PEDESTRIAN SAFETY

ATNI Transportation Committee

15th Annual Northwest Tribal Transportation Symposium

April 14, 2009

By: Kayloe Dawson, BIA-NWRO-DOT
A little about my background

- Involved with 5 Pedestrian Design Projects at the NWRO (see case history’s)
  - School Loop Road, Redesign
  - Niederman Sidewalk
  - SR106 Sidewalk
  - Skokomish Tribal Center Road
  - Port Gamble Admin Site Design

- Background in hydrology / stormwater. Now Engineer in Training, EIT

- Interest in integrated design of automobile, pedestrian, bicyclist, landscaping, and stormwater facilities
OUTLINE

- Intro and Context
- Regulations
- Basic Elements
- NWRO Case Stu
- Integrated Appr

03/2006: Pedestrian on Niederman Road, Chehalis
I.R. (Photo by KTD)
INTRO AND CONTEXT
Sidewalks “reduce the incidence of pedestrian collisions, injuries, and deaths in residential areas and along two-lane roadways”

“Sidewalks should be built and maintained in all urban areas, along non-interstate public highway rights-of-way, in commercial areas where the public is invited, and between all commercial transportation stops and public areas”

- ITE, Technical Council Committee (5A-5, 1998)
Intro and Context

What do streets do? “Functional Classification”

Street Purposes Not Always Compatible
• e.g. Capacity Versus Access.
• Ped Facilities more compatible with high access facilities
• from the balance of purposes: Local & Collectors would emphasize pedestrians more than arterials
Intro and Context

**Ped Safety = f(Vehicle Speed, ... )**

- Traffic Speed usually the most critical factor to walkability and pedestrian safety.
- Most streets designed to encourage higher speeds, volumes, motor-vehicle efficiency.
- Wider Streets, shallow curves, good safety delineation encourage higher speeds.
- More ped accidents occur in urban areas, but a higher percentage of fatalities in rural areas.

Ped Safety = f(Street Width, ...)

Narrower streets are slower and safer.

Longmont, CO study of 20,000 accidents found street width had the greatest relationship to injury accidents.

Accidents/mile/year were higher on wider streets:
- 40-foot wide street 2.23 a/m/y
- 36-foot wide street 1.21 a/m/y
- 24-foot wide street 0.32 a/m/y

What is Required?

THE REGULATIONS
The Regulations

**ADA + Guidelines of the AHJ**

1990, Americans with Disabilities Act
- Ensures people with disabilities have equal opportunity and access to public spaces.
- Covered {impaired mobility, vision, cognitive skills}
- Requires barriers be identified in existing infrastructure and priority placed for high use areas
- All new construction or retrofit projects must meet ADA requirements

Designing Sidewalks and Trails for Access, USDOT, FHWA

Design and Safety of Pedestrian Facilities, Institute of Traffic Engineers

Guide for Planning, Design, and Operation of Pedestrian Facilities, American Association of State Highway and Transportation Officials

Local, State requirements of the AHJ (authority having jurisdiction)
## Compiled Tables of Design Guidelines

*Table 4-1: Grade, Cross-Slope, and Curb Height Guidelines by Functional Class of Roadway (based on information contained in AASHTO, 1995)*

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Maximum Grade(%)¹ Level/Rolling/Mountain</th>
<th>Cross-Slope²(%)</th>
<th>Curb Height (mm)</th>
<th>Sidewalk Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban local</td>
<td>Consistent with terrain &lt;15.0/&lt;8.0²</td>
<td>1.5–6.0⁴</td>
<td>100–225</td>
<td>Commercial both sides Residential at least one side</td>
</tr>
<tr>
<td>Rural local</td>
<td>8.0/11.0/16.0</td>
<td>1.5–6.0⁴</td>
<td>n/a</td>
<td>n/a⁵</td>
</tr>
<tr>
<td>Urban collector</td>
<td>9.0/12.0/14.0</td>
<td>1.5–3.0</td>
<td>150–225</td>
<td>Same as Urban local</td>
</tr>
<tr>
<td>Rural collector</td>
<td>7.0/10.0/12.0</td>
<td>1.5–3.0</td>
<td>n/a</td>
<td>n/a⁵</td>
</tr>
<tr>
<td>Urban arterial</td>
<td>8.0/9.0/11.0</td>
<td>1.5–3.0</td>
<td>150–225</td>
<td>n/a⁵</td>
</tr>
<tr>
<td>Rural arterial</td>
<td>5.0/6.0/8.0</td>
<td>1.5–2.0</td>
<td>n/a</td>
<td>n/a⁵</td>
</tr>
<tr>
<td>Recreational</td>
<td>8.0/12.0/18.0</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a⁵</td>
</tr>
</tbody>
</table>

### The Regulations

**Compiled Tables of Design Guidelines**

#### Table 4-2.1: Federal Accessibility Guidelines for Accessible Routes

<table>
<thead>
<tr>
<th>Source</th>
<th>Maximum Allowable Running Grade without Handrails</th>
<th>Maximum Grade with Handrails and Level Landings</th>
<th>Maximum Allowable Running Cross-Slope</th>
<th>Minimum Clearance Width</th>
<th>Maximum Allowable Vertical Change in Level</th>
<th>Minimum Allowable Vertical Clearance (Overhead)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADA Standards for Accessible Design ¹ (US DOJ, 1991)</td>
<td>5.0 ²</td>
<td>8.33 ²</td>
<td>9.1</td>
<td>2.0</td>
<td>0.915³</td>
<td>6⁴</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.030</td>
</tr>
<tr>
<td>UFAS (US DoD, et al., 1984)</td>
<td>5.0 ²</td>
<td>8.33 ²</td>
<td>9.1</td>
<td>2.0</td>
<td>0.915³</td>
<td>6⁴</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.030</td>
</tr>
</tbody>
</table>

#### Table 4-3.1: Federal Accessibility Guidelines for Curb Ramps (CR)

<table>
<thead>
<tr>
<th>Source</th>
<th>Maximum Slope of Curb Ramps</th>
<th>Maximum Cross-Slope of Curb Ramps</th>
<th>Maximum Slope of Flared Sides</th>
<th>Minimum Ramp Width</th>
<th>Minimum Landing Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADA Standards for Accessible Design ¹ (US DOJ, 1991)</td>
<td>8.33², ³</td>
<td>2.0</td>
<td>10.0⁴, ⁵</td>
<td>0.915⁶</td>
<td>0.915</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UFAS (US DoD, et al., 1984)</td>
<td>8.33², ³</td>
<td>2.0</td>
<td>10.0⁴, ⁵</td>
<td>0.915⁶</td>
<td>0.915</td>
</tr>
</tbody>
</table>

Source: http://www.fhwa.dot.gov/environment/sidewalks/chap4b.htm
‘Pedestrian Facilities’

BASIC ELEMENTS
Basic Elements

Site Design “Broad Scale”

Multiple paths for emergency response vehicles (narrower streets ok), encourages slower driving due to cross-traffic, more walkable

Basic Elements

“Street Scale”
Pedestrian Level Car Queuing Road

Promotes “good friction” – decreases vehicle speeds, leap frog (works with grid Network for emergency vehicles
On-street parking, sidewalks both sides
Vegetation (pedestrian amenity, shade- urban heat island affect, stormwater)

• 74% of ROW devoted to Peds,
• 40% criteria per Michael Ronkin
Basic Elements

“Street Scale” with limited parking demand

- 66% of ROW devoted to Peds,
- 40% criteria per Michael Ronkin

On-street parking only on one side, sidewalks both sides
Basic Elements

“Street Scale” with limited ROW

• 54% of ROW devoted to Peds,
• 40% criteria per Michael Ronkin

No on-street parking (good if limited parking demand, or ROW)
Basic Elements

“Detail” Driveways

Problem…
Need Level Landing to Negotiate. Flare max slope (~10%) is >> than 2% cross-slope req. by ADA.

Back of Curb Solution

Green Strip Solution if ROW available

Source: http://www.fhwa.dot.gov/environment/sidewalks/chap4b.htm
Basic Elements

“Detail” Curb Ramp

Problem...
Again, a level landing is needed to adequately negotiate the corner and to access the ramp from the street.

Solution
Furniture strip allows for level landing.

Source: http://www.fhwa.dot.gov/environment/sidewalks/chap4b.htm
Basic Elements

“Detail” Crossings

Problem... Pedestrian Hidden by Parked Car, full width crossing

Solution... Curb Extension

... Mid-Block Crossing

Source: http://www.fhwa.dot.gov/environment/sidewalks/chap4b.htm
Basic Elements

“Detail” Geometric Grade

Problem: Excessive Slope Differences (gutter to ramp) can cause wheel chairs to tip forward or backward

Solution: Ensure rate of change in slope is less than 13% (this means less than 4.7% gutter-road cross slope if an 8.3% ramp)

Source: http://www.fhwa.dot.gov/environment/sidewalks/chap4b.htm
‘Recent NWRO Projects’

CASE STUDIES
Sheet 5 Excerpt from Final Plan Set:
**Shows Connectivity to Existing Development, New Pedestrian Facilities / Ammenities**
Deficiencies:

- Pedestrians mix with traffic,
- Speeding (anecdotal @ 45 mph)
- 28’ Traveled Way (wide if 25mph limit)
- Poor access control,
- Poor drainage on west side of road,
- Utility conflicts

Project:

- 6 ft sidewalk separated from traffic (6-18’), defined crosswalks,
- 1-2’ narrowed road,
- Defined driveways,
- Defined drainage, few curbs,
- Design fits with existing utility infrastructure
Niederman Road

Post Analysis – Comments – Lessons Learned:

**The Good**
- Primary deficiencies in pedestrian safety corrected, meets ADA requirements and AASHTO guidelines
- Amenities such as bus shelter, trash cans, benches, grass make Niederman more comfortable, appealing, and useful to pedestrians

**The Not-So-Good**
- The project doesn’t appear to be effective at decreasing overall travel speeds
  - Add edge striping to define a 20’ width travel way,
  - Add friction elements: on-street parking, street trees, curbed islands to further decrease speeds and enhance pedestrian feel ($$$$$$$$$$$)
- Swale section did not allow for traffic separation from existing light pedestals within clear zone.
- 31% of developed ROW devoted to pedestrian facilities -which includes swale, (40% needed per Michael Ronkin Criteria)
- Public comments- “Why (sidewalk) only on one side?” Future development (near and distant) would dictate sidewalks on both sides at N end.
Sidewalk - East Side: Improve Connectivity
Possibly add intervals of 2-3 car on-street parking:
Parking Benefit, Adds Friction

Street Trees, Landscaping:
Traffic Calming, Aesthetics

Sheet 5 Excerpt from Final Plan Set:
Future Safety Improvements Based on Post Analysis
Quileute Indian Reservation

School Loop Road

Deficiencies:

• Challenging alignment constraints
• Pedestrians mix with traffic,
• Wide expanses of pavement
• Obstacles in clear zone (light pole)
• Poor access control,
• Confusing signage

Project:

• 6 ft sidewalk separated from traffic by traffic curb
• Protected utility pole
• Defined driveways, drainage
• Clear and consistent signage and pavement markings

PEDESTRIAN SAFETY
Quileute Indian Reservation

School Loop Road

Deficiencies:

- Challenging alignment constraints
- Tight corner - Limited Sight Distance, Pinch Point for Pedestrians on Road
- School Zone

Project:

- Curb and sidewalk provides defined pedestrian space separated from traffic according to standard user expectancies,
- Curb and sidewalk provide protection for head start building.

PEDESTRIAN SAFETY
Quileute Indian Reservation

School Loop Road

Deficiencies:

• Uncontrolled intersection at shallow angle on private ROW and in school zone

Project:

• Realigned intersection at 90 degrees to School Loop Road
• Intersection control provided with stop sign, stop bar, crosswalk, ADA ramps, detectable warnings
• Clear and consistent signage and pavement markings
Post Analysis – Comments – Lessons Learned:

**The Good**
- Primary deficiencies in pedestrian safety corrected by realignment, addition of sidewalk, traffic curb, signage, crosswalks, ADA ramps
- Local drainage issues addressed with infiltration facilities, curb, gutter, storm pipe
- Motorist safety improved by protecting (2) light poles, and (1) building (headstart) through
  - realignment which decreased horizontal curve radii to minimums (AASHTO- local street) to better direct traffic away from existing obstacles (buildings, utility poles),
  - addition of traffic curbs, clear pavement markings.

**The Not-So-Good**
- 19% of built ROW devoted to PED facilities (40% Michael Ronkin criteria). On-street parking, west side sidewalk recommended to reach 40% criteria.
- Un-defined parking areas and pedestrian facilities to the west side of the street were not improved.
Deficiencies:

- Challenging alignment constraints
- Pedestrians mix with traffic,
- Wide expanses of pavement
- Obstacles in clear zone (light pole)
- Poor access control,
- Confusing signage

Project:

- 6 ft sidewalk separated from traffic by traffic curb
- Curbed island, object marker protect utility pole
- Defined driveways, drainage
- Clear and consistent signage and pavement markings
Deficiencies:

- Challenging alignment constraints
- Pedestrians mix with traffic,
- Wide expanses of pavement
- Obstacles in clear zone (light pole)
- Poor access control,
- Confusing signage

Project:

- 6 ft sidewalk separated from traffic by traffic curb
- Curbed island, object marker protect utility pole
- Defined driveways, drainage
- Clear and consistent signage and pavement markings
**NE Sandy Green Street**
(13<sup>th</sup>-47<sup>th</sup> Avenues)

### Goals
- Bike-ped-driver safety & convenience
- Neighborhood connections
- Business access
- Transit safety/convenience
- Landscaping/stormwater mgmt.
- Community identity

### Core Recommendations
- Curb ramps & extensions
- Control turning movements
- Reduce impervious surface
- Pedestrian refuge islands
- Bike parking
- Underground signal controls

### Budget
- $8M
Integrated Approach

Admin Site Design Project _ Port Gamble

Parallel Parking

Perpendicular Parking

Community Area

Connectivity

Transit

Stormwater Treatment

PEDESTRIAN SAFETY
Final Recommendations

Safety Evaluation
1. Define Functional Class of Road, Existing and Future ADT (traffic requirements)
2. Define minimum necessary lane widths and geometry (AASHTO), compare with existing cross-section
3. Measure travel speeds actual, compare with posted values
4. Estimate or Measure Pedestrian, Bicyclist Usage
5. Obtain Accident History
6. Identify trouble spots based on accidents, anecdotal evidence, ADA, and other design guidelines
7. Identify and prioritize solutions to trouble spots

New Facility or Retrofit Design Philosophy
1. Provide only the minimum lane widths to local and collector roads (redevelop towards centerline if necessary) to provide for traffic flow
2. Design system with an integrated approach
   • Address auto, ped, & bike users. Incorporate environmental and other site requirements in an aesthetic and useful manner.