



EP-USP

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



FAU-USP

Cascas

Uma Visão Geral

(05/06/2017)

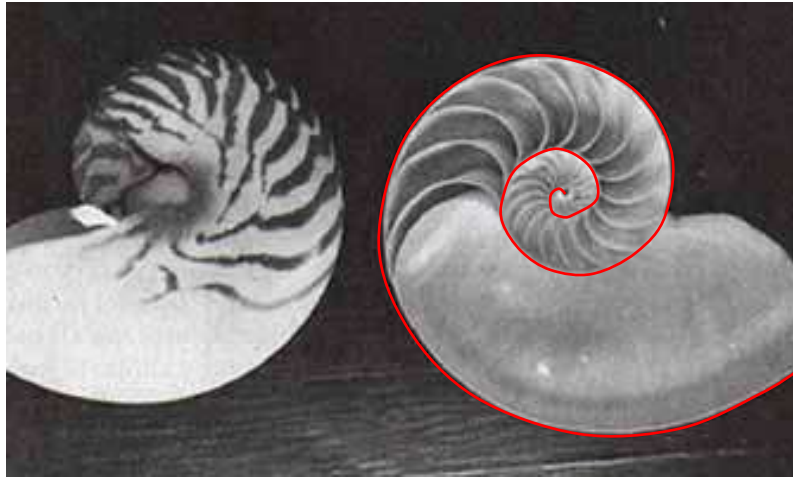
Professores

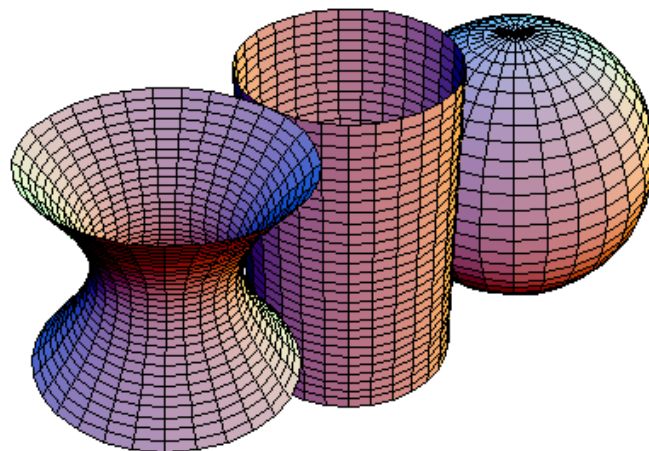
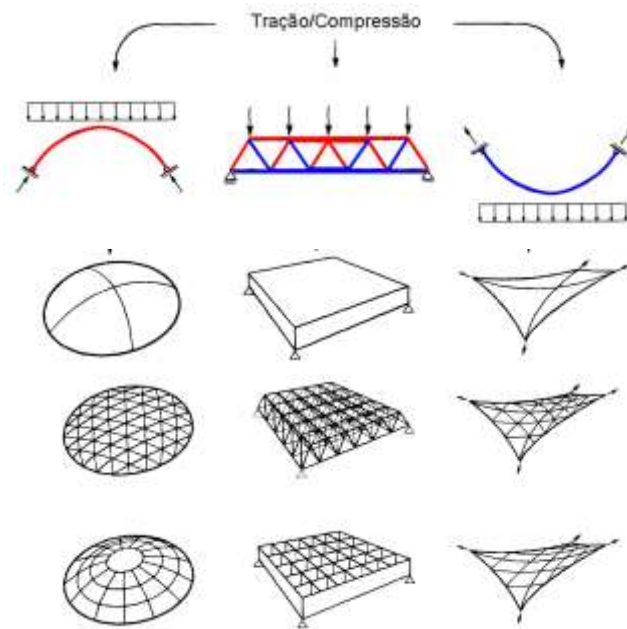
Ruy Marcelo O. Pauletti, Leila Cristina Meneghetti, Luís Bitencourt Jr.

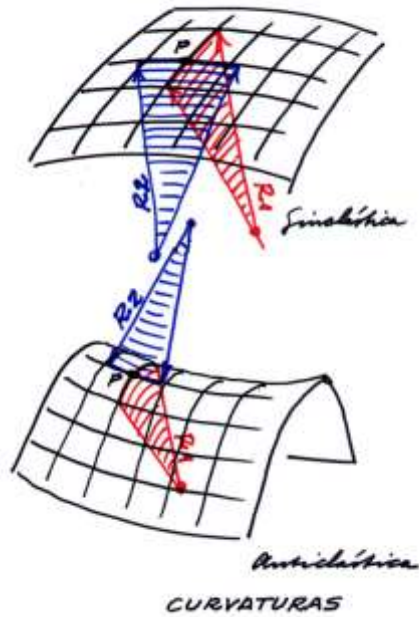
1º Semestre 2017





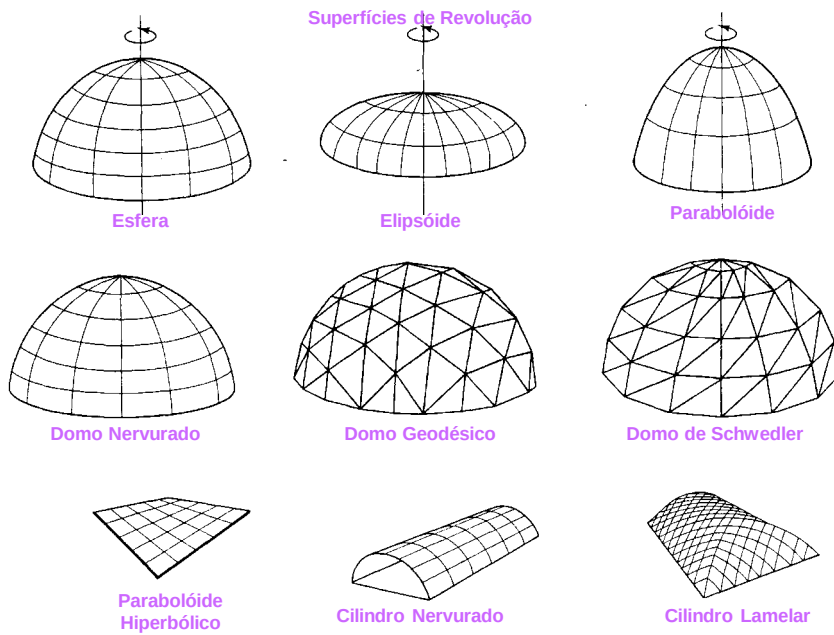






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Esquemas originais
– Prof. Mário Franco

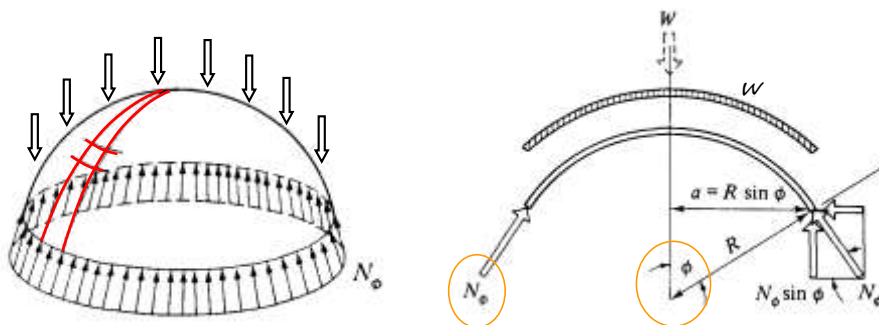


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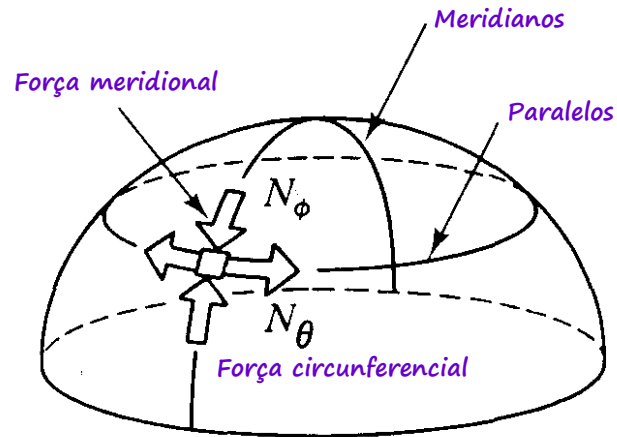


Esquemas originais – Prof. Mário Franco

Casca esférica sujeita a cargas verticais



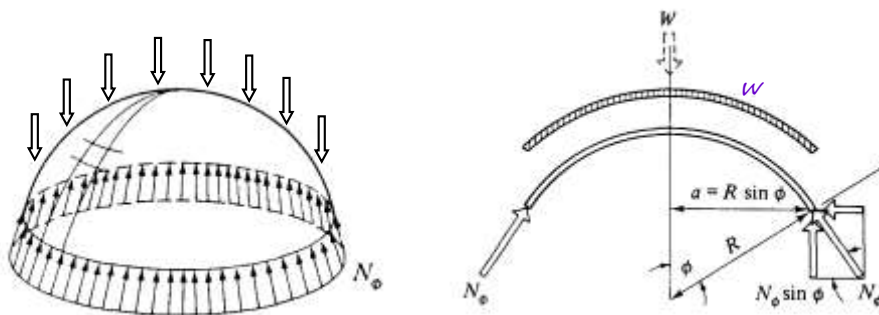
Casca parabólica:



Recordando a Equação de Laplace-Young:

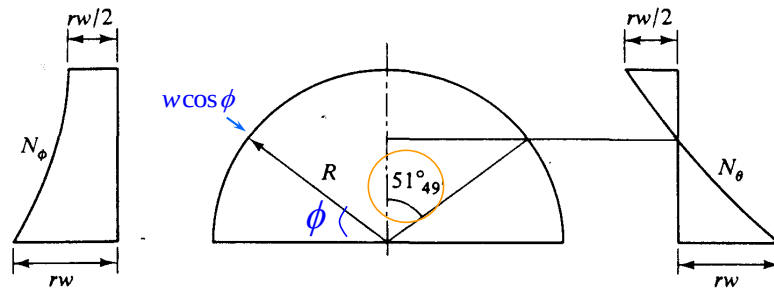
$$\frac{N_\theta}{R_\theta} + \frac{N_\phi}{R_\phi} = p_r$$

Casca esférica sujeita a cargas verticais

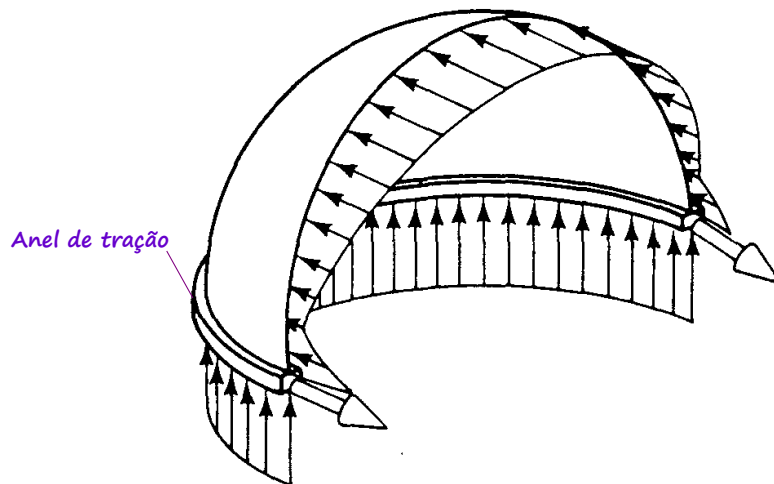


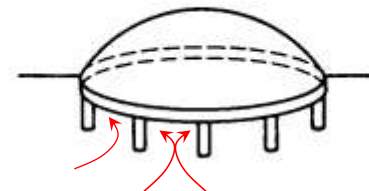
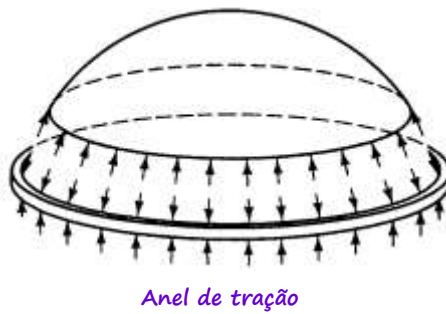
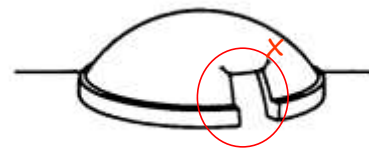
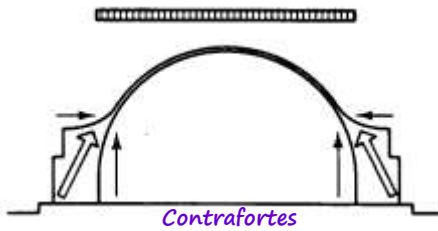
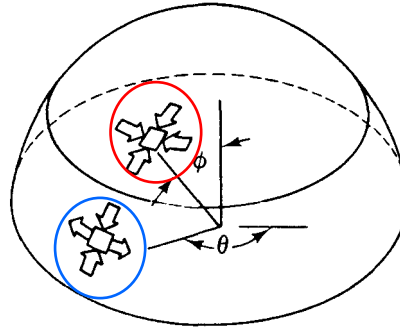
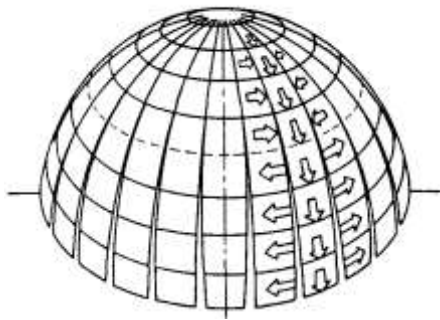
$$N_\phi = \frac{Rw}{1 + \cos \phi}$$

Eq. Laplace:
$$\frac{N_{\theta} + N_{\phi}}{R} = p_r = w \cos \phi$$

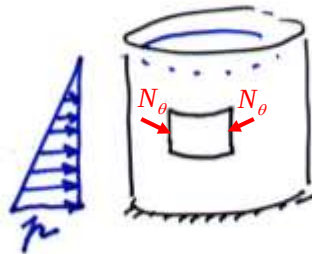


$$N_{\theta} = Rw \left(\cos \phi - \frac{1}{1 + \cos \phi} \right)$$



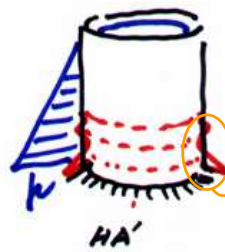
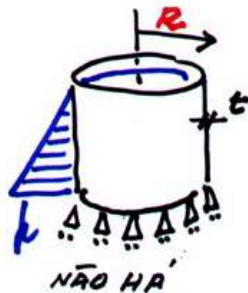


Reservatórios

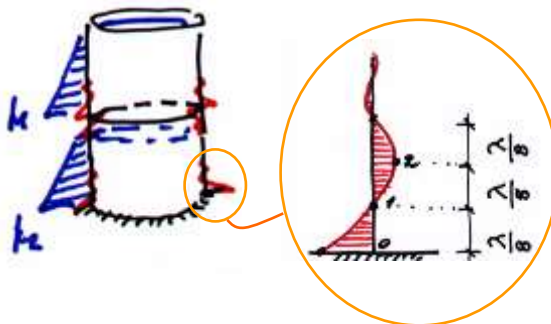


$$\frac{N_{\theta}}{R} = p_r$$

PERTURBAÇÕES DE BORDA



Esquemas originais – Prof. Mário Franco



$$\lambda = 4.83\sqrt{Rt}$$

$$M_0 = 0.294 pRt$$

$$M_1 = 0$$

$$M_2 = -0.061 pRt$$

Exemplo:

$$R = 4m, \quad t = 0.20m, \quad p = 150kN / m^2$$

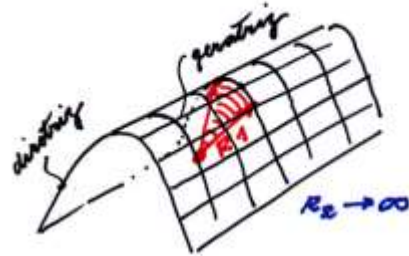
$$N_{\theta} = 600kN / m; \quad \lambda = 4.32m$$

$$M_0 = 35,3kNm / m (\phi 10 \text{ cada } 10cm)$$

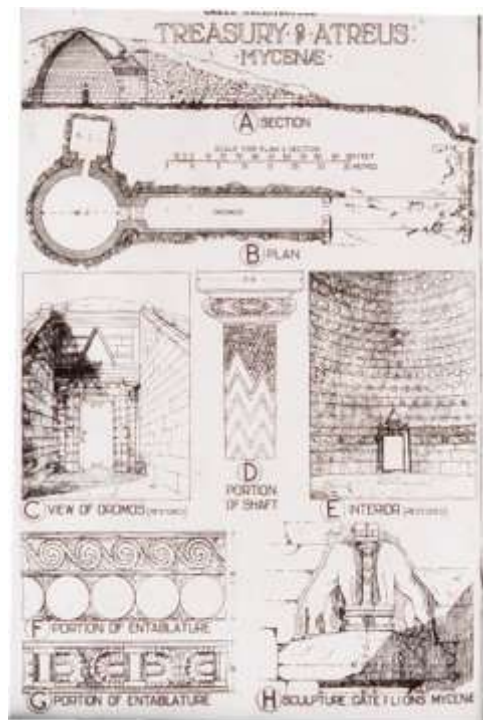
$$M_2 = -7,3kNm / m (\phi \text{ minimo})$$

Esquemas originais – Prof. Mário Franco

CASCA CILÍNDRICA

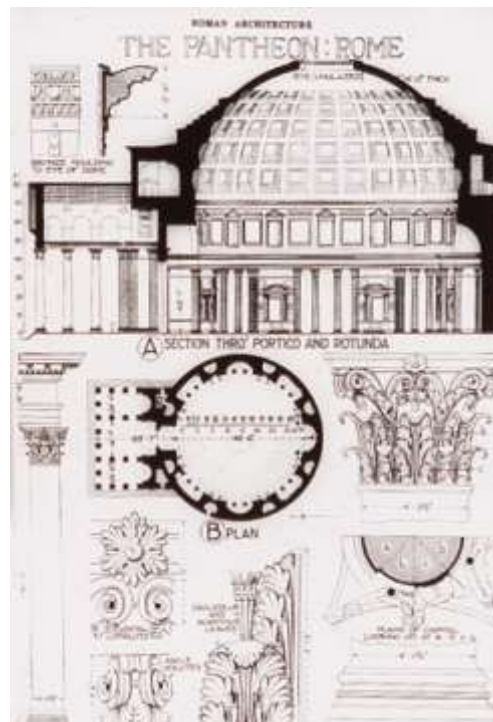


Esquemas originais – Prof. Mário Franco

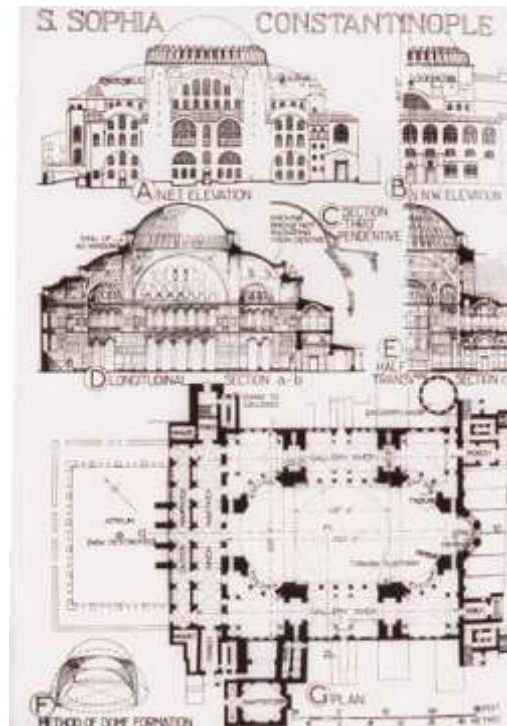


Trullos

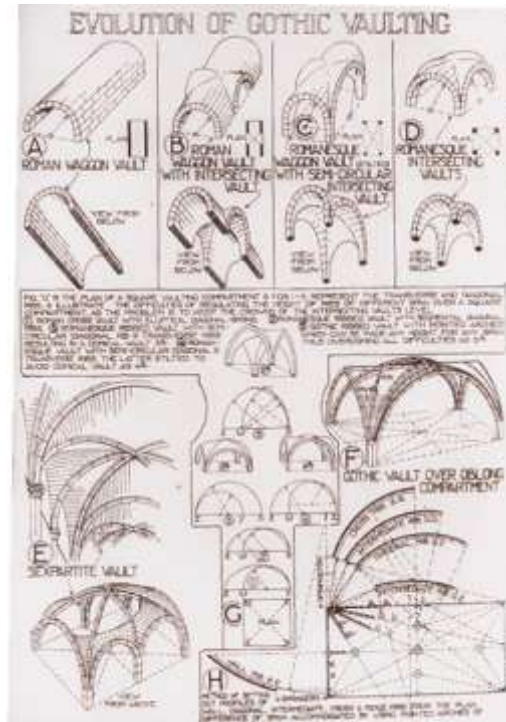


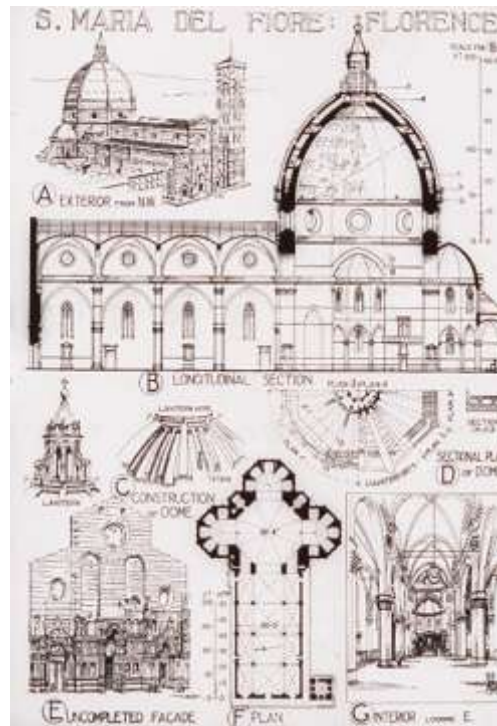
















Vladimir Shukhov
*First double curvature diagonally framed shell during
construction, in Vyksa near Nizhny Novgorod, 1897*



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



Piscina Coberta Centro Esportivo Baby Barioni - SP - 1948
Ícaro de Castro Mello



Palácio das Artes - SP - 1951
Oscar Niemeyer, Zenon Lotufo, Hêlio Uchôa, Eduardo K. de Mello



Planetário - SP - 1955
Eduardo Corona & Roberto José Goulart Tibau & Antônio Pitombo

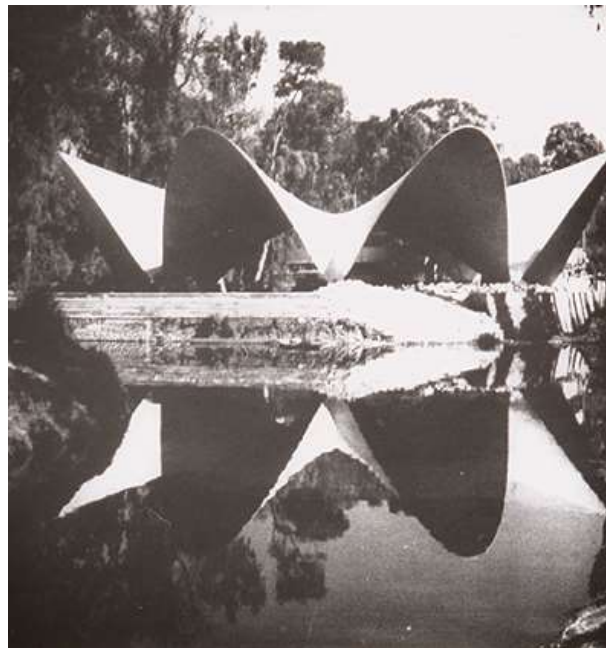


Palazzetto dello Sport – 1956 – 1957
Pier Luigi Nervi, Annibale Vitellozzi
1960 Olympics





Xochimilco Restaurant Los Manantiales, Mexico, 1957/1958
Felix Candela (Eng), Fernando Alvarez Ordóñez; Joaquin Alvarez Ordóñez (Arqs)





CNIT
Centre des nouvelles industries et technologies,
Paris, 1956 - 1958

Architect	Robert Edouard Camelot
	Jean de Mailly
	Bernard Louis Zehrufuss
Engineer	Nicolas Esquillan
	Jean Prouvé
Consultant	Pier Luigi Nervi

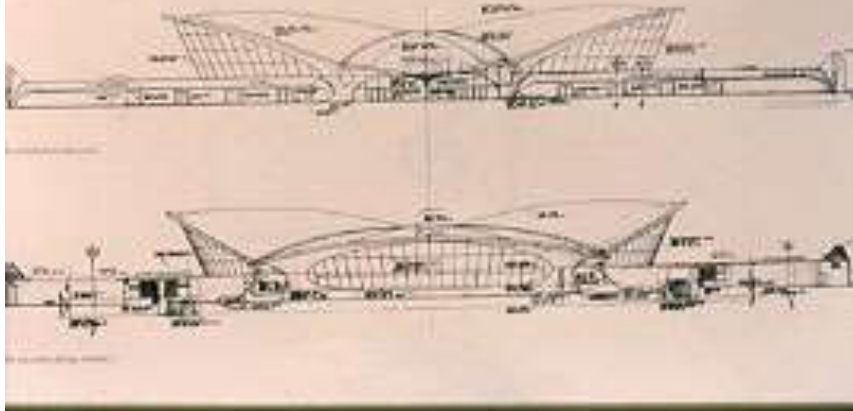




TWA Terminal at JFK International Airport , New York, 1956-1963

Design engineer: Boyd G. Anderson

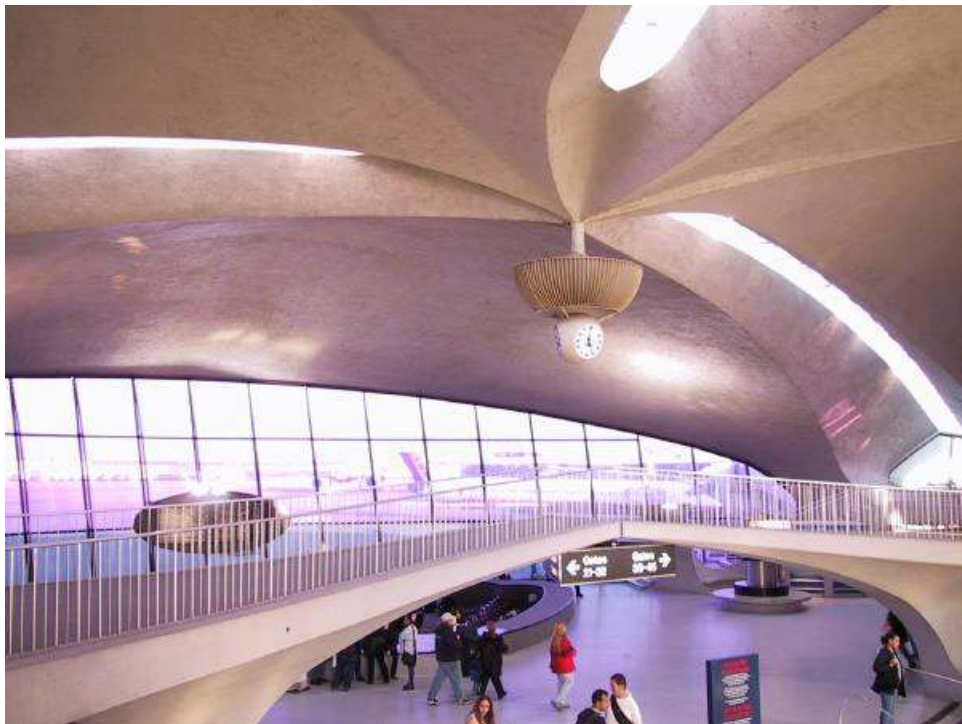
Architect: Eero Saarinen













St. Louis Abbey (or the Priory Chapel)

Gyo Obata of Hellmuth, Obata & Kassabaum (HOK) with Pier Luigi Nervi, consultant
1962







H. Isler, Wyss Garden Center, Suíça, 1961



Heinz Isler – Bürgi Garden Center – Suíça, 1973



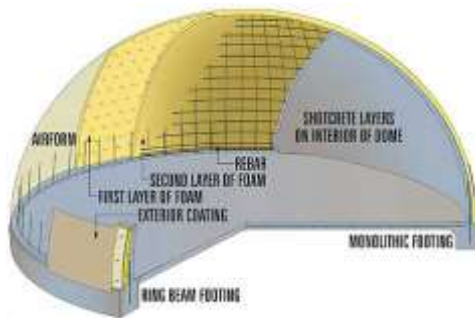
Heinz Isler – Bürgi Garden Center – Suíça, 1973



H. Isler, Brühl Sports Center , Suíça, 1982



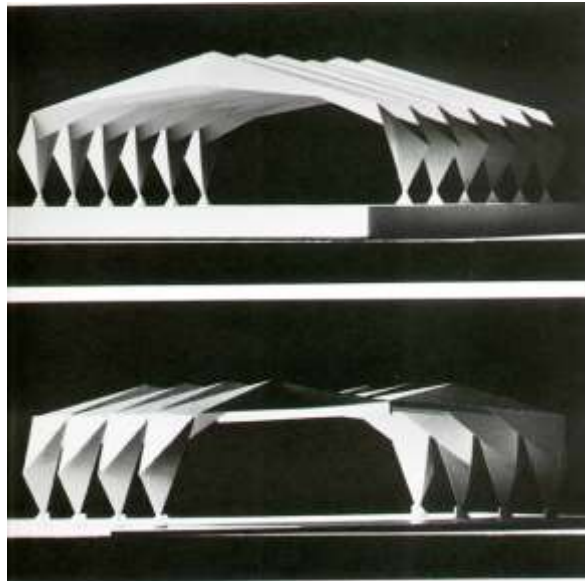
Sistema Bini
The Kallangur Shopping Center, Queensland, Australia



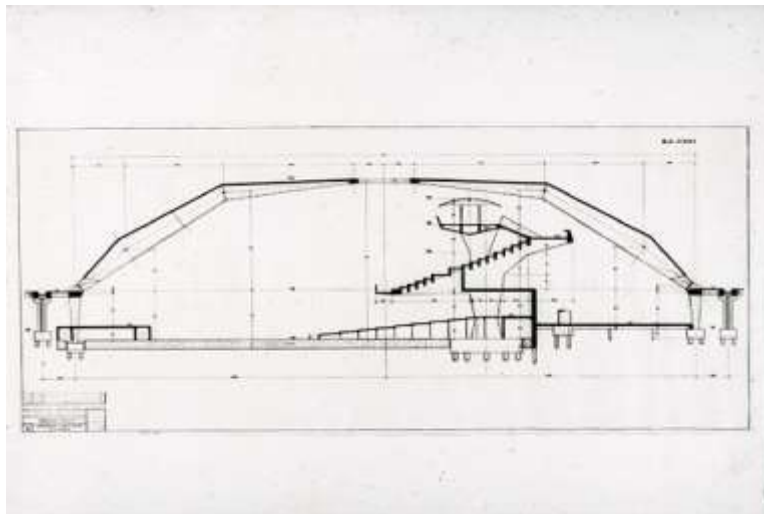




Palácio das Convenções - SP - 1967
Miguel Juliano e Silva, Jorge Wilhelm







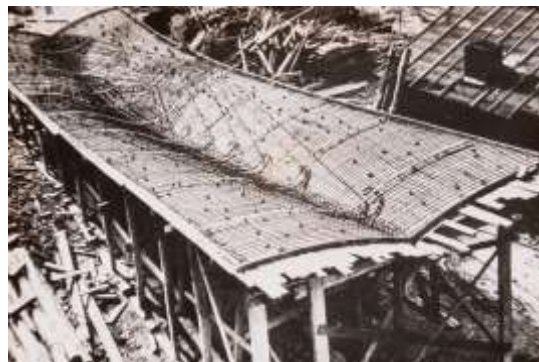
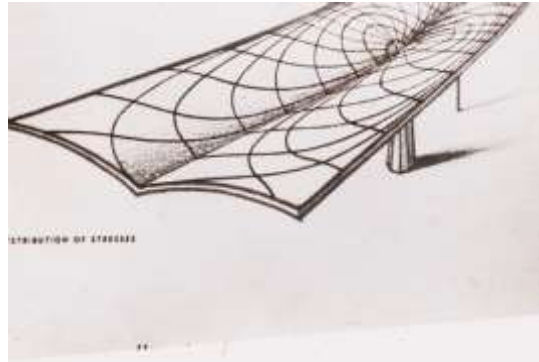


Posto Catacumba - RJ - 1968

Dilson Gestal Pereira, Waldyr Antunes Figueiredo, Paulo Roberto M. Souza, Alfredo Lemos











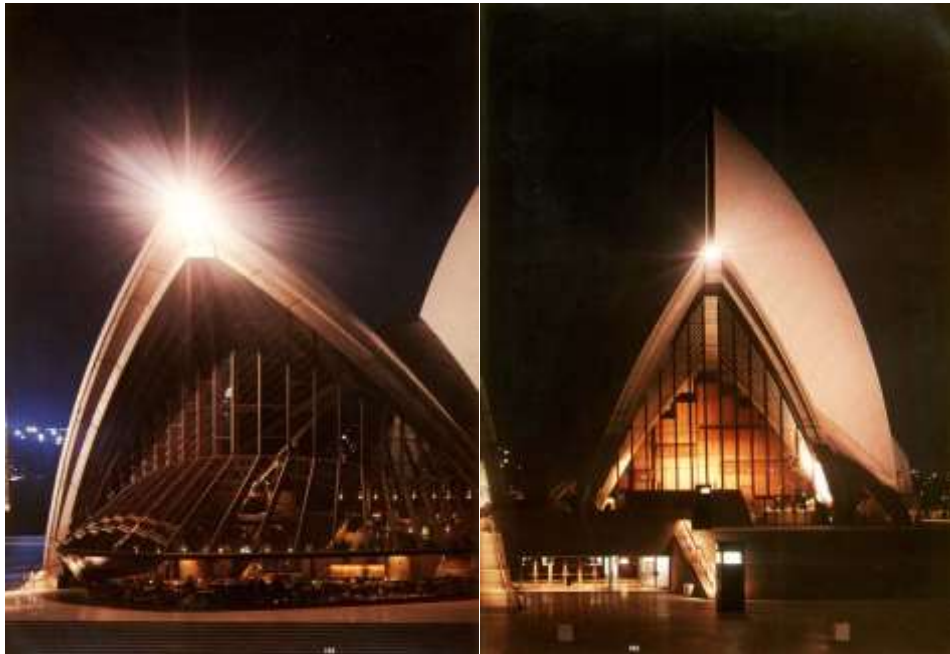




Sydney Opera House (1958 – 1973)

Double thin shell ribbed ; Concept designer Jørn Utzon; Architect E. H. Farmer , Peter Hall, David Littlemore, Lionel Todd ; Engineer: Ove Nyquist Arup





Fariborz Sahba (canadian architect)





Memorial da América Latina - SP - 1987
Oscar Niemeyer





Museu de Arte Contemporânea - RJ - 1996
Oscar Niemeyer







L'Oceanogràfic, Valencia , 2002
Félix Candela



Santiago Calatrava
Tenerife Concert Hall, 1996
 Canary Islands, Spain



The all-concrete building is characterized by the dramatic sweep of its roof. Rising off the base like a crashing wave, the roof soars to a height of 58 meters over the main auditorium before curving downward and narrowing to a point. The building's plinth forms a public plaza covering the site and allows for changes in grade between the different levels of the adjacent roads.





Guggenheim Museum, Bilbao, 1997
Architect: Frank Owen Gehry





Viveiro dos hipopótamos do zoológico de Berlim
Arq. J. Griebel (1999)
Desgin: Jorg Schlaich



Viveiro dos hipopótamos do zoológico de Berlim

*Fiera di Milano Exhibition Centre, Milan, Italy
Massimiliano Fuksas, 2005*





*Anaheim Regional Transportation Intermodal Center
Anaheim, California, 2015
HOK Architects*





*Metropol Parasol
Arq. Jürgen Mayer H. Architects (2011)*





*Centro Heydar Aliyev, Azerbaijão (2013)
Arqs. Zaha Hadid, Patrik Schumacher*





*Arnhem Central Station, the Netherlands, 2015
Architects: UNStudio*





*Bosjes Chapel, Witzenberg, South Africa, 2017
Steyn Studio (UK) & TV3 Architects (SA)*







