Designing for Older Road Users

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Gene Amparano, Federal Highway Administration
Jesse Mintz-Roth, New York City DOT

November 20, 2014
Today’s Presentation

- **Introduction and housekeeping**

- **Audio issues?**
  Dial into the phone line instead of using “mic & speakers”

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- **Questions at the end**
Thank You!

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  - Downloadable/streaming recording and presentation slides

Questions?
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  - Gene Amparano  |  Gene.Amparano@dot.gov
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FHWA Older Road Users Program

- The Office of Safety is committed to providing a safe environment for older road users, including drivers, pedestrians, bicyclists and motorcyclists.

- The Office of Safety's Older Road User program addresses the engineering aspects of highway safety.
Handbook for Designing Roadways for the Aging Population

This 2001 handbook was written for highway designers, engineers, and highway safety specialists. The handbook provides guidance on how to accommodate the declining functional capabilities of the older road users with effective road design practices and engineering enhancements.

FHWA Pub. No. FHWA-SA-14-015
NACEM: Noteworthy Practices Guide

• North American Conference on Elderly Mobility (NACEM), May 11-14, 2014

• Showcases national and international practices presented at the NACEM.
Older Drivers and Pedestrians

MAP-21 Section 1112(a):

23 U.S.C. 148 (g) “Special RULES.- (2) Older drivers.--If traffic fatalities and serious injuries per capita for drivers and pedestrians over the age of 65 in a State increases during the most recent 2-year period...State shall be required to include... strategies to address the increases...
• FHWA offers a 1-day workshop to review the treatments contained in the Handbook for Designing Roadways for the Aging Population.

• The workshop is designed for engineers responsible for highway design and operations.
Aging Road User Clearinghouse

- Produce, collect, organize, and disseminate information related to aging road users.

- Provide research, case studies, best practices, and evaluation tools in the areas of public safety research and technology transfer activities.
Contact Information

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http://safety.fhwa.dot.gov/older_users/
Handbook for Designing Roadways for the Aging Population

Aging Road User Webinar

November 20, 2014
Primary Handbook Questions:

What is it?
Why is it needed?
What is in it?

• Brief Overview

How and Where should it be used?
What is the Handbook?

1998 1st Edition
2001 2nd Edition
2014 3rd Edition

Note: There is a title change for the new 3rd edition

http://safety fhwa dot gov/older_users/
What is the Handbook?

- Provides information linking aging road user performance to highway design, operations, and traffic engineering
- Inclusion of newer research
- Two Parts I & II
- Supplements existing guidelines
What is the Handbook?

Changes?

- New Title
- Incorporates new research
- Promising Practices added*
- Format changes (HTML)
- Electronic version (http://safety.fhwa.dot.gov/older_users/)
- Omits recommendations that have been adopted into the MUTCD or AASHTO Greenbook

*Promising Practices - treatments being used by one or more agencies, though not fully evaluated, are believed to benefit aging roadway users.
Percentage Increase of the Elderly Population: 2000 to 2025

Why is the Handbook needed?

UNITED STATES 76.8%
Why is the Handbook needed?

Increase in Older Drivers

*Older drivers made up 16 percent of all licensed drivers in 2011*

Increasing proportion of drivers will experience:

- Declining Vision
- Slower decision making and reaction times
- Increased difficulty in driver attention sharing
- Reductions in physical strength and flexibility

*Source: NHTSA 2012 Older Driver Traffic Safety Facts*
Primary reasons for the need of highway design and operations strategies for older drivers and pedestrians?

- Our older population has increased significantly over the previous decades
- Increasing % of 65+ people remaining in the workforce (delaying retirement)
- Data shows that fatalities and injuries for older drivers and pedestrians are over representative
- Older road users should be accommodated by the design and operational characteristics of a highway to the extent practical.

Changing Demographics = Change in "Design Driver"
What is in the Handbook?

Part I – Treatments: 144 Recommendations

<table>
<thead>
<tr>
<th>Category</th>
<th>Proven Practices</th>
<th>*Promising Practices</th>
<th>Total Treatments</th>
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<tbody>
<tr>
<td>Chapter 2: Intersections</td>
<td>16</td>
<td>8</td>
<td>24</td>
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<tr>
<td>Chapter 3: Interchanges</td>
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<td>Chapter 4: Roadway Segments</td>
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<td>Chapter 5: Work Zones</td>
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<td>Total</td>
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</table>

*Promising Practices: Treatments being used by one or more agencies, though not fully evaluated, are believed to benefit aging roadway users.
Information provided for each Treatment and/or Recommendation:

- **Design Element** — each design element is numbered to allow for quick reference.

- **Category** — identifies the current section of the guide.

- **Recommendations** — each recommendation is identified with a letter for quick reference.

- **Figures** — figures are used throughout the guide to illustrate the recommendations. They are numbered for easy reference.

**Street Name Signs**

A. **Letter Heights and Sign Border**

To accommodate the reduction in visual acuity associated with increasing age, minimum letter heights of 4 in for uppercase letters and 4.5 in for lowercase letters are recommended for use on ground-mounted street-name signs (MUTCD 90.4, as shown in Figure 18) on all roads where the posted speed limit is at or below 25 mph. On all roads where the posted speed limit is greater than 25 mph, letter heights of 5 in for uppercase letters and 6 in for lowercase letters should be used.

The use of overhead-mounted street-name signs is recommended at major intersections as a supplement to ground-mounted street-name signs. Minimum letter heights of 3 in for uppercase letters and 4 in for lowercase letters are recommended by the MUTCD.

In the design of street-name signs, the use of larger letter heights may require a larger sign panel. The border may be eliminated on street-name signs if necessary to minimize sign panel size while accommodating the larger letter size.

**Relationship Codes** — each recommendation includes numbered references to supporting information in the design guides most frequently used by practitioners. A legend at the bottom of the page defines the relationship codes.

**References**

- MUTCD, NCHRP 500-94

**Figures 18, 19**

- Intersection Warning W2-1 Sign and W16-BI Supplemental Advance Street Name Plaque

**References**

- MUTCD, NCHRP 500-94

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**REFERENCES LEGEND**

1: most conservative
2: preferred among differing guides
3: new application of current practice
4: more specific, detailed or stringent
5: permissible only in accordance with MUTCD section 1A.10, Interpretations, Experimentations, and Changes
Part II – Rationale and Supporting Evidence

One treatment category per chapter:

- Chapter 7: Intersections
- Chapter 8: Interchanges
- Chapter 9: Roadway Segments
- Chapter 10: Construction/Work Zones
- Chapter 11: Highway-Rail Grade Crossings

Appendices:

- Supplemental Technical Notes
- Photograph and Image Credits
- Glossary
- References
## What is in the Handbook?

### Chapter 2 – Intersections

<table>
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<th>No.</th>
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<tr>
<td>1</td>
<td>Intersection Angle (Skew)</td>
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<td>Intersections Sight-Distance</td>
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<td>Offset Left-Turn Lanes</td>
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<td>Delineation of Edgelines and Curbs</td>
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<td>Left-Turn Traffic Control for Signalized Intersections</td>
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<td>Street Name Signs</td>
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<td>11</td>
<td>Stop and Yield Signs</td>
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<td>12</td>
<td>Lane Assignment on Intersection Approach</td>
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<td>13</td>
<td>Traffic Signals</td>
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<td>Intersection Lighting</td>
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<td>15</td>
<td>Pedestrian Crossings</td>
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<td>Roundabouts</td>
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### Promising Practices for Intersections (8)

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<td>17</td>
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<td>18</td>
<td>Combination Lane-Use/Destination Overhead Guide Signs</td>
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<td>19</td>
<td>Signal Head Visibility</td>
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<td>High Visibility Crosswalks</td>
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<td>Supplemental Pavement Markings for Stop and Yield Signs</td>
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<td>Reduced Left-Turn Conflict Intersections</td>
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<td>23</td>
<td>Accessible Pedestrian Signal (APS) Treatments</td>
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<tr>
<td>24</td>
<td>Flashing Yellow Arrow</td>
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</tbody>
</table>
Chapter 2 – Intersections: Additions to Proven Practices

(5) Offset Left-Turn Lanes

• Provide a pedestrian refuge area where pedestrians have to cross in two stages (3.0 ft/s)

(13) Traffic Signals

• Install 12-inch Signal Heads
• Provide yellow retroreflective borders on backplates
Chapter 2 – Intersections: Additions to Proven Practices

(15) Pedestrian Crossings:

- Walking Speed revised from 2.8 ft/s to 3.0 ft/s
- Crossing distance measured 6 ft back from the curb or edge of travel lane
- Leading Pedestrian Interval (LPI) equation adjusted for the above

\[
LPI = (ML + PL + 6.0)/3.0
\]

NEW. Install Countdown Pedestrian Signals at all signalized intersections
(16) Roundabouts:

• Enhanced information and figures on Roundabouts

• 3 NEW RECOMMENDATIONS:
  – Provide Advance Warning Signs (W2-6)
  – Provide Directional Arrow Signs (R6-4)
  – Install Roundabout Circulation Plaque (R6-5P)
Chapter 2 – Promising Practices

(17) Right-Turn Channelization Design

• Use tighter radii (25 – 40 ft)
• Reduces turning speeds to 14 - 18 mph
• Optimizes line of sight for turning drivers
(19) Signal Head Visibility

- One signal head per lane, centered over each lane
(20) High-Visibility Crosswalks

- Use marking patterns that are more visible than standard markings
  - Ladder
  - Diagonal
(22) Reduced Left-Turn-Conflict Intersections

- Consider innovative designs that reduce or eliminate unprotected left turns

![Diagram of Restricted Crossing U-Turn (RCUT)](image)
A. Pushbutton-Activated Extended Pedestrian Crossing Phase

Consider inclusion of pushbutton-activated extension of the pedestrian crossing phase

- Press and hold for 2 sec for additional preset crossing time
- Described in MUTCD Section 4E.08

B. Passive Pedestrian Detection

Uses sensors to detect the presence of pedestrians and register a pedestrian call with the signal system

- Pedestrian does not have to push a button to request a WALK signal or extended crossing time
Chapter 2 – Promising Practices

(23) Accessible Pedestrian Treatments

A. Pushbutton-activated extension of crossing phase
   - Activated by the pedestrian
   - Press and hold for 2 sec for additional preset crossing time

B. Passive pedestrian detection (sensors detect presence of pedestrians within crosswalk)
Chapter 2 – Promising Practices

(24) Flashing Yellow Arrow

- Recommended signal indication for permissive left-turn movements
Chapter 3 – Interchanges

6 Proven Practices: 20 Recommendations

<table>
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<th>Chapter 3: INTERCHANGES (6) Proven Practices</th>
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2 Promising Practices: 2 Recommendations

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<td>31</td>
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</table>
Chapter 3 – Promising Practices

(32) Wrong-Way Driving Countermeasures

• Consider additional treatments to counter wrong-way driving
  – improved lighting, signs, and markings
### What is in the Handbook?

#### Chapter 4 – Roadway Segments

**4 Proven Practices:** 11 Recommendations

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<table>
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<td>Horizontal Curves</td>
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<td>34</td>
<td>Vertical Curves</td>
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<td>35</td>
<td>Passing Zones</td>
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<td>Lane Control Devices</td>
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**6 Promising Practices:** 6 Recommendations

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<td>Lane Drop Markings</td>
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<td>38</td>
<td>Contrast Markings on Concrete Pavement</td>
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<td>39</td>
<td>Utilize Most Retroreflective Marking Material Available</td>
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<td>40</td>
<td>Curve Warning Markings</td>
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<td>41</td>
<td>Road Diets</td>
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<tr>
<td>42</td>
<td>High Friction Surface Treatments</td>
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</tbody>
</table>
Chapter 4 – Roadway Segments: Additions to Proven Practices

(33) Horizontal Curves

• Use RPMs where nighttime wet pavement visibility is problematic, regardless of curve radius

(34) Vertical Curves

• Employ strict adherence to 2.5s PRT for vertical curve design
Chapter 4 – Promising Practices

(41) Road Diets
- Reduction of lanes allocates space for other road users (bikes, peds, parking)

(42) High Friction Surface Treatments (HFSTs)
- Amplifies braking and expedites the reduction in vehicle speeds, helping drivers retain control
Chapter 5 – Construction/Work Zones

5 Proven Practices: 24 Recommendations

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<th>Chapter 5: CONSTRUCTION/WORKZONES: (5) Proven Practices</th>
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2 Promising Practices: 2 Recommendations

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</table>
(43) Signing and Advance Warning:

- Legibility Distance
  - Use 1 inch letter height per 30 feet of legibility distance

(44) Portable Changeable Message Signs

- Sign Height
  - Elevated to a height sufficient to be seen across multiple lanes of traffic
Chapter 6 – Highway-Rail Grade Crossings

2 Proven Practices: 2 Recommendations

| Chapter 6: HIGHWAY-RAIL GRADE CROSSINGS (PASSIVE): (2) Proven Practices |
|-----------------|--------------------------------------------------|
| 50              | Passive Traffic Control Devices                  |
| 51              | Lighting                                         |

0 Promising Practices:

Reorganized Proven Practices into 2 treatment categories rather than 1 (No Major Additions)
The *Handbook* supplements existing standards and guidelines.

The Recommendations do not constitute a new *standard* of required practice.

The *Handbook* provides guidance to enhance the safety & ease of use for older drivers and pedestrians.
Problem Identification/Project Review Questions:

1. Demonstrated crash problem with aging road users?

2. Any complaints from aging road users or potential safety concern for aging road users either through observation, agency documentation, or engineering judgment?

3. Project located on a direct link to a travel origin or destination for which aging persons constitute a significant proportion of current users?

4. Project located in a census tract that has experienced an increase in the proportion of residents age 65 and older?"
Implementation is a 3-Step Process:

1. Problem Identification/Project Review
   - Answer the four basic Problem ID questions
     - Front of Handbook (Chapter 1, Pages 6 & 7)

2. Identification of Candidate Handbook Applications
   - List Relevant Design Elements
   - Identify Handbook Recommendations
   - Assess Differences in Design Practices

3. Implementation Decision

Where and How to use the Handbook?
If you design for the Old
You include the young
If you design for the Young
You exclude the Old

Dr. Bernard Isaacs, Renowned Geriatric Physician and Author
Thank You!

F. E. (Gene) Amparano, P.E.
Safety Engineer
FHWA, Resource Center
Kansas City, MO
Safe Streets for Seniors
New York City

Jesse Mintz-Roth - Senior Project Manager, Research Implementation and Safety
New York City Department of Transportation - November 20, 2014

PBIC
FHWA
2014
New York City: By the numbers

- NYC population: 8.4 million (MSA 22.2 million)
- Extensive 24/7 subway and bus networks
- NYC traffic fatality rate: 3.1 per 100,000: Low among large US cities
  - Over 50% are pedestrians: High among large US cities
- Low car ownership; Everyone is a pedestrian; No Right Turn on Red
- Vision Zero multi-agency street safety initiative (2014-):
  - New 25 mph speed limit (11/7/14)
  - 50 Street Safety Projects per year
  - NYCDOT working with Police Dept, Taxi Cmn

![Traffic fatality rates of 25 largest US cities](chart.png)
NYC Senior Pedestrians

- 12% of the NYC population are seniors
- 36% of NYC traffic fatalities are senior pedestrians
NYC Senior Population Increasing

Identifying Focus Areas

First 25 areas (2008)
• Mapped pedestrians age 65+ killed and severely injured (KSI)
  • Circled clustering on heat map to identify first focus areas

12 new areas (2012)
• Also studied and included senior centers, housing, other spatial variables
Senior Pedestrian Issues

• Not enough time to cross the street
• Broken or missing pedestrian ramps
• Faded and hard-to-see markings
• Poor drainage or ponding in crosswalks
• Turning vehicles failing to yield
Identifying/Evaluating Project Locations

Priority: Top 10% or 33% Pedestrian KSI/mi in each Borough
Ranked by KSI per mile (KSI = Killed or Severely Injured)

- NYCDOT developed intranet site to let project managers compare and rank safety projects using the most recent 5 years of cleaned crash data
- Before/After Analysis: average of 3 previous years vs 1/2/3 year(s) since, excluding build
Toolbox of Typical Safety Improvements

**Daylighting:**
Better driver-pedestrian visibility

**Countdown Signals:**
Tell pedestrians how much more time they have to cross

**Signal Timing:**
Can add more time to cross where possible, LPIs, split phases

**Pedestrian Safety Islands:**
Shortens crossings on wide streets, provides safer crossing

**Road Diet:**
Organizes traffic, less speeding

**Sidewalk Extensions:**
Shortens crossing distance, slows turning cars
### Street Design: 3 construction options

<table>
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<tr>
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<th>Capital Concrete</th>
<th>In-House Concrete</th>
<th>Temporary Materials</th>
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<td><strong>Build Time</strong></td>
<td>5+ years</td>
<td>1-2 years</td>
<td>1-2 years</td>
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<tr>
<td><strong>Cost</strong></td>
<td>High</td>
<td>Low</td>
<td>Very Low</td>
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</tbody>
</table>

For safety projects, quicker build time saves lives.

Optional follow-up: Concrete Build Out
Temporary Materials: Input from Visually-Impaired

• Partnership with advocates for the visually and hearing impaired has led to better informed policy and design decisions for using truffle paint and gravel curb extensions

• In 2013, NYC DOT installed over 400 Detectable Warning Strips in 14 of street improvement projects

• Testing new materials for durability and to achieve safety goals
Funding: Public Interest Finding

- Federal funding from FHWA, FTA for Livability, Air Quality, Mobility
- PIF lets NYCDOT use FHWA, FTA funds for in-house construction
- Faster implementation and lower cost than capital construction
- Allows NYCDOT to respond to street safety needs faster
- Transforming dangerous streets into safe desirable places to walk

![Graph showing cost savings](http://www.fhwa.dot.gov/livability/case_studies/newyork/)
Safety Improvements at Key Intersections

W 23rd St/7th Ave (2010)

Location:
• Chelsea, Manhattan
• Truck Routes
• Subway: 1-train
• High pedestrian volumes
• Near American Foundation for the Blind
• Near Penn South NORC
Safety Improvements at Key Intersections

7th Ave and W 23rd St, Manhattan
- Pedestrian injuries down by 68%

- Modified signal timing to add protected pedestrian crossing
- Installed two pedestrian safety islands
- Created separated left turns
- Accessible Pedestrian Signal (APS) installed
Safety Improvements Near Housing

Bowery (2010)

Location:
- Chinatown, Manhattan
- Truck Routes
- Heavy traffic on Canal between Holland Tunnel and Manhattan Bridge
- Very high pedestrian volumes
Safety Improvements Near Housing

Bowery, Manhattan
- Pedestrian injuries reduced by 39%

Better organized and calmed Bowery traffic

Added planted median between Canal and Division

Chinatown Senior Area

Chinatown/Lower East Side, Manhattan

Before

After

Bowery at Canal St (Manhattan Bridge entrance), looking south
Safety Improvements on Arterials

Context: Columbus Ave

Location:
- Upper West Side, Manhattan
- Truck Route, Bus Route
- Near Subway: B/C trains
- High pedestrian volumes
- Goddard Riverside NORC and Senior Center, Park West Village NORC
Safety Improvements on Arterials

Columbus Ave, Manhattan
Phase 1 (W 77th to W 97th St)
• Pedestrian injuries down by 39%

Upper West Side Senior Area

Created separated left turn bays and protected bike lanes

Installed pedestrian safety islands

Before: Phase 2

After: Phase 2
CityBench Program

• Working with DOT’s City Bench program

• Placing benches at strategic locations, such as:
  • Senior centers
  • Bus stops without shelters
  • Public libraries
  • Municipal facilities
Outreach with NYC Seniors

- Working with the NYC Department for the Aging
- Coordinating with NYCDOT’s Safety Education Team
- Going into Senior Centers to get feedback
- Approaching Aging Committees on Community Boards for project ideas
Partner Agencies and Initiatives
Guidelines for other cities

Focus on Safety
• Age-friendly NYC initiative unites senior population growth with DOT safety goals
• Know your crash data:
  • Create agency priorities
  • Data anomalies determine study areas
• Public Interest Finding, Temporary Materials: Faster implementation saves lives

Grants
• Think Big: Link to sustainability, livability, mobility, and resilience
  • Improving link between housing and fixed route transportation
  • Mode shift to pedestrian/public transit creates attractive walkable corridors

Outreach
• Know your issues, know your local audience, work with partner organizations
More at nyc.gov/dot

Thank You