

ELEMENTS OF ARCHITECTURAL STRUCTURES:
FORM, BEHAVIOR, AND DESIGN

ARCH 614

DR. ANNE NICHOLS

SPRING 2013

lecture
seventeen

steel construction:
trusses, decks & plate girders



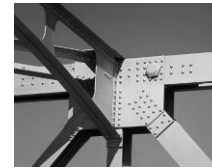
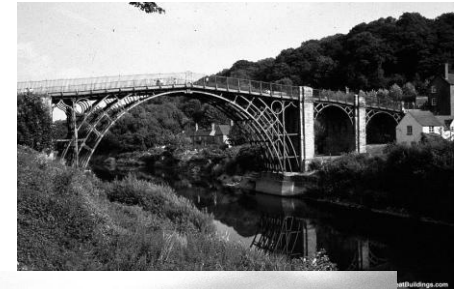
Steel Trusses 1
Lecture 17

Elements of Architectural Structures
ARCH 614

S2009abn

Iron & Steel Trusses

- cast iron
 - 18th century
 - chain links
- wrought-iron
- rivets



<http://nisee.berkeley.edu/godden>

Steel Trusses 2
Lecture 17

Elements of Architectural Structures
ARCH 614

S2009abn

Truss Connections

- gusset plates
- bolts
- welds



<http://courses.civil.ualberta.ca>

Steel Trusses 3
Lecture 17

(AISC - Steel Structures of the Everyday)

Elements of Architectural Structures
ARCH 614

S2009abn

Trusses

- require lateral bracing
- consider buckling
- indeterminate trusses
 - extra members
 - solvable with statics
 - cables can't hold compression
 - displacement methods
 - elastic elongation
 - too few members, unstable



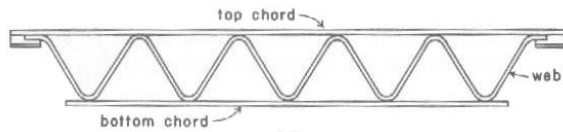
Steel Trusses 4
Lecture 17

Elements of Architectural Structures
ARCH 614

S2007abn

Manufactured Trusses

- open web joists
- parallel chord



SECTION THRU JOISTS SHOWING FLANG TYPE



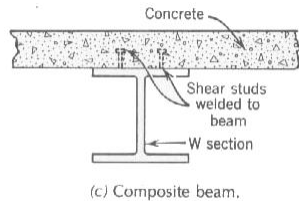
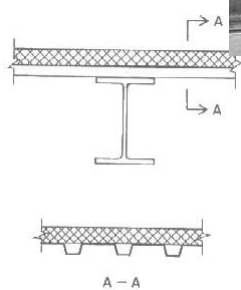
Steel Trusses 5
Lecture 17

Elements of Architectural Structures
ARCH 614

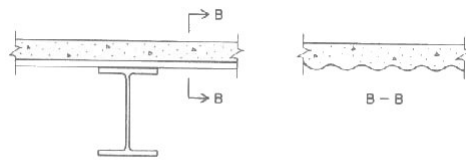
S2007abn

Decks

- sheet steel
- composite



(c) Composite beam.



(b)

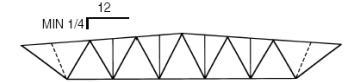
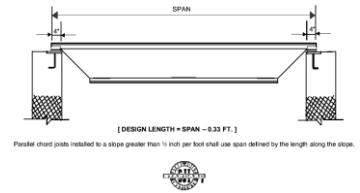
Steel Trusses 7
Lecture 17

Elements of Architectural Structures
ARCH 614

S2007abn

Open Web Joists

- SJI: www.steeljoist.com
- Vulcraft: www.vulcraft.com
 - K Series (Standard)
 - 8-30" deep, spans 8-50 ft
 - LH Series (Long span)
 - 18-48" deep, spans 25-96 ft
 - DLH (Deep Long Spans)
 - 52-72" deep, spans 89-144 ft
 - SLH (Long spans with high strength steel)
 - pitched top chord
 - 80-120" deep, spans 111-240 ft



Steel Trusses 6
Lecture 17

Elements of Architectural Structures
ARCH 614

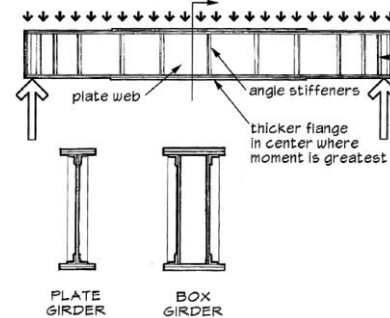
S2007abn

Plate Girders

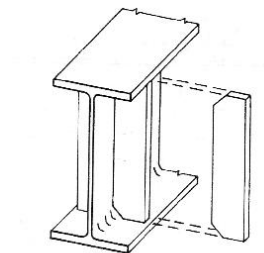
- welds
- web stiffeners



<http://nisee.berkeley.edu/godden>



stiffeners at end where shear is greatest and at support



stiffeners to prevent lateral buckling

Steel Trusses 8
Lecture 17

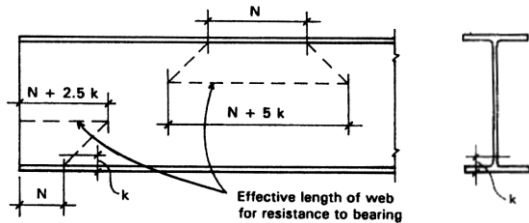
Elements of Architectural Structures
ARCH 614

Web Bearing

- max loads

$$P_{n(max-end)} = (N + 2.5k) F_y t_w$$

$$P_{n(max-interior)} = (N + 5k) F_y t_w$$



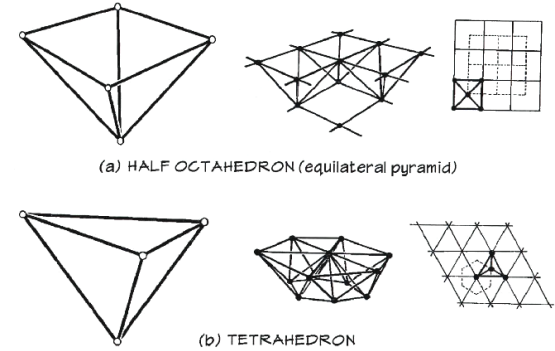
Steel Trusses 9
Lecture 17

Elements of Architectural Structures
ARCH 614

S2007abn

Space Trusses

- 3D with 2 force bodies and pins
 - pyramid
 - tetrahedron
- “frames” have fixed joints
- layers
- 40’s



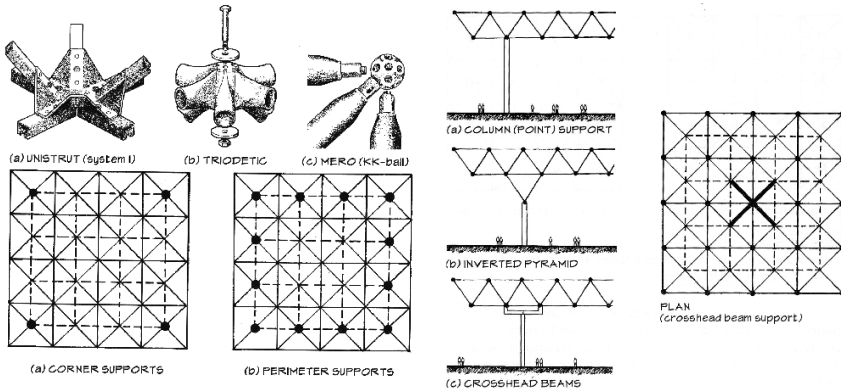
Steel Trusses 10
Lecture 17

Elements of Architectural Structures
ARCH 614

S2007abn

Space Trusses

- connections
- supports

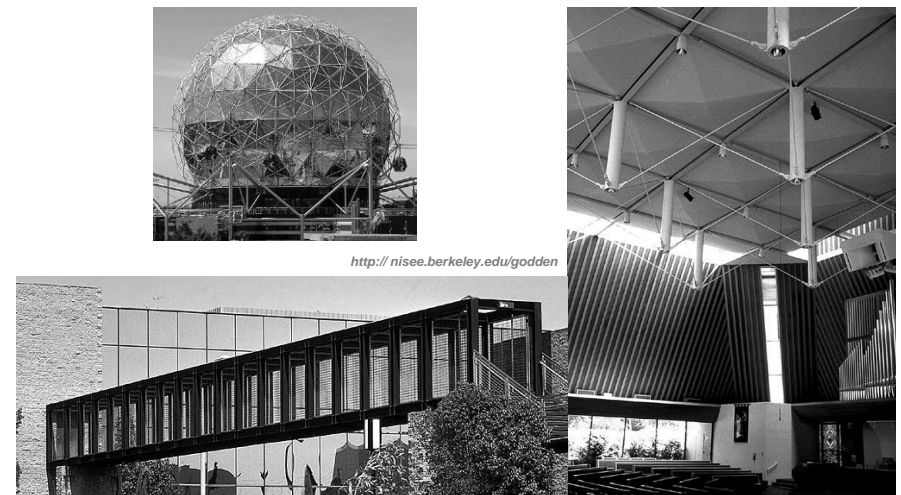


Steel Trusses 11
Lecture 17

Elements of Architectural Structures
ARCH 614

S2007abn

Space Trusses



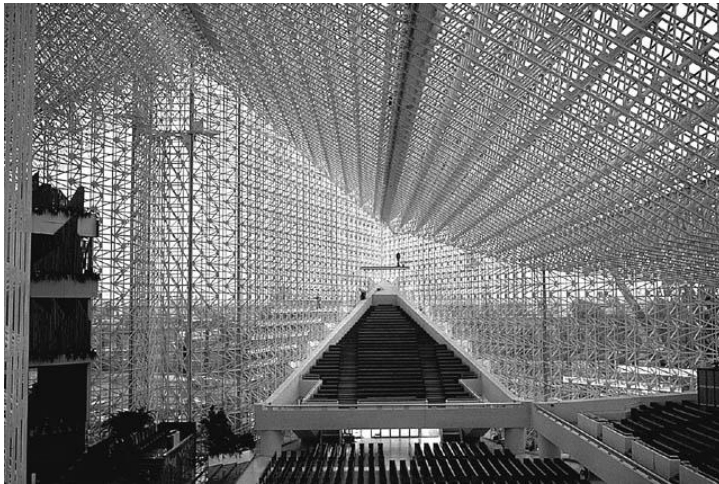
<http://nisee.berkeley.edu/godden>

Steel Trusses 12
Lecture 17

Elements of Architectural Structures
ARCH 614

S2007abn

Space Trusses



Steel Trusses 13
Lecture 17

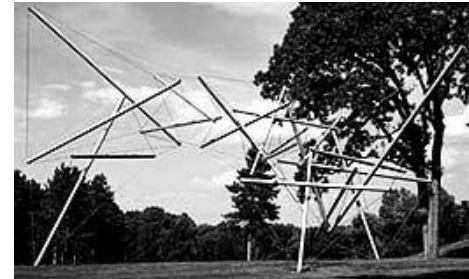
Elements of Architectural Structures
ARCH 614

<http://nisee.berkeley.edu/godden>

S2007abn

Tensegrities

- 3D frame
- discontinuous struts
- continuous cables



Free Ride Home – Kenneth Snelson

Steel Trusses 14
Lecture 17

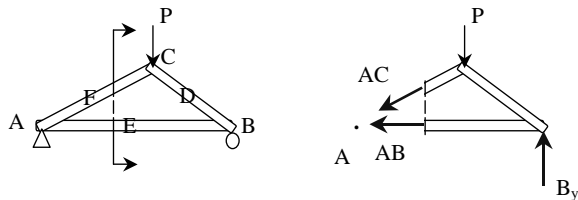
Elements of Architectural Structures
ARCH 614



S2007abn

Method of Sections

- relies on internal forces being in equilibrium on a section
- cut to expose 3 or less members
- coplanar forces $\rightarrow \sum M = 0$ too



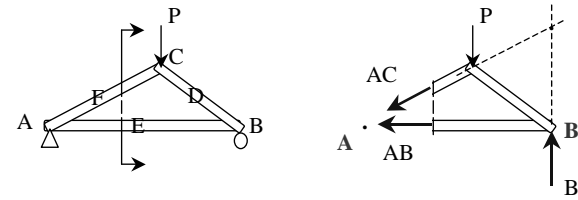
Steel Trusses 15
Lecture 17

Elements of Architectural Structures
ARCH 614

S2007abn

Method of Sections

- joints on or off the section are good to sum moments
- quick for few members
- not always obvious where to cut or sum



Steel Trusses 16
Lecture 17

Elements of Architectural Structures
ARCH 614

S2007abn