DESIGNING FOR PEDESTRIAN SAFETY

Module 1
Logistics

- Health and safety (emergency exits, procedures for evacuation, etc.)
- Please silence your cell phones/pagers
- Breaks (when, restrooms, snacks)
- Lunch arrangements
- Other site-specific issues
Self Introductions

- Please tell us:
  - Your Name and Title
  - Your employer
  - What is your ONE pedestrian safety issue?
Instructors:

- Peter Eun
  - Transportation Safety Engineer
  - FHWA Resource Center Safety & Design TST
  - peter.eun@dot.gov
  - 360-753-9551

- Dan Nabors
  - Senior Transportation Engineer
  - VHB
  - DNabors@vhb.com
  - 703-847-3071 x 5235
This is a workshop: Expect to do some work!

- Ask questions and issues as you have them
- May be covered in course material or
- Will be placed on the “Park Bench” for later
- Exercises, questions, and discussions — YOU provide the answers!
- Field trip: Assess the situation, apply the principles, and make recommendations
- Identify and prioritize potential policies and procedures

Designing for Pedestrian Safety - Introduction
Designing for Pedestrian Safety Workshop Outcomes

- At the end of this workshop, you will be able to:
- Describe the influence of planning factors: land use, street connectivity, access management, site design, and level of service.
- Describe how pedestrians should be considered and provided for during the planning, design, work zone, maintenance, and operations phases.
- Describe how human behavior affects the interaction between pedestrians and drivers.
- Identify good practices and effective solutions to enhance pedestrian safety and accessibility.
Overview of Pedestrian Safety Problem

- Annually almost 4,500 pedestrians are killed in traffic crashes, representing about 12% of all traffic deaths.
- Nearly 70,000 pedestrians are injured each year.
- Most crashes occur when the pedestrian crosses a road.
- Most fatalities and serious injuries occur on roads designed with little attention for pedestrian safety.
- Pedestrians are less likely to be killed in walkable environments.
Pedestrian Fatalities by Year U.S. Data

Designing for Pedestrian Safety - Introduction
Pedestrian Injuries by Year U.S. Data

Designing for Pedestrian Safety - Introduction
## NY Pedestrian Fatalities

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>STATEWIDE</td>
<td>312</td>
<td>296</td>
<td>311</td>
<td>307</td>
<td>302</td>
<td>272</td>
<td>315</td>
<td>306</td>
<td>294</td>
</tr>
<tr>
<td>Putnam</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Rockland</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Westchester</td>
<td>11</td>
<td>7</td>
<td>5</td>
<td>9</td>
<td>11</td>
<td>7</td>
<td>9</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Bronx</td>
<td>17</td>
<td>28</td>
<td>27</td>
<td>25</td>
<td>22</td>
<td>13</td>
<td>23</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>Brooklyn</td>
<td>41</td>
<td>46</td>
<td>39</td>
<td>44</td>
<td>52</td>
<td>53</td>
<td>43</td>
<td>42</td>
<td>50</td>
</tr>
<tr>
<td>Manhattan</td>
<td>32</td>
<td>30</td>
<td>29</td>
<td>35</td>
<td>38</td>
<td>35</td>
<td>46</td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td>Queens</td>
<td>37</td>
<td>36</td>
<td>43</td>
<td>47</td>
<td>34</td>
<td>26</td>
<td>34</td>
<td>39</td>
<td>36</td>
</tr>
<tr>
<td>Staten Island</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>7</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Nassau</td>
<td>39</td>
<td>19</td>
<td>32</td>
<td>33</td>
<td>27</td>
<td>27</td>
<td>30</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>Suffolk</td>
<td>41</td>
<td>47</td>
<td>34</td>
<td>29</td>
<td>32</td>
<td>29</td>
<td>26</td>
<td>41</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>232</td>
<td>222</td>
<td>225</td>
<td>235</td>
<td>223</td>
<td>202</td>
<td>229</td>
<td>226</td>
<td>222</td>
</tr>
</tbody>
</table>
## NY Pedestrian Injuries

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STATEWIDE</strong></td>
<td>15607</td>
<td>15689</td>
<td>16090</td>
<td>15321</td>
<td>15317</td>
<td>15472</td>
<td>15369</td>
<td>15,795</td>
<td>15,370</td>
</tr>
<tr>
<td>Putnam</td>
<td>15</td>
<td>13</td>
<td>19</td>
<td>17</td>
<td>20</td>
<td>11</td>
<td>19</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Rockland</td>
<td>152</td>
<td>138</td>
<td>158</td>
<td>159</td>
<td>127</td>
<td>119</td>
<td>132</td>
<td>149</td>
<td>135</td>
</tr>
<tr>
<td>Westchester</td>
<td>541</td>
<td>569</td>
<td>580</td>
<td>514</td>
<td>547</td>
<td>551</td>
<td>569</td>
<td>563</td>
<td>537</td>
</tr>
<tr>
<td>Bronx</td>
<td>1589</td>
<td>1403</td>
<td>1821</td>
<td>1703</td>
<td>1729</td>
<td>1726</td>
<td>1645</td>
<td>1,604</td>
<td>1,719</td>
</tr>
<tr>
<td>Brooklyn</td>
<td>3524</td>
<td>3572</td>
<td>3793</td>
<td>3519</td>
<td>3500</td>
<td>3397</td>
<td>3384</td>
<td>3,630</td>
<td>3,472</td>
</tr>
<tr>
<td>Manhattan</td>
<td>2964</td>
<td>2958</td>
<td>2709</td>
<td>2573</td>
<td>2938</td>
<td>3171</td>
<td>3290</td>
<td>2,877</td>
<td>2,894</td>
</tr>
<tr>
<td>Queens</td>
<td>2316</td>
<td>2334</td>
<td>2413</td>
<td>2364</td>
<td>2237</td>
<td>2240</td>
<td>2115</td>
<td>2,354</td>
<td>2,280</td>
</tr>
<tr>
<td>Staten Island</td>
<td>416</td>
<td>393</td>
<td>348</td>
<td>284</td>
<td>318</td>
<td>325</td>
<td>310</td>
<td>386</td>
<td>309</td>
</tr>
<tr>
<td>Nassau</td>
<td>996</td>
<td>981</td>
<td>1000</td>
<td>950</td>
<td>904</td>
<td>904</td>
<td>953</td>
<td>992</td>
<td>919</td>
</tr>
<tr>
<td>Suffolk</td>
<td>559</td>
<td>625</td>
<td>524</td>
<td>572</td>
<td>558</td>
<td>575</td>
<td>540</td>
<td>569</td>
<td>568</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>13072</td>
<td>12986</td>
<td>13365</td>
<td>12655</td>
<td>12878</td>
<td>13019</td>
<td>12957</td>
<td>13,141</td>
<td>12,851</td>
</tr>
</tbody>
</table>
Agenda overview

- Planning factors: land use, street connectivity, access management, site design, and level of service
- Walking along the road: Effectiveness of sidewalks
- Street crossings: Human behavior, midblock crossings, crosswalks, medians, signals, over/under-crossings
- Pedestrian-friendly intersections: Geometry, radii, curb extensions, islands, crosswalks
- Signalized Intersections: Making them better for pedestrians
- Interchanges: Providing pedestrian safety and accessibility
- Roundabouts: Making them work for pedestrians
- Transit: Stop locations & pedestrian crossings
- Road diets: Making room for pedestrians
- Field Exercise: Apply what we have learned
- Policy Discussion – Optional based on time
Why is it important to accommodate pedestrian safety and accessibility?

Because we are all pedestrians
Why?

Because other modes depend on walking
Why?

Because it’s good for business – people walk into stores
Why?

Because pedestrians use and belong on streets and highways.
Why?

Because walking is healthy exercise
Why?

Because it will make roads safer for all road users
Why?

- Myth: Accommodating pedestrians increases liability
- Fact: ignoring a problem increases liability
- A good solution is to identify the problem and have a plan to address it.

“A Circuit Court civil jury … awarded $3.3 million to relatives of a woman killed by a motorist as she walked on a stretch of Pennsylvania Avenue that did not have a sidewalk or guard rails. The jury found the state of Maryland liable in the wrongful death lawsuit, and voted to award $2.5 million to Kayla Martin, the daughter of Kelay Smith, who was struck and killed by a motorist on Aug. 12, 2008.”

—Washington Post; March 11, 2011

- To reduce liability
AASHTO: “Because of the demands of vehicular traffic in congested areas, it is often extremely difficult to make adequate provisions for pedestrians. Yet this should be done, because pedestrians are the lifeblood of our urban areas…”

Why?


Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems.

It’s also been Federal Policy since ISTEA (1991)

U.S. Transportation Secretary
Anthony Foxx
Why?

- USDOT Policy Statement – Actions to integrate non-motorized modes into future projects:
  - Consider walking and bicycling as equals with other transportation modes;
  - Ensure convenient choices for people of all ages and abilities;
  - Go beyond minimum design standards;
  - Collect data on walking and biking trips;
  - Set mode share targets for walking and bicycling;
  - Maintain sidewalks paths, including snow removal;
  - Improve non-motorized facilities during maintenance projects.
Resources

PBIC: www.walkinginfo.org
FHWA: safety.fhwa.dot.gov
NHTSA: nhtsa.dot.gov
ITE: www.ite.org
AASHTO/NCHRP: safety.transportation.org
Highway Safety Manual

- Science-based technical approach for safety analysis

- AASHTO HSM Website:
  - www.highwaysafetymanual.org

- FHWA HSM Website:
  - http://safety fhwa dot gov/hsm/

- TRB Highway Safety Performance Committee Website:
  - www.safetyperformance.org

- FHWA RC HSM Webinar Series
  - http://www.highwaysafetymanual.org/Pages/FHWAResourceCenterHSMWebinarSeries.aspx
Calculating Reduction in Number of Crashes

Crash Modification Factor (CMF): factor used to compute the expected number of crashes after implementing a given countermeasure.

Crash Reduction Factor (CRF): % fewer crashes experienced on a road with a given countermeasure than on similar road without the countermeasure.

Relationship between CMF and CRF:

\[
CMF = 1 - \frac{CRF}{100}\\
CRF = 100 \times (1 - CMF)
\]

CMF/CFR Clearinghouse: [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)
CMF - Important Concepts

- May apply to all crashes, or crash specific subsets (e.g., run-off-road, night, wet weather, multi-vehicle, etc.)

- Same treatment in different contexts or highway types may have different effects and different CMF values
Planning elements that affect pedestrian safety:

- Land Use
- Street Connectivity
- Access Management
- Site Design
- Level of Service
Land Use

Designing for Pedestrian Safety - Introduction
Why do we have cities?

To minimize travel & maximize exchange (to be closer together)
How have we built our urban roadway system?

To facilitate travel over longer distances
Reducing travel demand is best achieved through **Land Use** policies that bring destinations closer together

- The problem:
- Commercial activities concentrated in auto-dominated corridors.
- Segregated land uses
- Result: long travel distances, not conducive to walking

Potential solutions?
1. Allow small-scale retail in neighborhoods
2. Create neighborhood parks
3. Site school closer to residences & parks
Neo-traditional development: destinations are close to residential areas
Street Connectivity

Designing for Pedestrian Safety - Introduction
Connectivity creates a walkable street system by:

- Reducing walking distances;
- Offering more route choices on quiet local streets;
- Dispersing traffic – reducing reliance on arterials for all trips
You live here, your child wants to visit a friend who lives not far away; how do you get there?

Designing for Pedestrian Safety - Introduction

Cul-de-sac patterns increase walking distances & increase reliance on arterials
Can you increase connectivity with paths, greenways?

- Reduces walking distances: YES
- Offers more route choices: YES
- Disperses traffic: NO
- Dedicate R.O.W. to link cul-de-sacs with linear parks
- Land Use & Connectivity: Schools next to parks.
Designing for Pedestrian Safety - Introduction

High Connectivity

Moderate Connectivity

Low Connectivity

Travel Lanes Required
Lack of connectivity => overly wide streets
Lack of connectivity => few but large intersections
Access Management

Every driveway is a potential conflict
Drivers and pedestrians must make choices:
- Walk in front or in back? Pull forward or back up?
Access Management => fewer conflicts at driveways
2 techniques: (1) median (no left turns) (2) consolidate driveways
Which has greater crash reduction factor: (1) Median (no left turns) or (2) consolidate driveways?
Driveways can be closed for safety
Severing public streets not a desirable access management technique.

Available crossings and movements before access control

Available crossings and movements after access control

Non-traversable barrier

Possible bicyclist and pedestrian movement

This limits people’s ability to walk or bicycle
Connecting severed streets reestablishes walking routes
Severed street can be reconnected for pedestrians
Site Design

Designing for Pedestrian Safety - Introduction
Bringing Buildings closer to the Street

- Creates a street where drivers know to expect pedestrians
Parking between sidewalk and building is not pedestrian-friendly
Designing for Pedestrian Safety - Introduction

Building at back of walk: pedestrian-oriented design

Designing for Pedestrian Safety - Introduction
Fast food typically favors drive-thru over walk-ins
Pedestrians must cross drive-thru lane
Alternative design: Direct pedestrian access is provided with no vehicular conflicts
Parking and drive through are still provided
Even a gas station / convenience store can be built with pedestrian friendly design, at back of walk
Pedway retrofitted from sidewalk to building through parking

Accessible Parking Space

Store

Landscape Bulbout

Sidewalk

Wheaton IL

Pedway retrofitted from sidewalk to building through parking
Same principles apply to large-scale developments:

- Direct, safe & convenient access is provided
Designing for Pedestrian Safety - Introduction

Poor Design: Drivers use sidewalk for backing

So desperate for parking, they cut down tree!
Do your local ordinances support pedestrian-oriented planning and design?

- These goals are achieved by local ordinances, which must be enforced.
- They are beyond the scope of road designers, yet contribute greatly to the safety, comfort and aesthetics of the walking experience.
Rethinking The Role of Urban Streets
A “complete street” accommodates many uses and provides for all purposes of a street:

- Mobility (all modes)
- Access to destinations
- Thriving businesses
- Beauty
Transforming a street
Narrow lanes; add bike lanes, median, trees, texture
Bring in buildings that face the street
More buildings: Infill
The street now has life and is safer for pedestrians
Level of Service

The impact of LOS standards on street design and pedestrian safety
HCM 2000 says LOS = A; little traffic, no impediments

Result: very wide roads that reduce pedestrian safety
- HCM 2000: ped LOS = A; few people walking
- New HCM 2010: worse ped LOS due to poor quality
HCM 2000: ped LOS = F; too many peds!
New HCM 2010: considers quality and density for peds
HCM 2010 Approach

- Multimodal evaluation for urban streets
  - Emphasizes combined evaluation of auto, bike, and transit modes

Streetfilms.org - NYC

NYC LOS A examples

Designing for Pedestrian Safety - Introduction
Pedestrian LOS

- LOS model determined from research on pedestrians’ perceptions
- LOS models are provided for:
  - Urban street segments
  - Signalized intersections
  - Two Way Stop Controlled (TWSC) intersections
  - Roundabouts
  - Off-street facilities
Pedestrian LOS

- Urban street segments
  - Density of pedestrians and comfort / perceived exposure
- Signalized intersections
  - Pedestrian delay and perceived exposure

A = actual sidewalk width
E = effective sidewalk width
Pedestrian LOS

- TWSC intersections
  - Average pedestrian delay crossing major street
- Off-street facilities
  - Affected by bicyclists
Why are pedestrians at high risk on this street?

- Multi-lane roadway, high speeds
Why are pedestrians at low risk on this street?

Narrow roadway, low speeds, busy
What is the core safety issue?
Pedestrians & drivers must use the street together

- Narrow cross-section
- Buildings close to street
- Sidewalks
- Crosswalk
- People!

What does the driver see that says “slow down, watch for pedestrians”? On-street parking

Designing for Pedestrian Safety - Introduction
Reinventing the roadway:

- Transform a 5-lane commercial strip to ...
...a safer road for everyone

Discussion: 1. What changed?

Discussion: 2. What didn’t change?
Let’s Recap

- Why is it important to accommodate pedestrian safety and accessibility?
- How does the street environment influence drivers’ and pedestrians’ expectations and interactions?
- Where is the information?
- What planning factors influence pedestrian safety and accessibility?
Questions?