

Structural Systems in Architecture

Jonathan Ochshorn

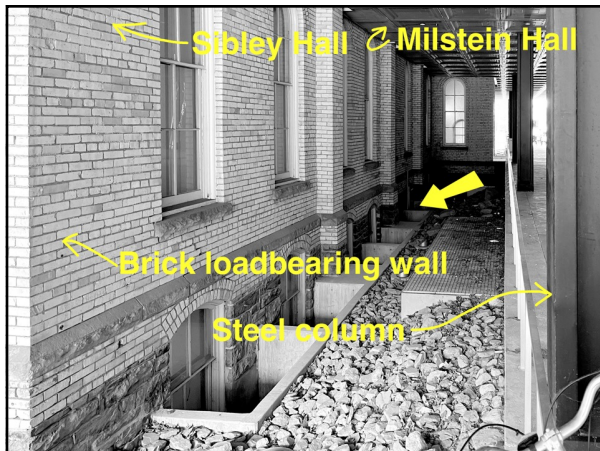
Cornell University, July 3, 2025

www.jonochshorn.com

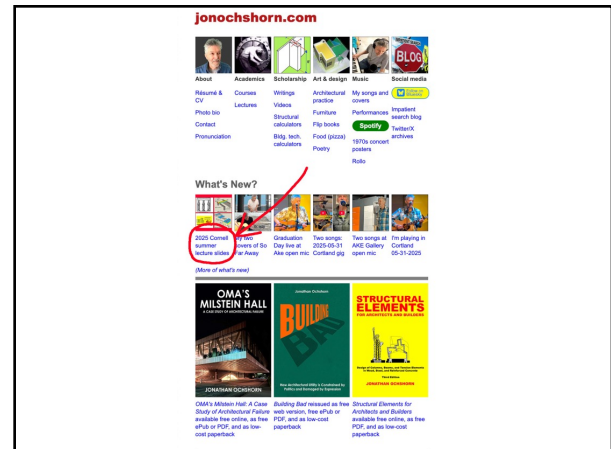
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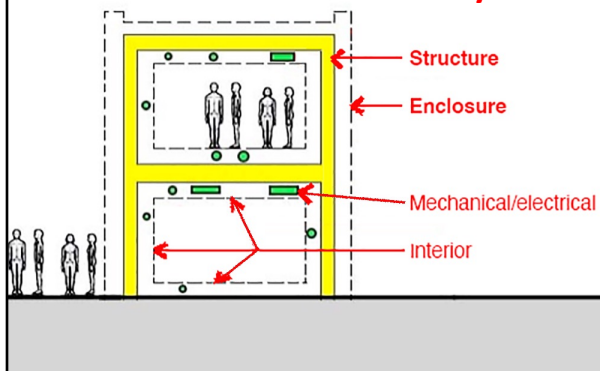


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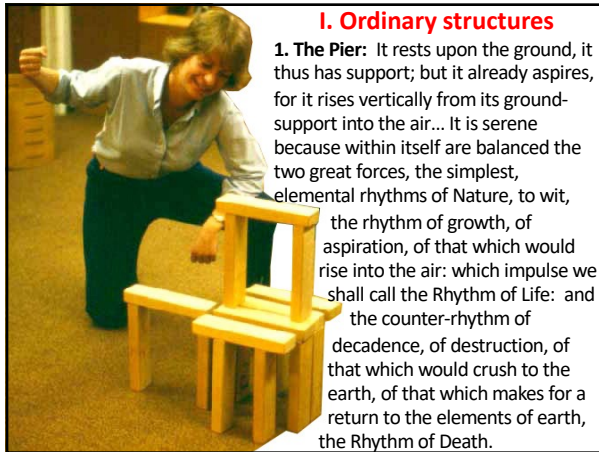
Structural and construction systems



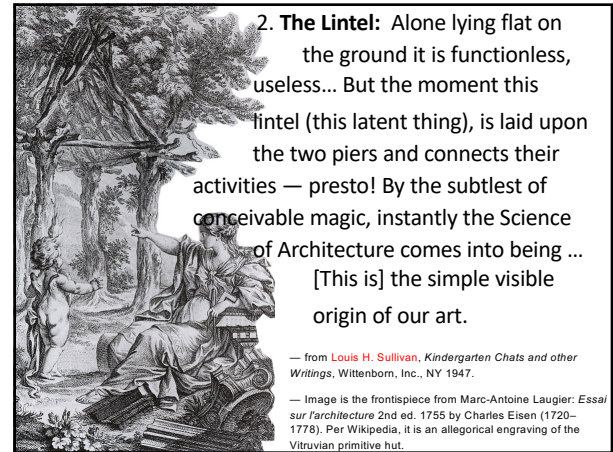
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Structural systems

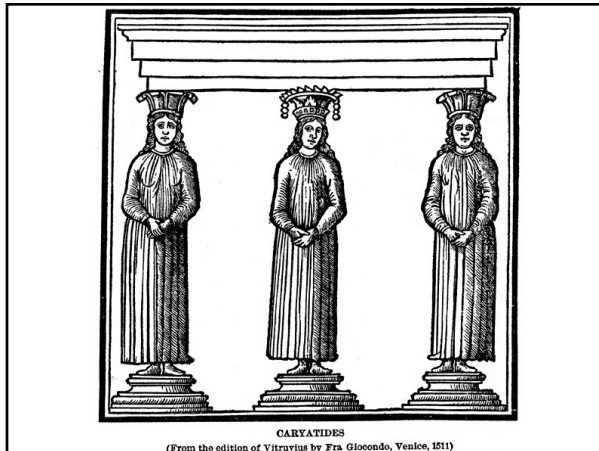
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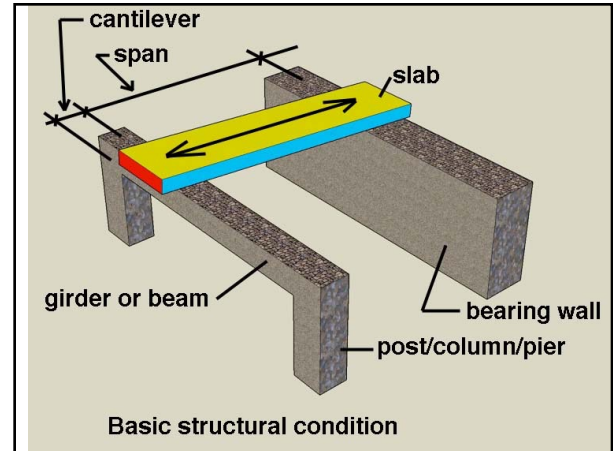
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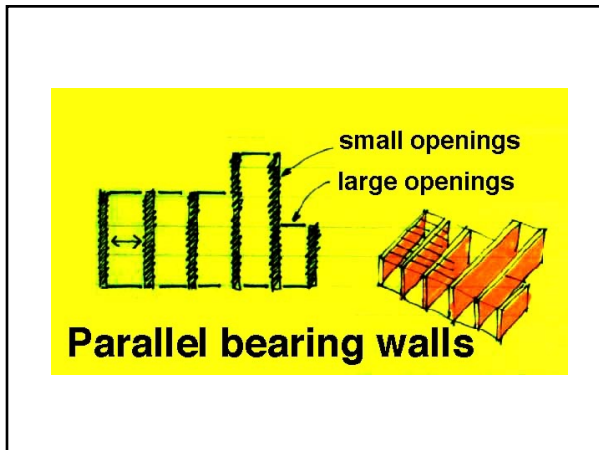
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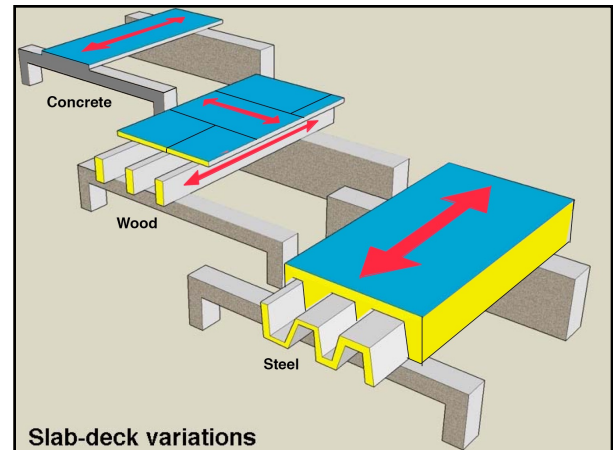
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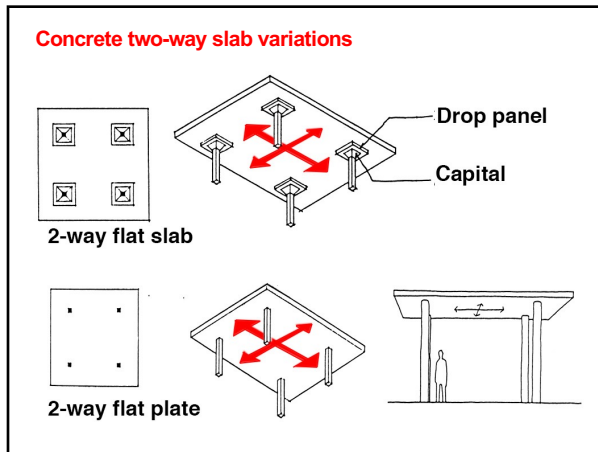
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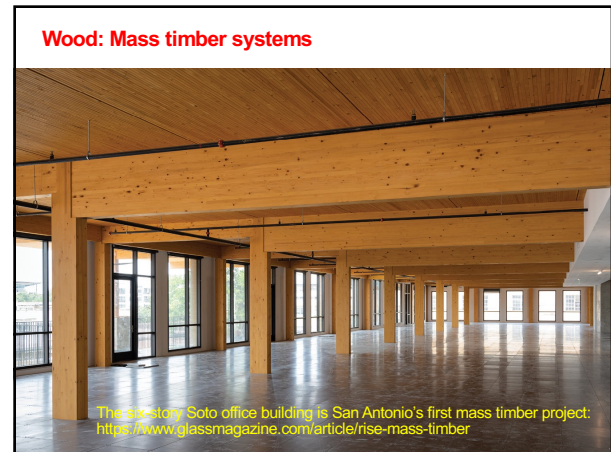
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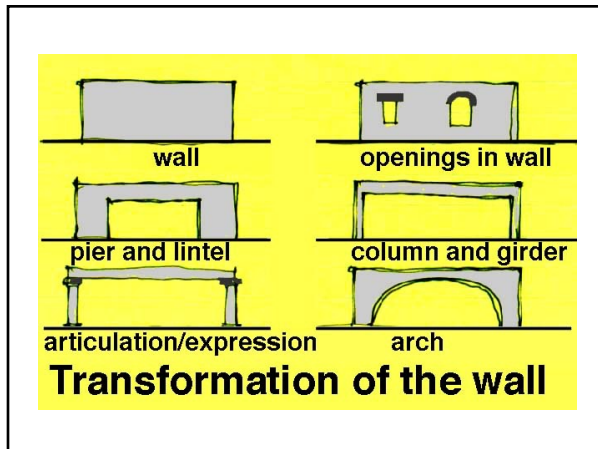
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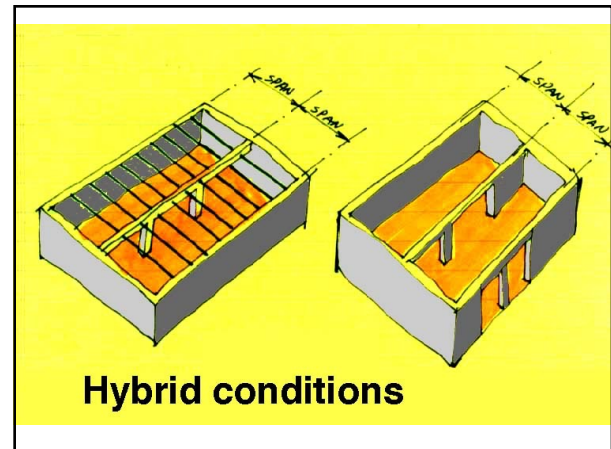
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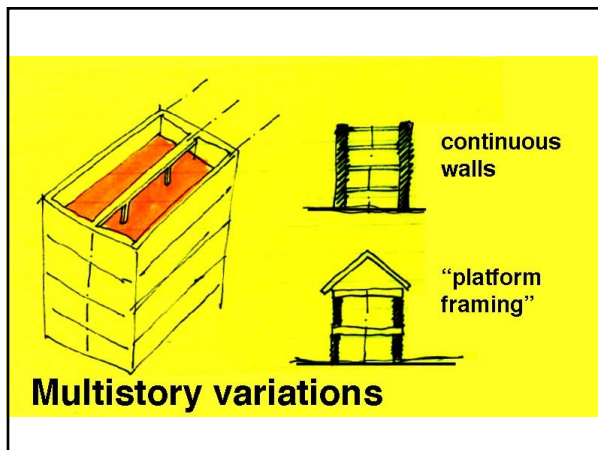
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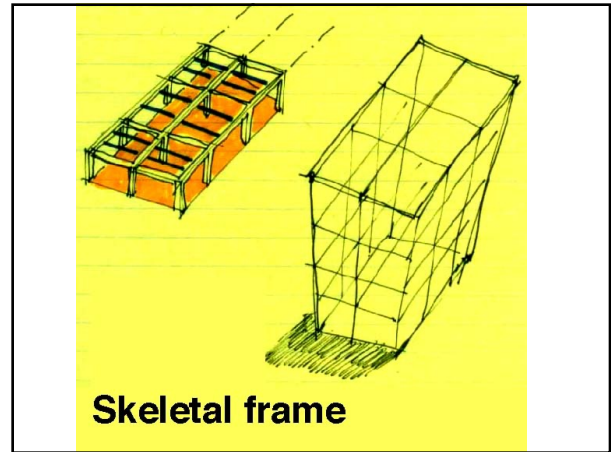
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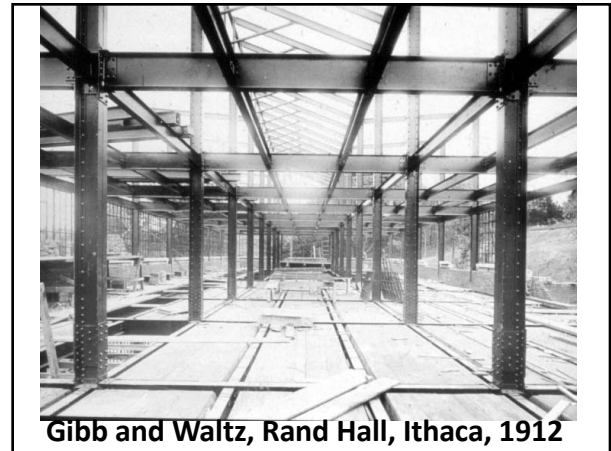
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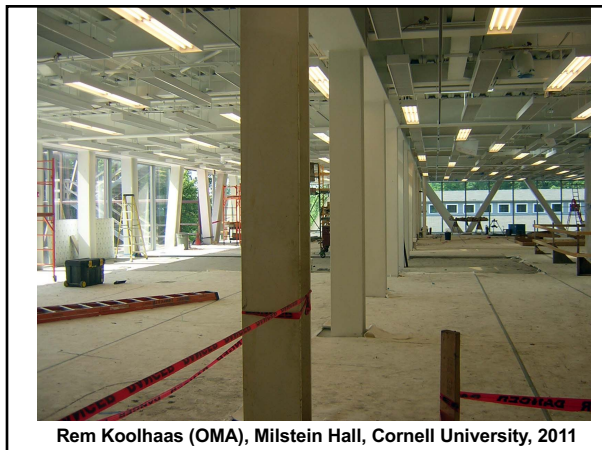
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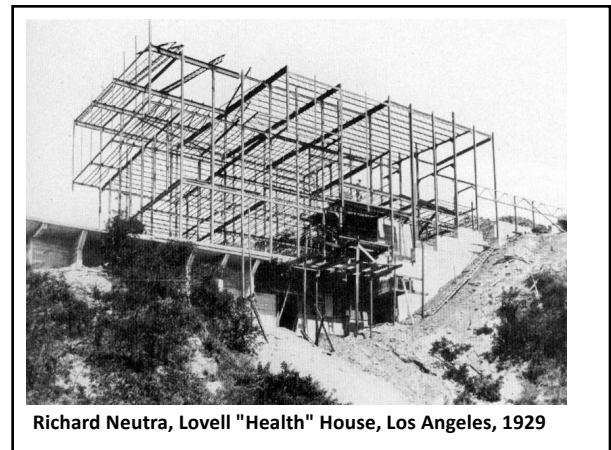
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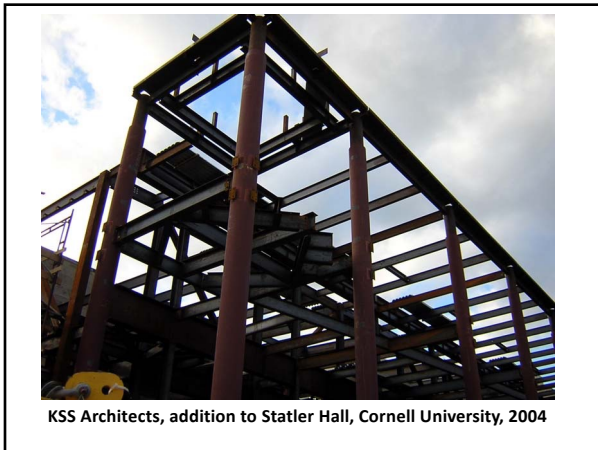
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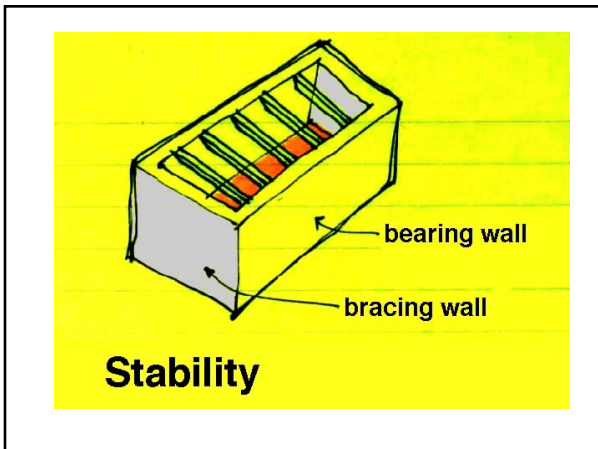
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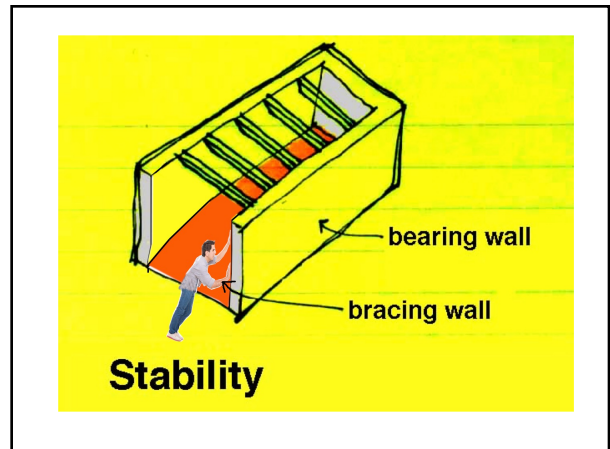
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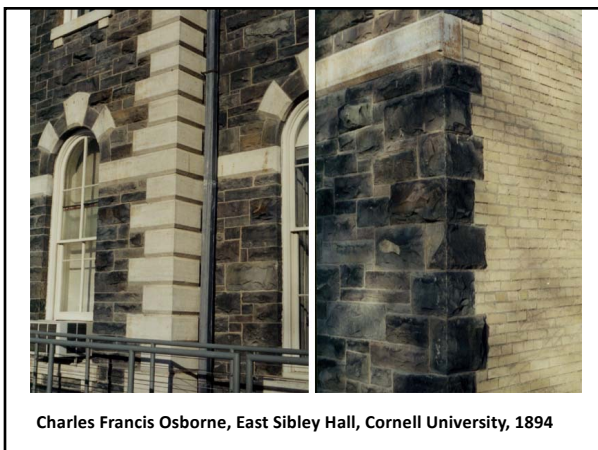
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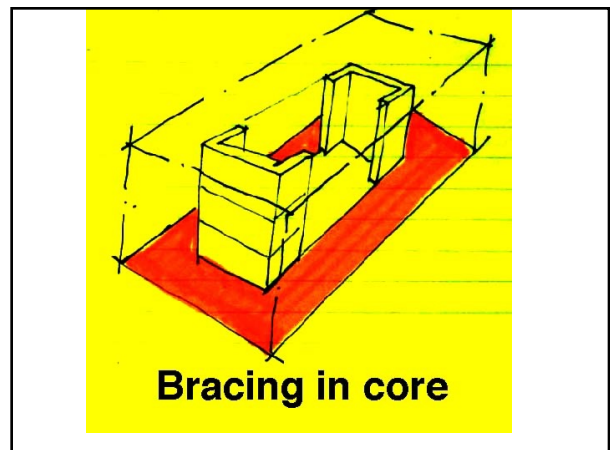
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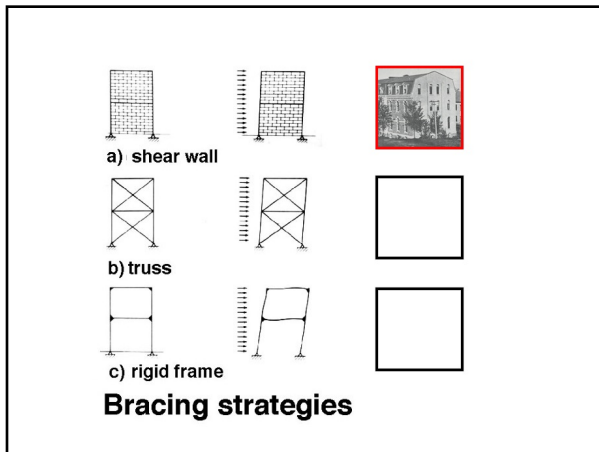
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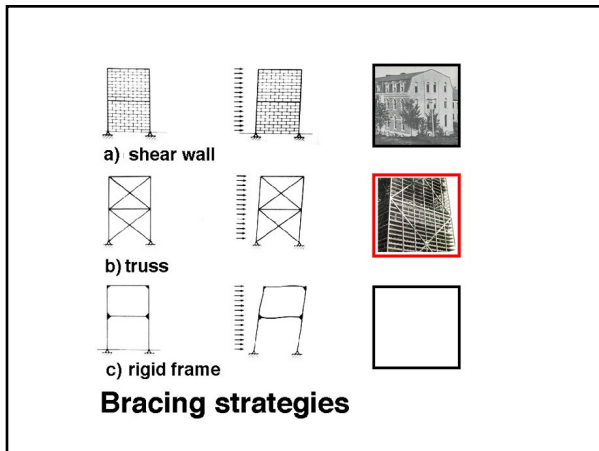
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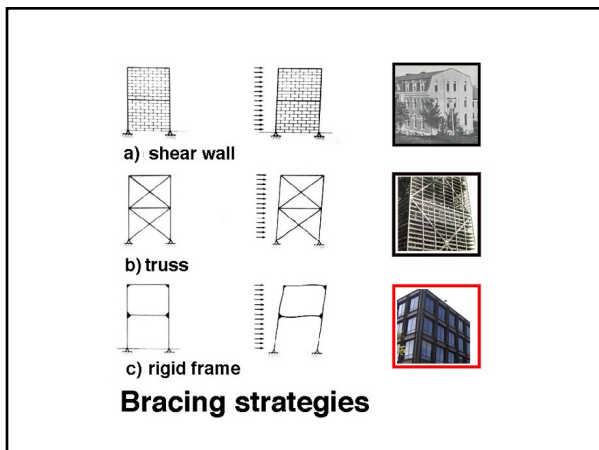
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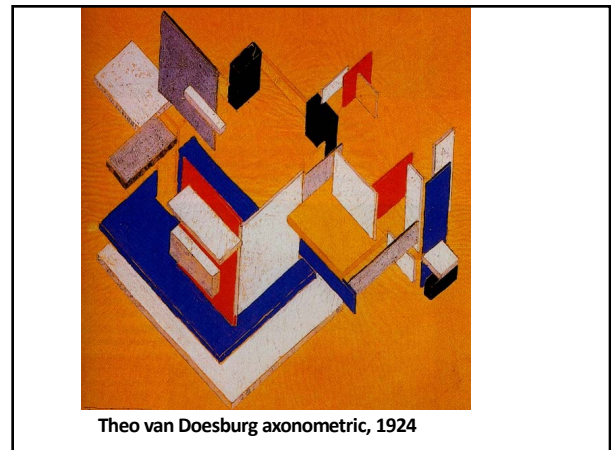
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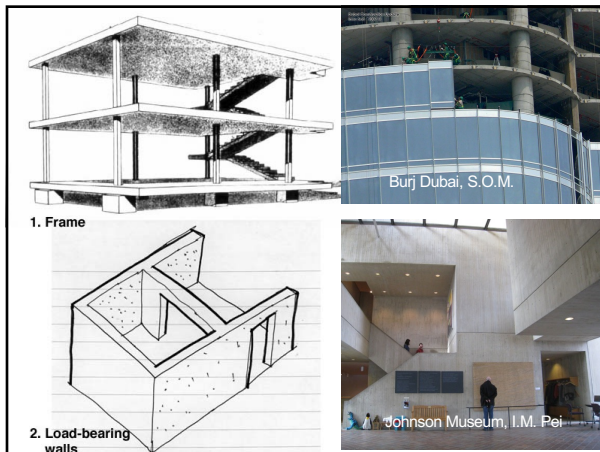
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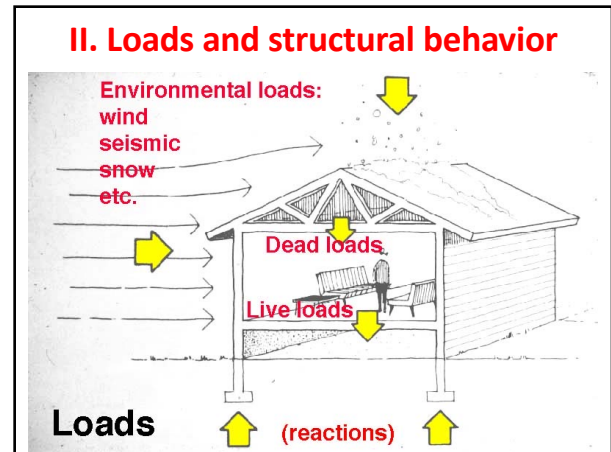
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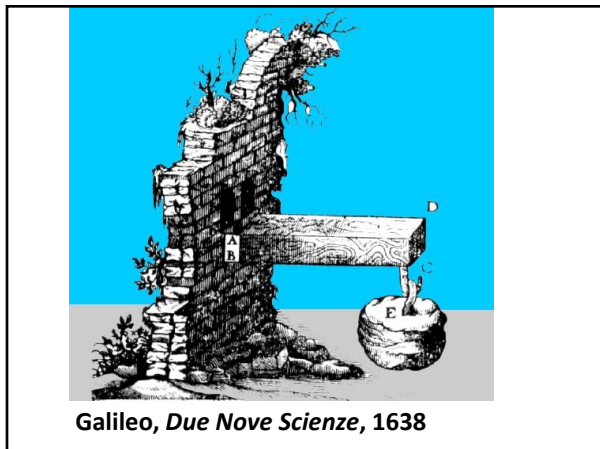
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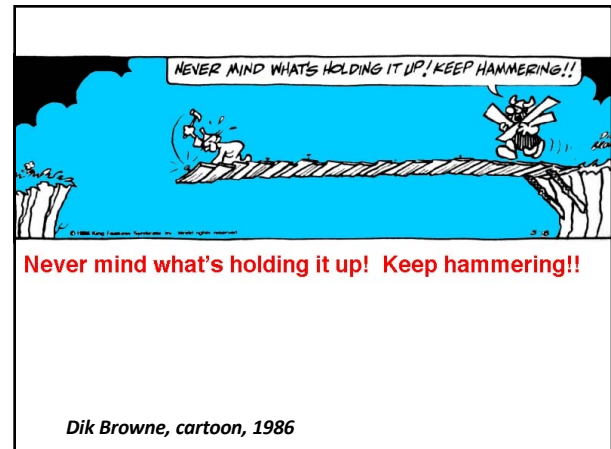
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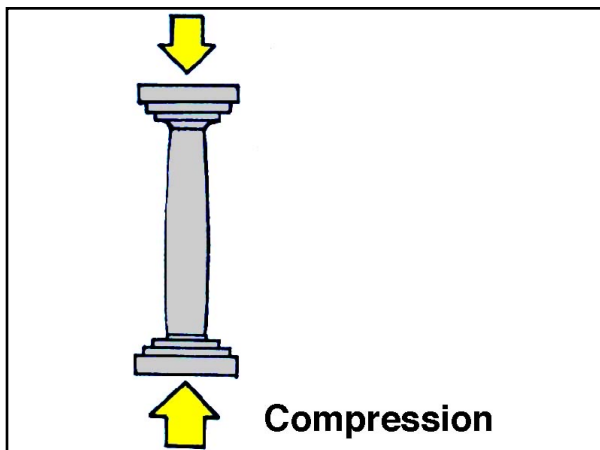
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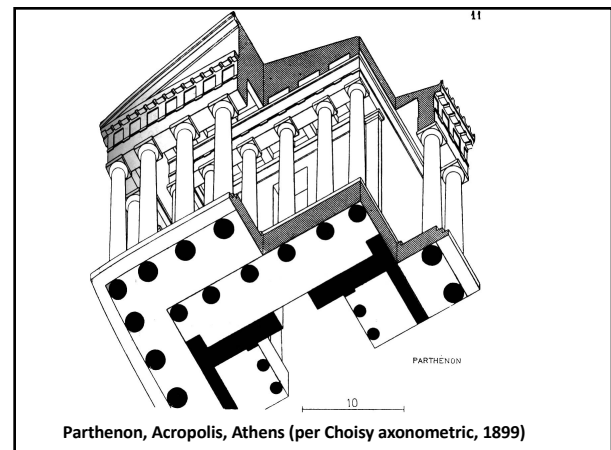
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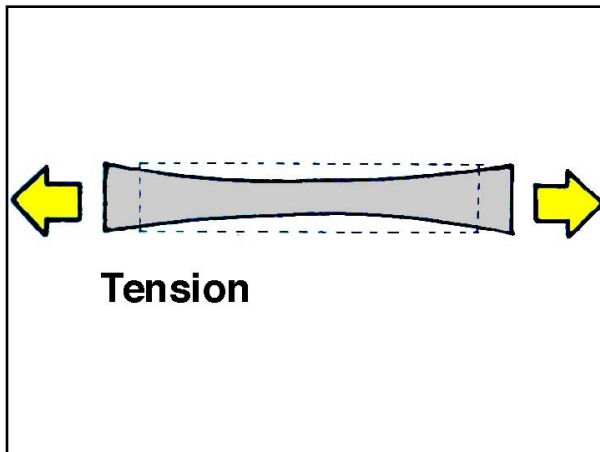
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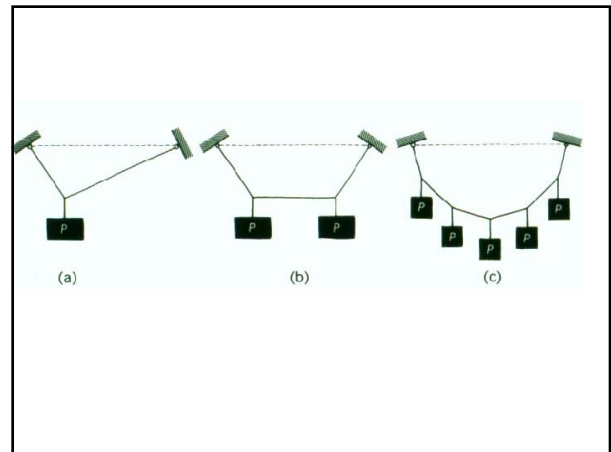
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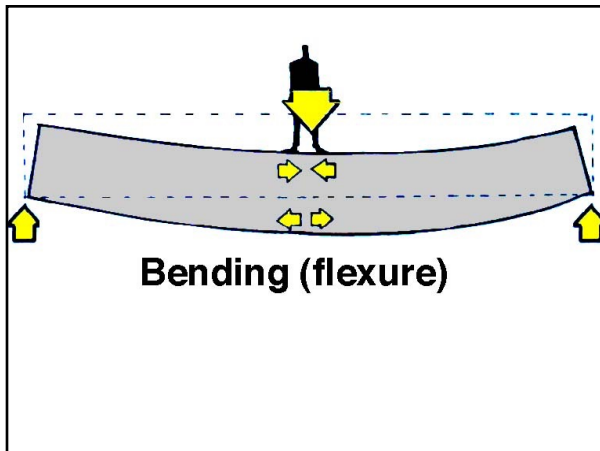
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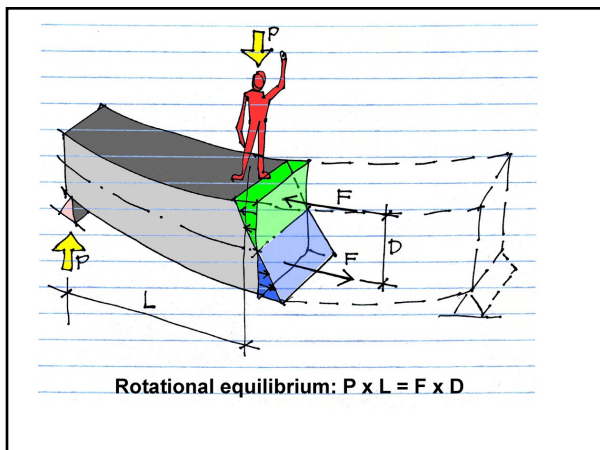


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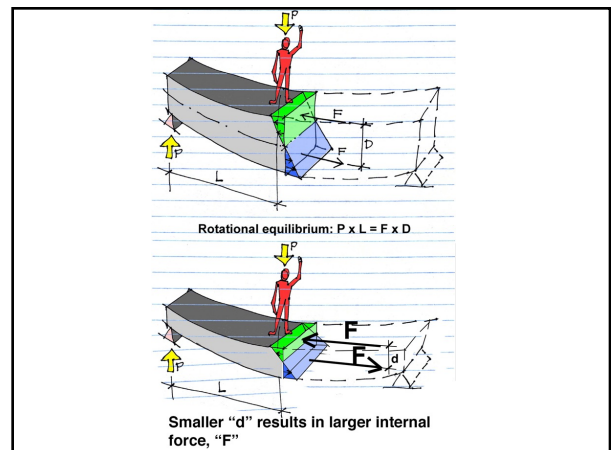


Pierre Koenig, Case Study House 21, Los Angeles, 1958

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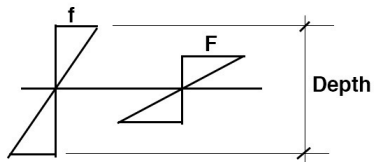


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Strategies for bending elements (beams)

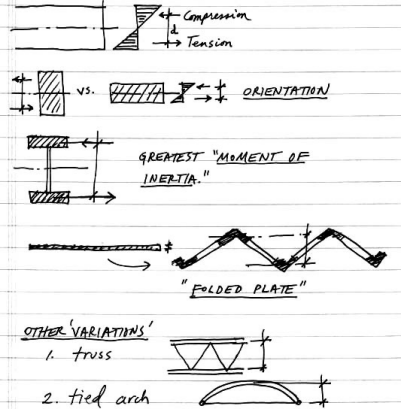


1. Reduce internal stress (force) by increasing depth
2. Place material where stress is largest (top and bottom)



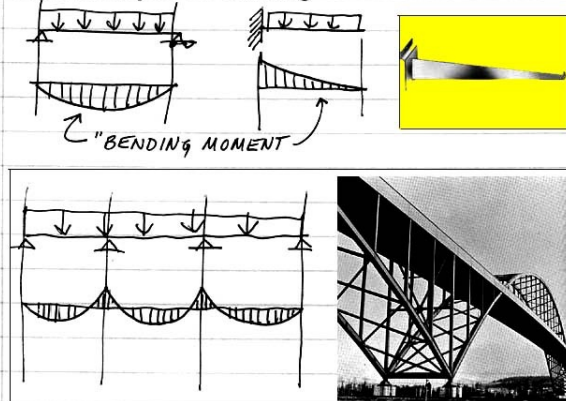
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Cross-sectional shapes for bending

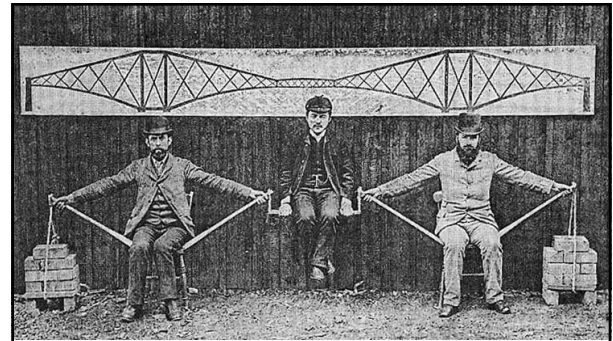


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Overall shapes for bending

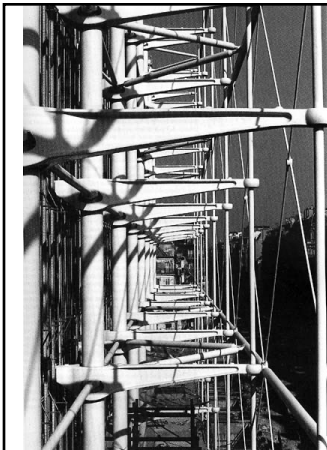


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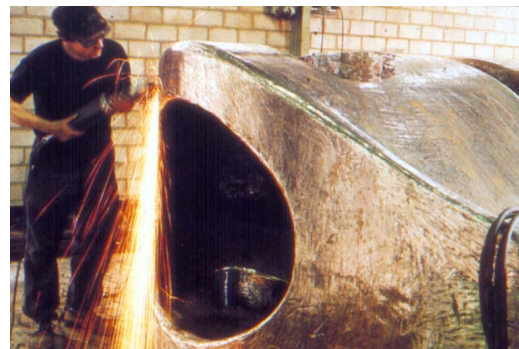
Forth Bridge, Scotland, John Fowler and Benjamin Baker, 1883-90

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Piano and Rogers
(Peter Rice - Ove Arup,
Engineers), Pompidou
Center, Paris, 1977

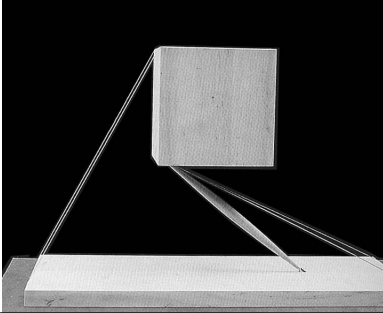
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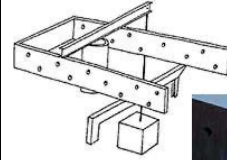
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III. Axial force structures

Long-span, "funicular," heroic structures

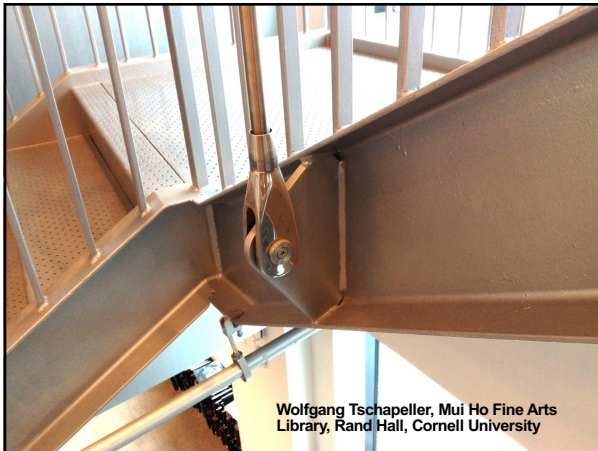


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Koolhaas, Villa in Bordeaux (Balmond)

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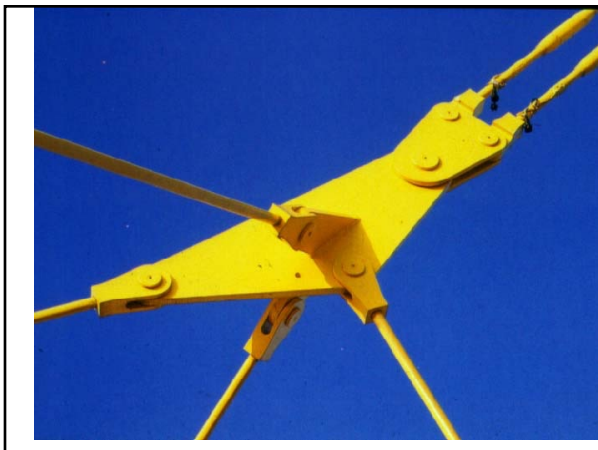
Wolfgang Tschapeller, Mui Ho Fine Arts Library, Rand Hall, Cornell University

57

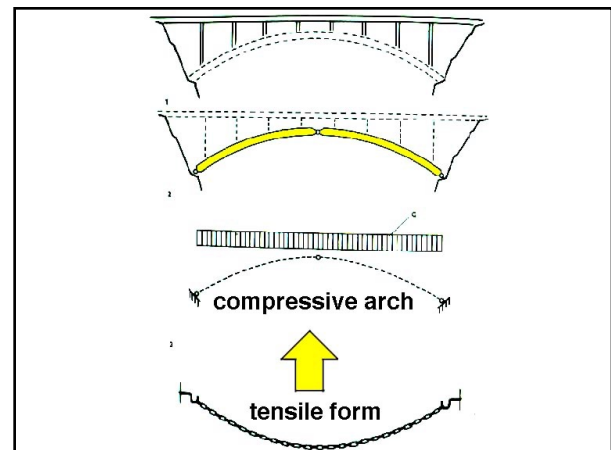


Grimshaw and Partners, Igus Headquarters and Factory, Cologne, 1992

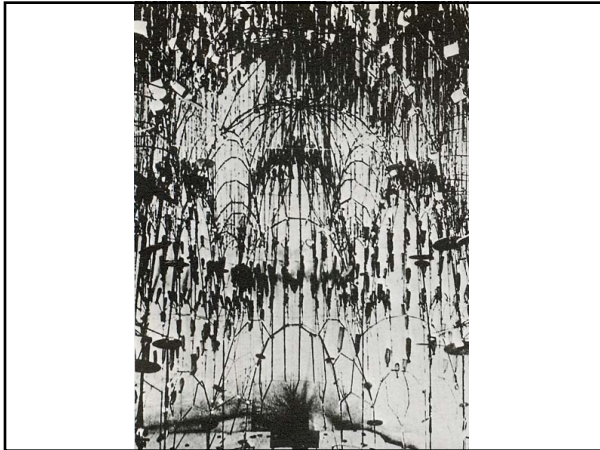
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Gaudi, Cripta de la Colònia Güell, Barcelona, 1908–1914

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Eero Saarinen, Gateway Arch, St. Louis, 1947 competition (1961-66)

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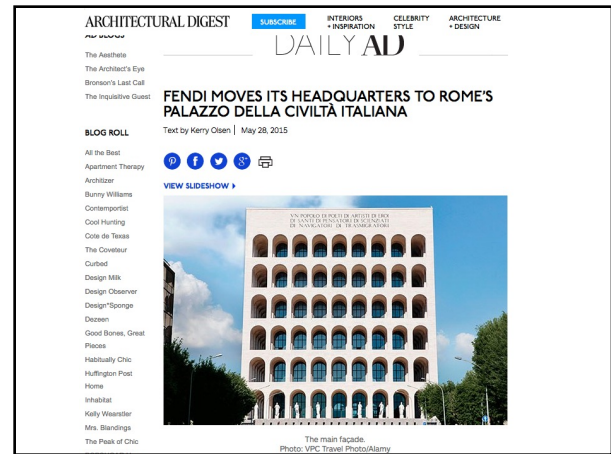


Auguste Perret, Esders Factory, Paris, 1919

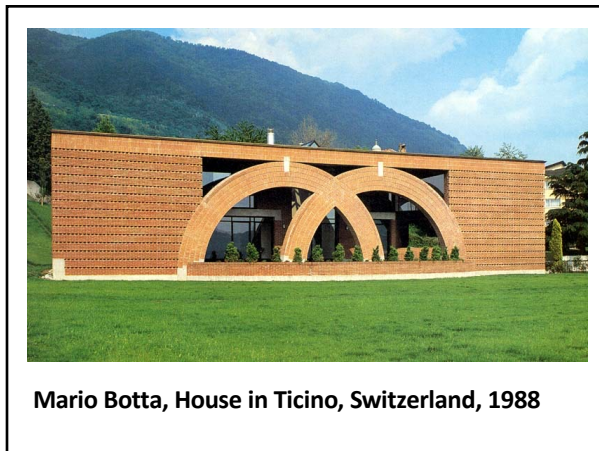
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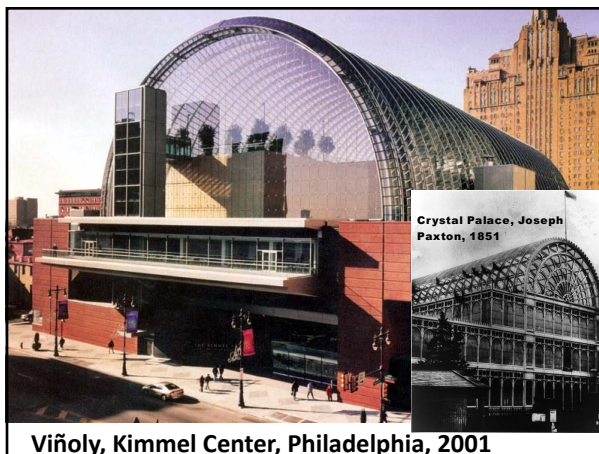
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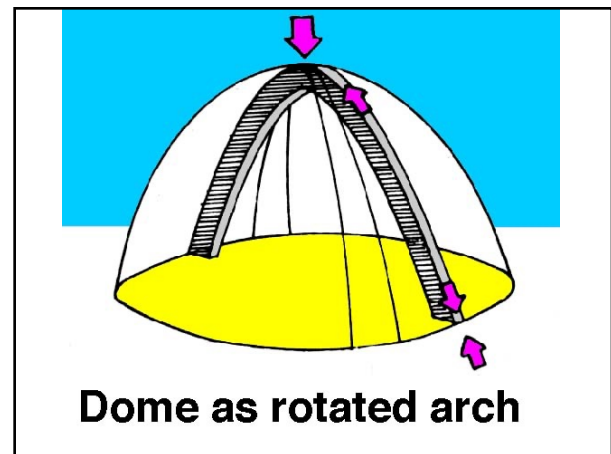
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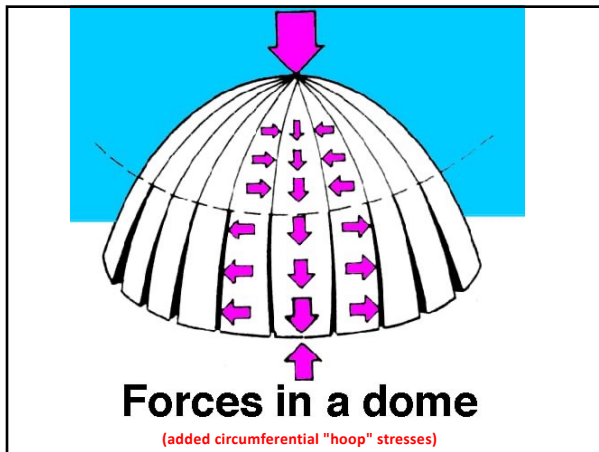
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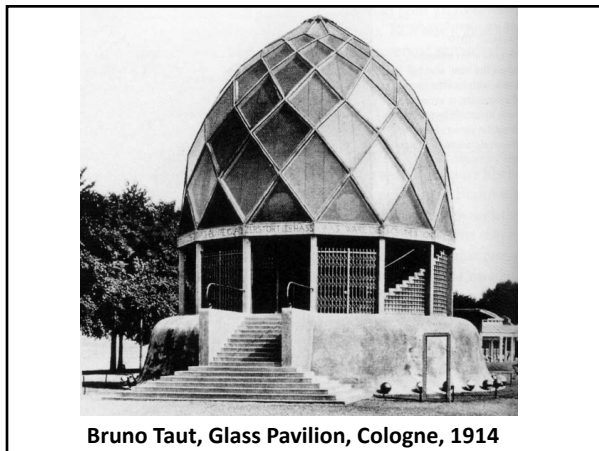
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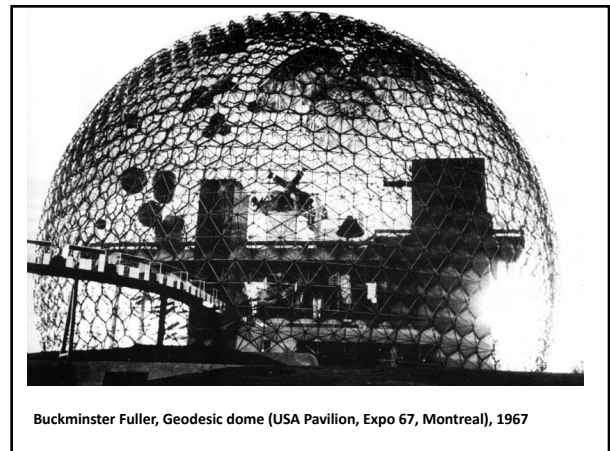
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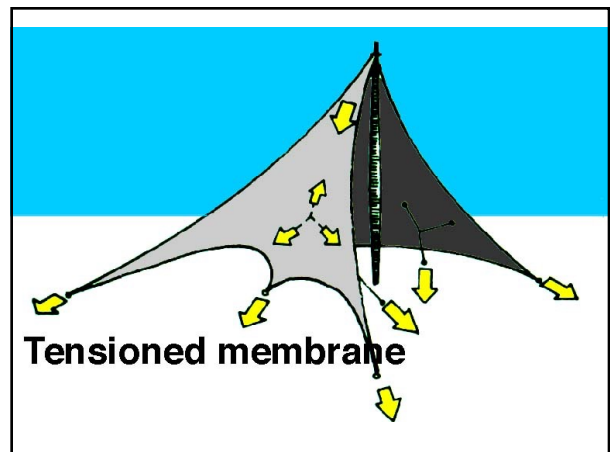
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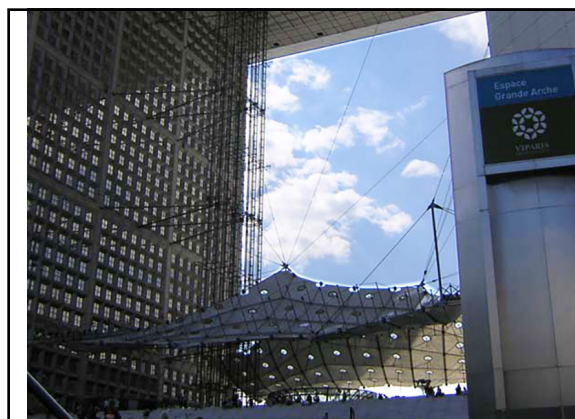


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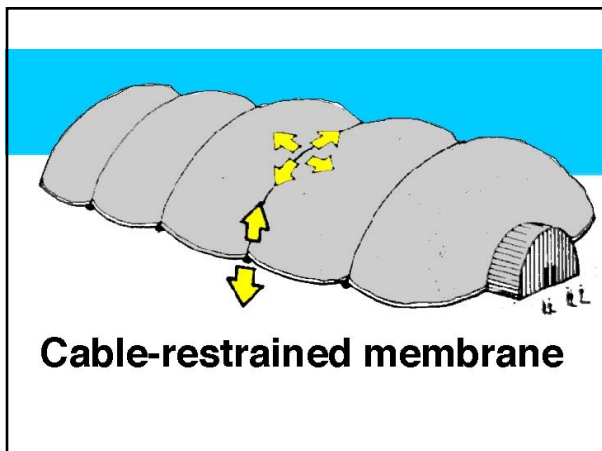
Tents: Frei Otto, Munich Olympics, 1968-72

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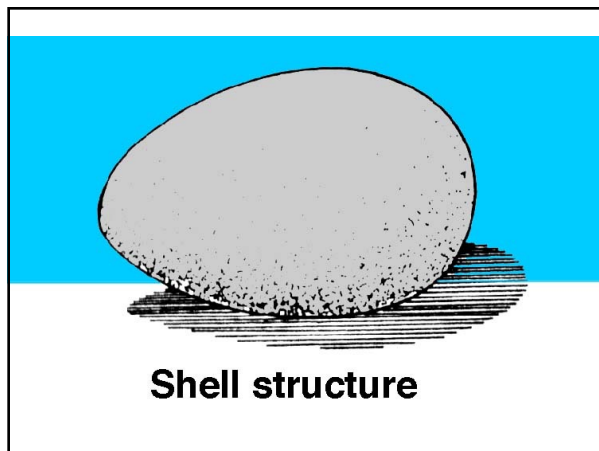


La Grande Arche, Johann Otto von Spreckelsen; La Défense, Paris (1989)

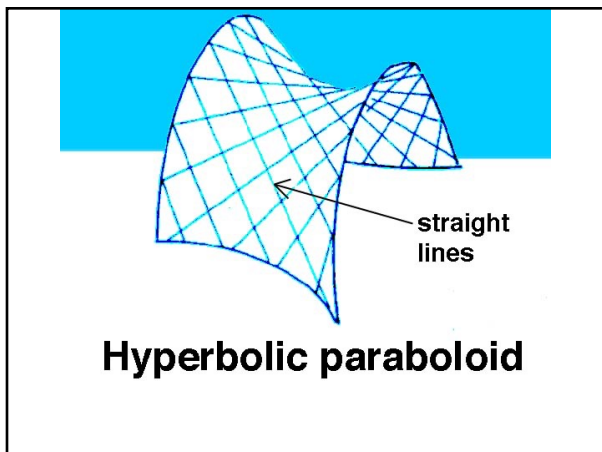
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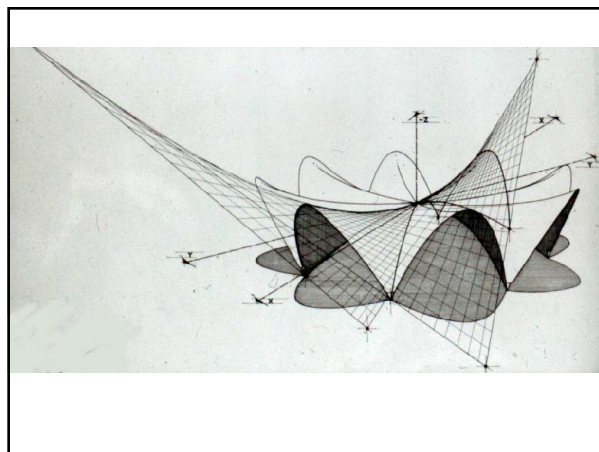
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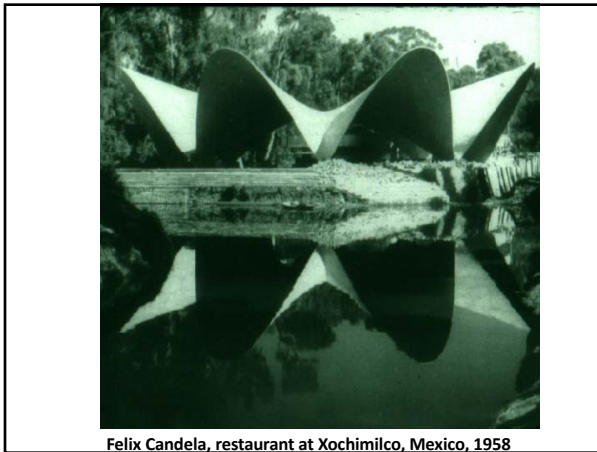
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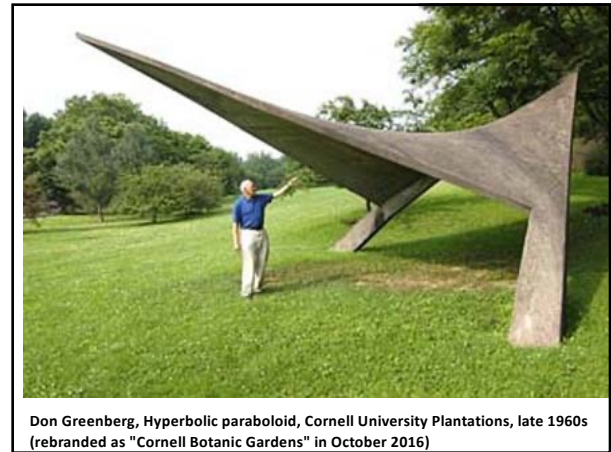
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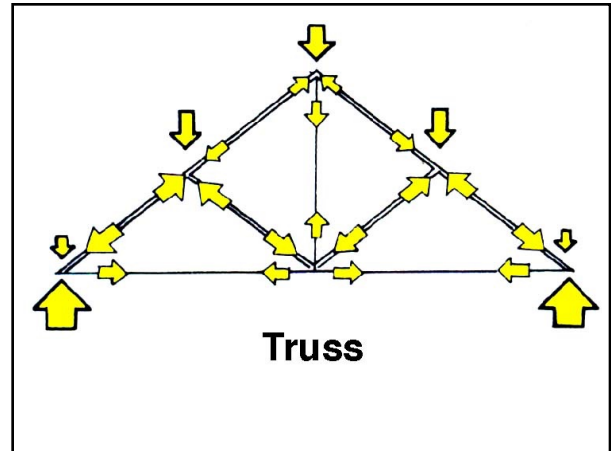
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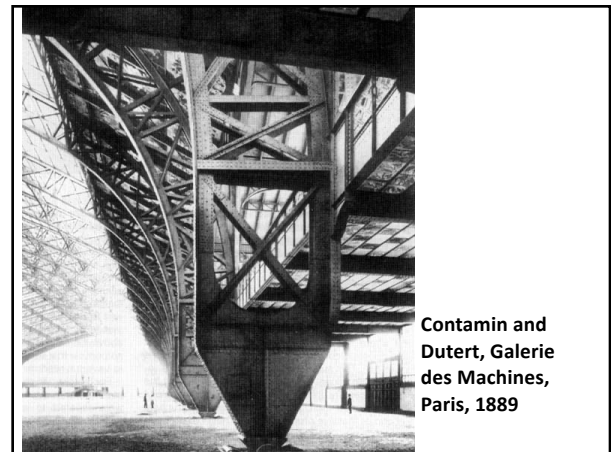
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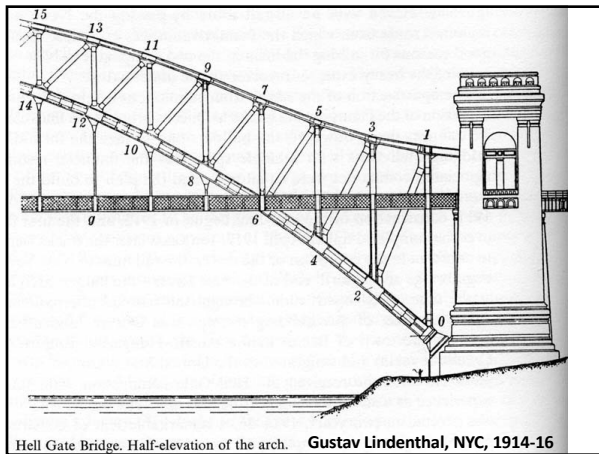
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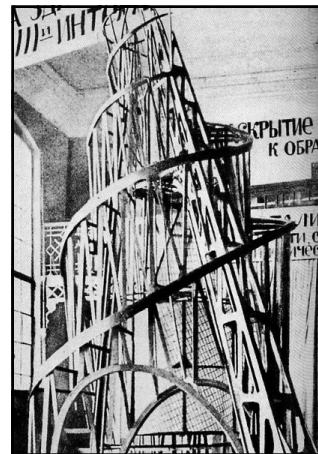


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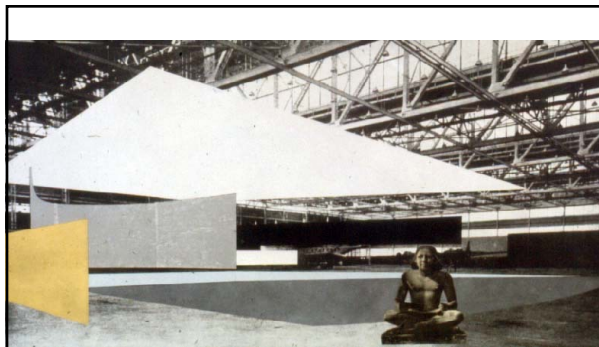
Hell Gate Bridge. Half-elevation of the arch. **Gustav Lindenthal, NYC, 1914-16**

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Vladimir Tatlin, Monument to the Third International, 1919-20

92



Mies van der Rohe, Concert Hall Project, 1942 (Glenn Martin collage); Albert Kahn, Glenn Martin Assembly Building, Baltimore, 1937

93



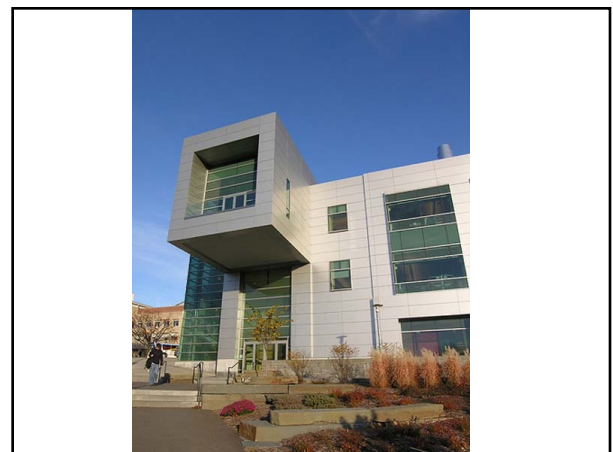
Alvar Aalto, Saynatsalo Town Hall, 1952

94



Zimmer Gunsul Frasca, Duffield Hall, Cornell University, 2004

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96



<http://www.aap.cornell.edu/milstein/>

97



Michael
Hopkins, House,
London, 1977

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99

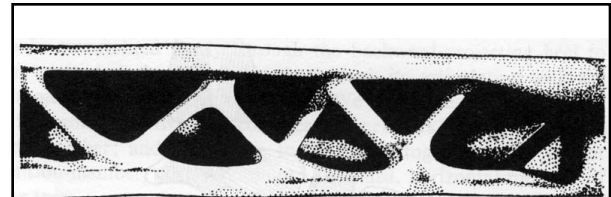


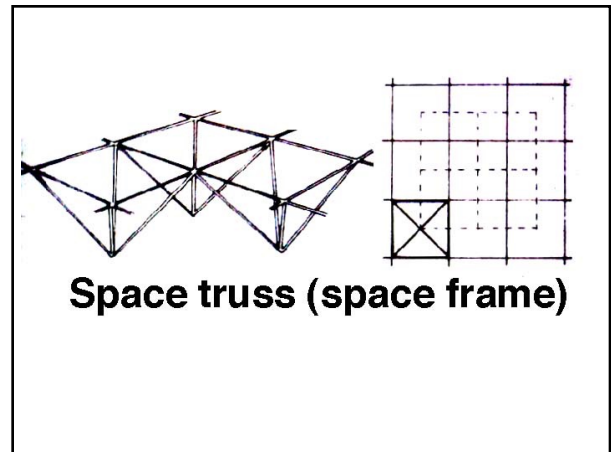
Fig. 103. Metacarpal bone from a vulture's wing; stiffened after the manner of a Warren's truss. From O. Prochnow, *Formenkunst der Natur*.

(From D'Arcy Thompson's *On Growth and Form*, 1917)

100



101

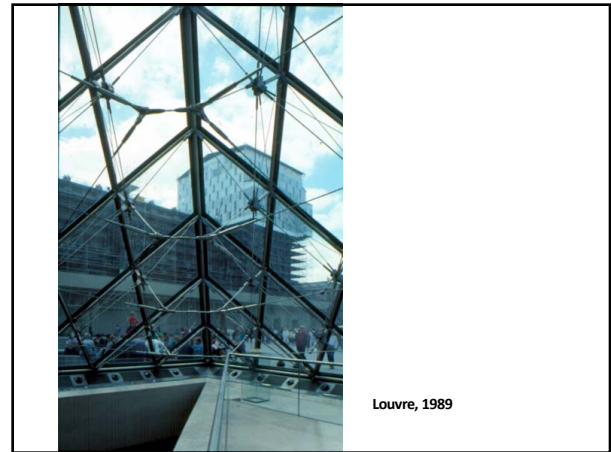


Space truss (space frame)

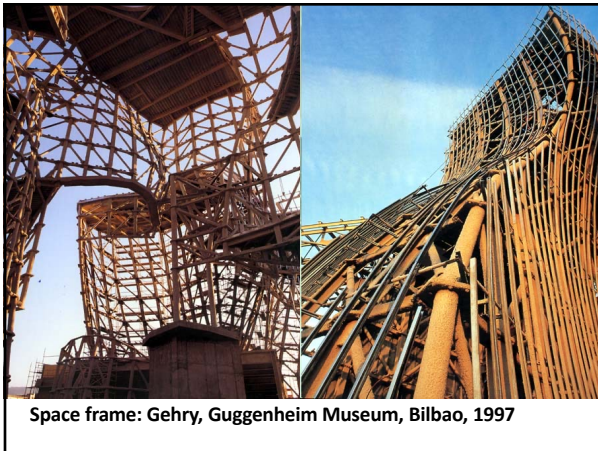
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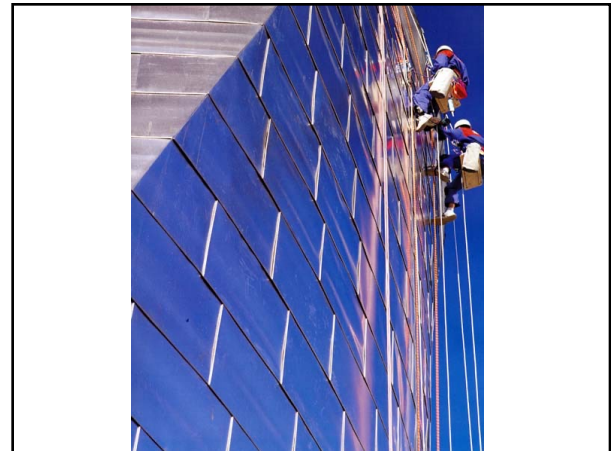
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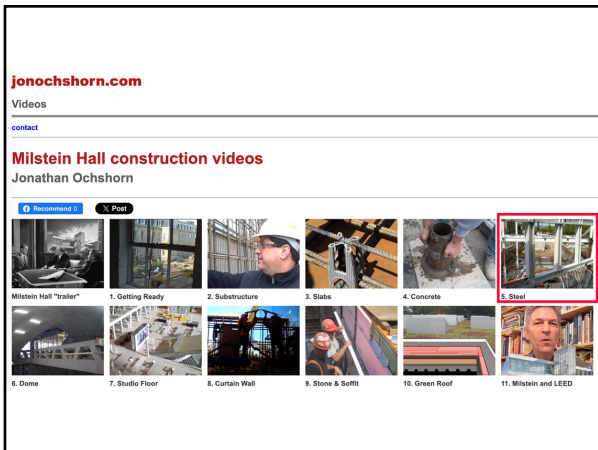
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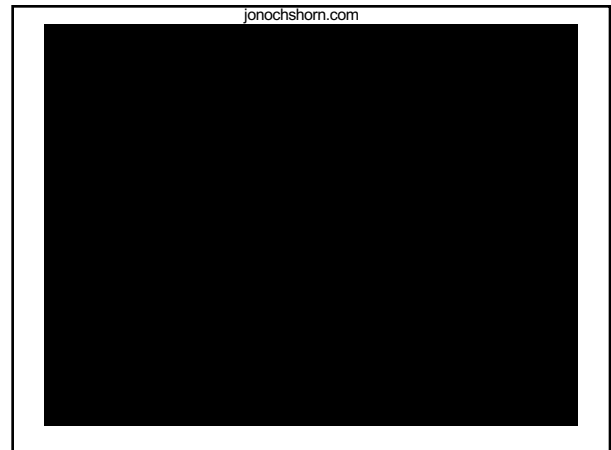
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