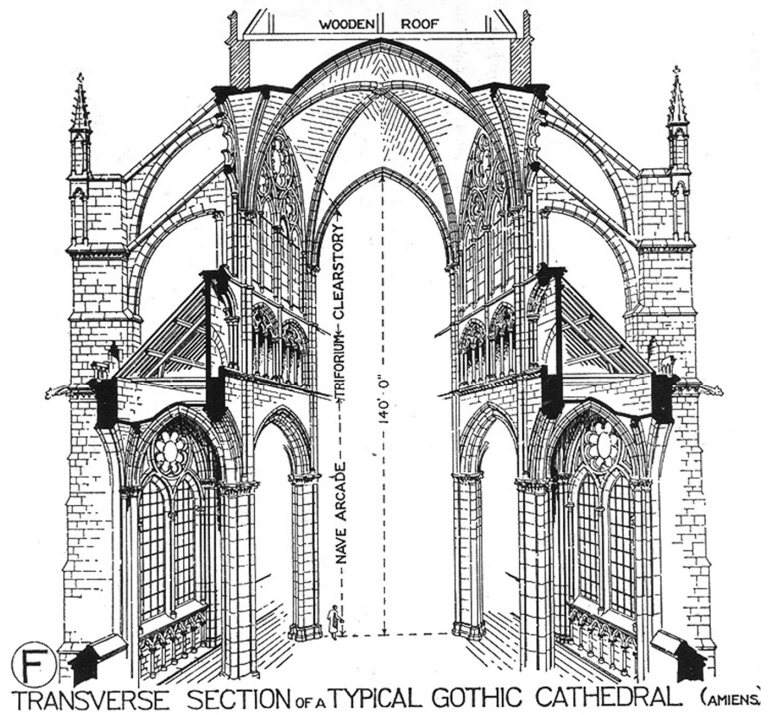


Masonry Vaults and Shells

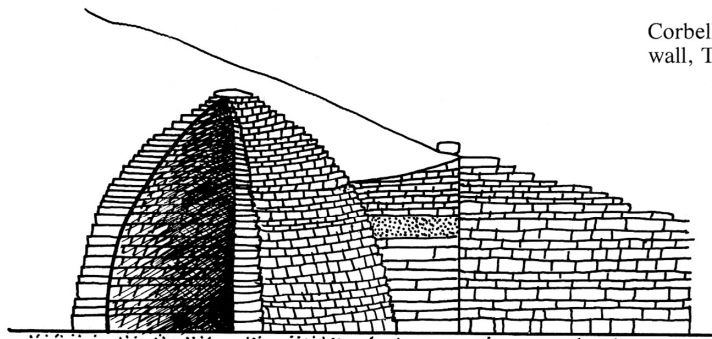
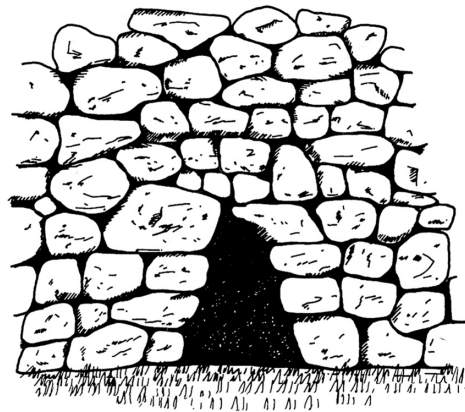
- Roman Domes
- Byzantine Domes
- Renaissance Domes
- Gothic Vaults
- Catalonian Shells



Amiens Cathedral

Corbeled Dome

- Greek
- Corbels (not a true arch)



Pantheon

Roman

Pantheon 125 AD

- First to use
- Spherical form
- Braced sides
- 43.6 m

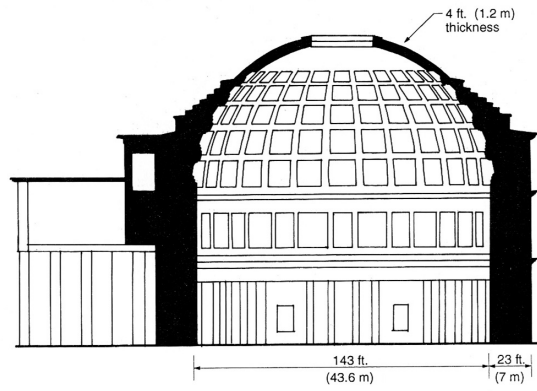
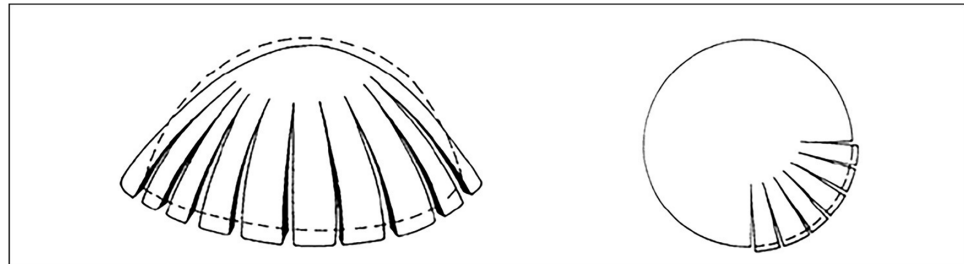


Figure 1.23 The Pantheon in Rome (A.D. 123). (Redrawn from Ref. 1.9)

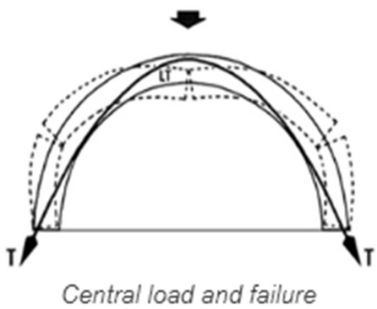


Pantheon

Roman Arches

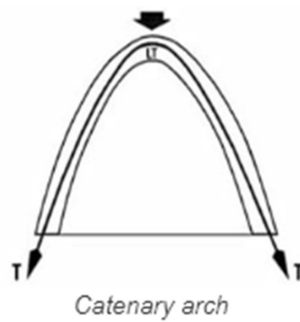


Example 1



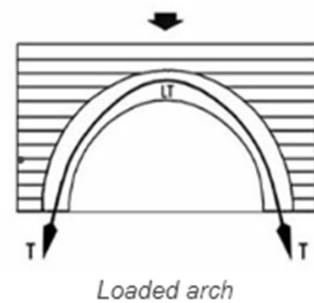
Remedy 1 to Example 1

Change the shape of the arch.



Remedy 2 to Example 1

Keep the shape and load the haunches.



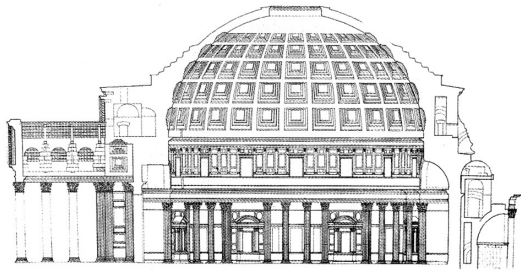
Historic Masonry

Roman

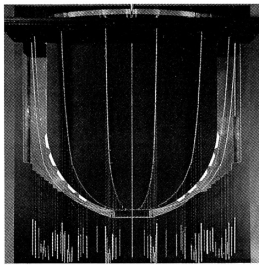
Pantheon

- Thrust line
- Catenary models

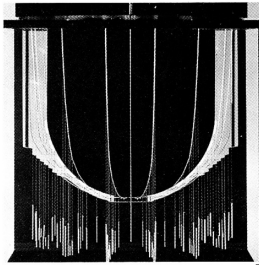
Institute for Lightweight Structures (IL)



3



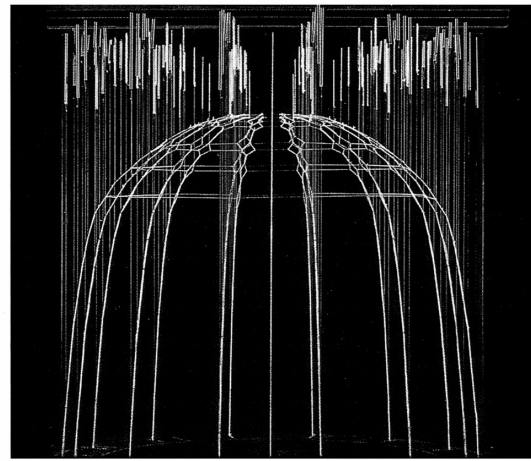
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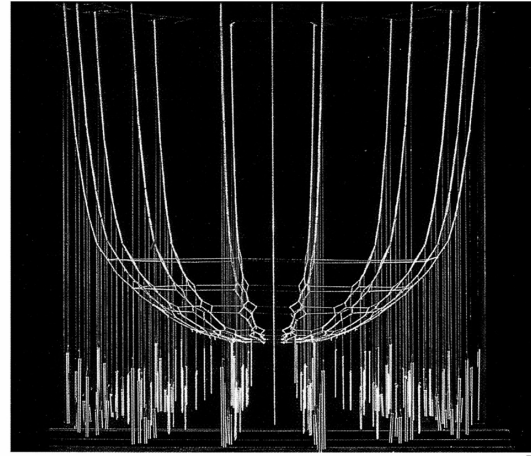
5

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6



7

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Domes – from “Building Big” video series by David Macaulay



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Masonry

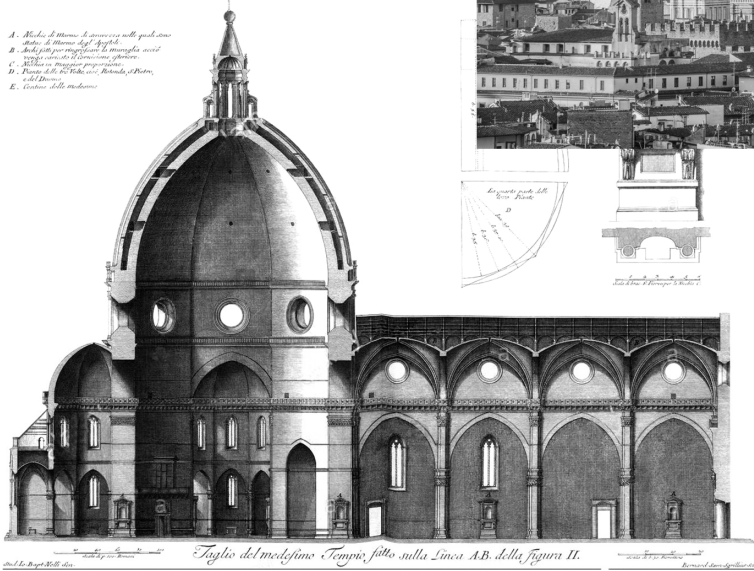
Slide 6 of 32

Florence Dome

Gothic/Renaissance

Santa Maria del Fiore

- Brunelleschi
- 1296-1436
- 43 or 45 m span ?
- Largest brick dome



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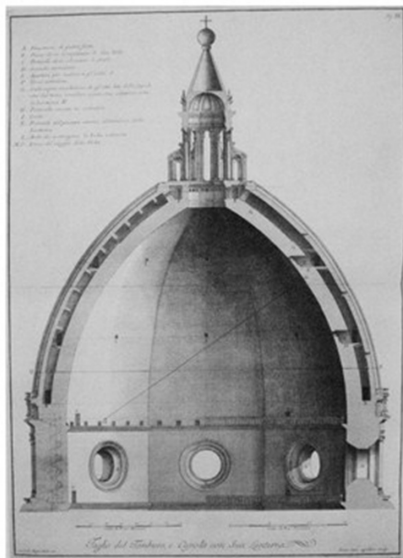
Slide 7 of 32

Florence Dome

Gothic/Renaissance

Santa Maria del Fiore

- Brunelleschi
- 1296-1436
- 43 or 45 m span ?
- Largest brick dome



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Slide 8 of 32

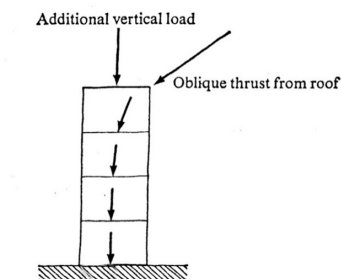
Gothic Vaulting – by David Macaulay



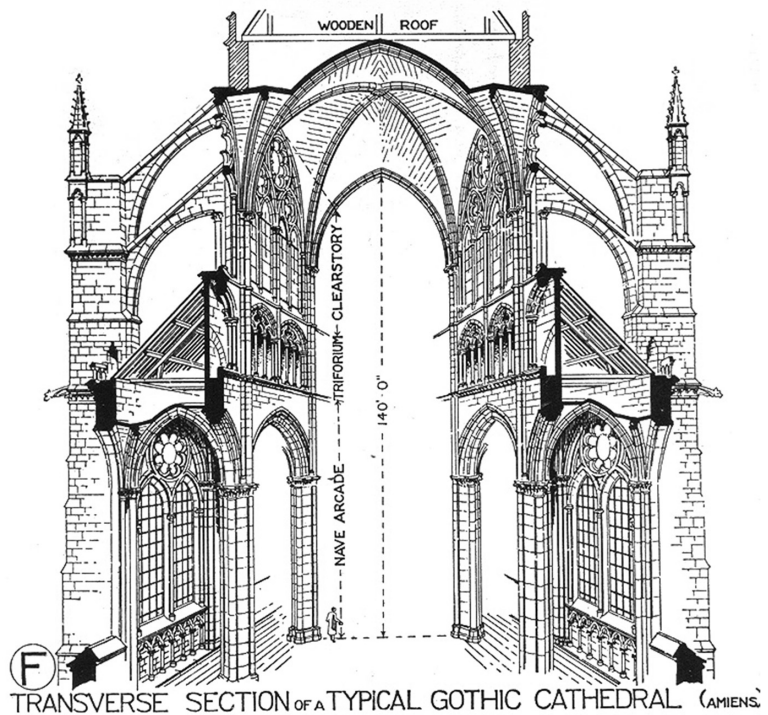
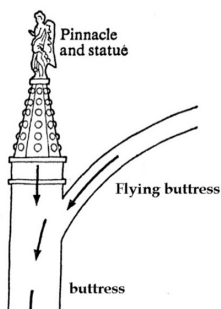
Gothic Vaulting

Gothic vaults and buttressing

- Amiens
- 1220-1225



The effect of an additional load at the top of the buttress is to *reduce* the eccentricity of the thrust line.



Gothic Vaulting

Gothic vaults

- Amiens
- 1220-1225



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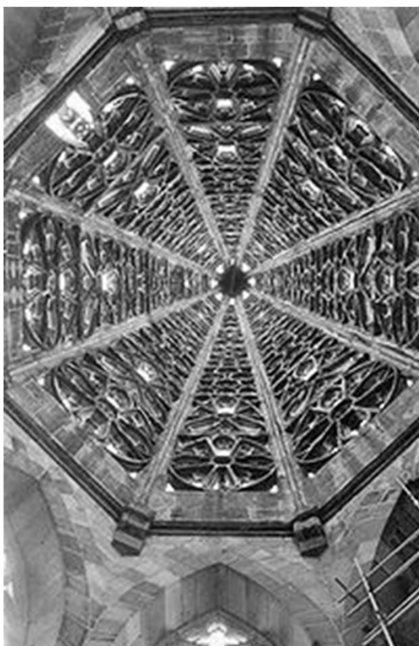


Masonry

Gothic Vaulting

Gothic vaults

- Freiburg
- 1260



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Masonry

Gothic Vaulting

Gothic vaults

- Chartres
- 1194



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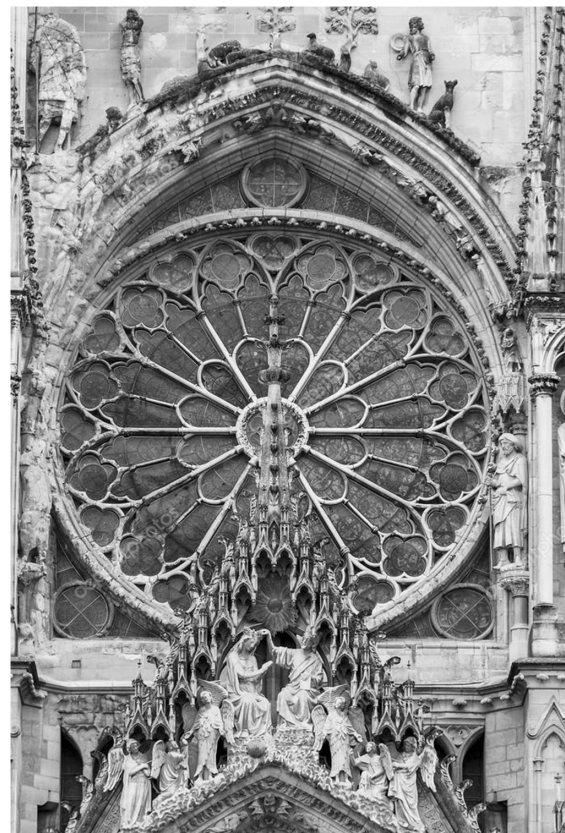
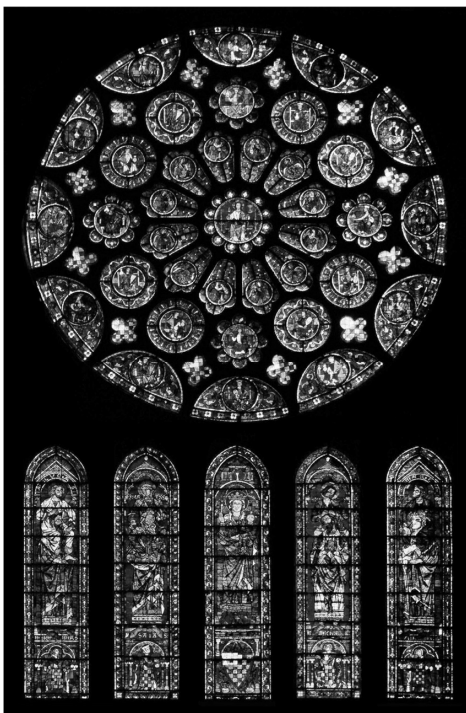
Masonry

Slide 13 of 32

Gothic Vaulting

Gothic vaults

- Chartres
- 1194



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Masonry

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Gothic Vaulting

Gothic vaults

- Kölner Dom (Cologne) 1248 -1880
- Spire height 157 m (515 ft)



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Masonry

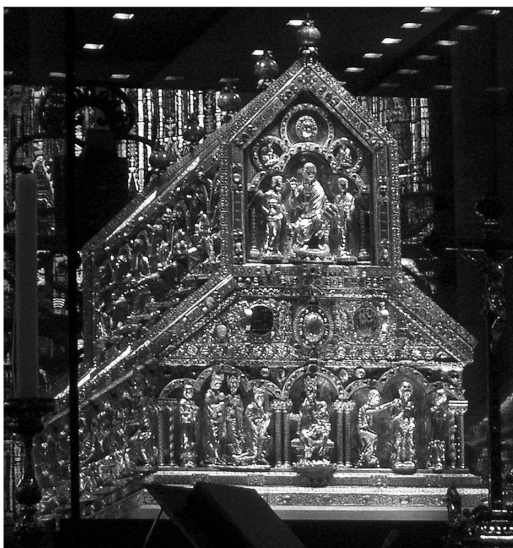
Slide 15 of 32



Gothic Vaulting

Gothic vaults

- Kölner Dom (Cologne) 1248 -1880
- Spire height 157 m (515 ft)



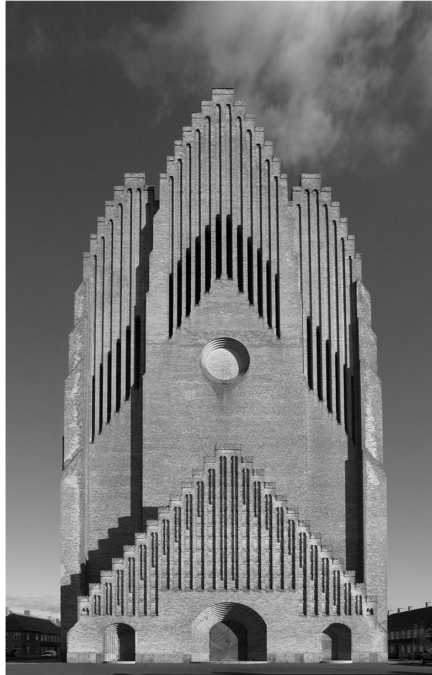
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Masonry

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German Expressionism



Grundtvig Church, Copenhagen
Jensen Klit

University of Michigan, TCAUP



Chilehaus, Hamburg
Fritz Höger

Masonry

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German Expressionism



University of Michigan, TCAUP

Masonry



Einstein Tower, Potsdam
Erich Mendelsohn

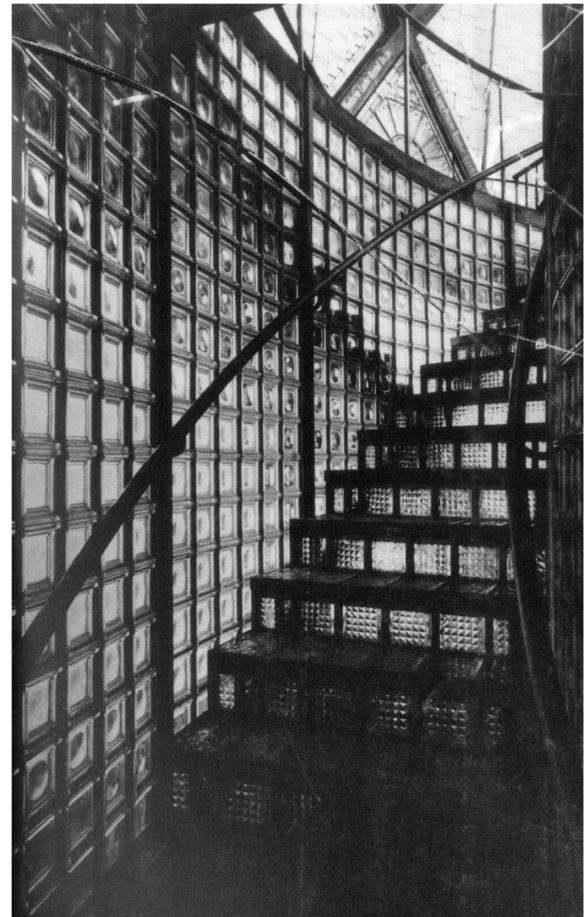
Goetheanum, Dornach CH
Rudolf Steiner

Slide 18 of 32

German Expressionism

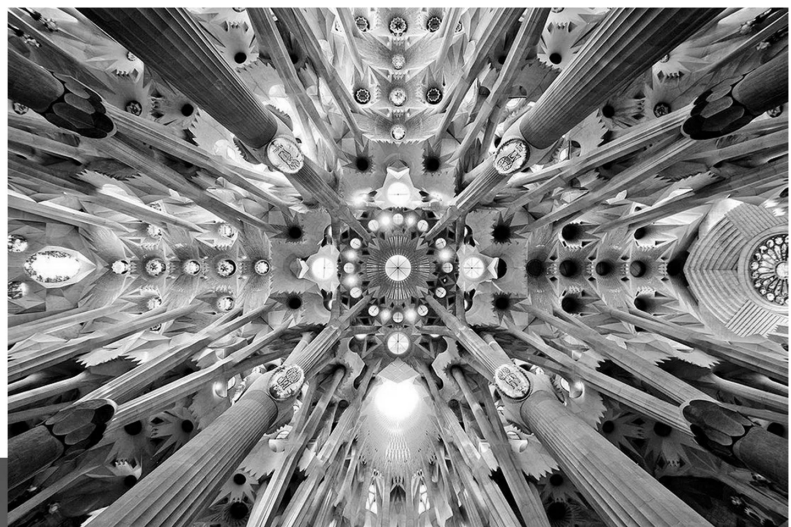


Glass Pavilion, Buno Taut



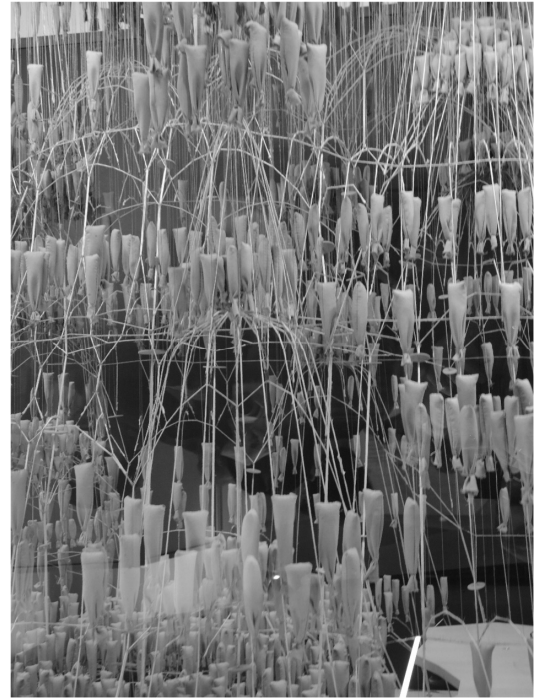
Art Nueveau Catalonian

- Antonio Gaudi 1852 - 1926
- Catalonian Art Nouveau
- La Sagrada Familia



La Sagrada Familia

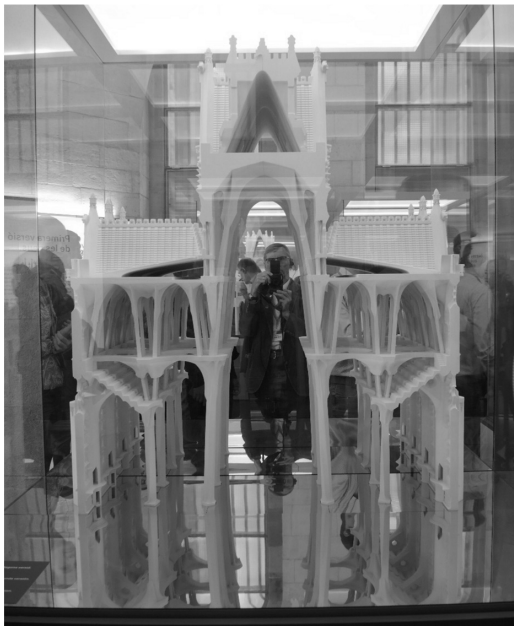
- catenary design
- original model destroyed in Spanish Civil War (1936 – 1939)



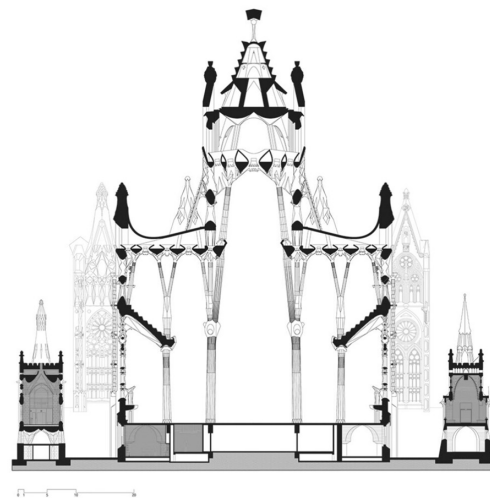
catenary model of Sagrada Familia

La Sagrada Familia

- catenary design
- no buttress support



Sagrada Familia - model



Sagrada Familia - section

La Sagrada Familia

- scheduled completion - 1926
- 100th anniversary of Gaudi's death
- 3 portals - 18 towers



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Masonry

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Art Nouveau

Catalonian

- Antonio Gaudi 1852 - 1926
- Catalonian Art Nouveau
- Park Güell



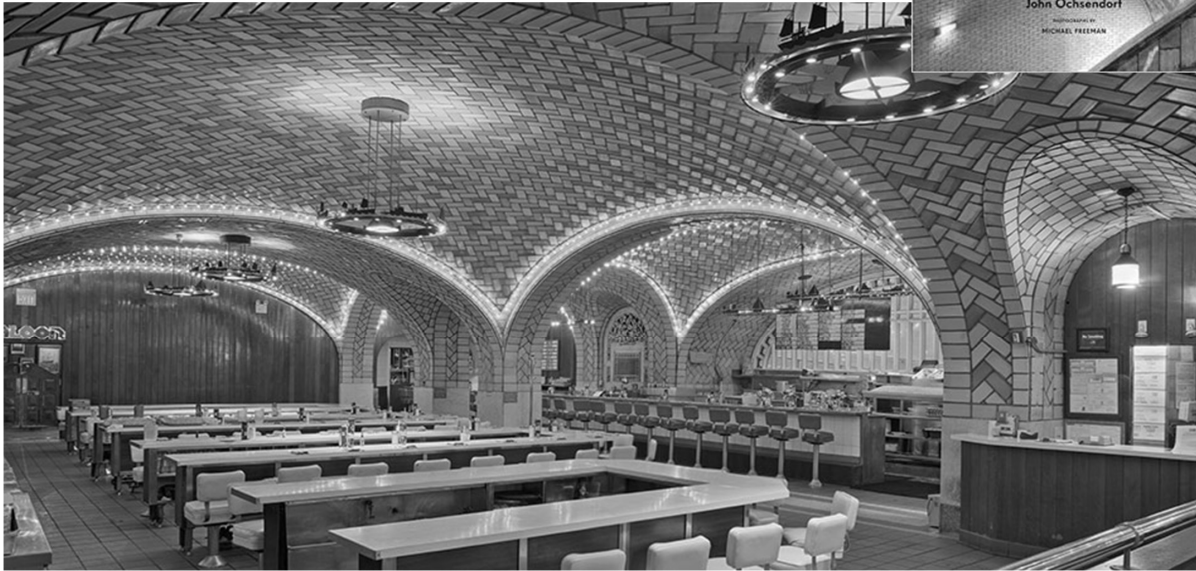
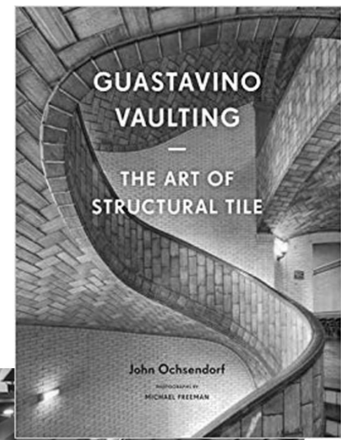
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Masonry

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Guastavino Vaulting

- Guastavino Co. 1885 – 1962
- Started in Boston



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Guastavino Vaulting

- Guastavino Co. 1885 – 1962
- Detroit Train Station



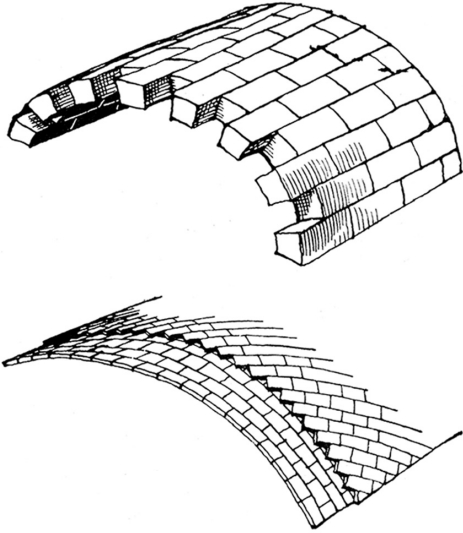
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Masonry

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Guastavino Vaulting

- Guastavino Co. 1885 – 1962
- Started in Boston



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Guastavino Vaulting

- Other examples



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Masonry

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High Rise

Walls – thrust line calculation

- Sum moments at sections to find axis

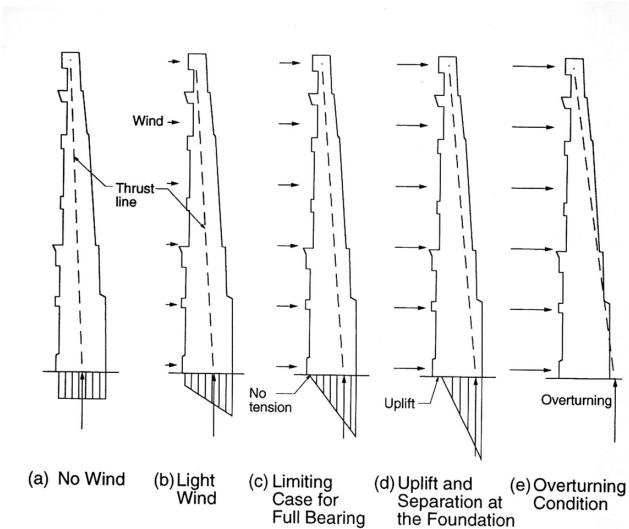


Figure 1.9 Stability of wall under increasing wind force.

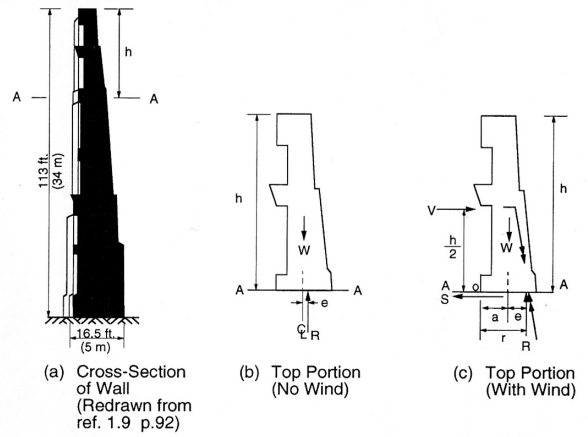


Figure 1.8 Equilibrium of mud brick wall at Palace of Ctesiphon (c. A.D. 550).

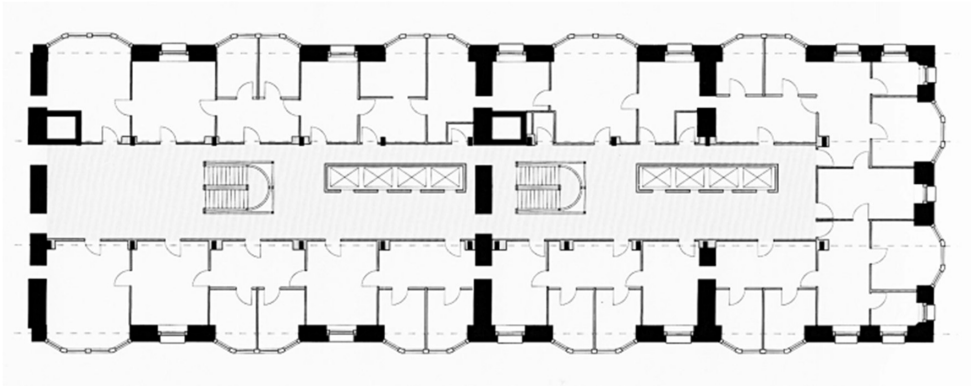
High Rise

Monadnock Building
Burnham & Root
1892, Chicago
215 ft., 16 stories



High Rise

Monadnock Building
Burnham & Root
1892, Chicago
215 ft., 16 stories



Modern Multistory Masonry

- Reinforced cavity
- Tied to slab
- Diaphragm action



Figure 17.1 16-story loadbearing brick masonry building, Biel, Switzerland. (Courtesy of Brick Institute of America.)

