Bicycle Railing Heights
(Everything you wanted to know about design guidelines but were afraid to ask)

Scott Lewendon
Rob Leslie
Clough Harbour & Associates
Problem Statement

- Recommended railing height was 54 inches raised numerous complaints:
  - Sight obstruction
  - High cost
  - Aesthetics

- 1999 - AASHTO Guidelines for Bicycle Facilities recommends (“should”) 42 inch height

- AASHTO Guidelines for Bridges requires (“shall”) 54 inch height
National Cooperative Highway Research Program (NCHRP)

- Basis for Heights
- Literature Search
- Preference Survey
- Investigate Accidents
- Recommendations
The Survey

- Internet based
  - State DOT Bicycle Coordinators and Structural Engineers
  - Advocacy Groups
  - APBP

- Height Preference and Why?
- Issues related to railing height?
- Knowledge of accident records?
- Knowledge of specific accidents?
Survey Findings

- 43% of advocacy groups prefer a 1.1-meter (42-inch) railing height.
- 46% of state bicycle coordinators and bridge designers prefer a 1.1-meter (42-inch) railing height.
- Remainder evenly divided between 54” and “other”
Height Issues

- Obstructs viewshed
- Obstructs sight distance
- Aesthetics of a trail or bridge
- Creates a feeling of confinement
  - No escape from an assault
- Greater expense
- Sense of safety
  - Falling
  - Strong cross winds
Obstruction of View

Eye Level Height

Cone of Vision Angle

65.4 inches

Railing Height

3-inches
# Eye Height vs. Railing Height

<table>
<thead>
<tr>
<th></th>
<th>Average Eye Level Height (in.)</th>
<th>Difference from 42” rail (in.)</th>
<th>Difference from 54” rail (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Male</td>
<td>65.4</td>
<td>23.4</td>
<td>11.4</td>
</tr>
<tr>
<td>Adult Female</td>
<td>61.5</td>
<td>19.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Child - 12 yrs.</td>
<td>54.5</td>
<td>12.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Cost
(per meter)

- **Bicycle Railing**
  - Pipe railing $110 to $150
  - Wood Railing $63 to $70
  - Chain Link Fence $55

- **Vehicular Railing**
  - Vehicular Railing $270
  - Vehicular/Pedestrian Railing $350
  - Vehicular/Bicycle Railing $475
## Crash Experience

<table>
<thead>
<tr>
<th>Country</th>
<th>Location</th>
<th>Height</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>Roadway Bridge</td>
<td>&lt;1.1 m</td>
<td>Bicyclist hit by overtaking vehicle and fell over railing</td>
</tr>
<tr>
<td>U.S.</td>
<td>Roadway Bridge</td>
<td>&lt;1.1 m</td>
<td>Bicyclist fell over bridge vehicular railing. (Cause unknown)</td>
</tr>
<tr>
<td>G.B.</td>
<td>Roadway Bridge</td>
<td>&lt;1.1 m</td>
<td>Bicyclist veered off course due to slippery surface and fell over railing</td>
</tr>
<tr>
<td>U.S.</td>
<td>Roadway Bridge</td>
<td>N/A</td>
<td>Motor vehicle collided with two bicyclists who were thrown over railing</td>
</tr>
<tr>
<td>U.S.</td>
<td>Roadway Bridge</td>
<td>1m+/-</td>
<td>Collided with obstruction and fell over railing</td>
</tr>
<tr>
<td>U.S.</td>
<td>Shared use path</td>
<td>1.4 m</td>
<td>Bicyclist traveling too fast lost control and vaulted over bridge structure</td>
</tr>
<tr>
<td>G.B.</td>
<td>Shared use path</td>
<td>N/A</td>
<td>Single vehicle incident. Details unknown</td>
</tr>
<tr>
<td>Can.</td>
<td>Shared use path</td>
<td>1.4 m</td>
<td>Bicyclist collided with bridge structure (did not collide with railing)</td>
</tr>
<tr>
<td>Can.</td>
<td>Shared-use Path</td>
<td>None</td>
<td>Bicyclist collided with pedestrian and fell path of motor vehicle traffic</td>
</tr>
</tbody>
</table>
Bicycle Railing Crash Lessons Learned

- Greatest threat – Low vehicular railings on bridges
- Most crashes occurring on roadway bridges or shared use paths on bridges
- Bicycle accident surveillance systems do not record road conditions
- One crash related to vaulting over a 54 inch railing
Bicyclist Center of Gravity

C.G. 41.9"

50th Percentile

C.G. 45.9"

85th Percentile

David Orr – Texas A&M University

Source: Orr, TTI
Bicyclist Center of Gravity

50th Percentile Cyclist
- C.G. 51.24"

95th Percentile Cyclist
- C.G. 54.89"

Source: Orr, TTI

David Orr – Texas A&M University
1.2 Meter (48 inch) High Railing

- Bicycle facility immediately adjacent to the edge of a highway bridge.
- Where a bicyclist may fall over a railing into the path of oncoming traffic.
- A bikeway bridge with a drop off of 0.6 meters (2 feet) or greater
- A shared use path adjacent to a hazard where the bicyclist would could be severely injured
Golden Gate Bridge
1.4 Meter (54 inch) High Railing

- On a shared use path or the approach to a bridge where the radius of a curve adjacent to a hazard is not adequate for the anticipated speed.

- On a shared use path where inadequate sight distance or large volume of users could cause a bicyclist to take evasive action and collide with a railing at a sharp angle.

- On a shared use path or bridge at the end of a long descent where speeds of bicyclists are greater.
Higher Railing Needed
Railing Used as a Physical Barrier
Railing Used as a Physical Barrier
Transparency
Railing Setback
Cantilevered Top Rail

1 ½” sq. steel tube painted black
2” x 6” cedar rail
4” x 4” steel tube painted black
2” x 2” woven wire mesh screen in 1 ½ sq. steel frame

Effective Height

Section

Elevation
Lessons Learned

- In a litigious society, guidelines are dictating design
- Guidelines are often based on best judgment at the time – not science
- Guidelines are guidelines, not standards
- Deviation from guidelines should be documented
- Good design requires flexibility
- Use experienced professionals