



PEF2603
*Estruturas na Arquitetura III -
 Sistemas Reticulados e Laminares*



Evolução das Tensoestruturas

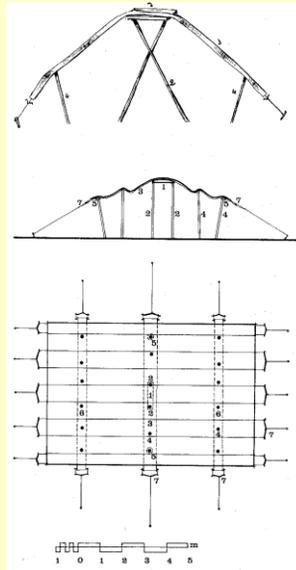
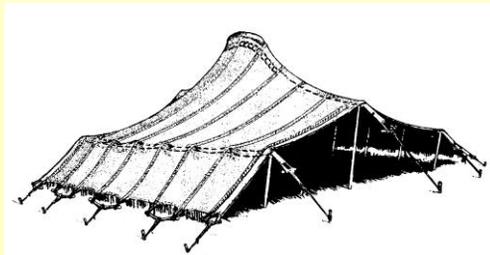
(29/05/2017)

Professores

Ruy Marcelo O. Pauletti , Leila Cristina Meneghetti, Luís Bitencourt Jr.

1º Semestre 2017

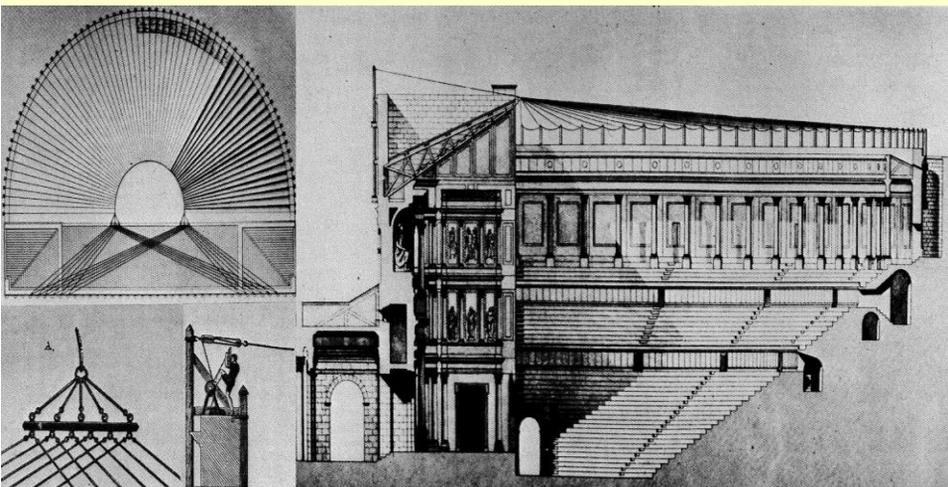
Primórdios: *Tenda Negra do Oriente*



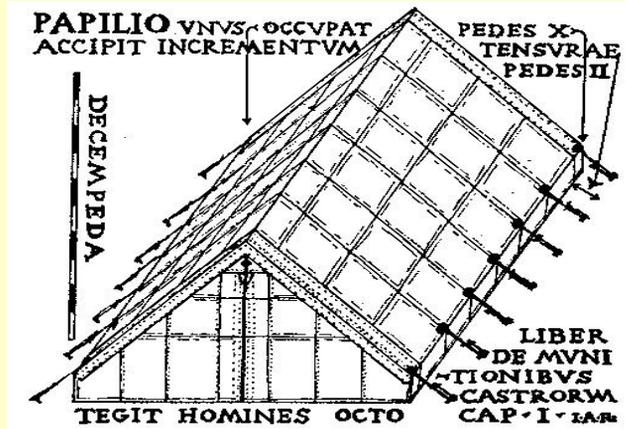
Tapeçarias representando tendas persas



Esquema de uma velária cobrindo um anfiteatro romano



Tenda militar romana (papilio)



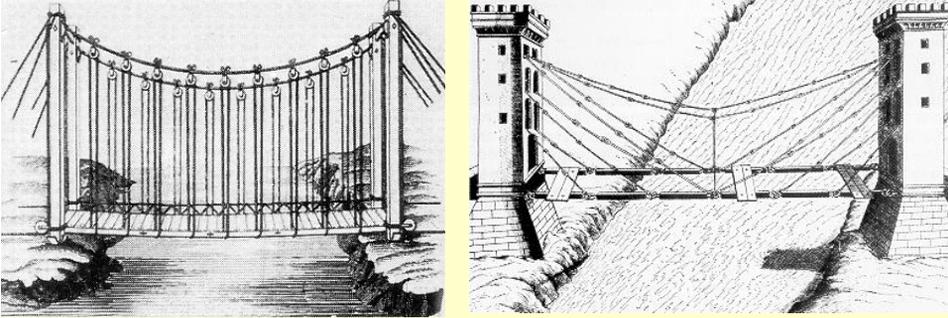
Pontes



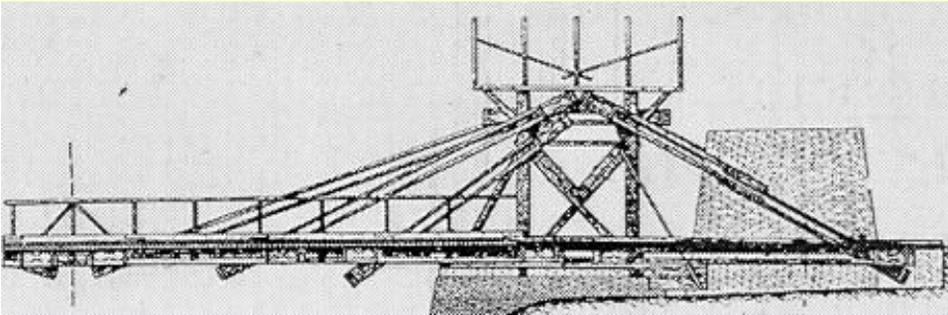
*Ponte sobre o rio Mekong
Vão 74m, circa 1470*

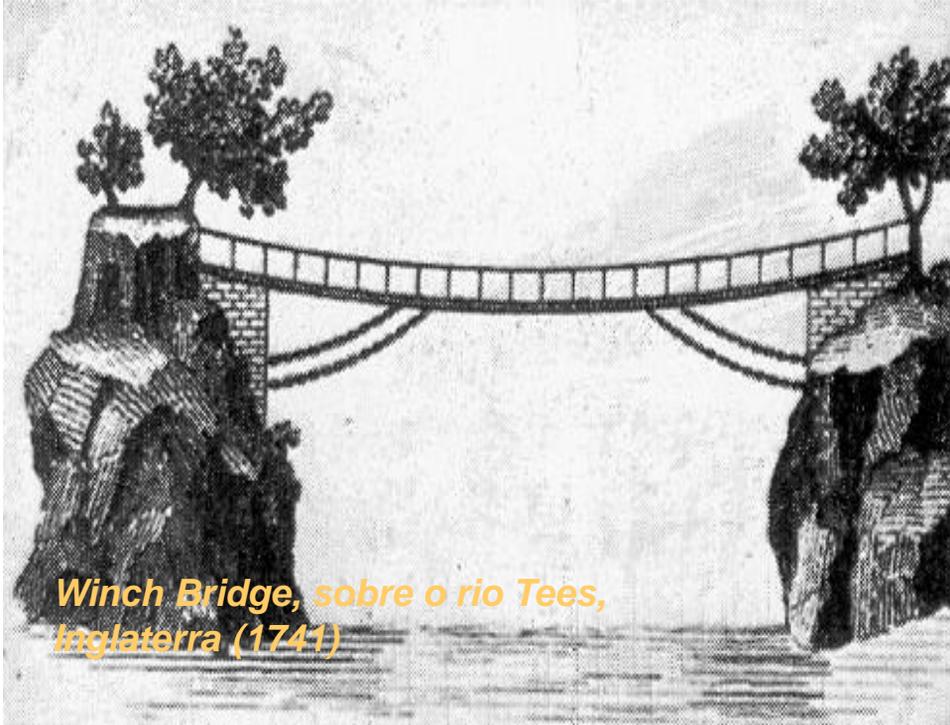


***Esquemas de Faustus Verantius para pontes
suspensas e estaiadas (1617)***



***Esquema de Immanuel Loscher, para
uma ponte estaiada de madeira (1784)***

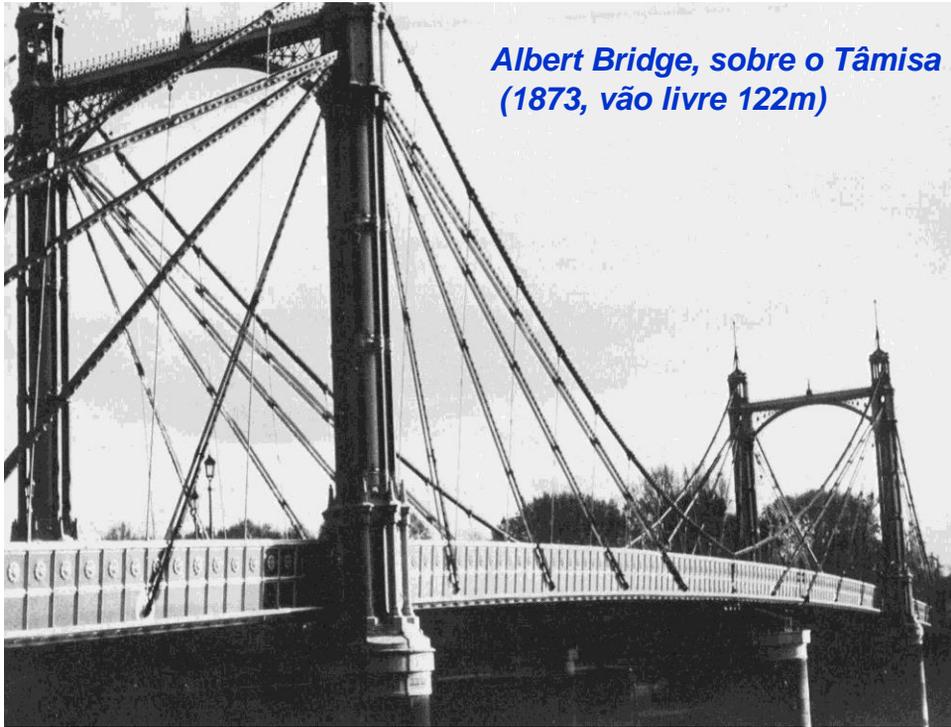




Winch Bridge, sobre o rio Tees, Inglaterra (1741)

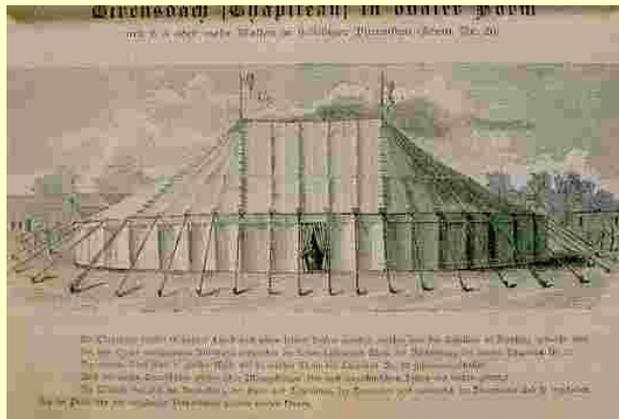


Ponte sobre o estreito de Menai (1826, vão livre 177m)



**Albert Bridge, sobre o Tâmega
(1873, vão livre 122m)**

Tenda de circo (“Chapiteu”)



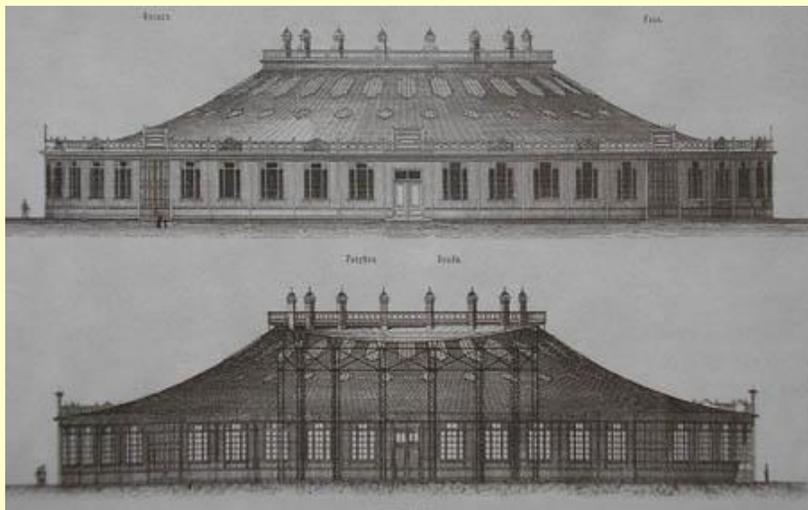
Tendas de aço da Exposição Pan-russa de 1896



Tendas de aço da Exposição Pan-russa de 1896

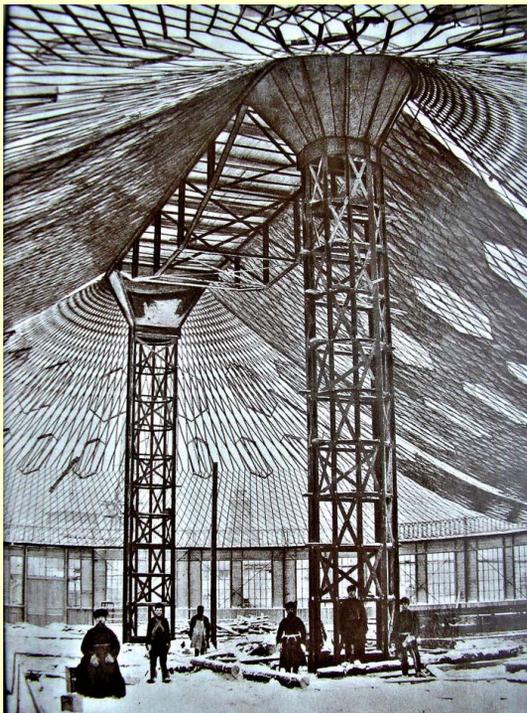
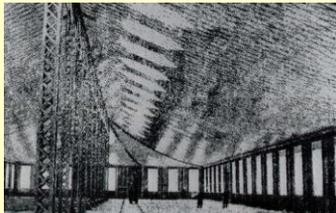
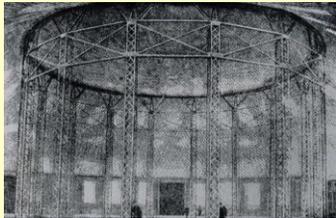


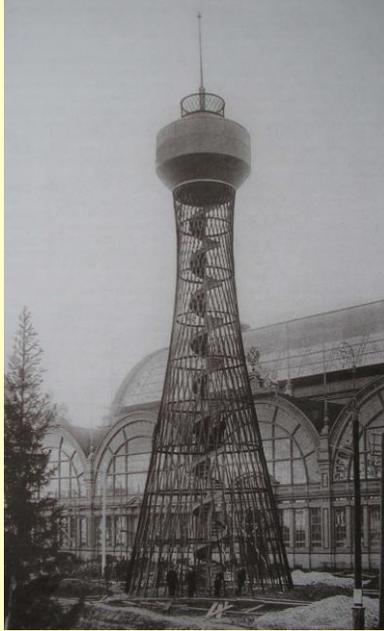
Tendas de aço da Exposição Pan-russa de 1896



The world's first hyperboloid structure by Vladimir Shukhov, Nizhny Novgorod, 1896

Tendas de aço da Exposição Pan-russa de 1896



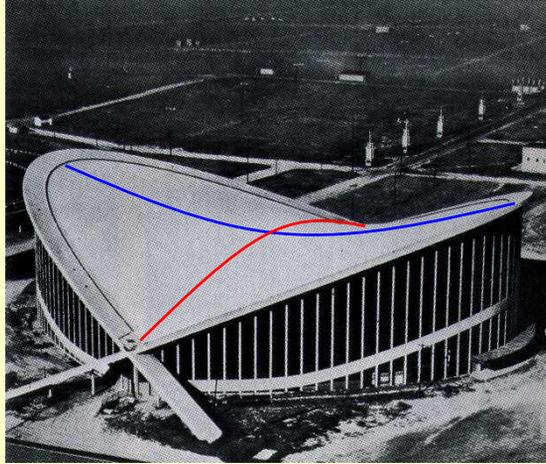


The world's first hyperboloid structure
by Vladimir Shukhov, Nizhny Novgorod, 1896

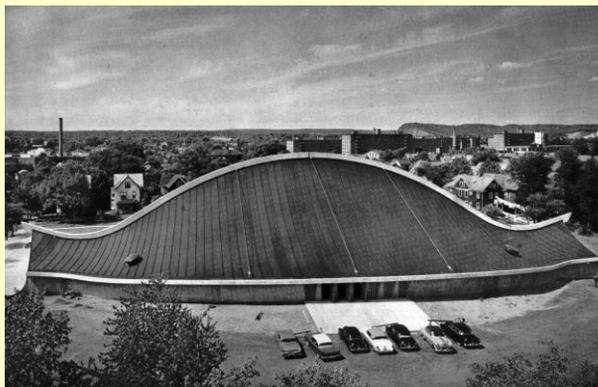


Description The double curvature diagonally framed Shell by Vladimir Shukhov in Vyksa near Nizhny Novgorod during construction, 1897
Source Trudy po istorii tekhniki, AN SSSR, 8, 1954.
Date 1897

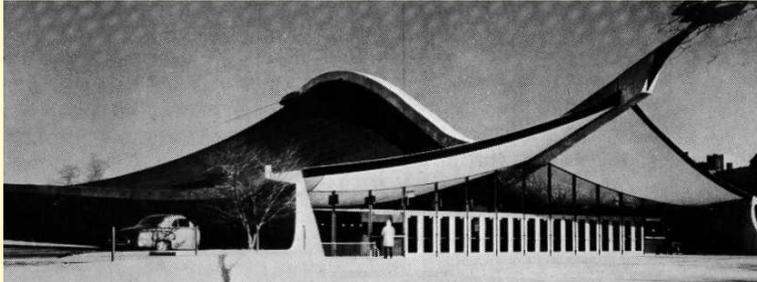
Arena de Raleigh (1950, vão 95m)



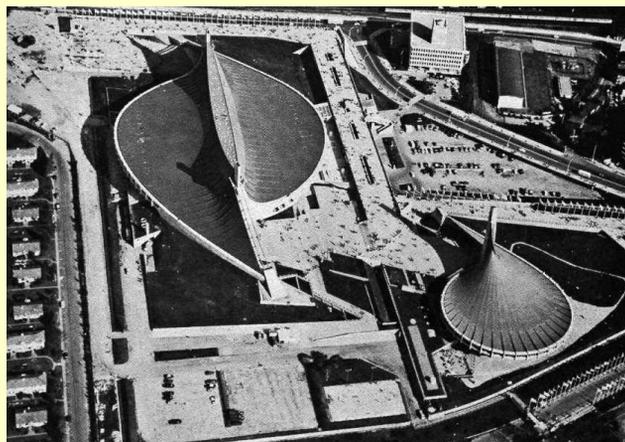
Estádio de Hokey de Yale, EUA (1958)



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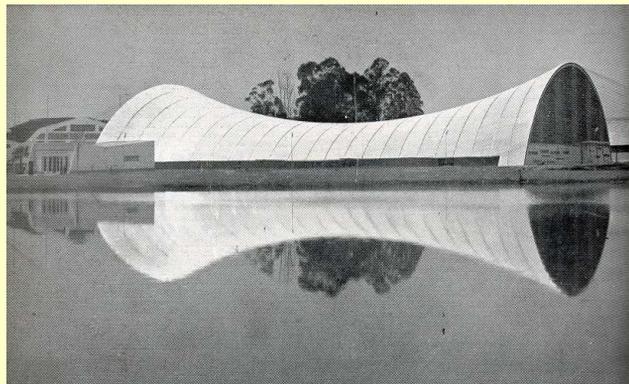


Estádios das Olimpíadas de Tóquio de 1966

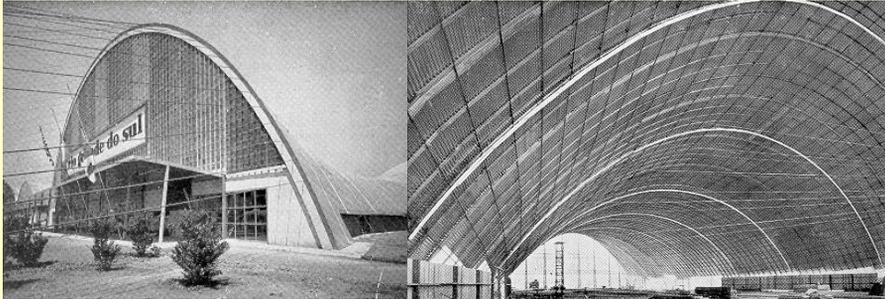




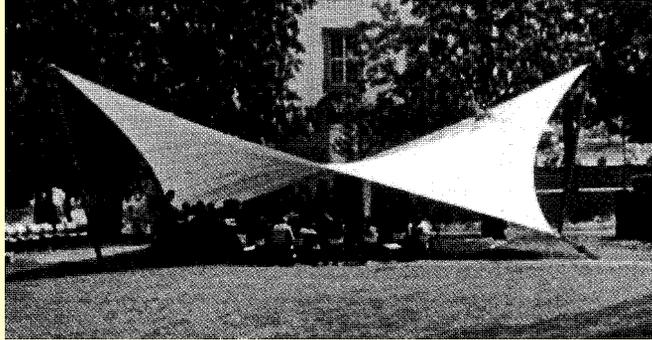
***Pavilhão do Rio Grande do Sul
IV Centenário de São Paulo (1954)***



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IV Centenário de São Paulo (1954)***



Frei Otto. Pavilhão de música em Kassel, 1955

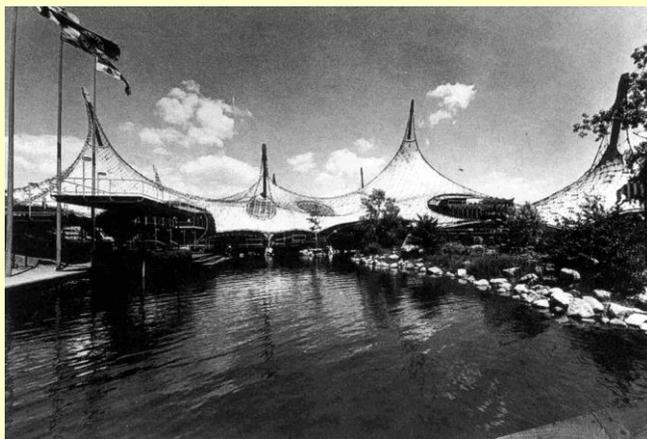


***Concha acústica Sidney Myer
Melbourne, Austrália (1958)***





Pavilhão Alemão da EXPO67, Montreal

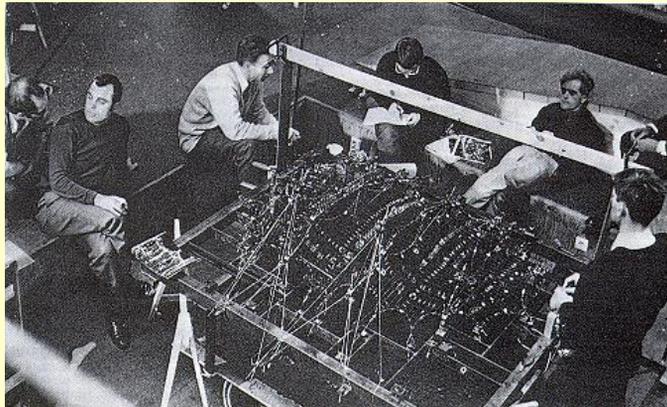


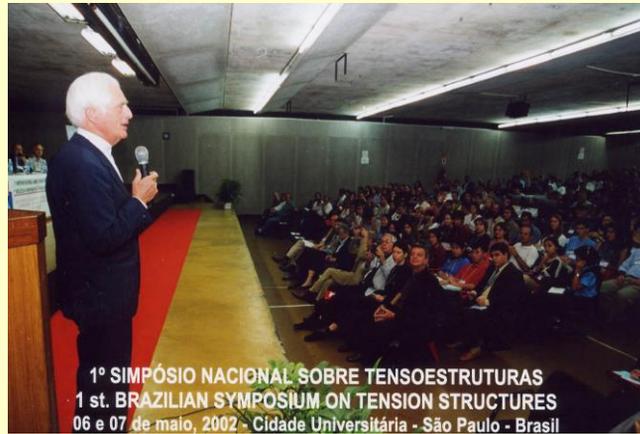
Estádio Olímpico de Munique (1972). Vista panorâmica.



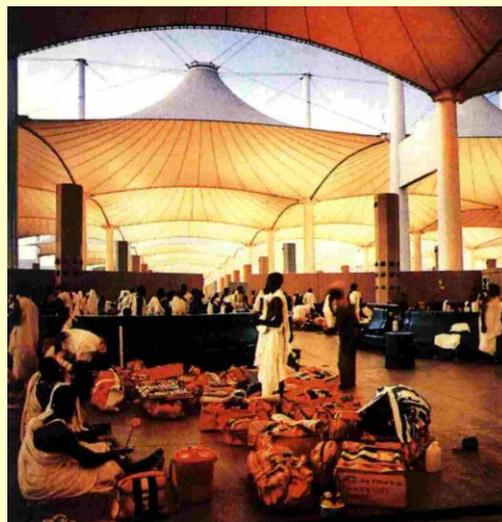
***Estádio Olímpico de Munique
(a) vista interna; (b) detalhe de coluna de sustentação***







Terminal de Passageiros de Jeddah Arábia Saudita, 1981.



Cobertura da Piazzale Roma, Milão (1986)



Estádio dos Alpes de Turim (1990) Vistas aérea.



Estádio dos Alpes de Turim (1990) Vistas interna.



Estádio Olímpico de Roma (coberto em 1990) Vistas aérea.



Estádio Olímpico de Roma (coberto em 1990) Vista interna.



Figura 14 – Pavilhão Alemão na EXPO 92

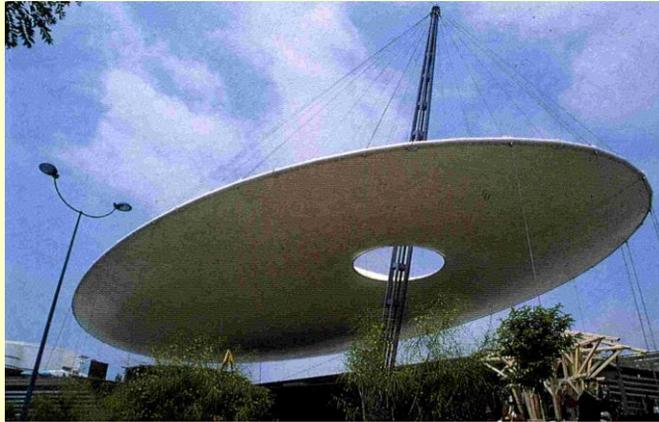


(a) Vista externa



(b) Vista interna

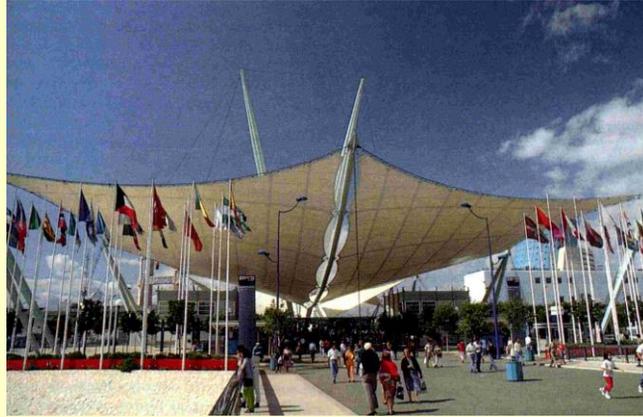
***Lente pneumática de cobertura
Do Pavilhão Alemão na EXPO92***



“Diadema”. Portão de acesso à EXPO92 em Sevilha



“Oleada”. Portão de acesso à EXPO92 em Sevilha



Estádio Rei Fahd, Riad, Arábia Saudita



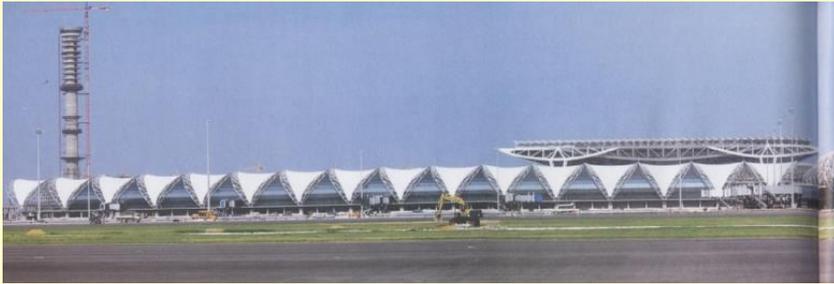
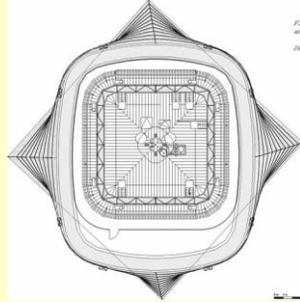
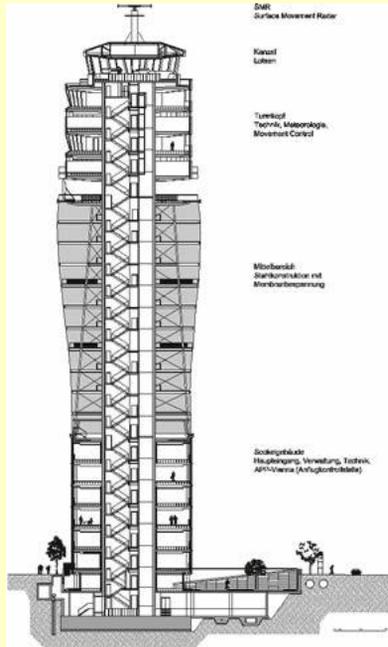
Estádio Rei Fahd, Riad, Arábia Saudita

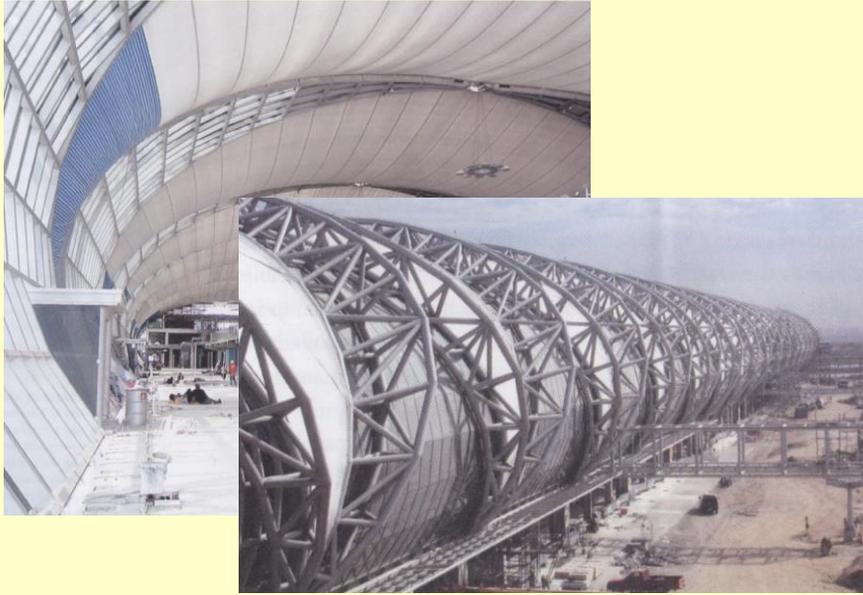


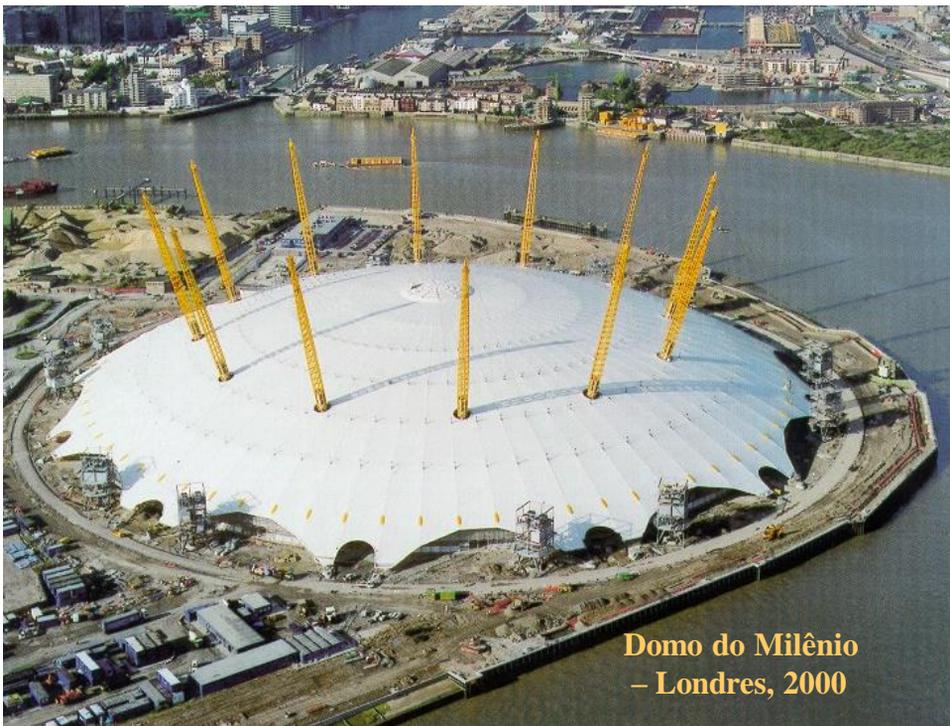
Aeroporto de Denver (1993)











**Domo do Milênio
– Londres, 2000**

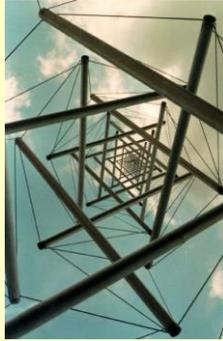
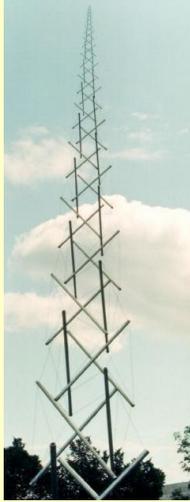
Domo do Milênio: cobertura e sistema de cabos.



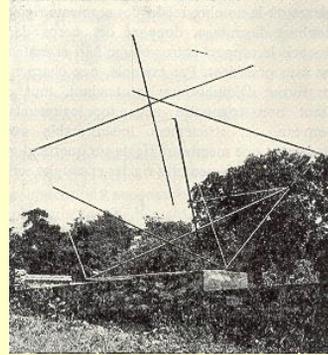
Detalhes Domo do Milênio...



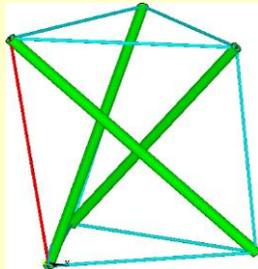
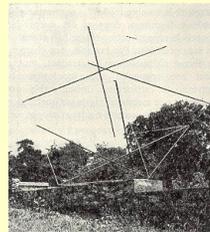
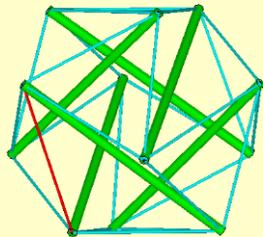
Estruturas tensegrity

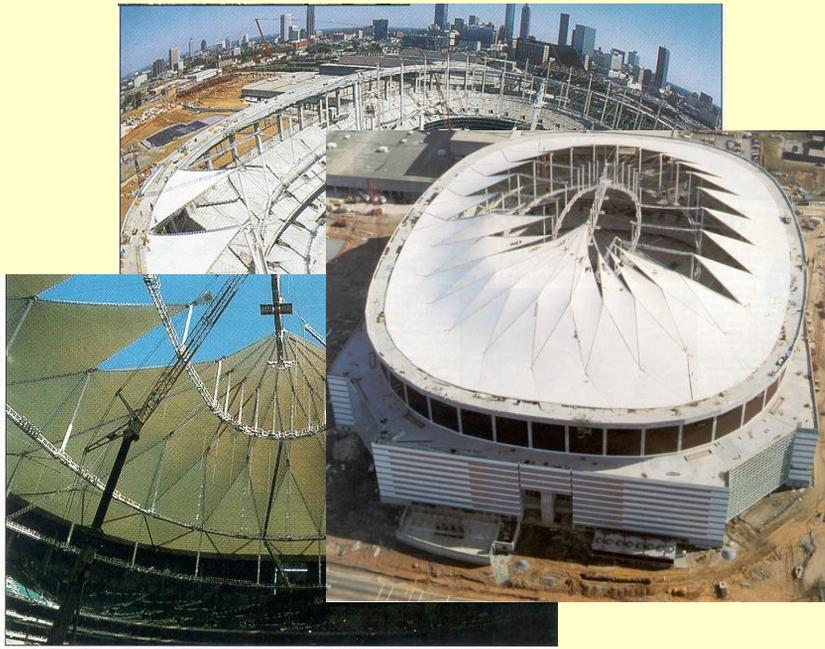


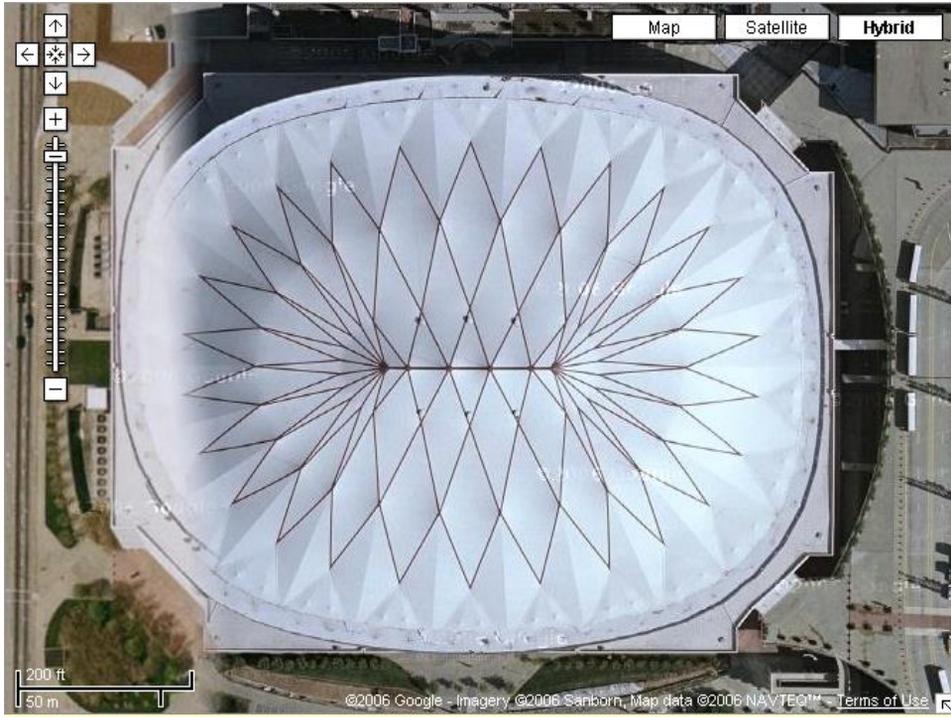
**"Needle Tower",
Keneth Snelson, 1948**



***Monument à la Forme Fugitive
Emmerich, 1966***

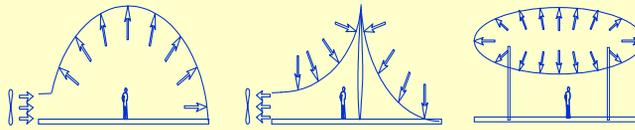






Evolução das Estruturas Pneumáticas

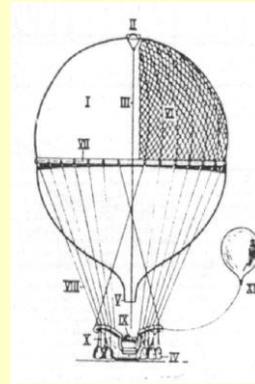
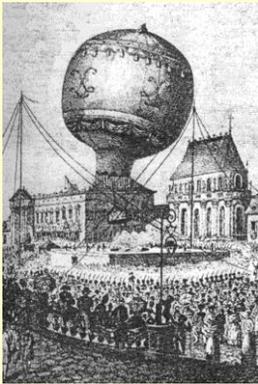
Tipos de Estruturas pneumáticas



(a) Insufladas;

(b) Aspiradas;

(c) Infladas



(a/b) Balão de ar quente dos irmãos Montgolfier (1783)

(c) Balão de hidrogênio de Jacques Charles (1783)



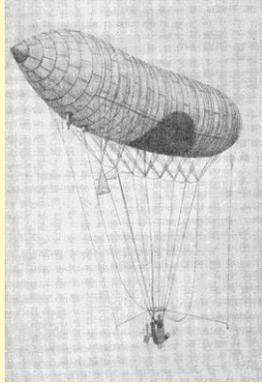
Panic among the inhabitants of Gonesse, who believe a monster has fallen from the sky. August 27, 1785.



LA COQUETTE PHYSIQUESNE
 Si vous, de vous gâter, comblez... Il faut le faire naturellement.
 Qui veut se rendre, sans effort... Point de deuil, sans cesse. Point de...



Robida's vision of the future, Le Vingtième Siècle—la Vie électrique, 1883.

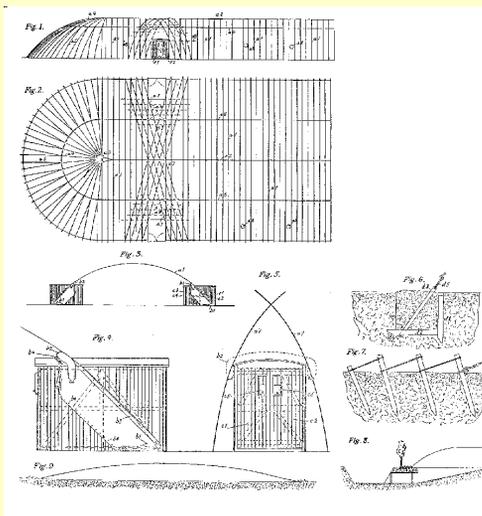


(a) Dirigível No 1 de Santos Dumont (1898)



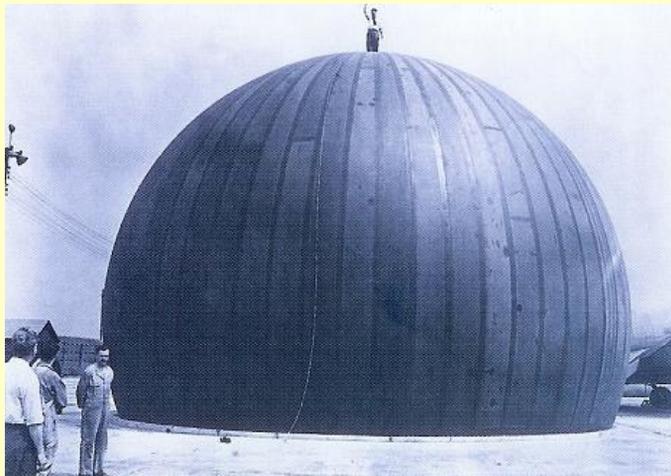
(b) R101 –Royal Airship 101, UK (1929)

**Detalhes da patente de F.W. Lanchester
para tendas insufláveis (1918)**



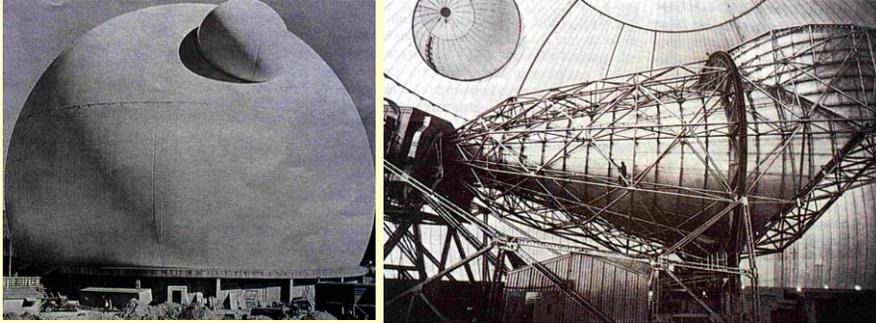


Camuflagens infláveis empregadas pelos britânicos, durante a II Guerra Mundial



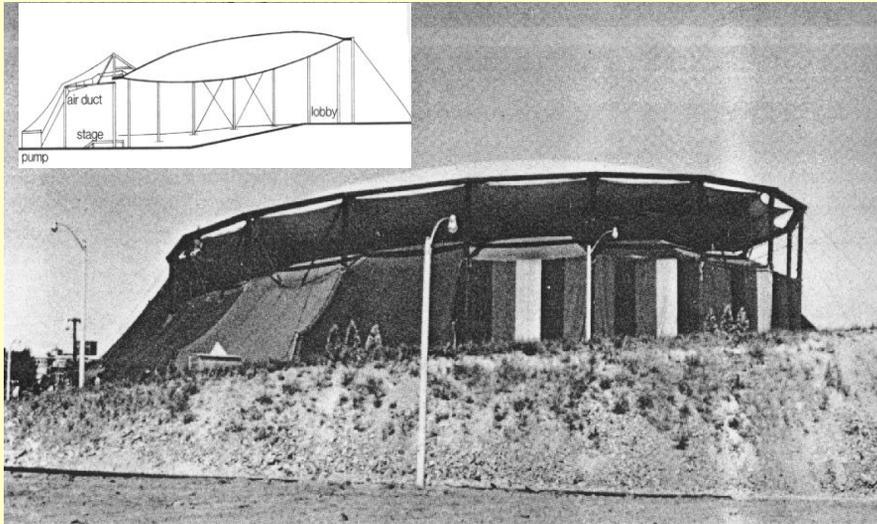
O primeiro Radome, construído por Walter Bird no Cornell Aeronautical Laboratory , 1948.

Radome no Maine, EUA (1961)



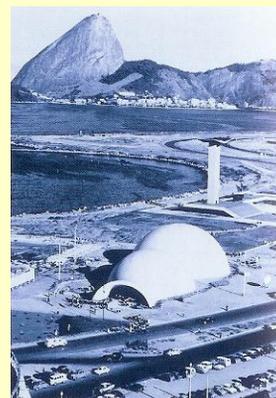
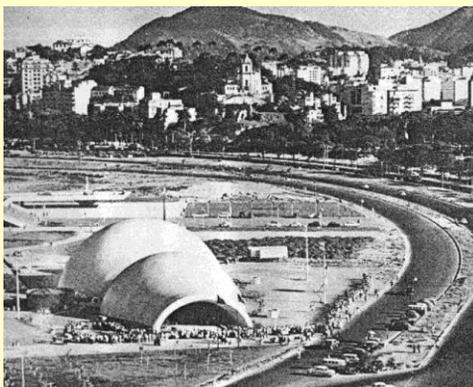
**Concepção artística das pesquisas de Walter Bird no CAL,
publicada no início dos anos 50.**

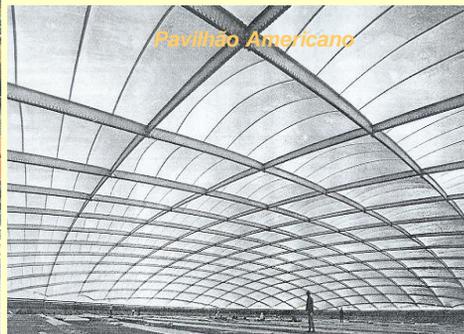
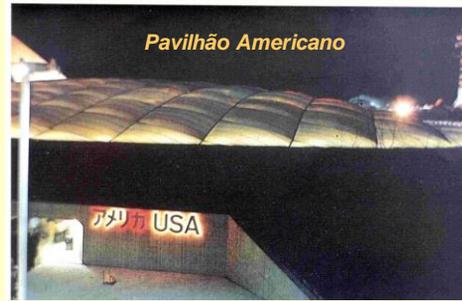
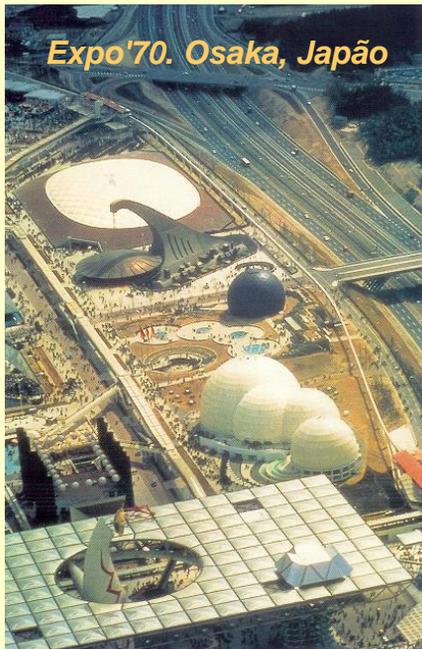
Teatro das Artes de Boston (1959)



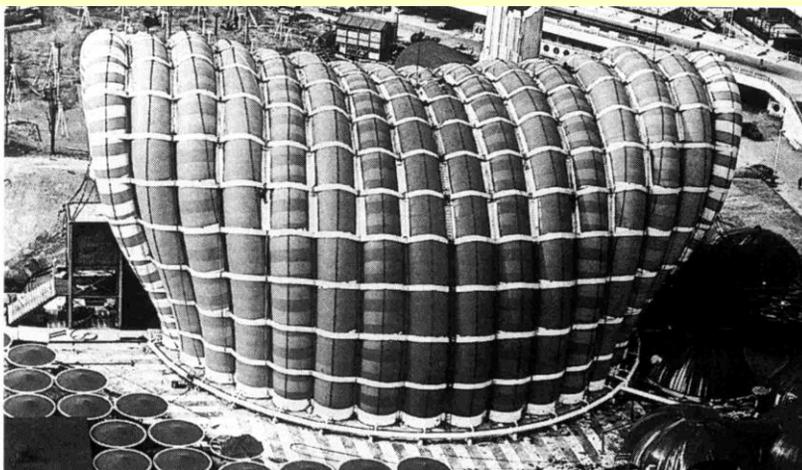
Pavilhão Atomos para a Paz, no Rio de Janeiro (1960)

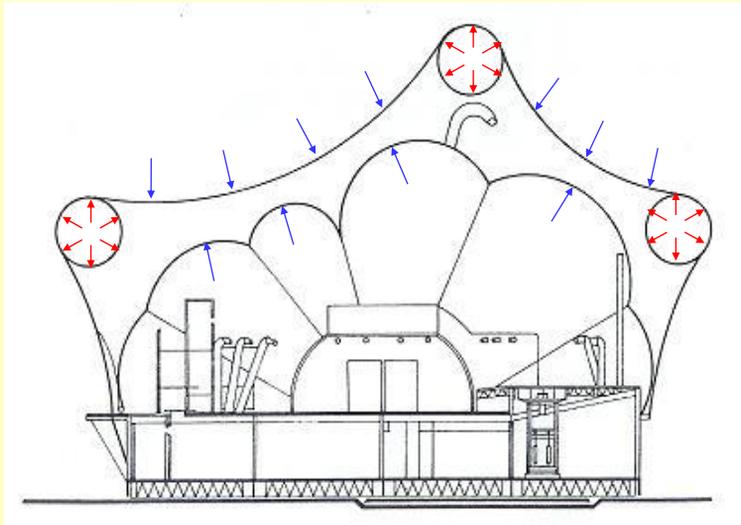
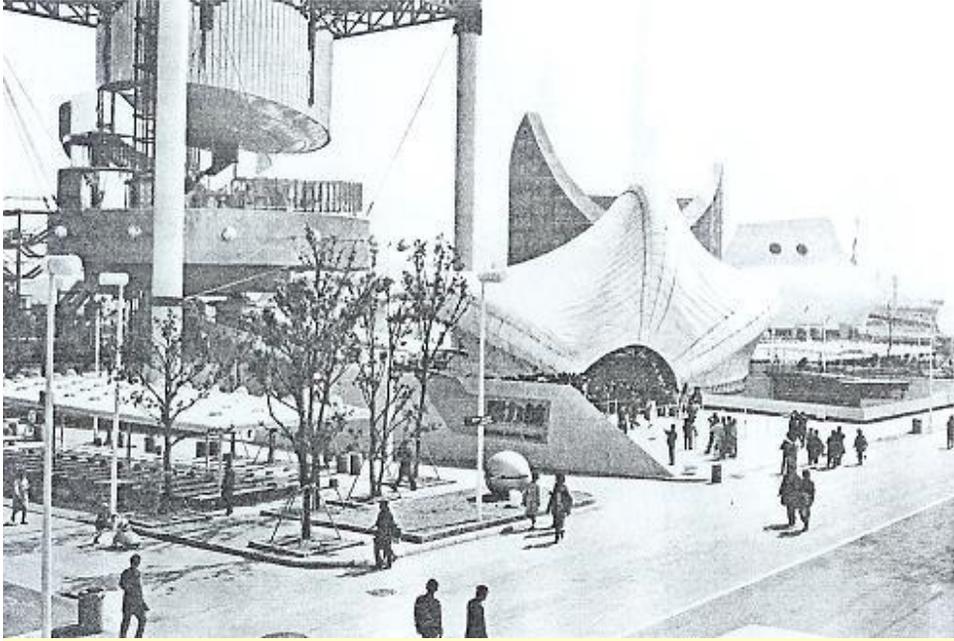
Projetado por Victor Lundy, produzido por Birdair.



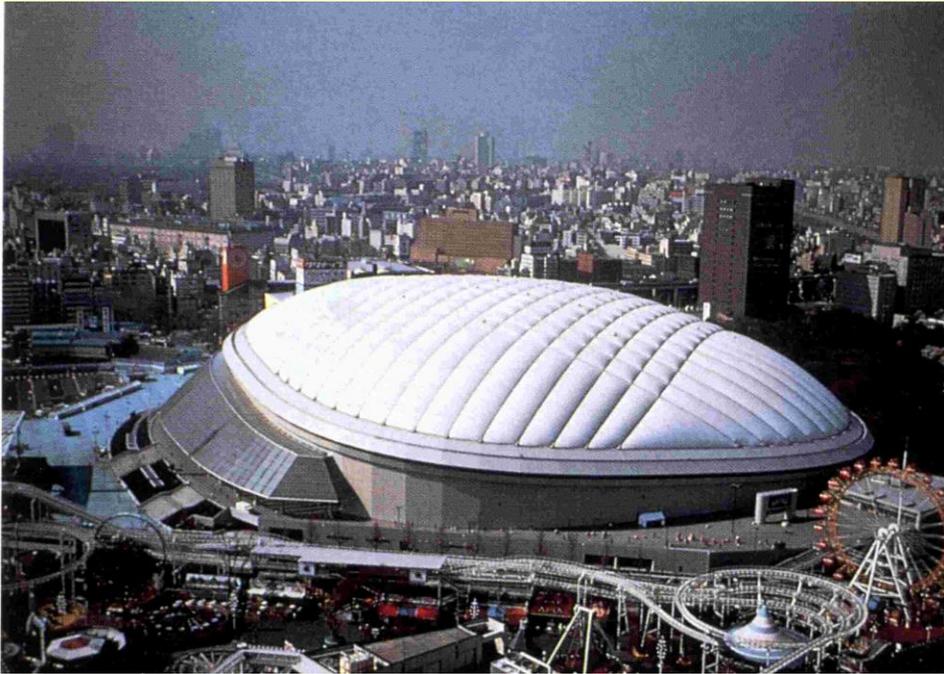


Expo'70. Osaka, Japão - Pavilhão da Fuji





Tokio Big-Egg Dome (1988)



Tokio Big-Egg Dome (1988)



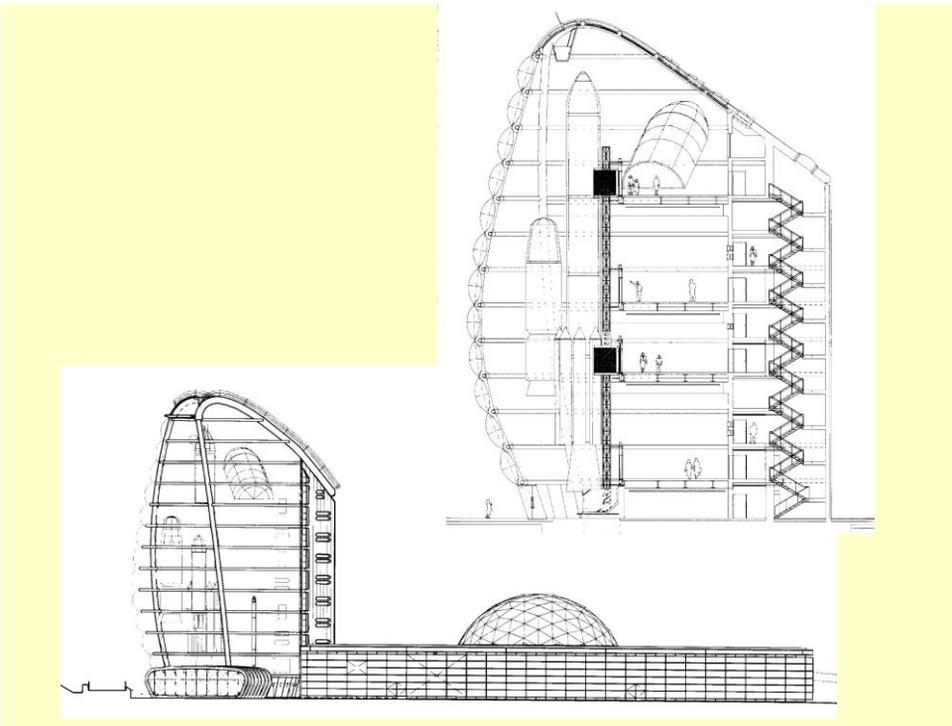
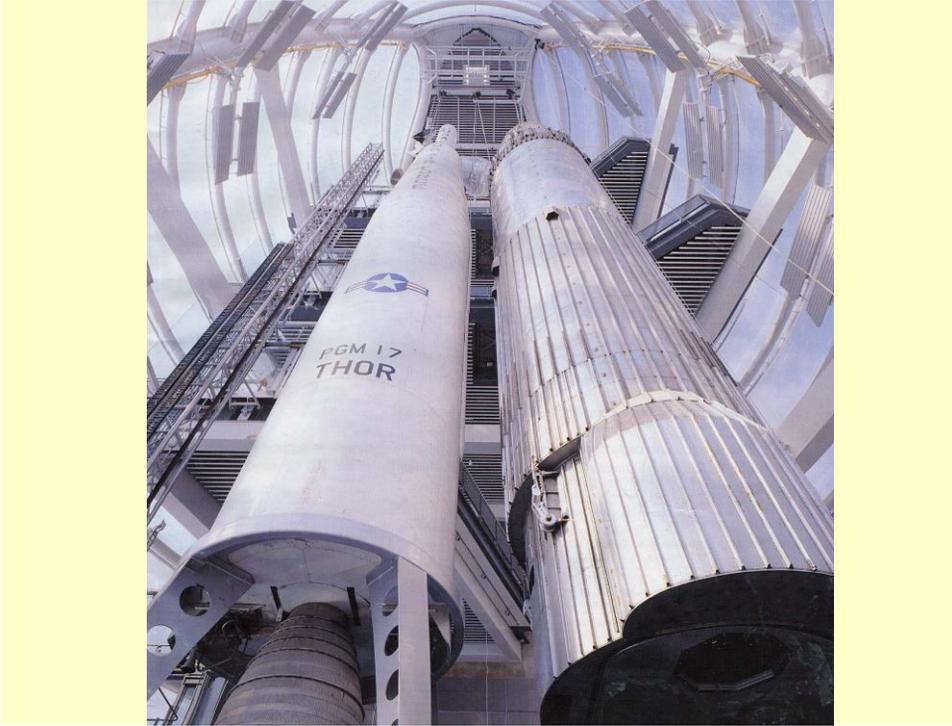
Anfiteatro romano de Nîmes (1988)



Eden Project, Cornwall, UK

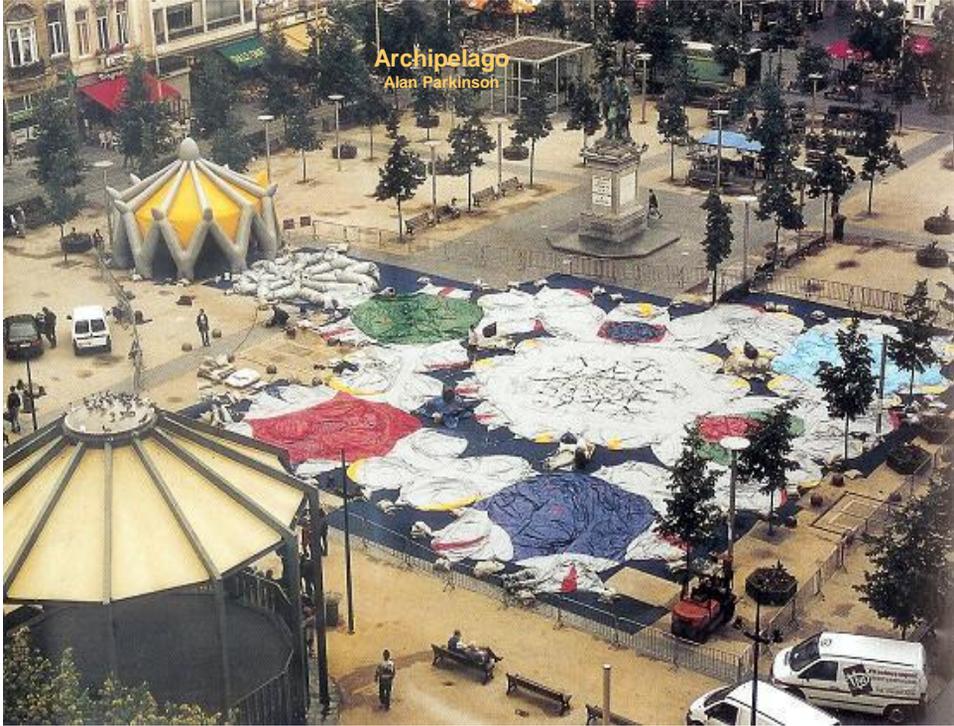






Dreamspace
Maurice Agis, 2000-2001



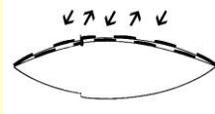
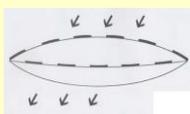
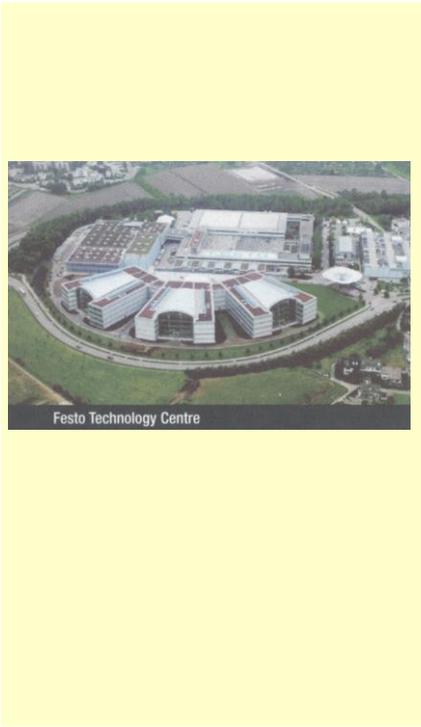


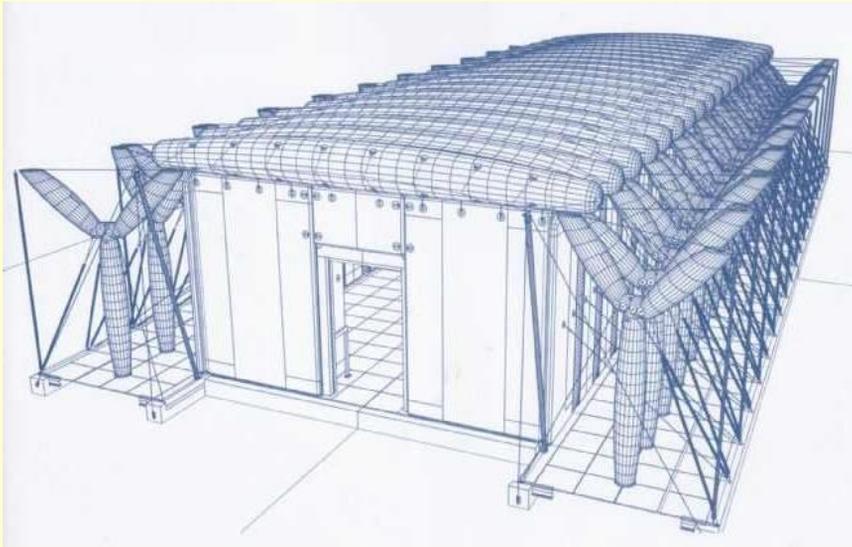


Jean Paul Gautier,
Mad Max Collection
Fall/winter, 1995-1996

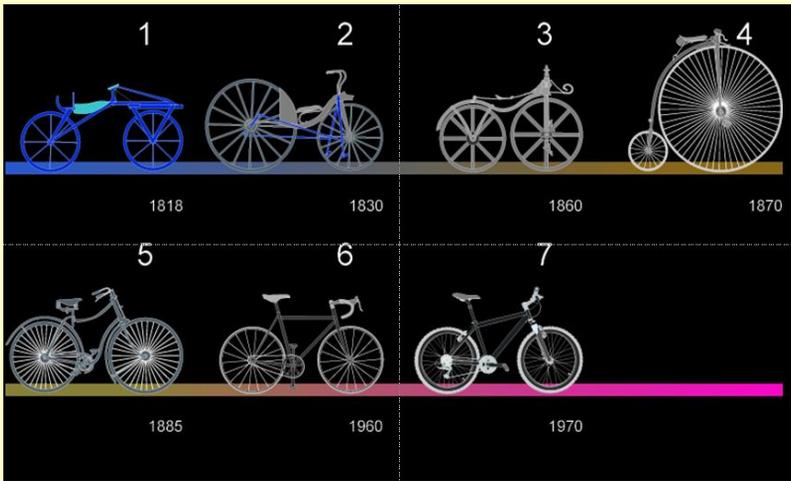
Robin Archer
Primavera 2001

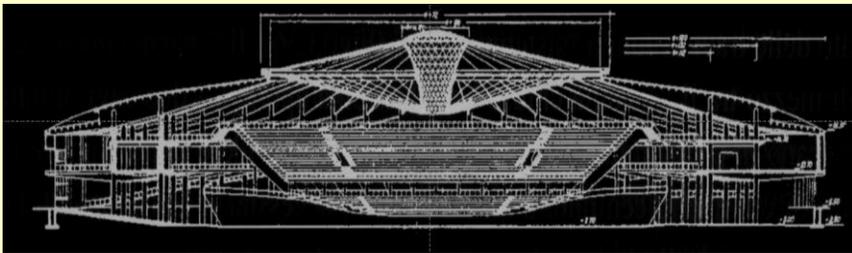


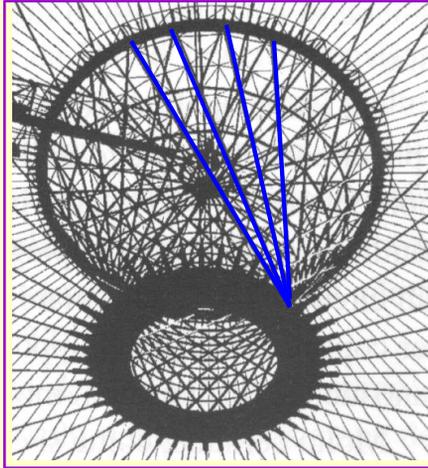
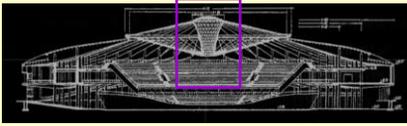


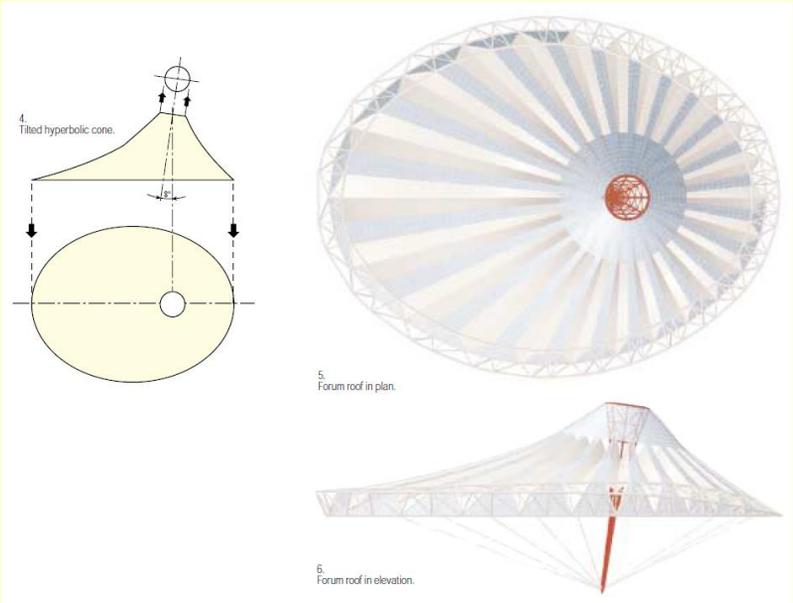




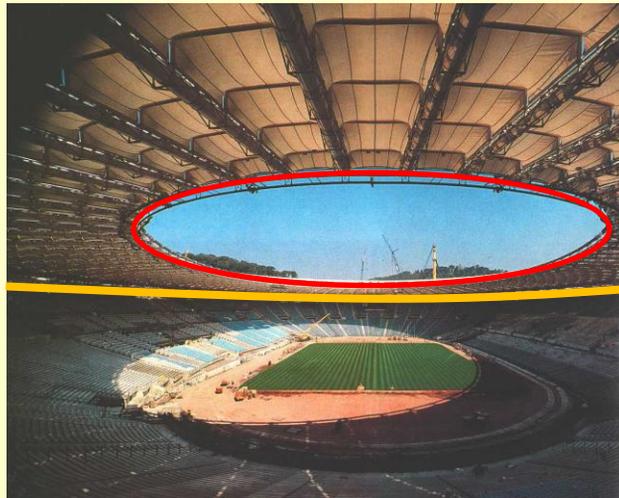
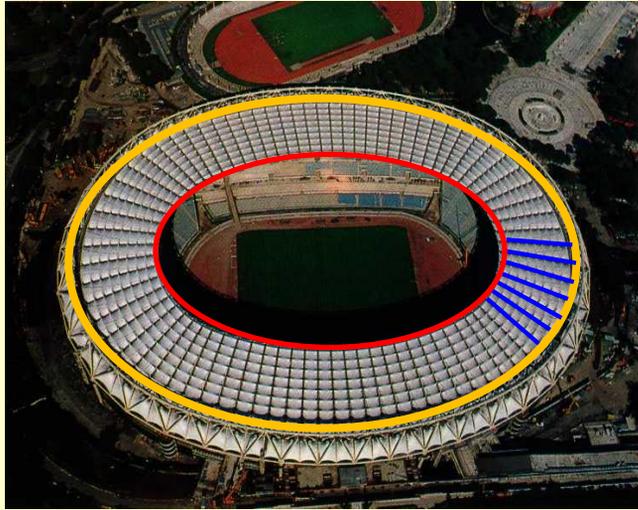


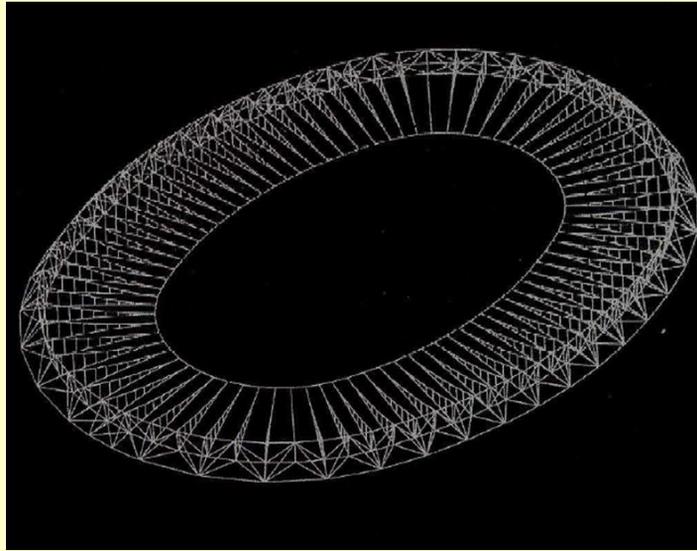






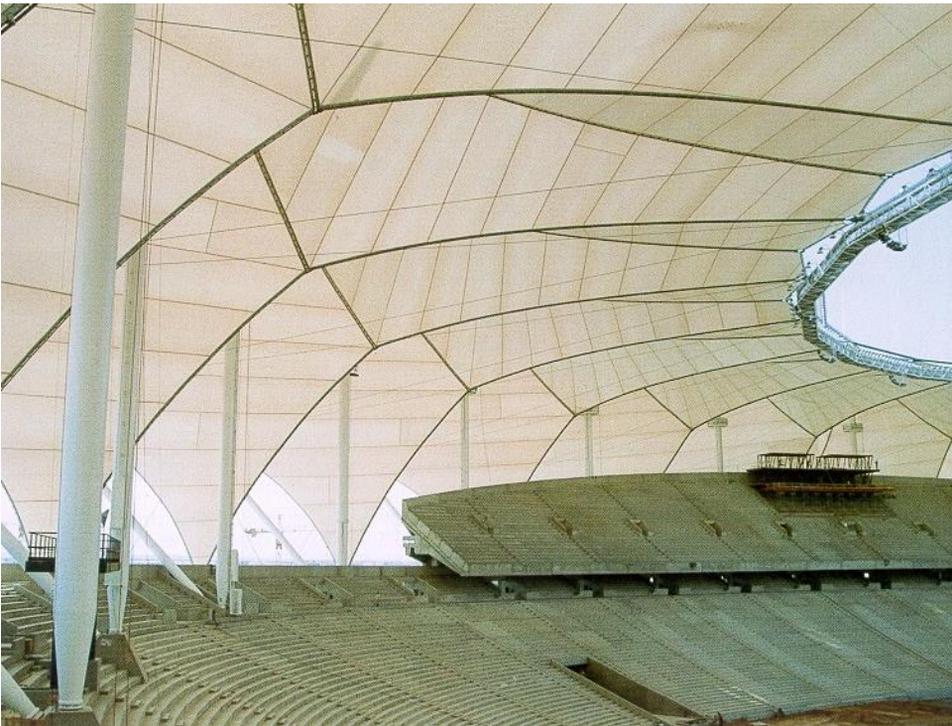






King Fahd Stadium, Riyadh, Arábia Saudita (1986

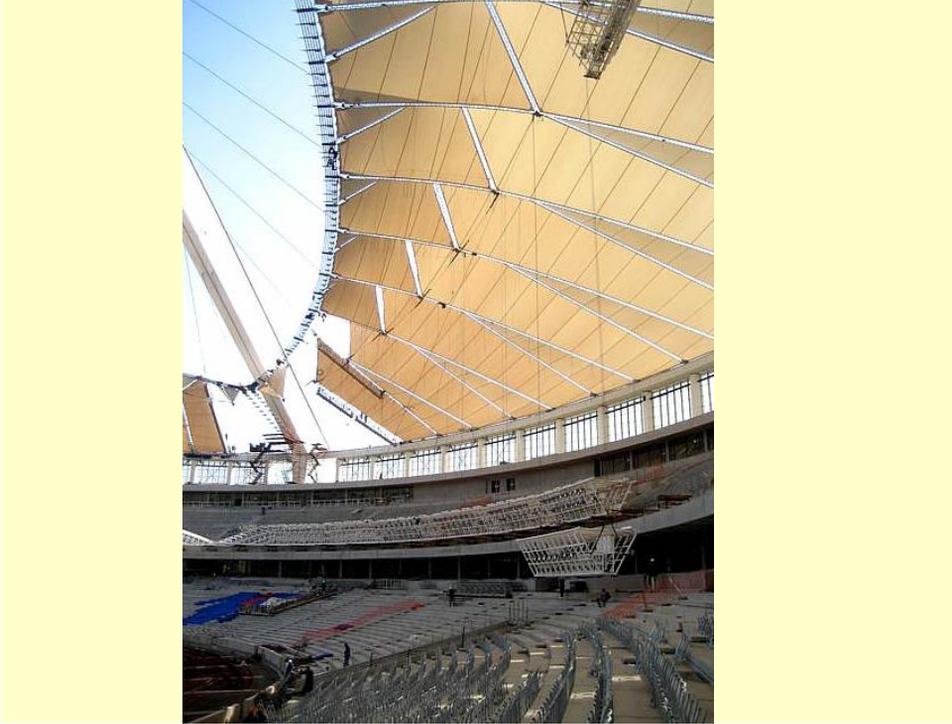


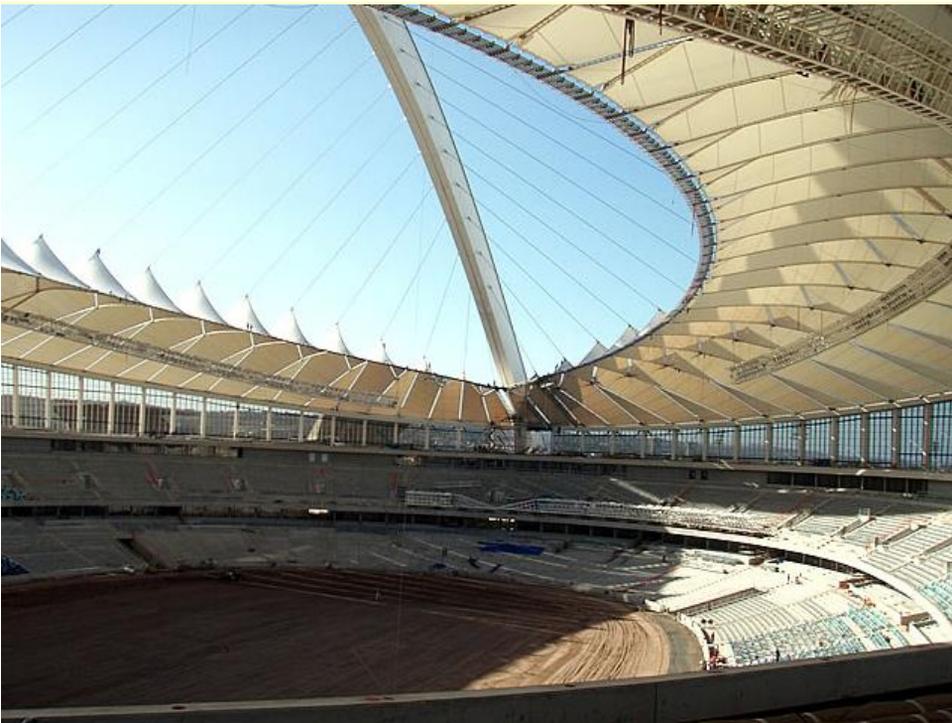








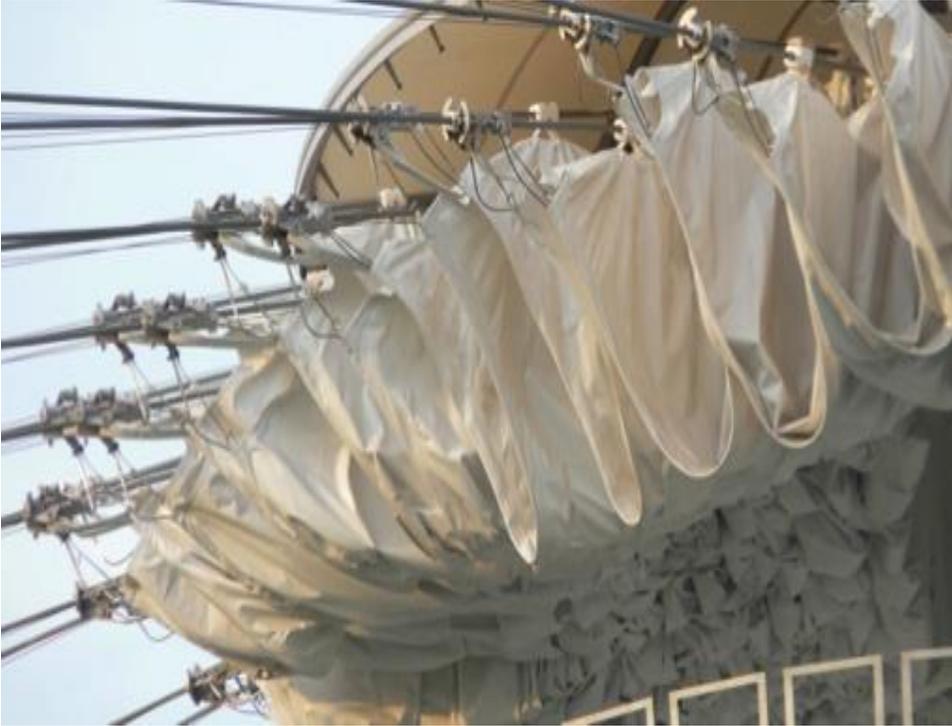






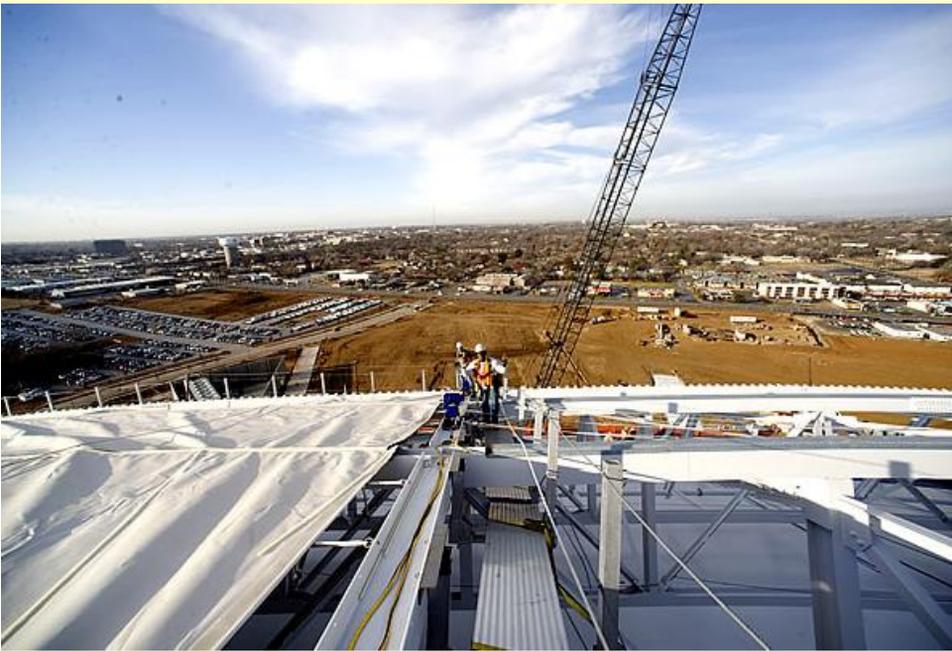




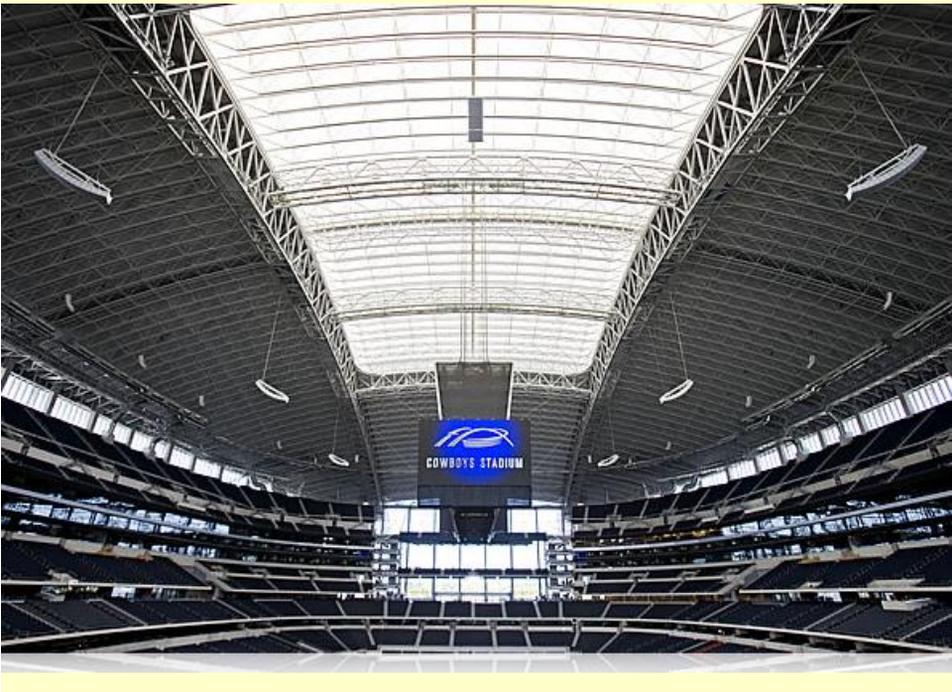


Dallas Cowboys Stadium, (2005-2009)

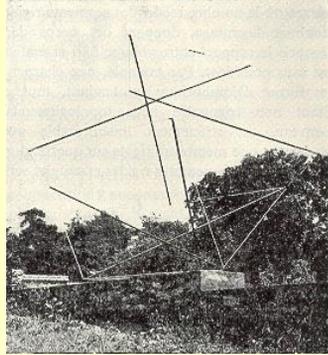
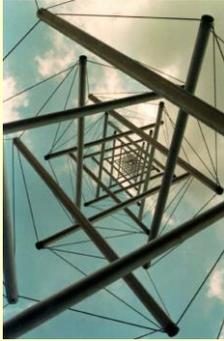


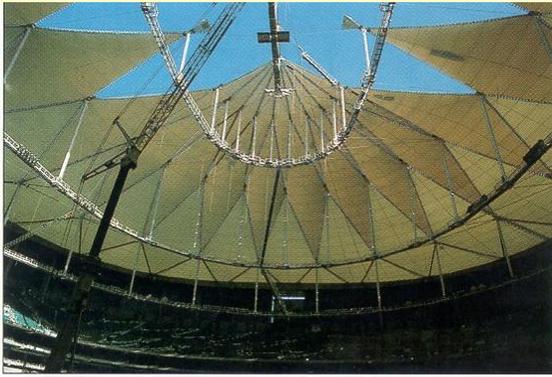




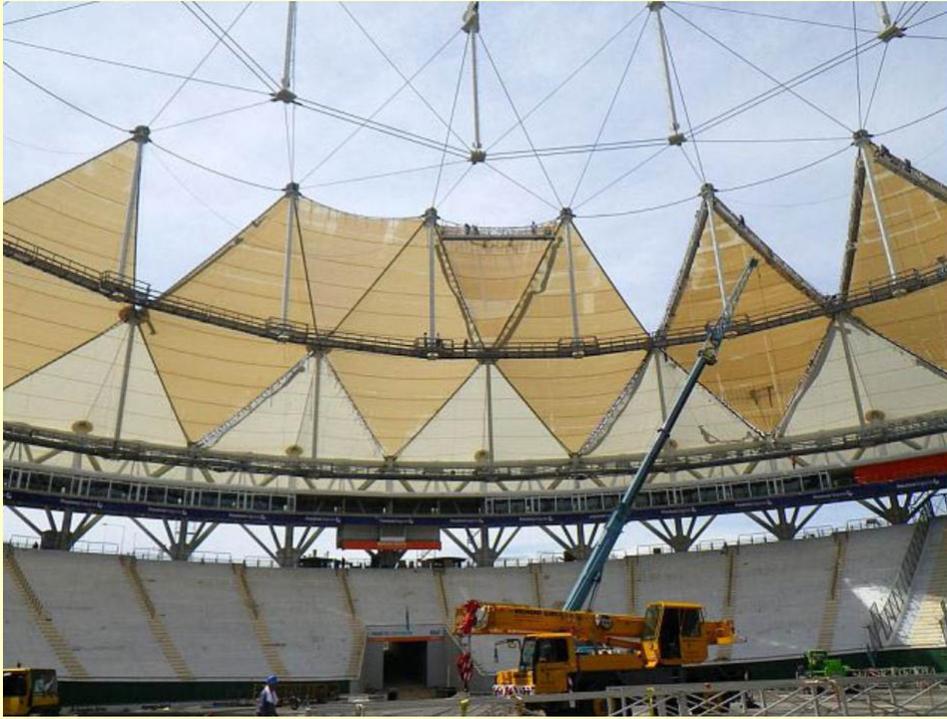












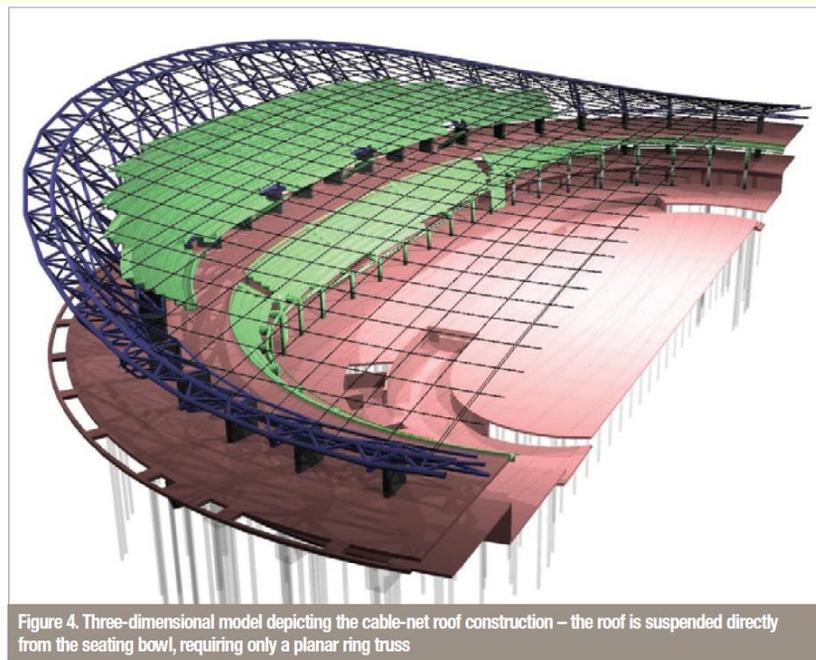


Figure 4. Three-dimensional model depicting the cable-net roof construction – the roof is suspended directly from the seating bowl, requiring only a planar ring truss



Figure 14. The £93 million Velopark, in which the Velodrome was completed 7 weeks ahead of schedule



Figure 9. Cable net being jacked into position from the conveniently flat ring truss – installation forces in the 16 km of cabling were close to those predicted

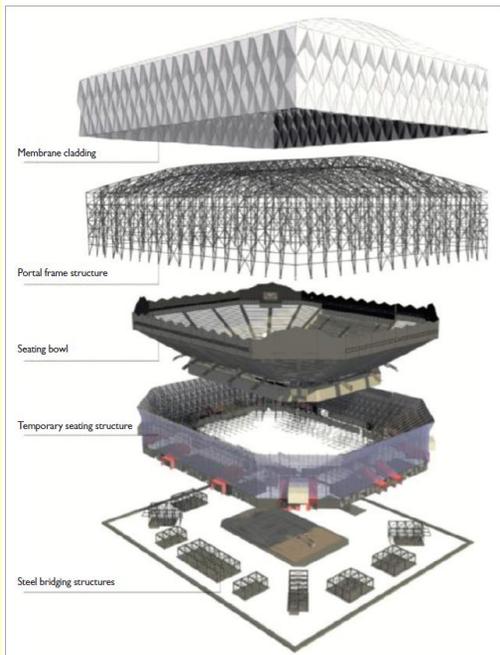


Figure 7. Exploded view of the Basketball Arena shows the 'kit of parts' that helps to provide an estimated potential reuse of 85% by weight and value



