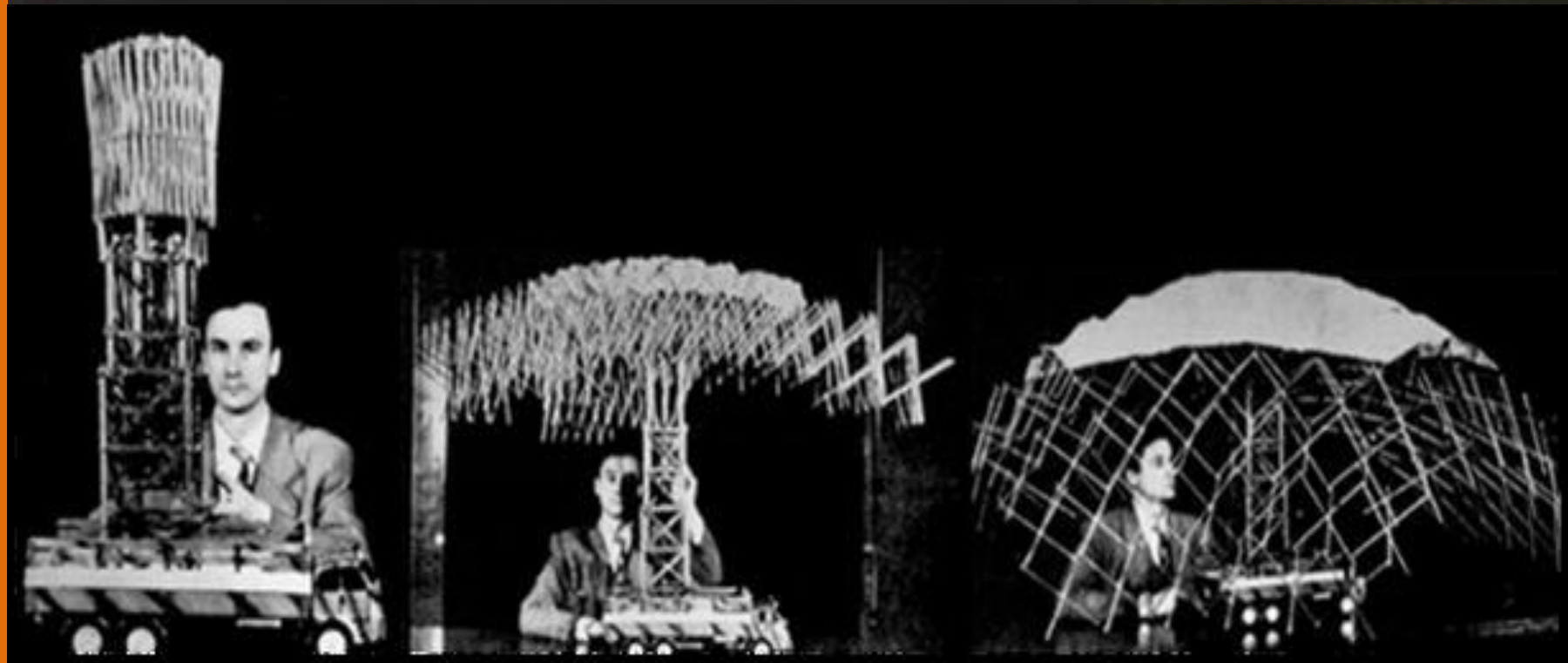
SMiA

Structural Morphology in Architecture

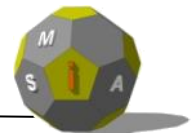
DEPLOYABLE STRUCTURES



TOPICS

1. Examples in nature
2. Definition deployable structures in architecture
3. Background
4. Types of deployable systems
5. Scissor system
6. Convertible Roofs
7. Details
8. Recent Research

1. Examples in Nature



In Nature

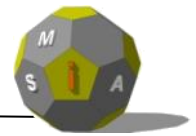
In Nature

QUEEN OF THE NIGHT (Epiphyllum Oxypetalum)

SL RASCH. Large Umbrellas for the Courts of the Prophet's Holy Mosque, Madinah, 1992.

HOBERMAN. *Transformable design*. Expanding Geodesic Dome . Jersey City. New Jersey, USA, 1991.

2. Definition: deployable structures in architecture



DEFINITION:

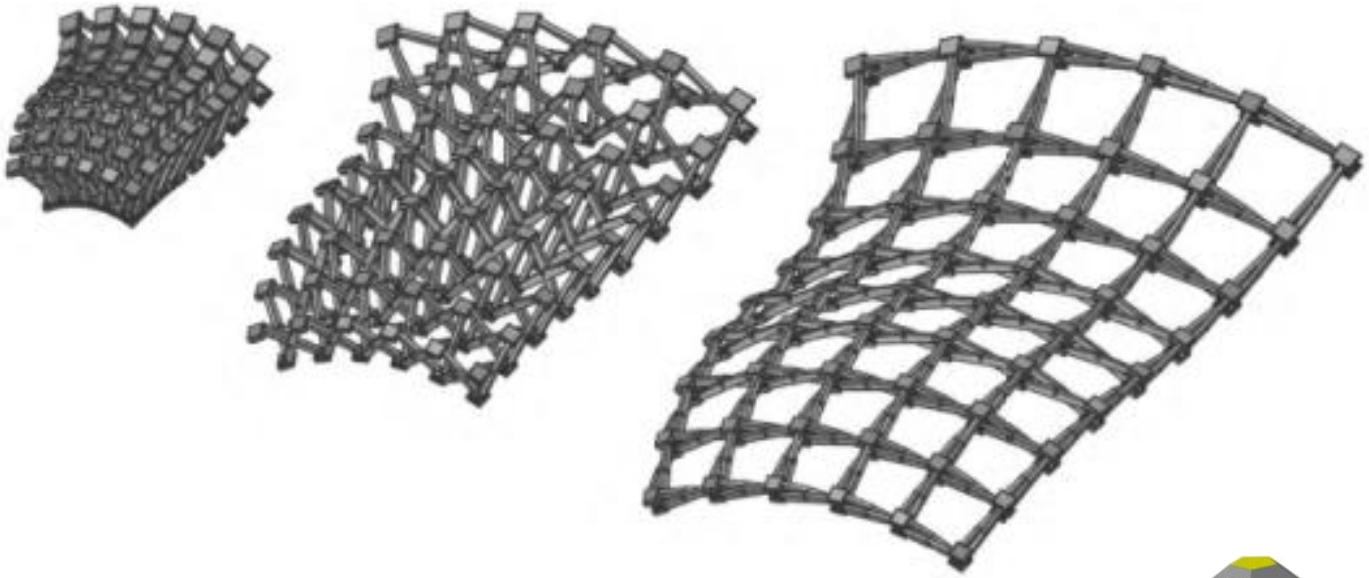
A deployable structure presents complete movement or movement of some of its parts, through mechanisms.

This achieves expandable structures which can be transformed according to the needs of each design.

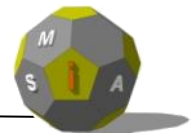
SL RASCH. Expo Pavilion of Venezuela in Hannover, Germany, 2000

ADVANTAGES:

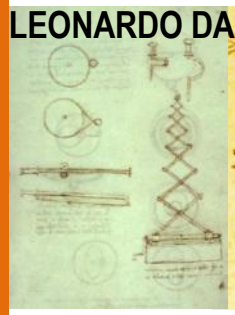
- Lightness
- Element modulation
- Easy assembly
- Structural efficiency
- Transportability

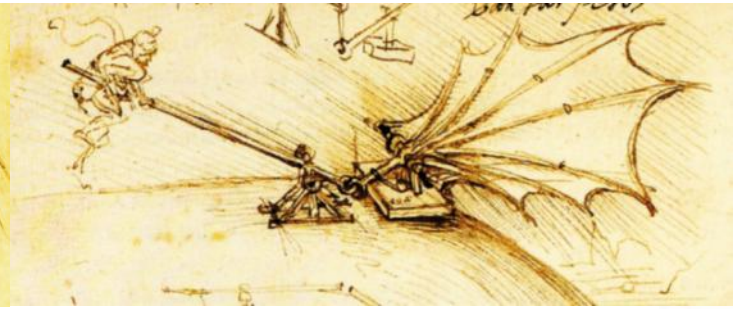
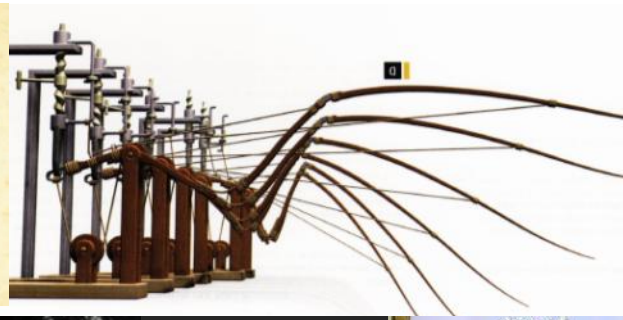


3. Background

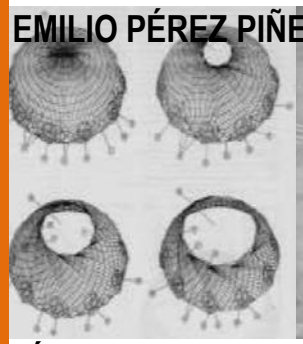


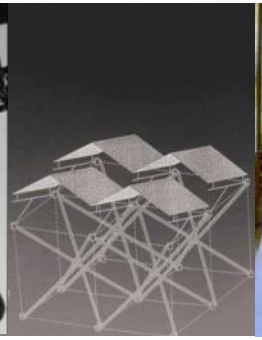
LEONARDO DA VINCI



EMILIO PÉREZ PIÑERO




FÉLIX ESCRIG PALLARÉS

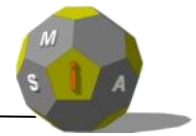



SERGIO PELLEGRINO

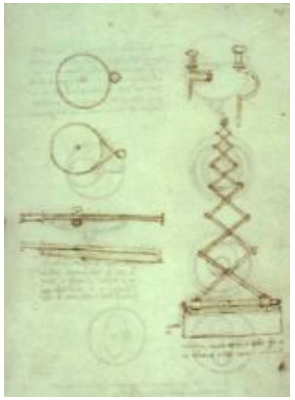


CHUCK HOBERMAN

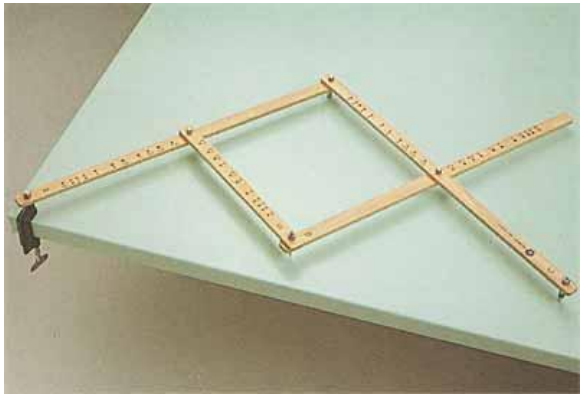
4. Types of deployable systems



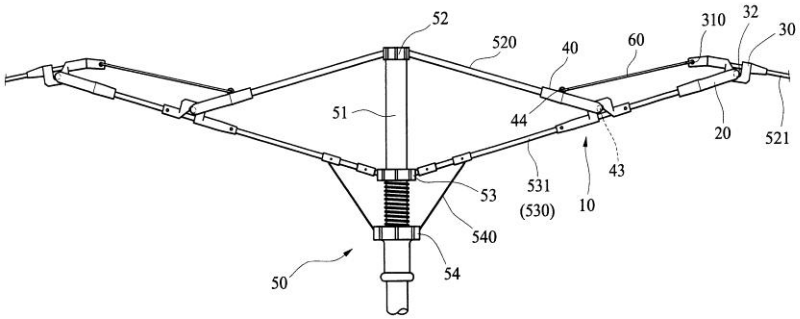
ARTICULATED SYSTEMS



Mechanical system
of scissors.
Leonardo Da Vinci



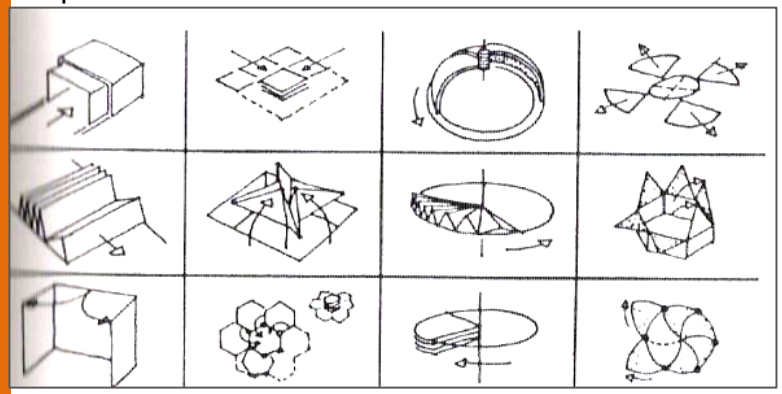
Pantograph



Umbrella system

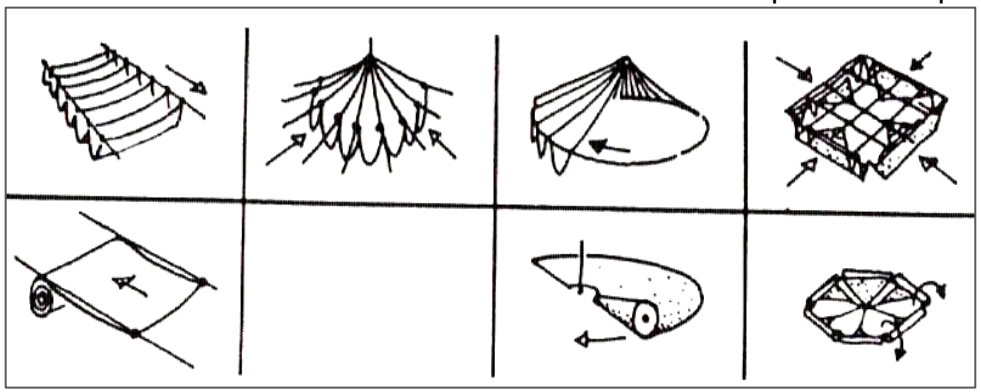
MOBILE PANELS:

Displacement and rotation



MOBILE MEMBRANES

Gather up and roll up

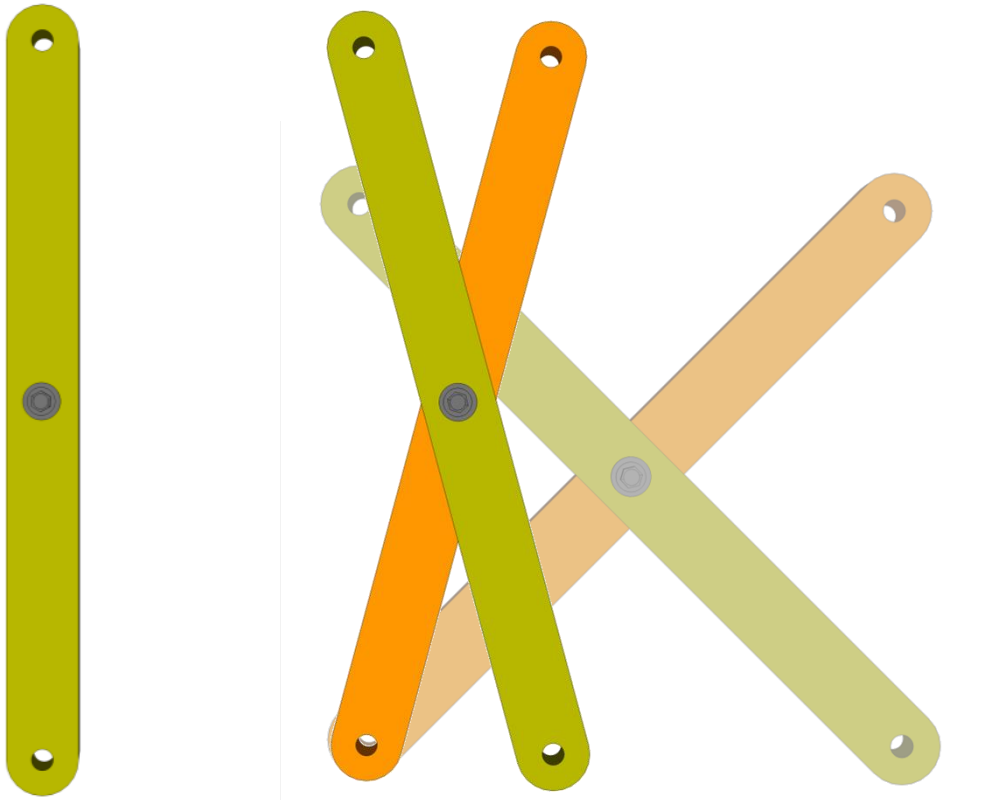


Typologies of mobile system. Friedmann Kugel and Frei Otto

5. Scissor system

DEFINITION:

What is defined as scissor system is the articulation between two rigid elements or bars. Some designs have replaced these bars for other elements like panels



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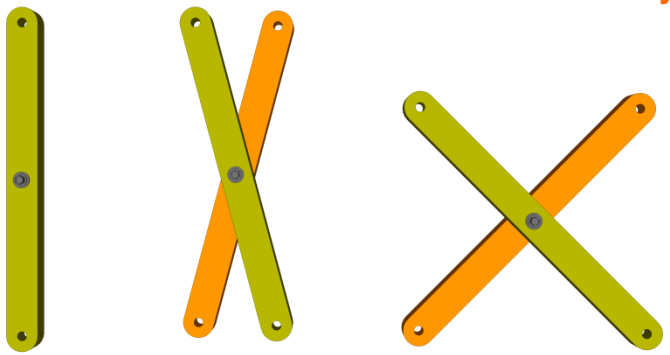
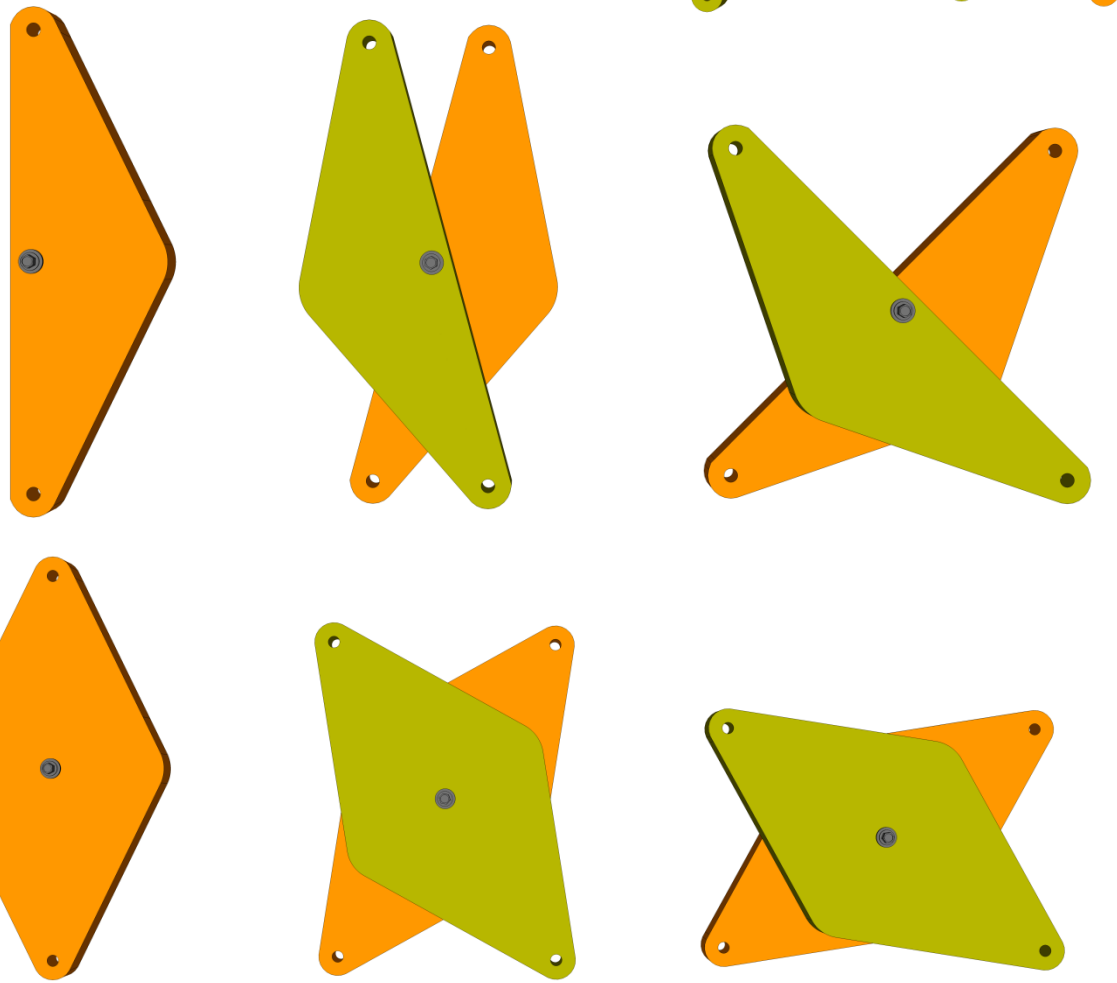
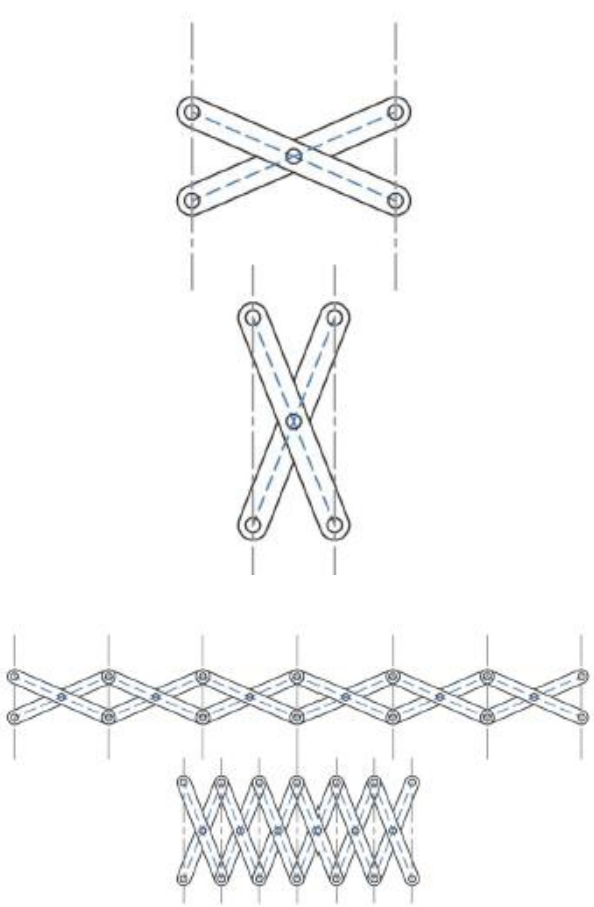


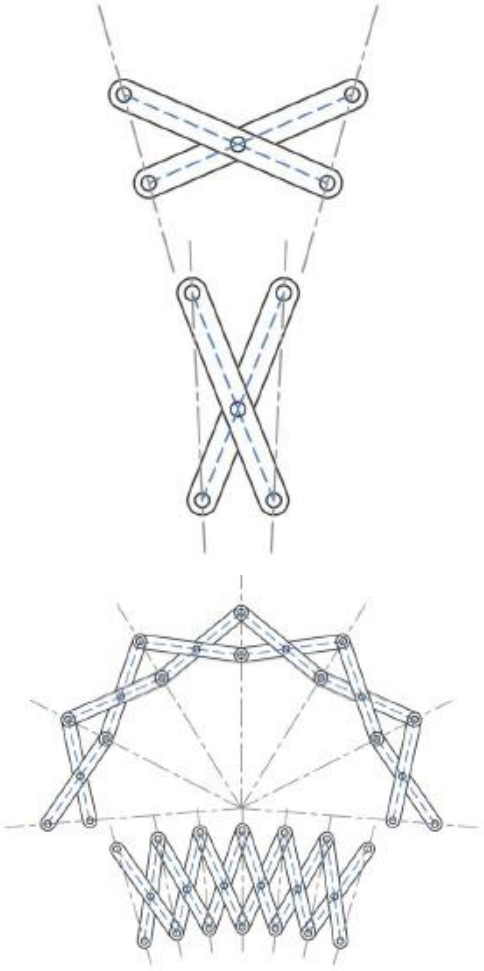


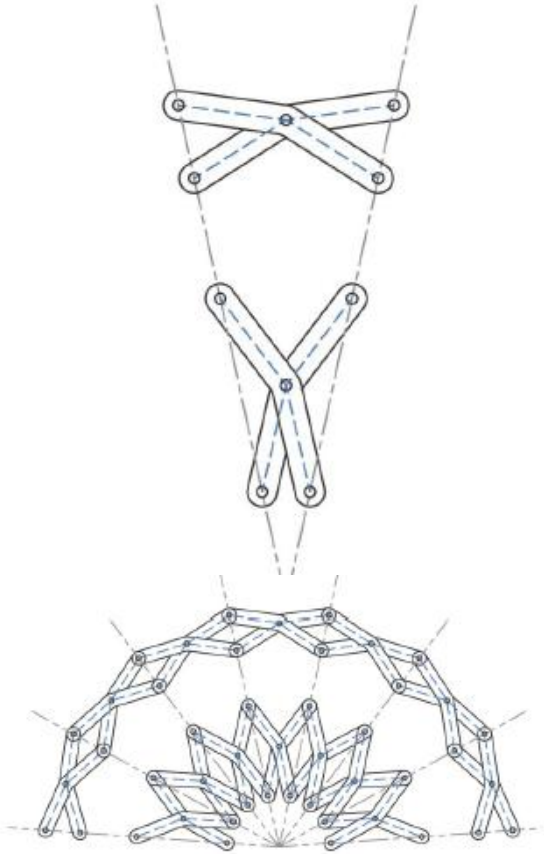
Symmetric straight scissor

Straight scissor asymmetric

Scissor angled







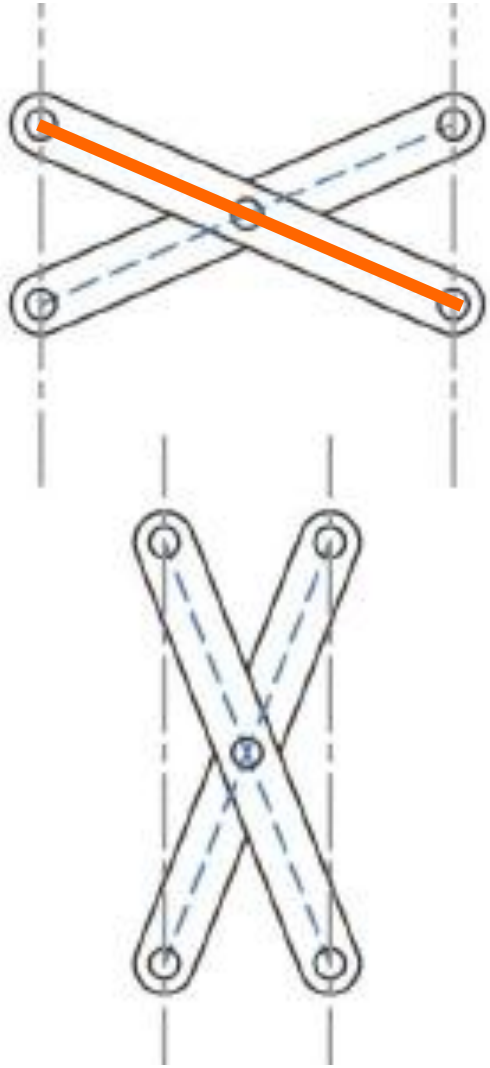
No curvature

Variable curvature

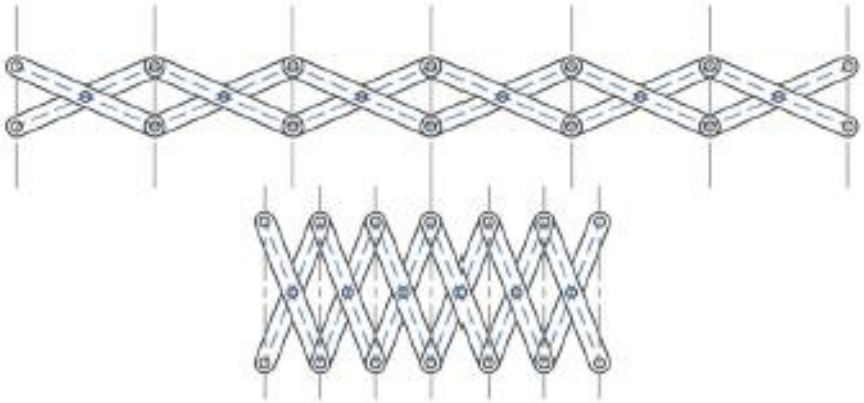
Constant curvature

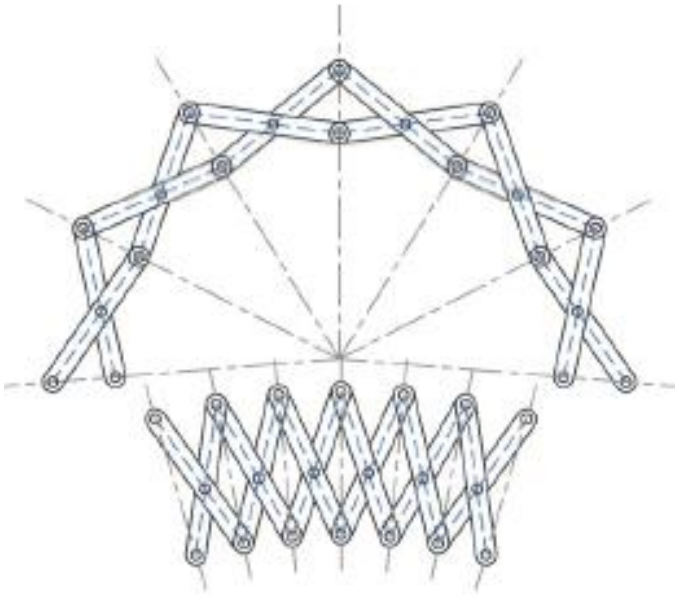
STRAIGHT SCISSORS

When the articulations of these elements are positioned on a straight line.

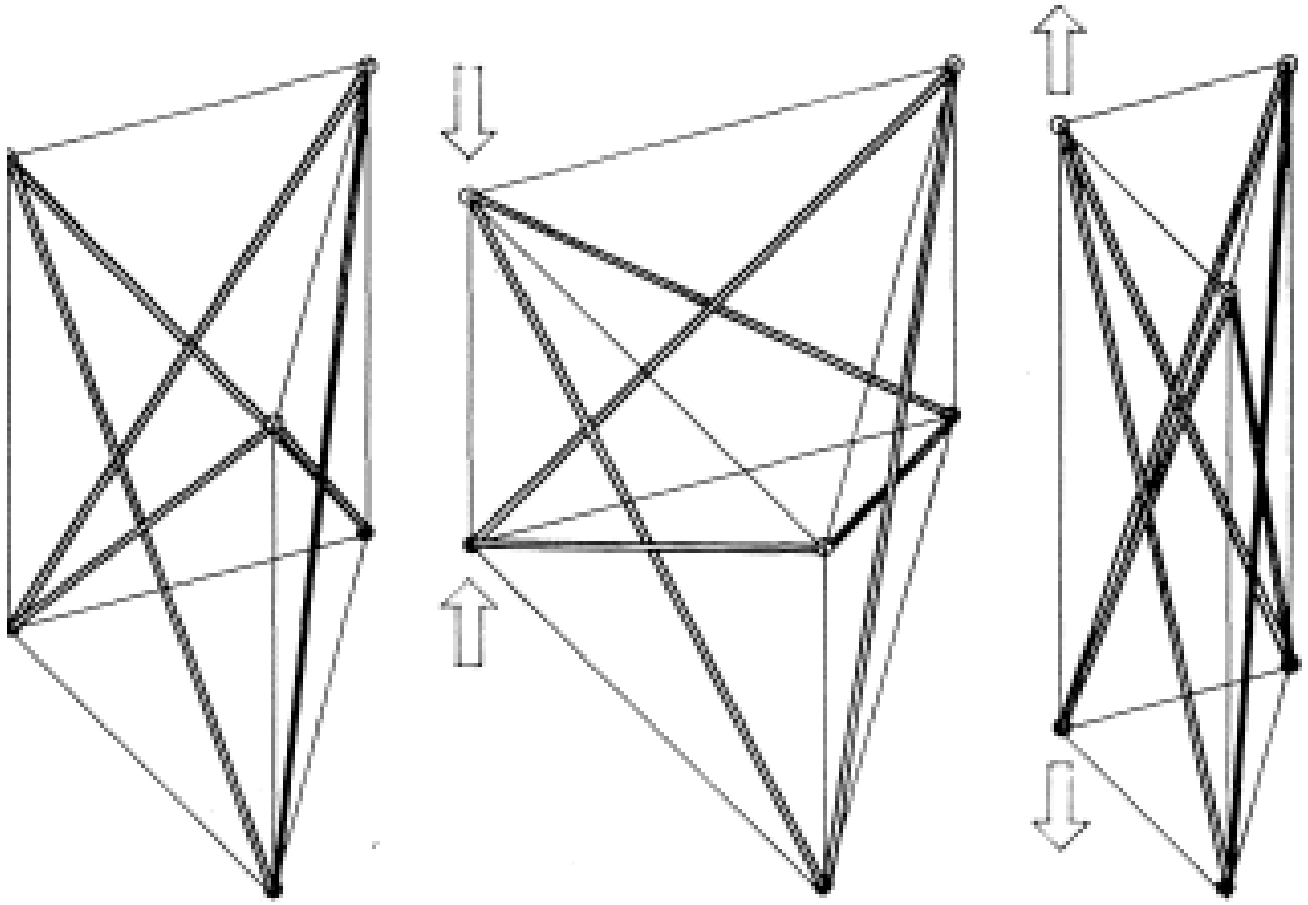


Straight scissor flat groupings



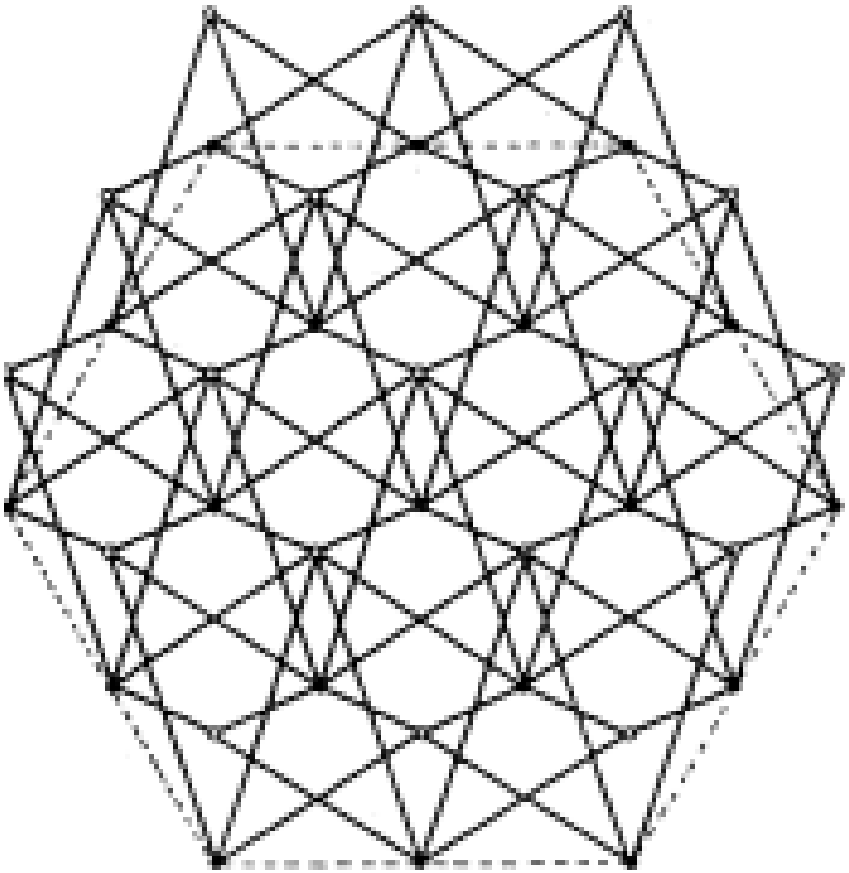


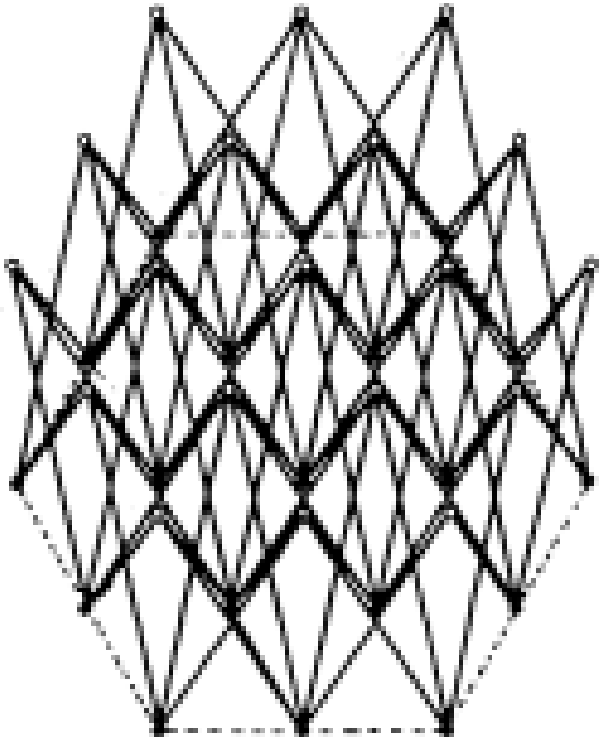
SPATIAL CLUSTERS. SYMMETRICAL STRAIGHT SCISSORS



TRIANGULAR PRISMS

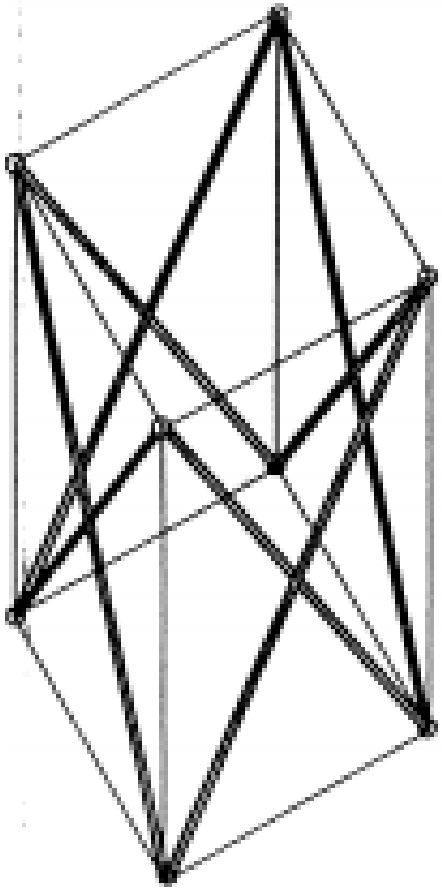
SPATIAL CLUSTERS. SYMMETRICAL STRAIGHT SCISSORS

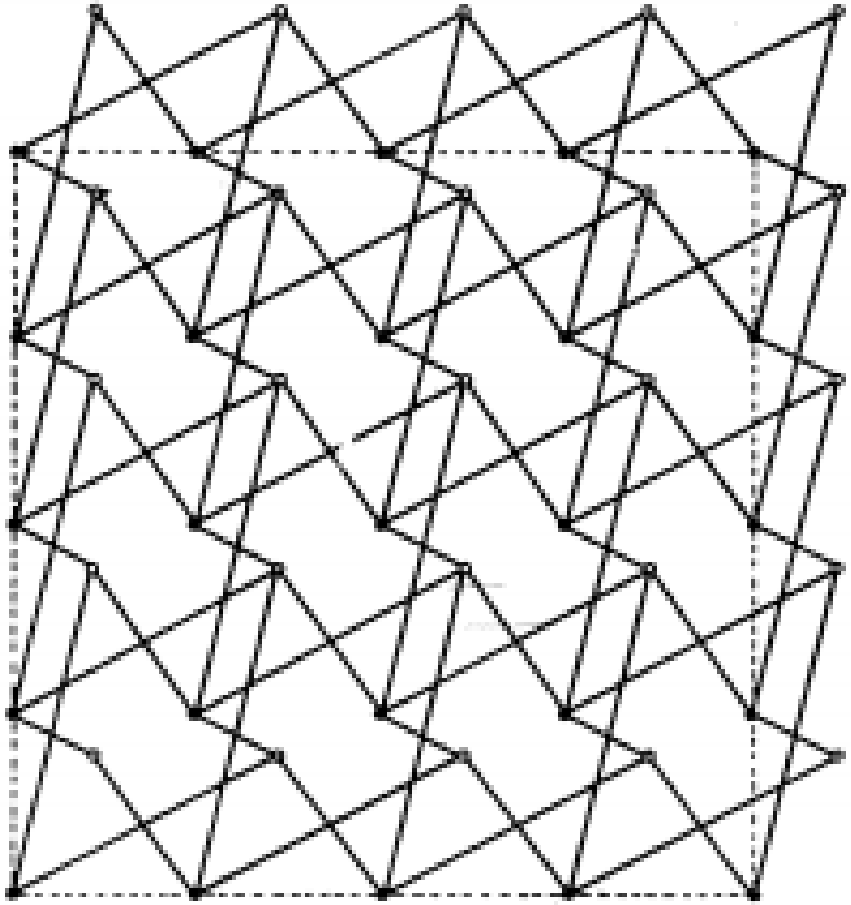




GROUPINGS. TRIANGULAR PRISMS

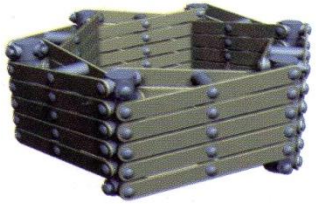
SPATIAL CLUSTERS. SYMMETRICAL STRAIGHT SCISSORS



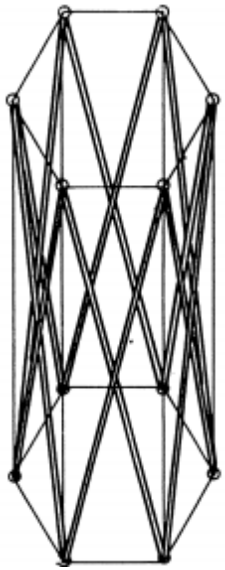


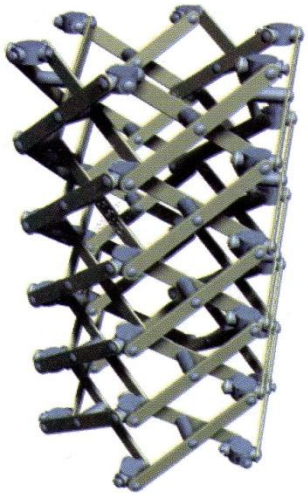
SQUARE-BASED PRISM

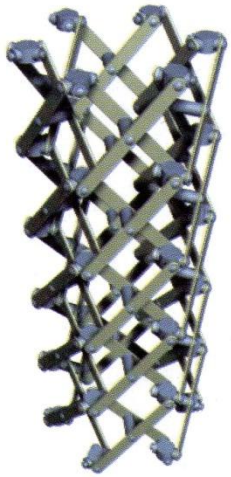
SPATIAL CLUSTERS. SYMMETRICAL STRAIGHT SCISSORS

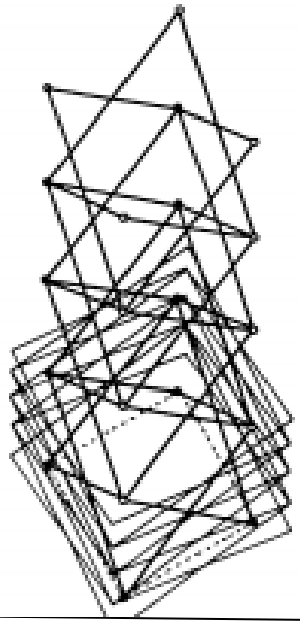


Prismas de tijeras

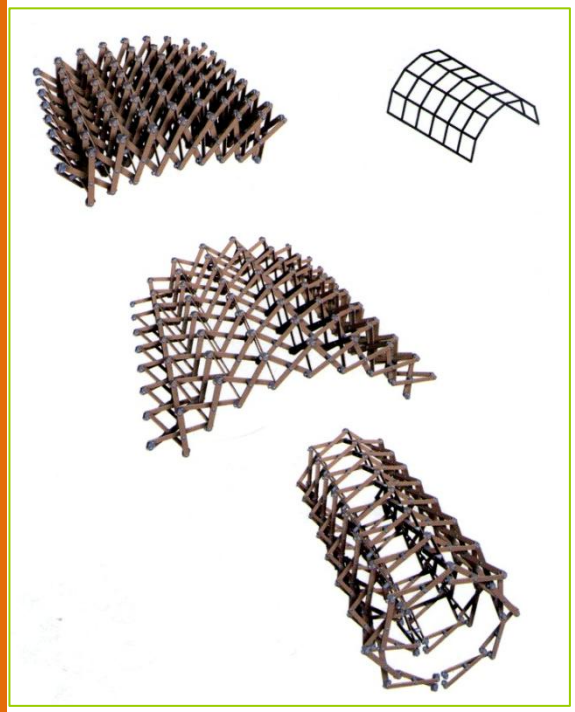


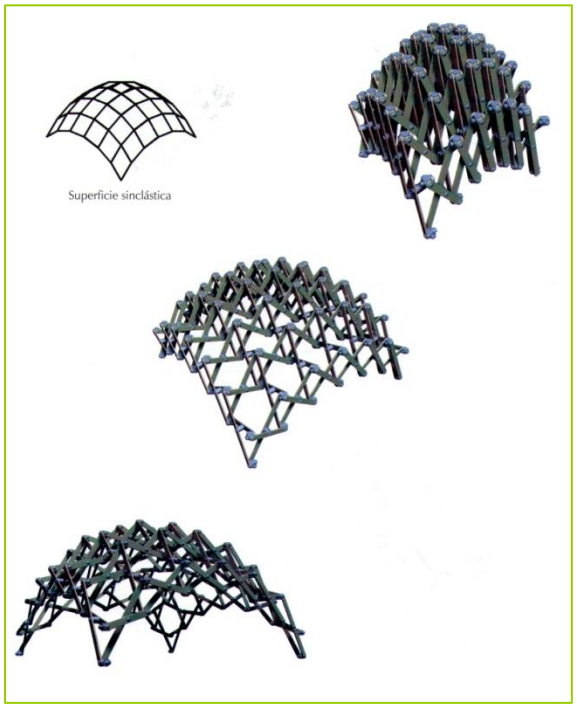


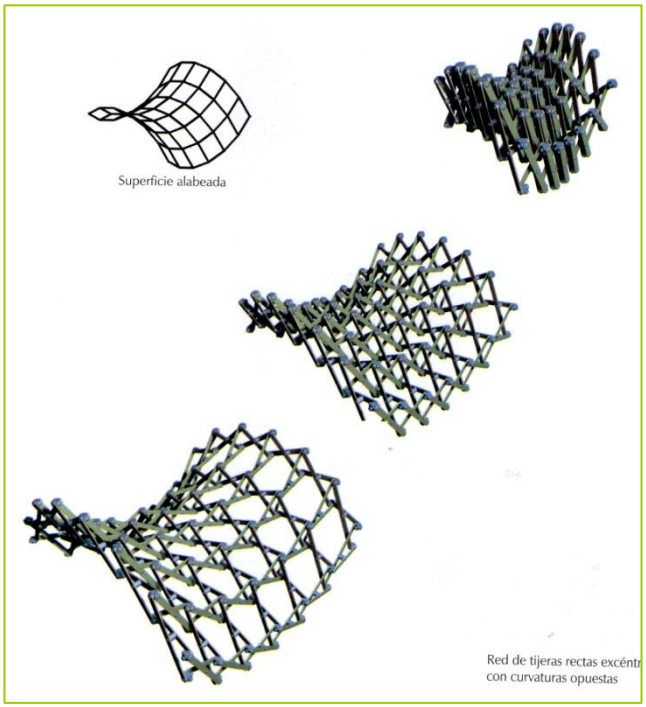




SPATIAL CLUSTERS. ASSYMERICAL SCISSOR SYSTEMS.

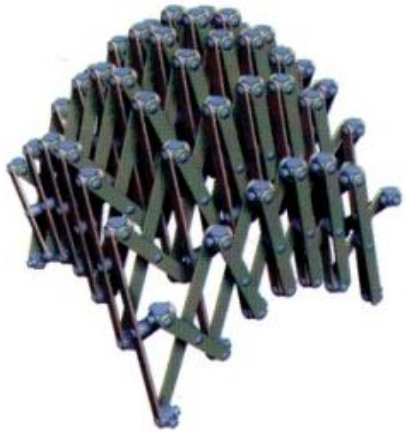


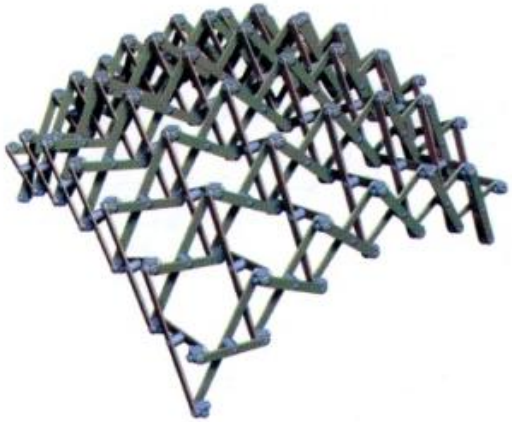




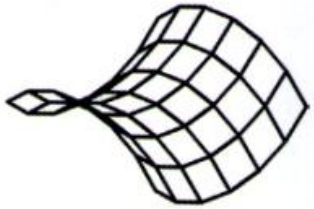
SPATIAL CLUSTERS. ASSYMERICAL SCISSOR SYSTEMS.

Superficie sinclástica

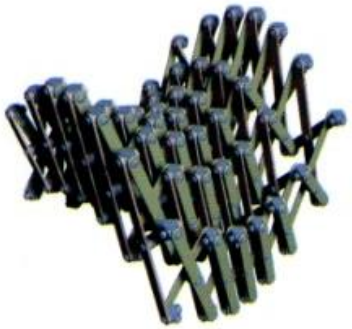


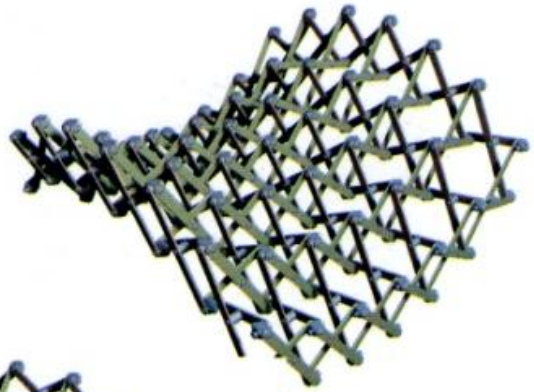


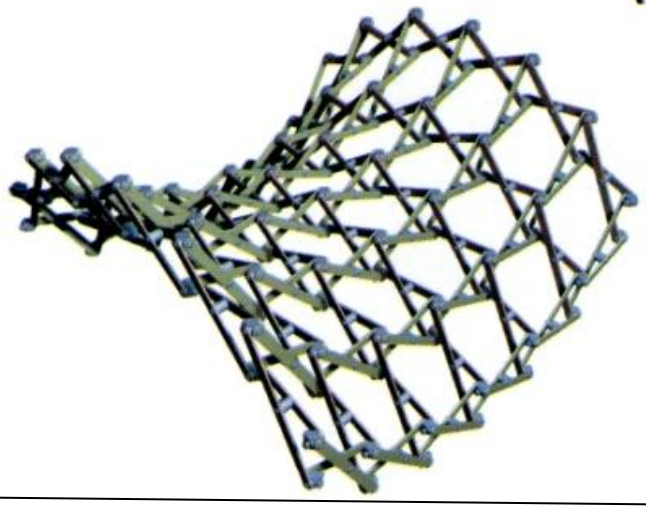
SPATIAL CLUSTERS. ASSYMERICAL SCISSOR SYSTEMS.



Superficie alabeada

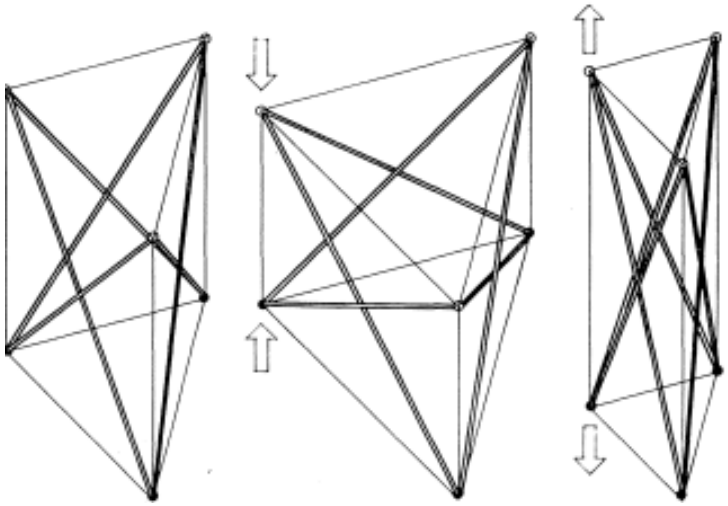


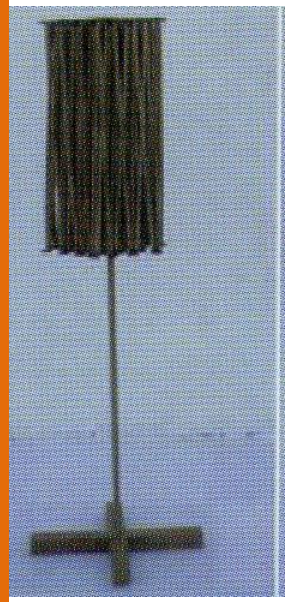


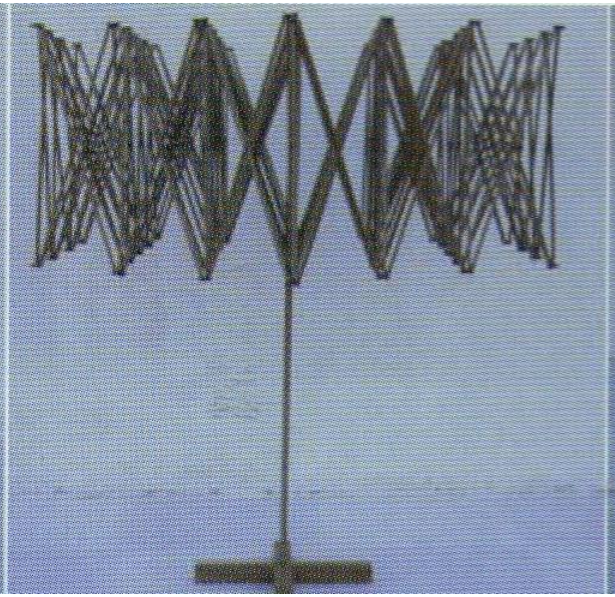


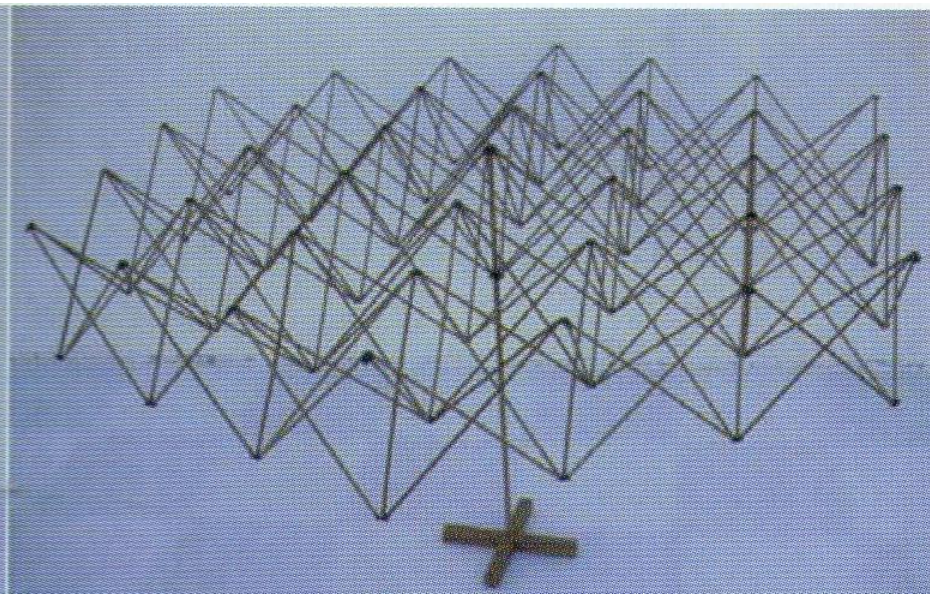
Red de tijeras rectas excéntr
con curvaturas opuestas

MAIN STUDIES AND APPLICATIONS WITH STRAIGHT SCISSORS









MAIN STUDIES AND APPLICATIONS WITH STRAIGHT SCISSORS

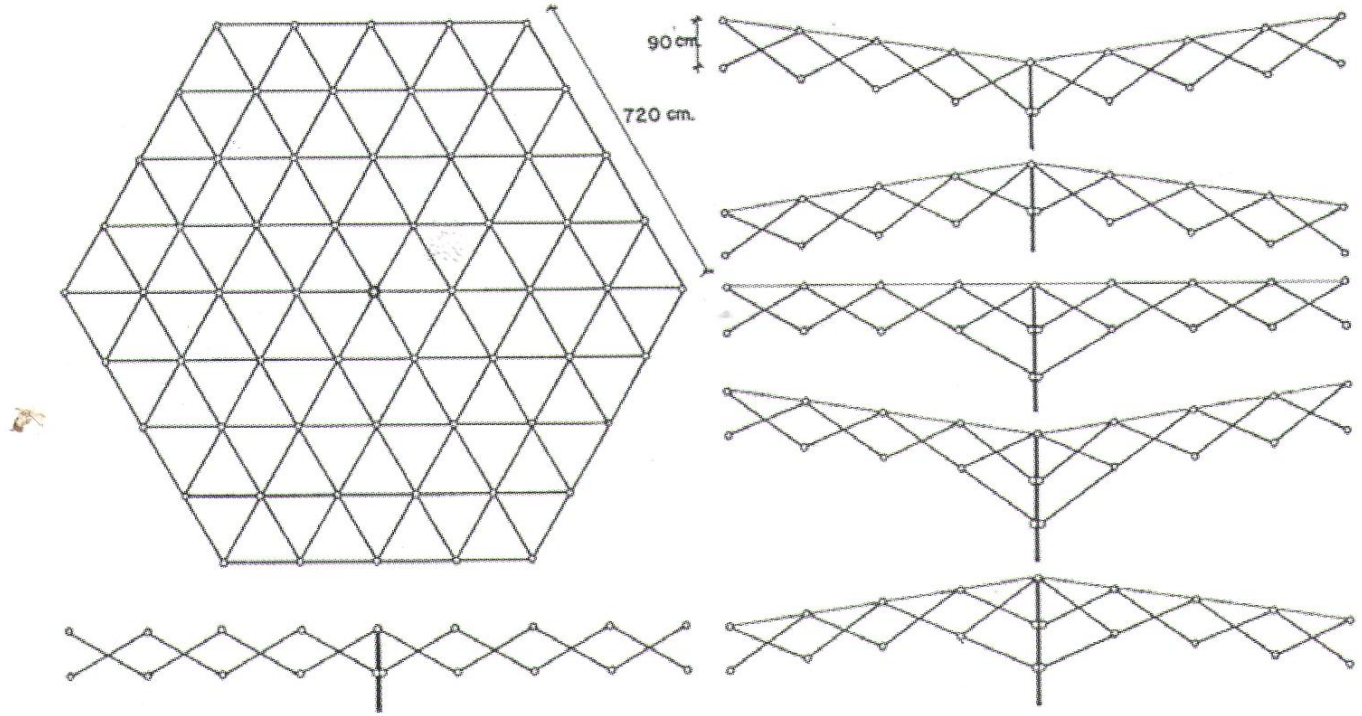
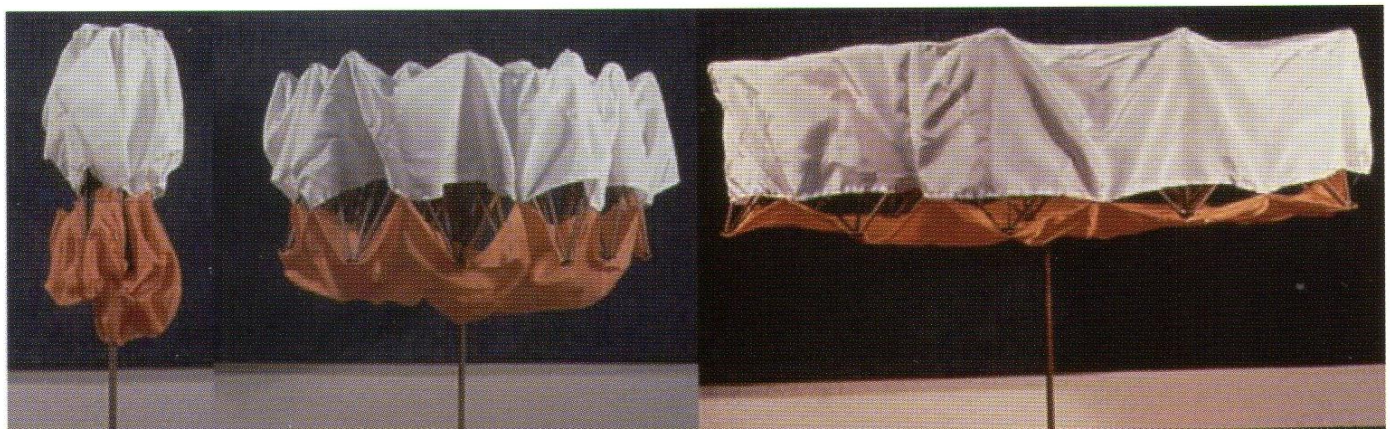
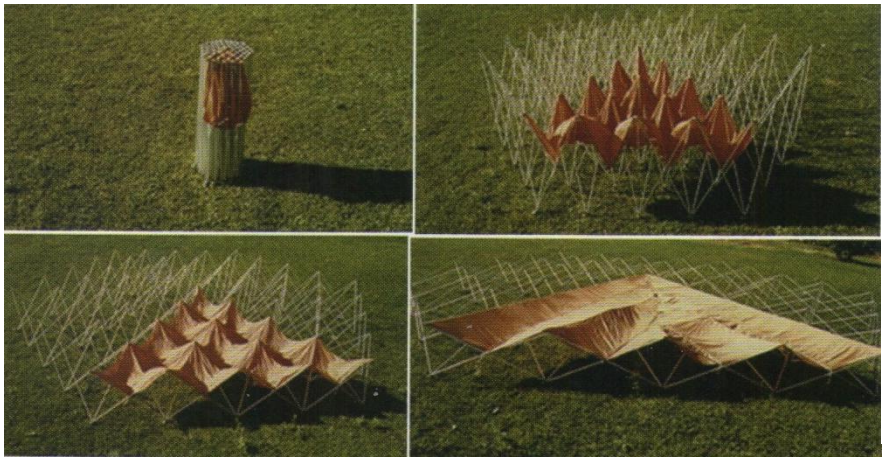


Fig. 2.15 Diferentes variantes analizadas para la ejecución del proyecto de Plaza de San Francisco.



MAIN STUDIES AND APPLICATIONS WITH STRAIGHT SCISSORS



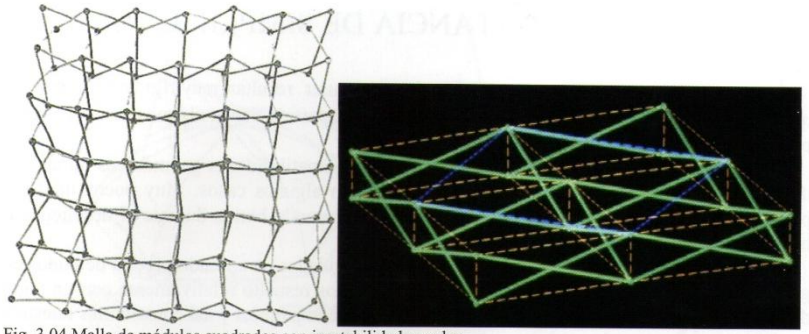
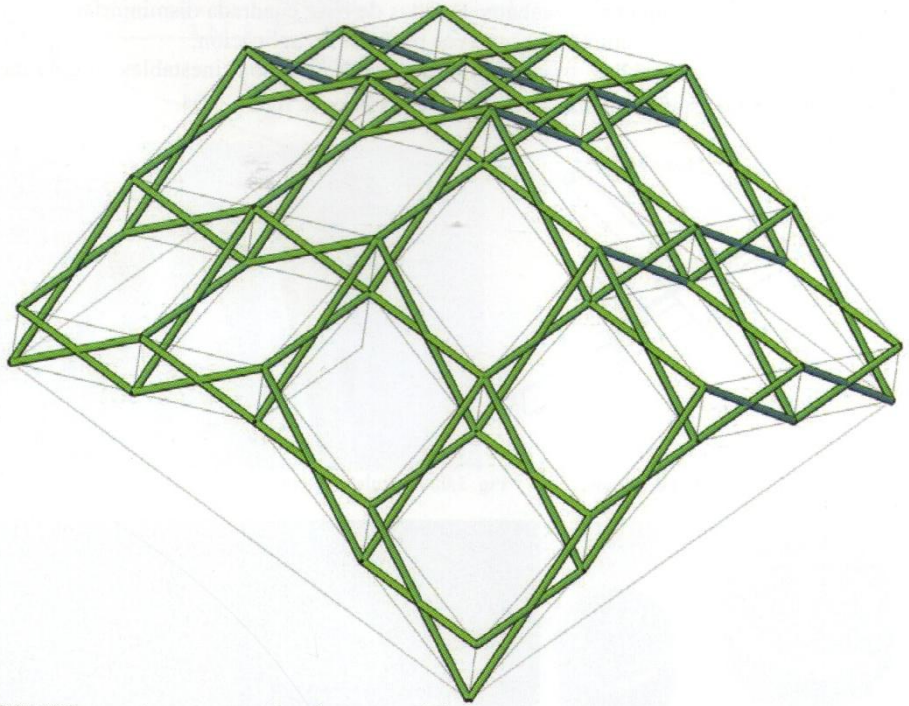
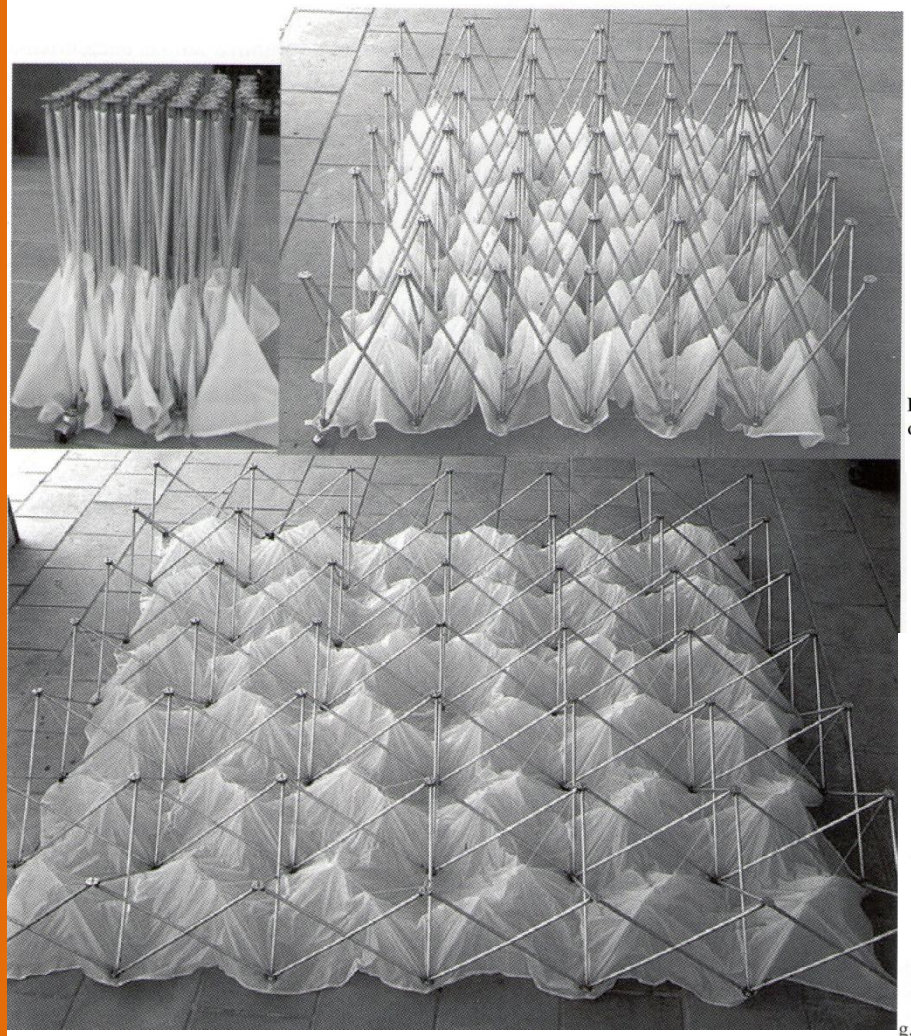


Fig. 3.04 Malla de módulos cuadrados con inestabilidad angular.
Fig. 3.05 Estabilización angular mediante cables (en azul).



3.06 Malla a cuatro aguas apoyada sobre cuatro vértices.

MAIN STUDIES AND APPLICATIONS WITH STRAIGHT SCISSORS



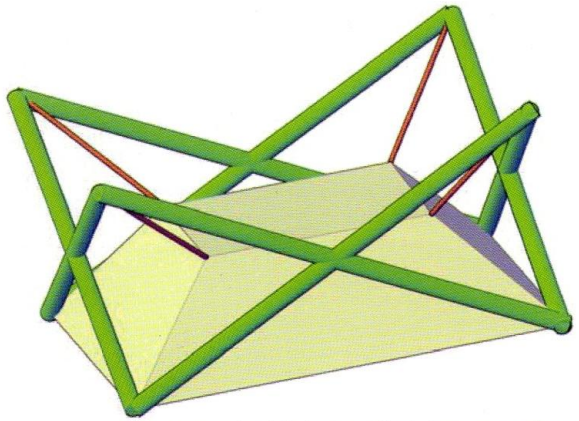
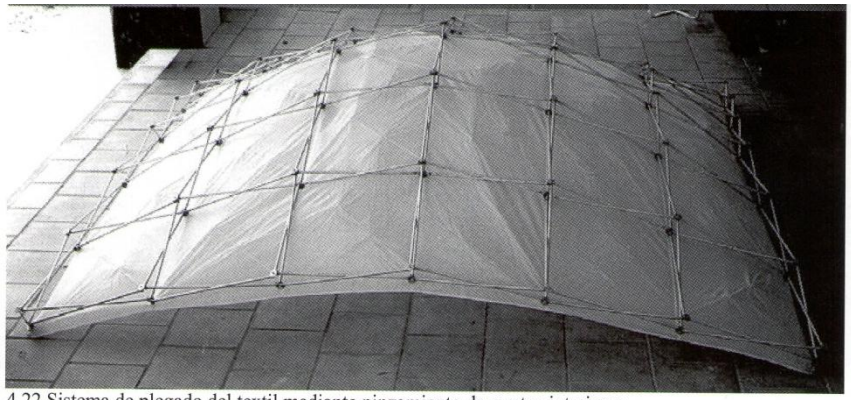


Fig. 4.21 Pinzado de la cubierta vinculada a los nudos inferiores mediante tensores que fuerzan un plegado ordenado en todo el proceso de montaje.



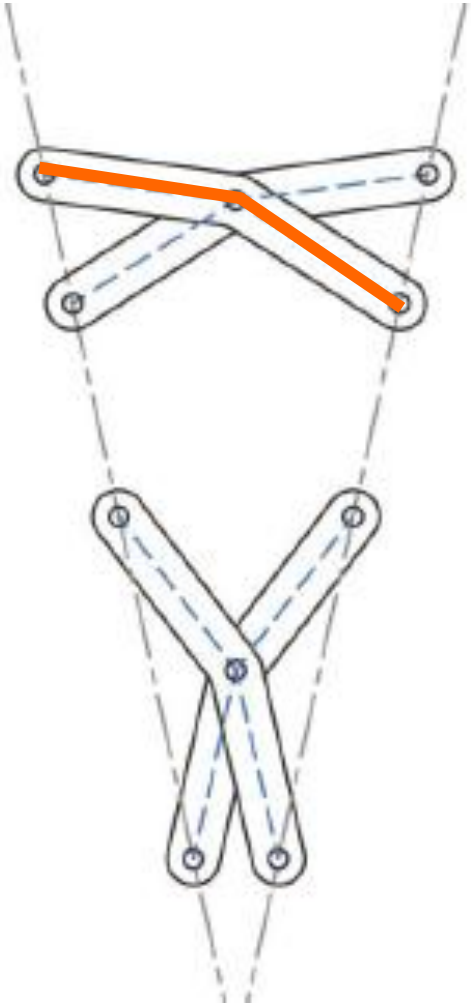
g. 4.22 Sistema de plegado del textil mediante pinzamiento de puntos interiores.

MAIN STUDIES AND APPLICATIONS WITH STRAIGHT SCISSORS

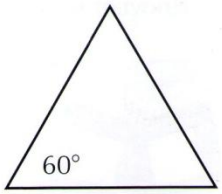
Piscina de San Pablo (Sevilla)

ANGULATED SCISSORS

When the articulations form angles different from an 180 degrees angle.
That is to say, they are not positioned in a straight line.



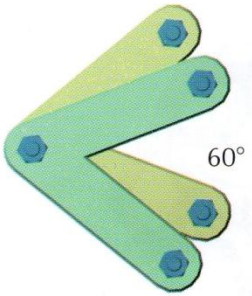
ANGULATED SCISSORS



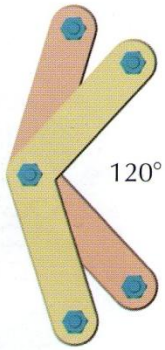
Tijeras anguladas

El ángulo es igual a. A=180-(360/N)

Donde N es el número de lados del polígono

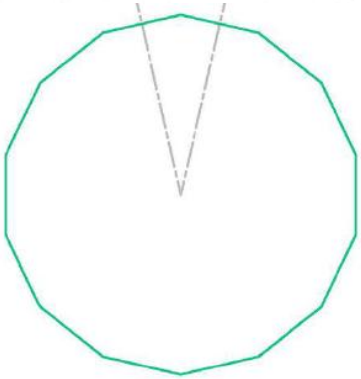


A=180-(360/N)
A=180-(360/3)
A=180-(120)
A=60°

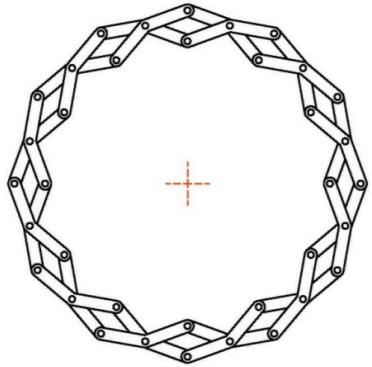


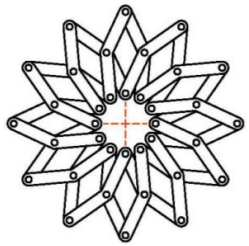
A=180-(360/N)
A=180-(360/6)
A=180-(60)
A=120°

Geometric construction - whe

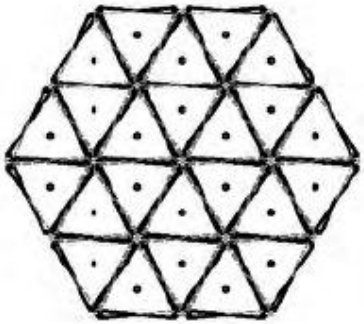


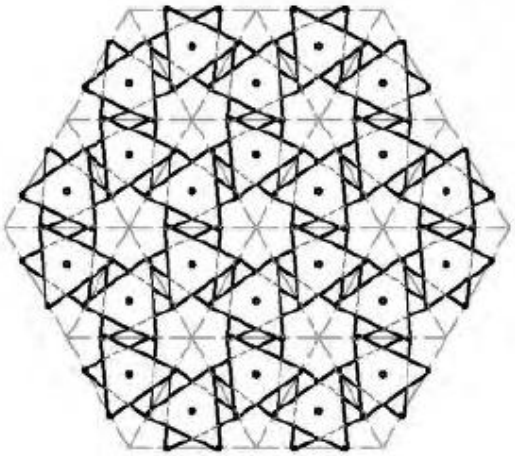
Arrayed 14 times

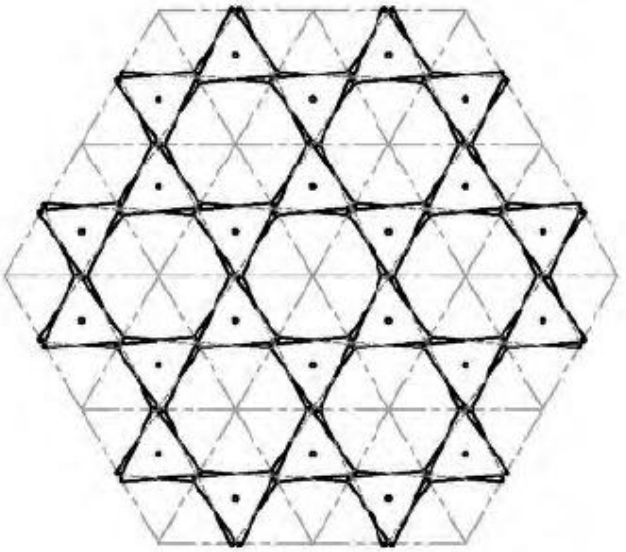




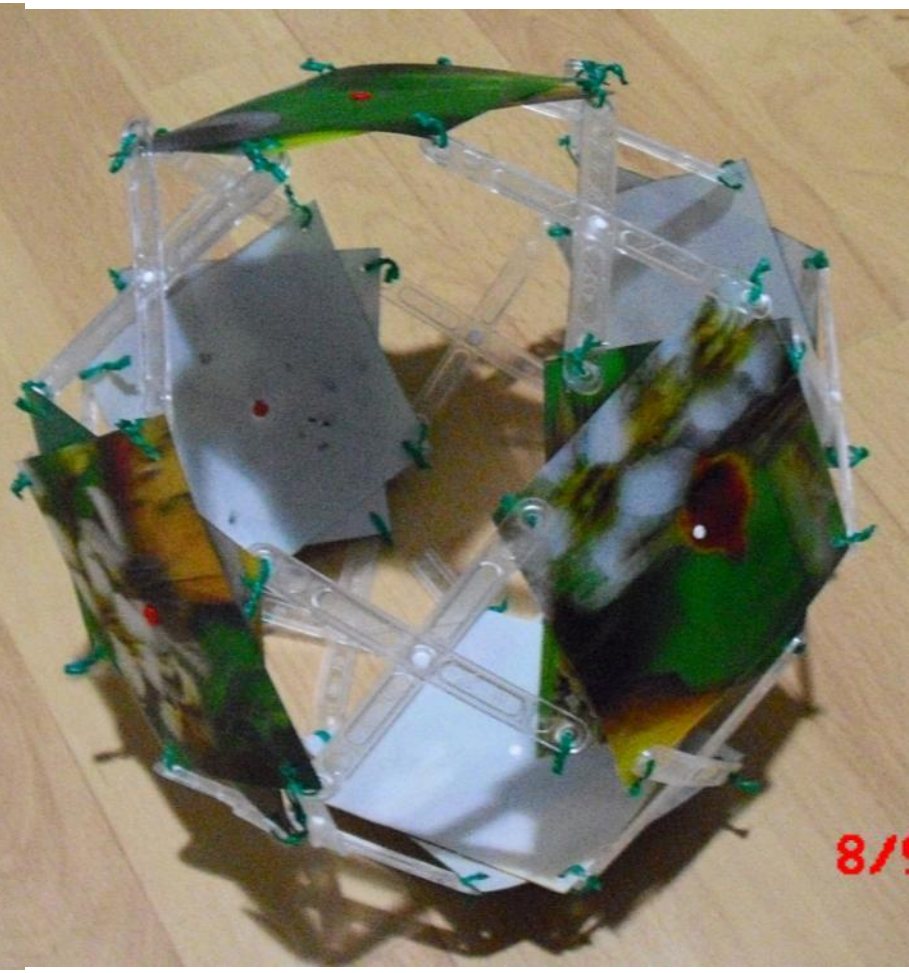
DEPLOYABLE NETS





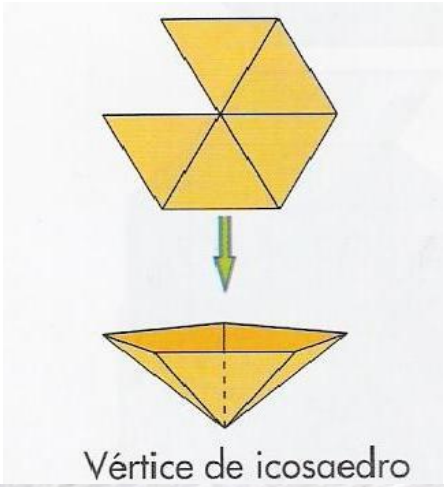


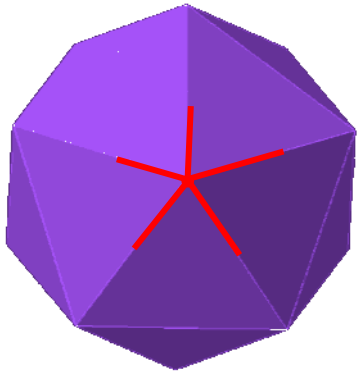
DEPLOYABLE POLYHEDRON

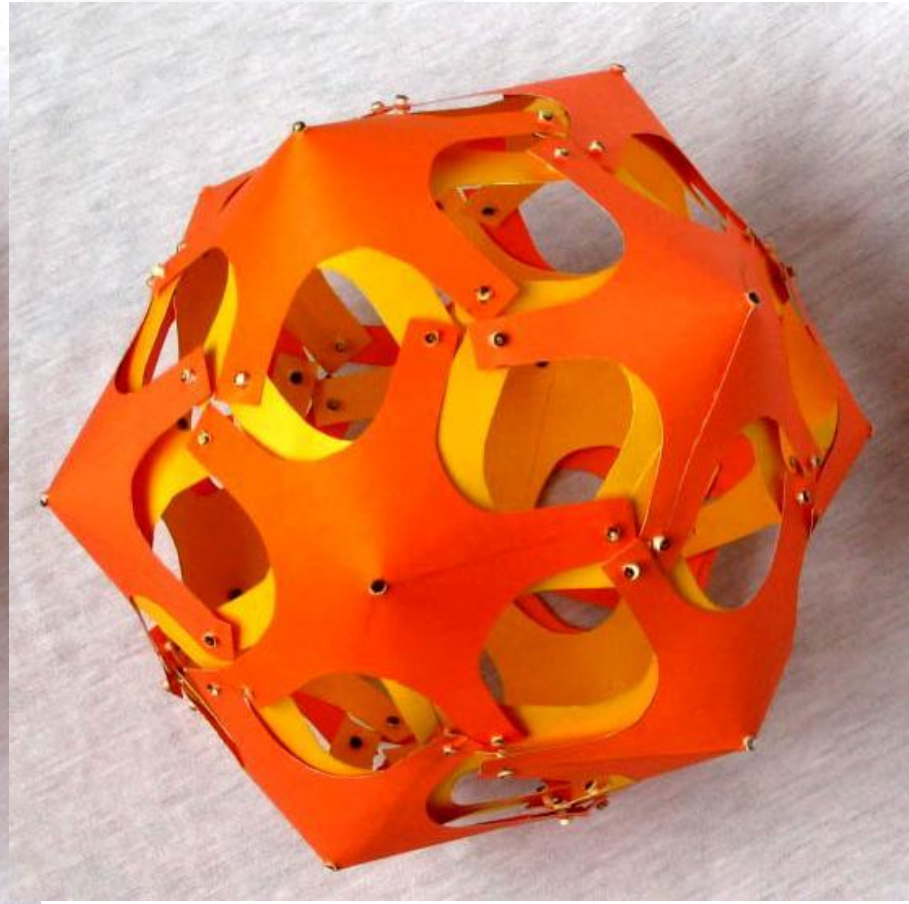


Scissor system

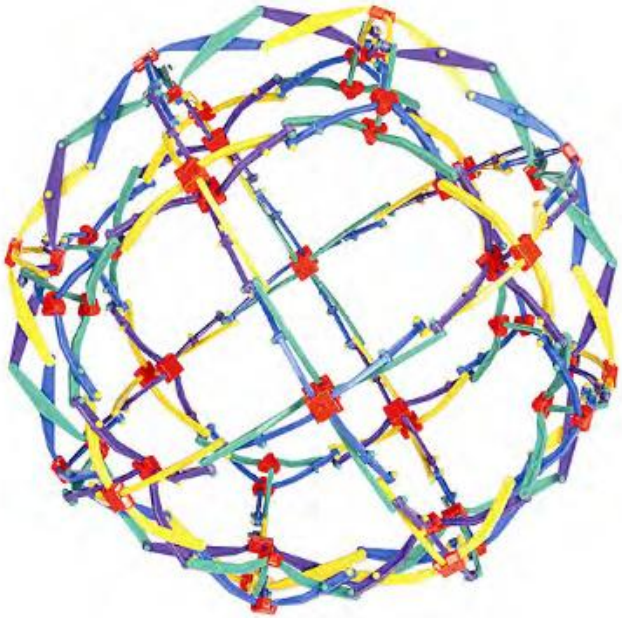
DEPLOYABLE POLYHEDRON

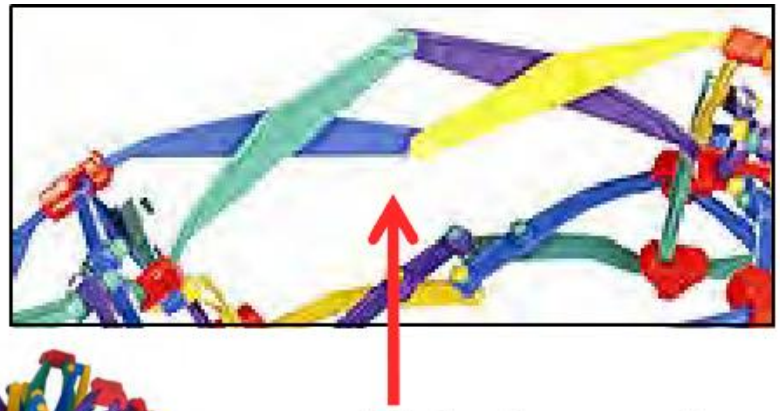






THE EXAPANDIBE SPHERE

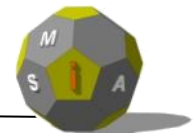




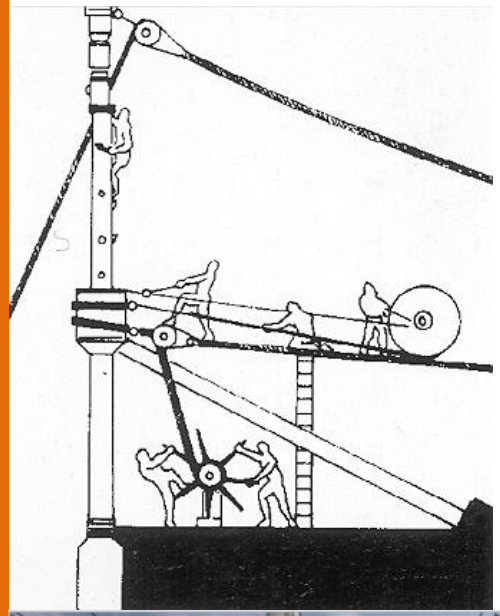
Mini sphere works with double scissor between hubs

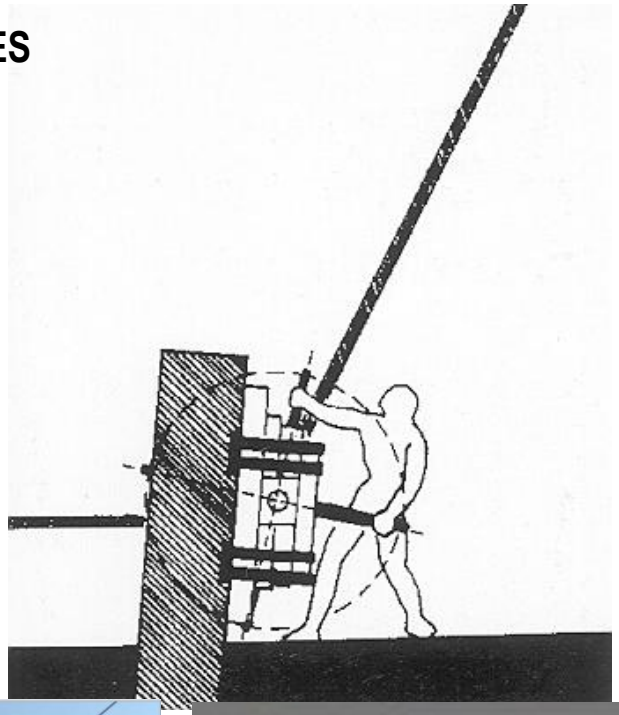
THE EXAPANDIBE SPHERE

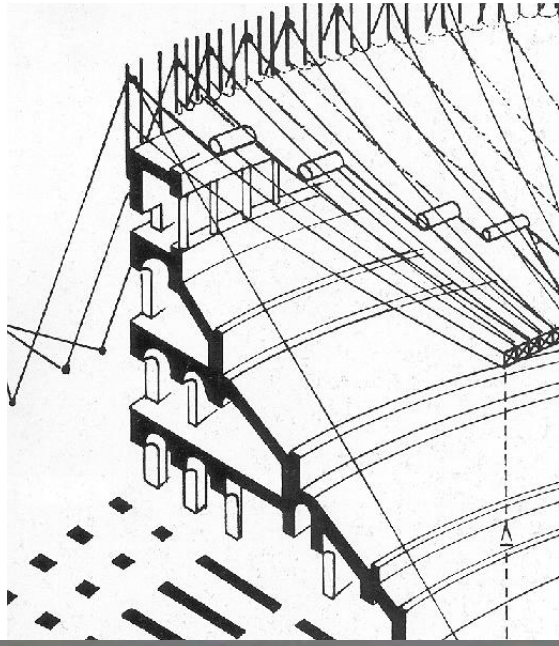
6. Convertible Roofs

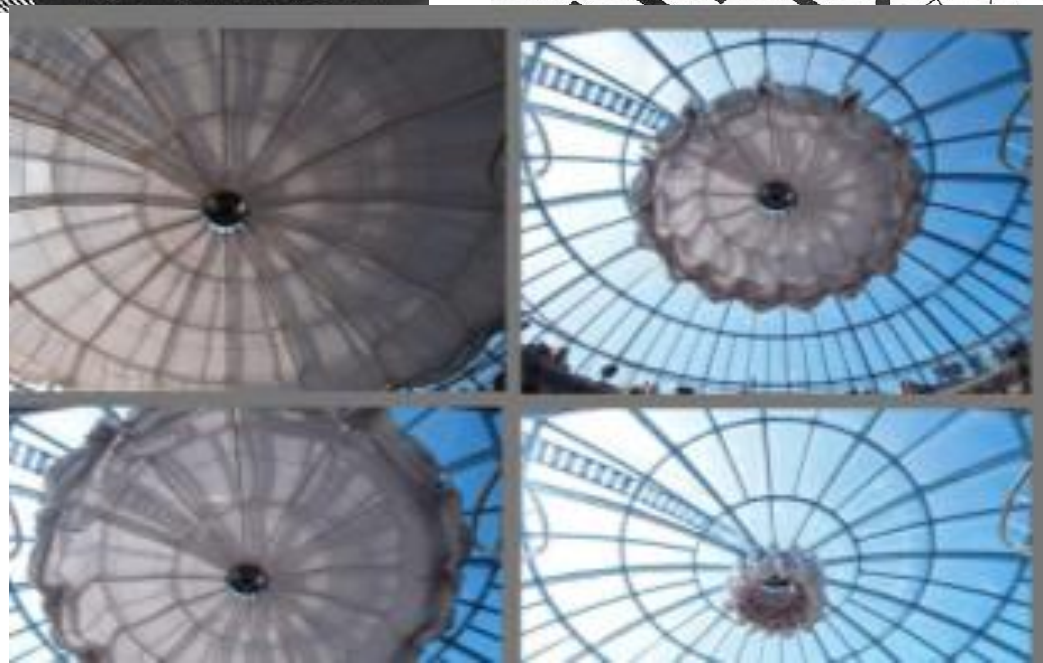


THE RETRACTABLE MEMBRANES









Retractable Roof Amphitheatre Lavis

Covered surface: 900 m²

Material: PVC-PES

Client: Commune Lavis

Planning time: 2010

Architects:
Kugel Architekten, Stuttgart

Structural engineering:
Alfred Rein Ingenieure, Stuttgart

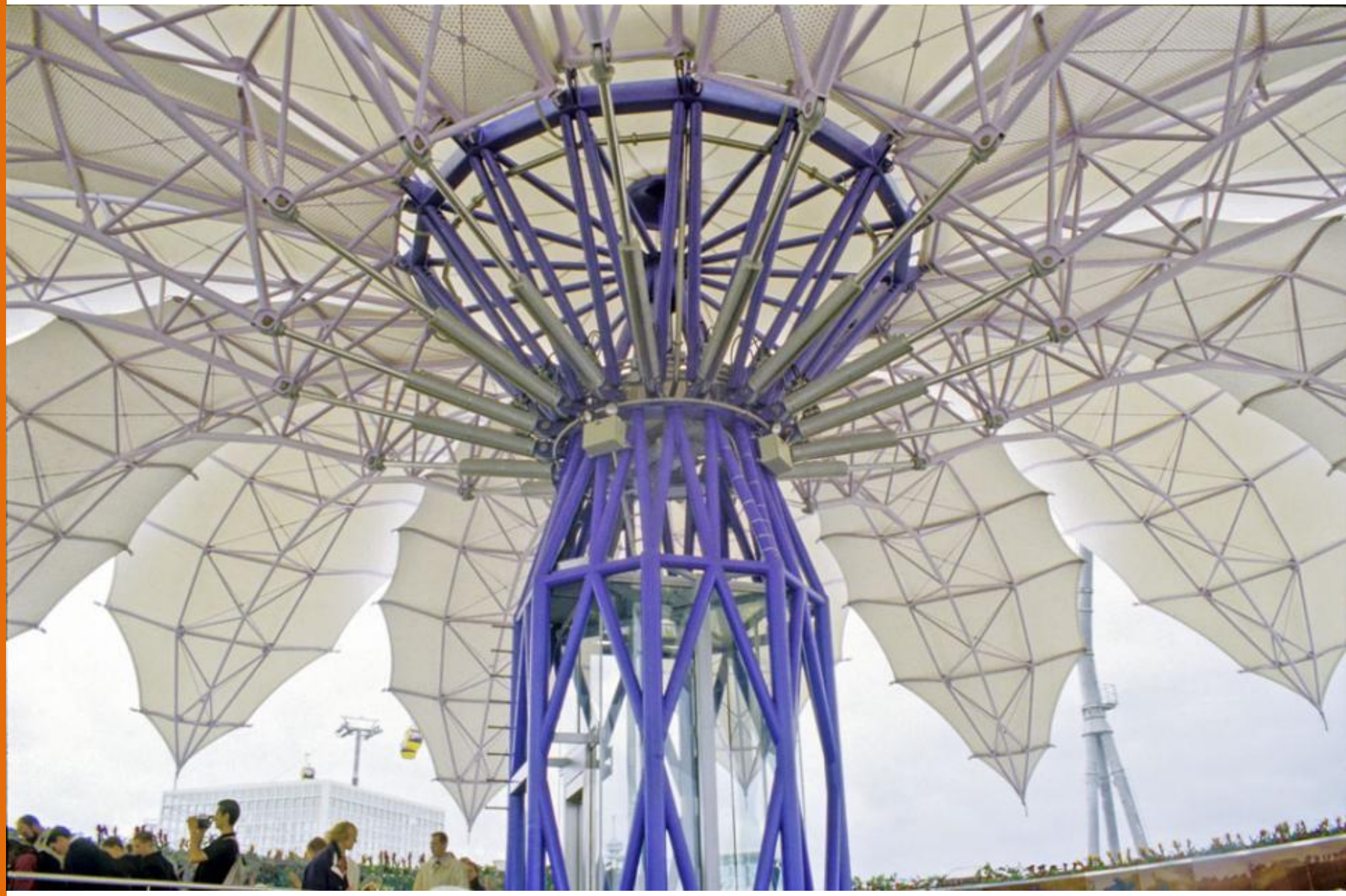
Local engineer / Site management
Hartmann & Gamper, Meran

Picture credits:
Alfred Rein Ingenieure
TemmeObermeier

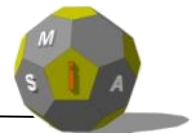
SL
RASCH GMBH

UMBRELLA SYSTEM

UMBRELLA SYSTEM

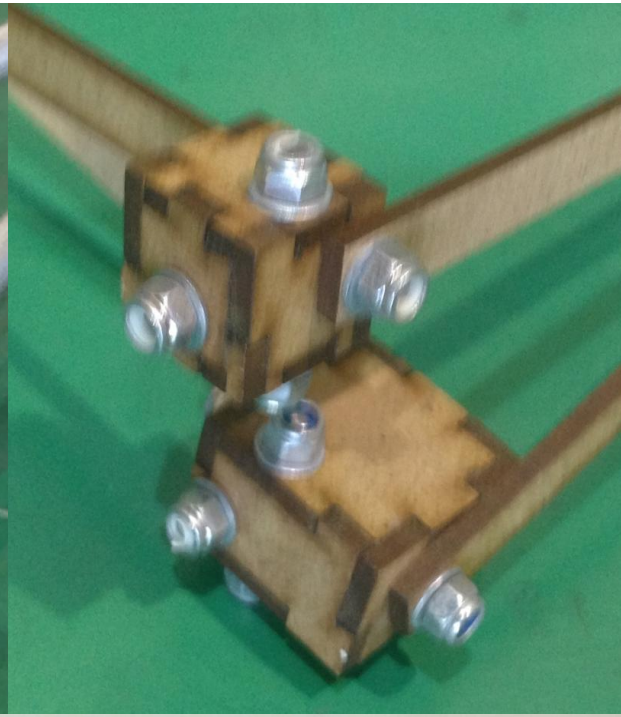


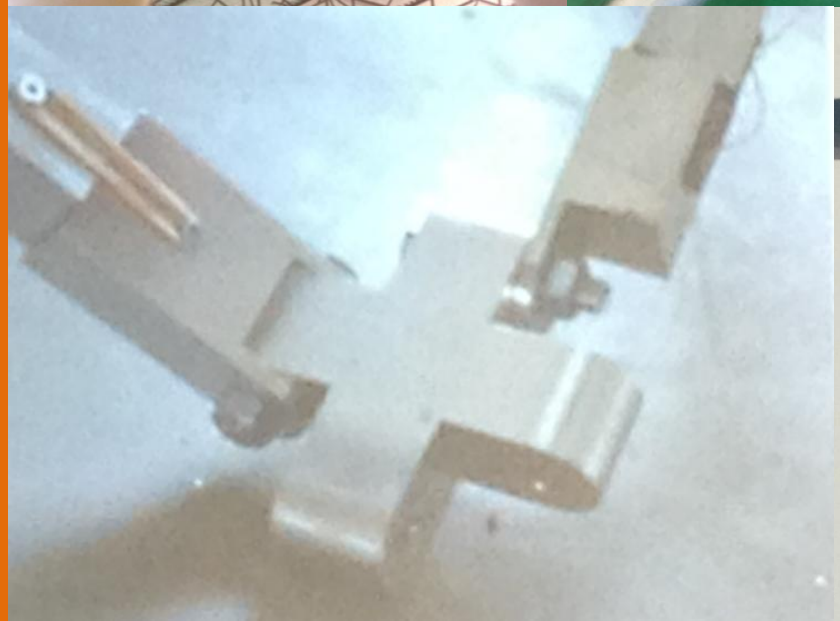
7. Details



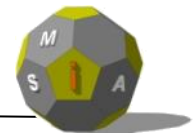
Details

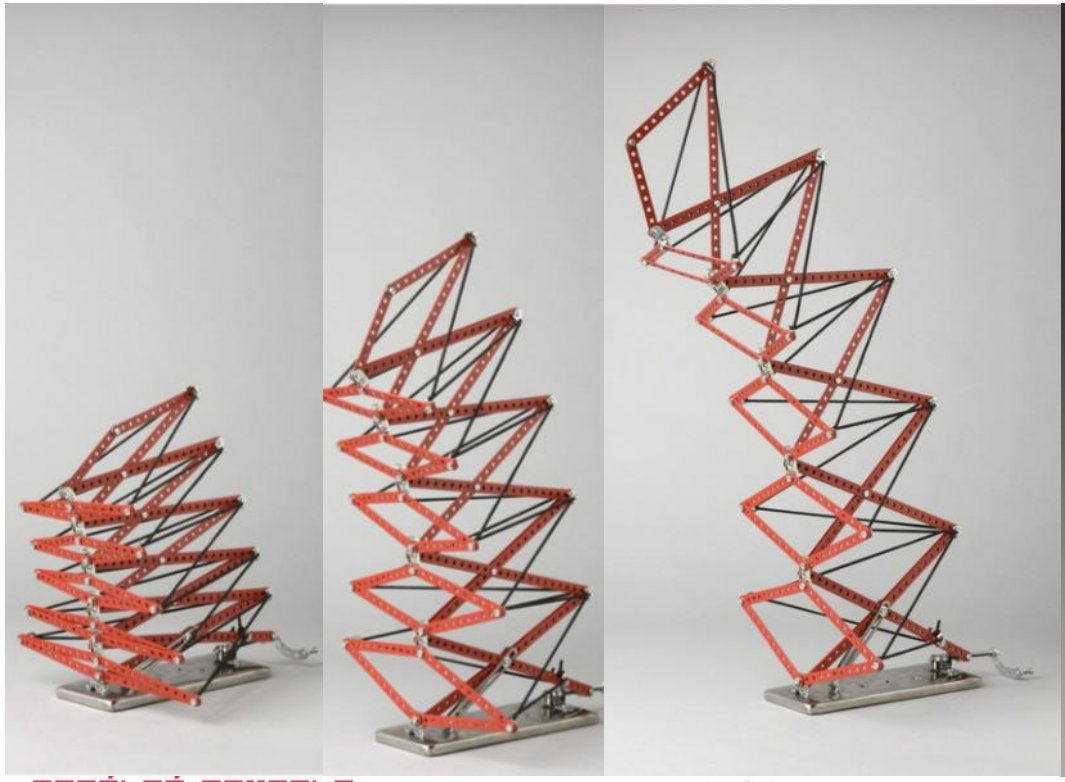
Details

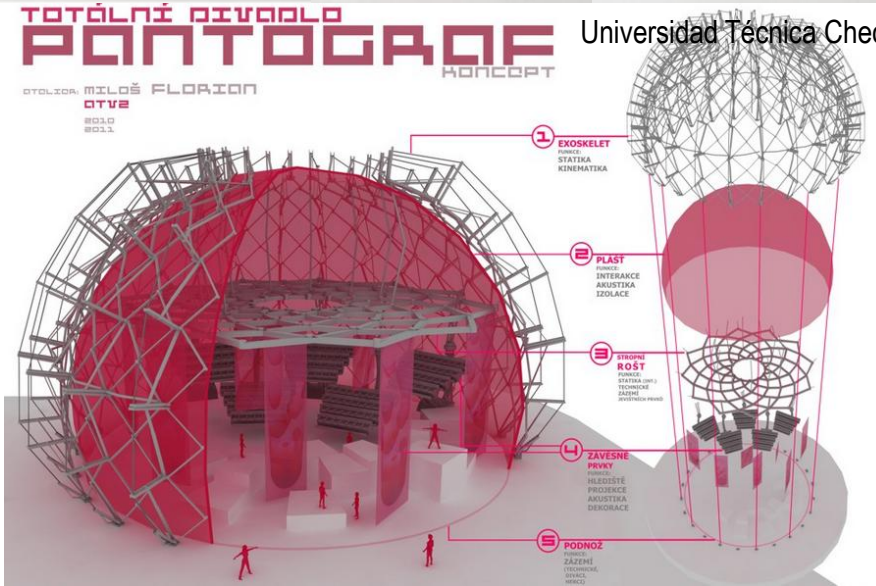




8. Recent Research







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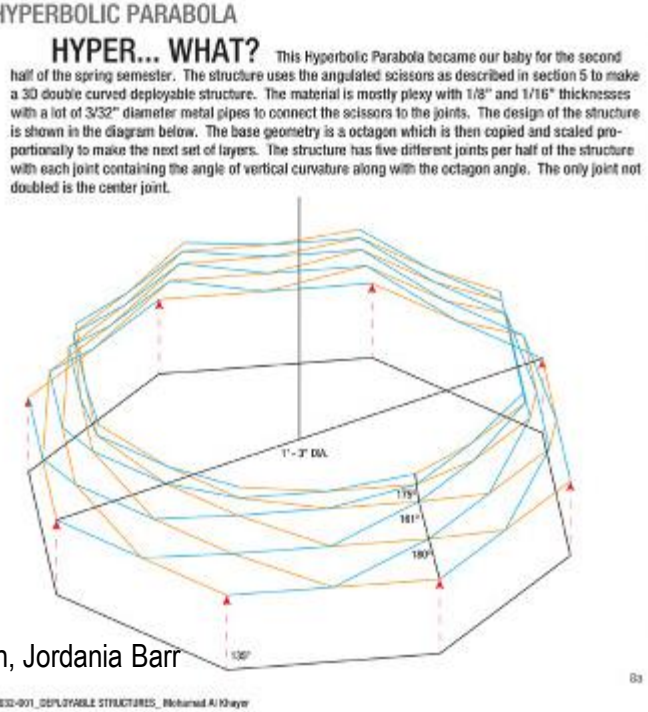
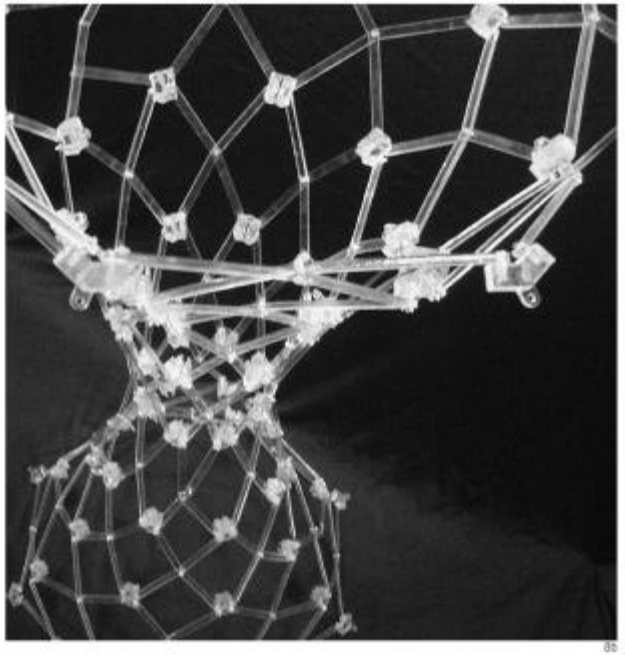
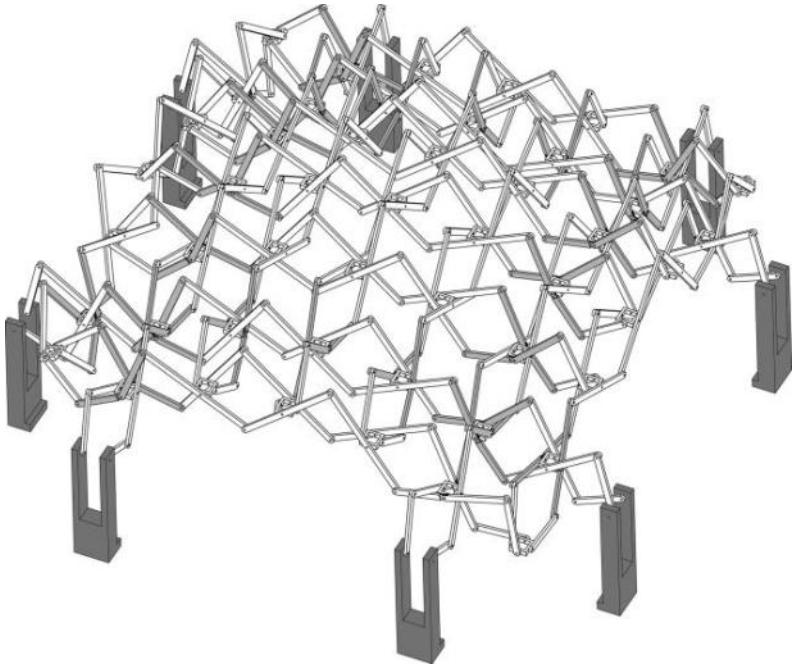




Estructuras Deployable
Filadelfia, EE.UU.
prof. Mohamad Al Khayer
Primavera 2011 del equipo: Brandon Smith, Jordania Barr



Universidad de Stuttgart
Yenal Akgun
Elazig - Turquía

SMiA

Structural Morphology in Architecture

http://smia-experimental.com

THANK YOU FOR YOUR ATTENTION

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PhD. Student

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smia.experimental@gmail.com

NEXT