Bicycle and Pedestrian Level of Service Measures

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Outline

- Why consider bike/peds in road designs?
  Why are measures needed?
- Bicycle Level of Service / Pedestrian Level of Service overviews, uses
- Policy possibilities
- Resources - including easy-to-use on-line calculator
Why should road designs accommodate bikes & peds?

- It’s what people want:
  - 53% want more fed $ on bike facilities, even if it means less gas tax for roads
  - 50% support requiring roads to have bike lanes or paths, even if it means less space for cars and trucks
  - Most bicycling takes place on roads, not separate trails.
  - 52% bike trips for recreation, 43% to get to destinations.

- Context-sensitive design
Why should road designs accommodate bikes & peds?

- Arterials and collectors provide the only access, especially in newer, non-grid areas.
Why should road designs accommodate bikes & peds?

- Encourage diversion of short trips, for health, environment, less congestion
- Provide for the many who don’t drive for economic, age, other reasons
Why should road designs accommodate bikes & peds?

- Bikes/peds will be there to some extent anyway, so better to design for them.
Bike/ped performance measures - why?

- “Accommodating bike/ped” a common goal, but very subjective
- Bicyclists’ needs especially tough to know for those lacking experience, training
- Other transportation goals (air quality, congestion) have performance measures
- Mainstream bike/ped planning
Bicycle Level of Service
Pedestrian Level of Service

- Both models developed by Sprinkle Consulting Inc., used throughout USA
- Research based on perception of comfort, safety for range of adults
- Both based on roadway corridor cross-sections and traffic conditions
- Numeric result, grade ranges “A” (best) to “F” (worst)
Bicycle Level of Service

- Measures on-road bicycling conditions, NOT separate trails!
- For mid-block cross-sections, not for intersections
- Applicable for teen and adult cyclists
BLOS input variables

- **Motorized traffic:** Volume, Speed, % Trucks, % Occupied Parking

- **Roadway:** # of Lanes, pavement condition, width of outside lane and extra pavement (shoulder/parking/bike lanes)
BLOS model

Bicycle LOS = 0.507 \ln(Vol_{15}/L) + 0.199 \ SP_t \ (1+10.38HV)^2
+ 7.066(1/PR_5)^2 - 0.005 \ We^2 + 0.760

Vol_{15} = volume of directional traffic in 15 minute time period
L = total number of through lanes
SP_t = effective speed limit = 1.1199 \ln(SP_p - 20) + 0.8103, SP_p is posted speed
HV = percentage of heavy vehicles
PR_5 = FHWA’s 5-point surface condition rating (5=best)
We = average effective width of outside through lane = W_t + W_l - \Sigma W_r
W_t = total width of outside lane and shoulder/parking pavement
W_l = width of paving from outside lane stripe to pavement edge
\Sigma W_r = width reduction due to encroachments in outside lane
# BLOS Levels

<table>
<thead>
<tr>
<th>Level-of-Service</th>
<th>BLOS Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>( \leq 1.5 )</td>
</tr>
<tr>
<td>B</td>
<td>( &gt;1.5 ) and ( \leq 2.5 )</td>
</tr>
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</tr>
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<tr>
<td>F</td>
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Sample street

- ADT = 12,000 vehicles/day
- Two 12’ lanes
- No paved shoulders, bike lanes, parking
- 40 mph speed limit
- $P_{R_5} = 4$ (good pavement)

- BLOS Score = 4.1 (D)
# Lane Width and Striping

Extra space benefits cyclists

- Striping particularly helpful

<table>
<thead>
<tr>
<th>Outside lane width</th>
<th>With striping</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>4.36 (D)</td>
</tr>
<tr>
<td>12</td>
<td>4.14 (D)</td>
</tr>
<tr>
<td>14</td>
<td>3.88 (D)</td>
</tr>
<tr>
<td>12 - 2</td>
<td>3.58 (D)</td>
</tr>
<tr>
<td>16</td>
<td>3.58 (D)</td>
</tr>
<tr>
<td>12 - 4</td>
<td>2.86 (C)</td>
</tr>
<tr>
<td>18</td>
<td>3.24 (C)</td>
</tr>
<tr>
<td>12 - 6</td>
<td>1.98 (B)</td>
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Lane Width and Striping
Pedestrian Level of Service

- Walkers’ perception of comfort and safety
- Mid-block cross-sections, including any sidewalks and buffers
PLOS input variables

- **Motorized traffic**: Volume; Speed; % Occupied Parking
- **Roadway**: # of Lanes; width of outside lane; width of extra pavement (shoulder/parking/bike lanes)
- **Sidewalk**: Width; buffer width and type (e.g., tree spacing)
PLOS model

Pedestrian LOS = -1.227 \ln(W_{ol} + W_1 + f_P \times \%OSP + f_b \times W_b + f_{SW} \times W_S) + 0.009 \left(\frac{Vol_{15}}{L}\right) + 0.0004 \text{ SPD}^2 + 6.046

\begin{align*}
W_{ol} &= \text{width of outside lane} \\
W_1 &= \text{width from outside lane stripe to pavement edge (shoulder, parking, bike lanes)} \\
f_P &= \text{on-street parking effect coefficient} \\
\%OSP &= \text{percent of segment with on-street parking} \\
f_b &= \text{buffer area barrier coefficient} \\
W_b &= \text{buffer width (between edge of pavement and sidewalk)} \\
f_{SW} &= \text{sidewalk presence coefficient} \\
W_S &= \text{width of sidewalk} \\
Vol_{15} &= \text{volume of directional traffic in 15 minute time period} \\
L &= \text{total number of through lanes} \\
\text{SPD} &= \text{average running speed of traffic}
\end{align*}
## PLOS Levels

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Sample cases
Sample cases

- ADT = 12,000 vehicles/day; Speed = 40 mph
- Two 12’ lanes; No paved shoulders, bike lanes, parking

- No sidewalk:  **PLOS = 5.03 (E)**
- 5’ sidewalk, 6’ buffer, no trees:  **PLOS = 3.53 (D+)**
- 5’ sidewalk, 20’ buffer, no trees:  **PLOS = 3.17 (C)**
- 5’ sidewalk, 6’ buffer, trees every 40’:  **PLOS = 3.16 (C)**
BLOS, PLOS Applications

- Pick routes for community bike network
- Identify “weak links” in bike or ped network
BLOS, PLOS Applications

- Prioritize sites needing improvement
- Evaluate alternate treatments during design - providing flexibility to engineers
BLOS, PLOS Applications

- Develop a suitability map to help with route selection
BLOS, PLOS as policy tools

- Performance measures can be tied to goals and policies for all road projects
- Policies can range from simply reporting bike/ped impact up to target LOS levels
3 levels of increasing policy commitment

1) Raise awareness: calculate and report before-and-after BLOS and PLOS

2) Provide incentive: include measures in road project selection

3) Policy requirement: meet a certain BLOS/PLOS level
Calculate and report before-and-after scores

- Each project proposal includes BLOS and PLOS - report scores in TIP?
- Use simple on-line calculator form
- Raises awareness of project impact, easy to do
Use as incentive during road project selection

- In selection criteria or formulas, include BLOS and PLOS terms
- Credit (or discredit) for post-project scores, and/or before-to-after change
- Terms could be weighted by simple demand-side criteria or other analysis
Policy requirement examples

- New roads & roads requiring ROW acq: BLOS of “C” or better, “B” or better in areas of higher demand. PLOS similar.
- All projects: maintain or improve scores - Do NOT worsen conditions!
On-line BLOS/PLOS calculator

www.bikelib.org/roads/blos/losform.html

First, enter data into form

| Through lanes per direction, (Default = 1) | 1 |
| Width of outside lane, to outside stripe, in ft, (Default = 12) | 2 |
| Paved shoulder or bikeway, outside lane stripe to pavement edge, in ft, (Default = 0) | 4 |
| Bi-directional Traffic Volume, in ADT, (Default = 12000) | 2000 |
| Posted speed limit in mph, (Default = 40) | 40 |
| Percentage of heavy vehicle, (Default = 3) | 3 |
| FHWA's pavement condition rating, (5 = Best, 1 = Worst, Default = 4) | 4 |
| Percentage of road segment with occupied on-street parking, (Default = 0) | 0 |
| Percentage of segment with sidewalks, (0 - 100, default = 100) | 100 |
| Sidewalk width, in ft, (Default = 5) | 5 |
| Sidewalk buffer/parkway width, in ft, (Default = 10) | 10 |
| Buffer/parkway average tree spacing, in ft, (Default = 80, 0 for no tree) | 80 |
On-line BLOS/PLOS calculator

www.bikelib.org/roads/blos/losform.html

Then, result window pops up with scores
Other Resources

- Bicycle LOS: Landis et al., TRB 1578
  Pedestrian LOS: Landis et al, TRB 1773 Sprinkle Consulting - 813-949-7449
- www.bicyclinginfo.org and www.walkinginfo.org (Pedestrian and Bicycle Information Center)