Structural Loads

- gravity acts on mass \( (F=m\cdot g) \)
- forces
  - acts at a point
    - ie. joist on beam
  - acts along a “line”
    - ie. floor on a beam
  - acts over an area
    - ie. people, books, snow on roof or floor

Load Tracing

- how loads are transferred
  - usually starts at top
  - distributed by supports as actions
  - distributed by tributary areas
Load Tracing

- **tributary load**
  - think of water flow
  - “concentrates” load of area into center

\[
w = \left( \frac{\text{load}}{\text{area}} \right) \times (\text{tributary width})
\]

Load Tracing

**Alamillo Bridge**
Calatrava 1992

Load Paths

(a) FBD—decking.
(b) FBD—joists.
(c) FBD—beams.
(d) FBD—girder.

Patcenter
Rogers 1986

Figure 3.5: Patcenter, load path diagram.

Figure 3.12: Alamillo bridge, load path diagram.
Load Paths

• wall systems

• openings & pilasters

• foundations

• deep foundations
Concentrated Loads

- statically determinate beam supports
  - simple
  - overhang
  - cantilever

Distributed Loads

- continuous beams
  - statically indeterminate
  - floors
**Equivalent Force Systems**

- replace forces by resultant
- place resultant where $M = 0$
- using calculus and area centroids

$$W = \int_0^L w \, dx = \int dA_{\text{loading}} = A_{\text{loading}}$$

**Area Centroids**

- Table 7.1 – pg. 242

<table>
<thead>
<tr>
<th>Shape</th>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangular area</td>
<td>$b/3$</td>
<td>$h/3$</td>
</tr>
<tr>
<td>Quarter-circular area</td>
<td>$ar$</td>
<td>$ar$</td>
</tr>
<tr>
<td>Semicircular area</td>
<td>$0$</td>
<td>$ar/3$</td>
</tr>
<tr>
<td>Semi-parabolic area</td>
<td>$3a/8$</td>
<td>$3a/8$</td>
</tr>
<tr>
<td>Parabolic area</td>
<td>$0$</td>
<td>$3a/8$</td>
</tr>
</tbody>
</table>

**Load Areas**

- area is width x “height” of load
- $w$ is load per unit length
- $W$ is total load