Steel Trusses 1
Lecture 19

Architectural Structures: Form, Behavior, and Design

ARCH 331
Dr. Anne Nichols
Fall 2013

lecture
nineteen

steel construction:
trusses, decks & plate girders
Iron & Steel Trusses

• cast iron
  – 18th century
  – chain links
• wrought-iron
• rivets
Truss Connections

- gusset plates
- bolts
- welds

(AISC - Steel Structures of the Everyday)

http://courses.civil.ualberta.ca
Trusses

- require lateral bracing
- consider buckling
- indeterminate trusses
  - extra members
    - diagonal tension counters
  - solvable with statics
    - cables can’t hold compression
  - displacement methods
    - elastic elongation
  - too few members, unstable
Manufactured Trusses

- open web joists
- parallel chord
Open Web Joists

- **SJL**: [www.steeljoist.com](http://www.steeljoist.com)
- **Vulcraft**: [www.vulcraft.com](http://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
Load Tables - \( w \)

### Load for Live Load Deflection Limit (L/360)

#### Based On A 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)

<table>
<thead>
<tr>
<th>Joist Designation</th>
<th>10K1</th>
<th>12K1</th>
<th>12K3</th>
<th>12K5</th>
<th>14K1</th>
<th>14K3</th>
<th>14K4</th>
<th>14K6</th>
<th>16K2</th>
<th>16K3</th>
<th>16K4</th>
<th>16K5</th>
<th>16K6</th>
<th>16K7</th>
<th>16K9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (in.)</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Approx. Wt (lbs./ft.)</td>
<td>5.0</td>
<td>5.0</td>
<td>5.7</td>
<td>7.1</td>
<td>5.2</td>
<td>6.0</td>
<td>6.7</td>
<td>7.7</td>
<td>5.5</td>
<td>6.3</td>
<td>7.0</td>
<td>7.5</td>
<td>8.1</td>
<td>8.6</td>
<td>10.0</td>
</tr>
<tr>
<td>Span (ft.)</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

**load for live load deflection limit (L/360) in RED total in BLACK**
Decks

- sheet steel
- composite
Light-gage Steel

- **sheet metal**
  - shaped
  - studs, panels, window frames
- **gage**
  - based on weight of 41.82 lb/ft² / inch of thickness
  - 24, 22, 18, 16, i.e.
  - 0.0239, 0.0329, 0.0474, 0.0598 in
  - 0.6, 0.85, 1.0, 1.3, 1.6 mm

http://nisee.berkeley.edu/godden
Steel Decks

- "Texas" style
  - corrugated
- common
  - 1 – 3 spans
  - can be insulated
  - composite
    - with concrete
Steel Decks

- **common fire proofing**
  - cementitious spray
  - composite concrete

- **non-composite**
  - concrete is fill

- **lateral bracing**

- **diaphragm action**
Load Tables - \( w \)

- **live load**
- **deflection limit**
  \( L/240 \)

### VERTICAL LOADS FOR TYPE 1.5B

<table>
<thead>
<tr>
<th>No. of Spans</th>
<th>Deck Type</th>
<th>Max. SD Const. Span</th>
<th>Allowable Total (Dead + Live) Uniform Load (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5'0</td>
<td>5'6</td>
</tr>
<tr>
<td>1</td>
<td>B 24</td>
<td>4'8</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>B 22</td>
<td>5'7</td>
<td>91</td>
</tr>
<tr>
<td></td>
<td>B 21</td>
<td>6'0</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>B 20</td>
<td>6'5</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>B 19</td>
<td>7'1</td>
<td>139</td>
</tr>
<tr>
<td></td>
<td>B 18</td>
<td>7'8</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td>B 16</td>
<td>8'8</td>
<td>206</td>
</tr>
<tr>
<td>2</td>
<td>B 24</td>
<td>5'10</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>B 22</td>
<td>6'11</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>B 21</td>
<td>7'4</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>B 20</td>
<td>7'9</td>
<td>132</td>
</tr>
<tr>
<td></td>
<td>B 19</td>
<td>8'5</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td>B 18</td>
<td>9'1</td>
<td>174</td>
</tr>
<tr>
<td></td>
<td>B 16</td>
<td>10'3</td>
<td>219</td>
</tr>
<tr>
<td></td>
<td>B 24</td>
<td>5'10</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>B 22</td>
<td>6'11</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>B 21</td>
<td>7'4</td>
<td>147</td>
</tr>
</tbody>
</table>

**Steel Trusses 12**
**Lecture 19**
**Architectural Structures**
**ARCH 331**
**F2013abn**
Plate Girders

- welds
- web stiffeners

http://nisee.berkeley.edu/godden
Web Bearing

- max loads

\[
P_{n(\text{max-end})} = (N + 2.5k)F_y t_w
\]

\[
P_{n(\text{max-interior})} = (N + 5k)F_{yw} t_w
\]
Space Trusses

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

- connections
- supports

(a) UNISTRUT (System 1)
(b) TRIODETIC
(c) MERC (KK-ball)

(a) CORNER SUPPORTS
(b) PERIMETER SUPPORTS
(c) CROSSHEAD BEAMS

(a) COLUMN (POINT) SUPPORT
(b) INVERTED PYRAMID

PLAN (crosshead beam support)
Space Trusses

http://nisee.berkeley.edu/godden
Space Trusses
Tensegrities

- 3D frame
- discontinuous struts
- continuous cables
Method of Sections

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

![Diagram of Method of Sections]