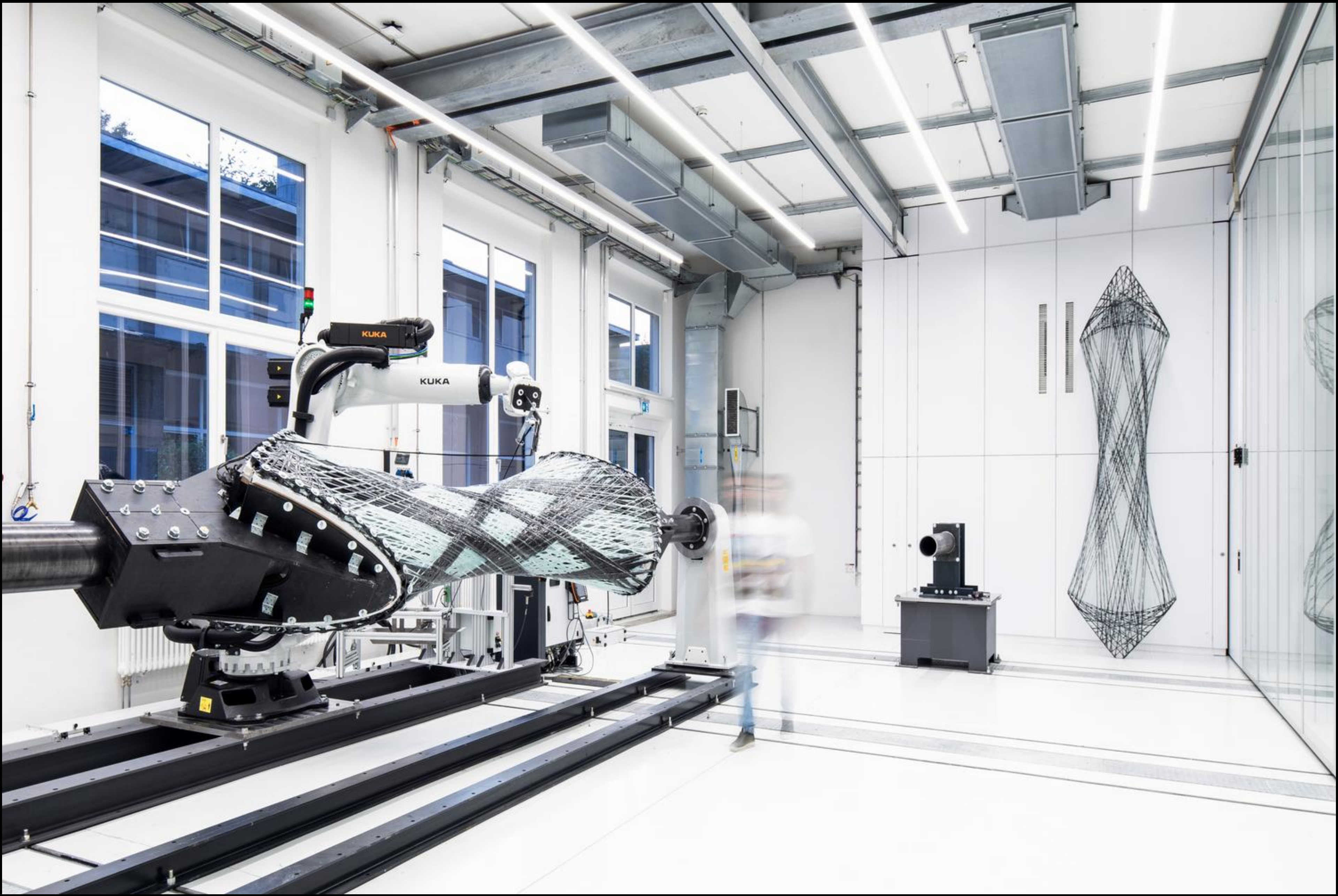

primary structure
parallel distribution
perpendicular distribution
opening reinforcement
top reinforcement
summation
top view
option1
option2
option3
option14
option5

ICD-ITKE BUGA Fibre Pavillion – University of Stuttgart


Haulotte


ENGINEERING
FABRICATION
A. METHODS
B. PROCESSES
DESIGN
CO-
DESIGN
CONSTRUCTION
BUILDING
MATERIAL
C. SYSTEMS




KUKA
KUKA