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

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

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Truss Connections

- gusset plates
- bolts
- welds
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

#### STANDARD LOAD TABLE FOR OPEN WEB STEEL JOISTS, K-SERIES

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>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>
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<tr>
<td></td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
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<td>500</td>
<td>500</td>
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<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</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

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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</th>
<th>Deck</th>
<th>Max. SDI Const.</th>
<th>Allowable Total (Dead + Live) Uniform Load (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type</td>
<td>Span</td>
<td>5'-0</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>
Plate Girders

- welds
- web stiffeners

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Stiffeners at end where shear is greatest and at support

Thicker flange in center where moment is greatest

Plate web

Angle stiffeners

Plate girder

Box girder

Stiffeners to prevent lateral buckling
Web Bearing

- max loads

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

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

- 3D with 2 force bodies and pins
  - pyramid
  - tetrahedron

- “frames” have fixed joints

- layers

- 40’s
Space Trusses

- connections

(a) UNISTRUT (system U)
(b) TRIODETIC
(c) MERC (KK-ball)

- supports

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

(c) CROSSHEAD BEAMS

(a) CORNER SUPPORTS
(b) PERIMETER SUPPORTS

PLAN
(crosshead beam support)
Space Trusses

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Space Trusses
Tensegrities

- 3D frame
- discontinuous struts
- continuous cables

Free Ride Home – Kenneth Snelson
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
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