

TL
152.3
.T62
2004

OLDER DRIVER

Best Engineering Practices for Roadway Improvement

SYNTHESIS

October 2004

Prepared by:

**Dave Morena
Safety and Traffic Operations Engineer
FHWA Michigan Division**

Printed and distributed by:

**Iowa Department of Transportation
Office of Traffic and Safety**

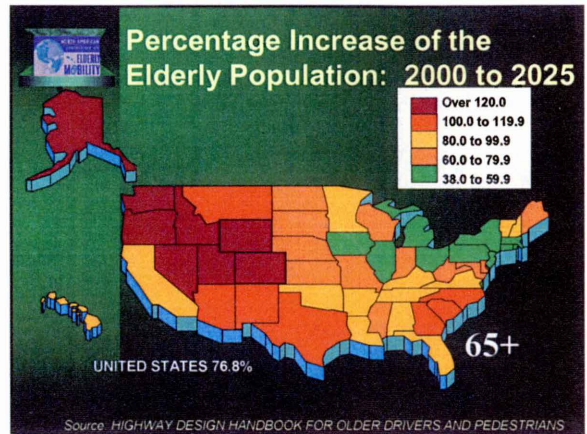
CONTENTS

- ✿ **Traffic Signs**
- ✿ **Traffic Signals**
- ✿ **Pavement Markings**
- ✿ **Geometric Design**
- ✿ **Work Zones**
- ✿ **Railroad Grade Crossings**

Best Practices from Around the World

Best Engineering Practices for Roadway Improvement – Local, State and National

John K. Abraham, Ph.D., P.E.
Deputy City Engineer / Traffic Engineer
City of Troy, Michigan

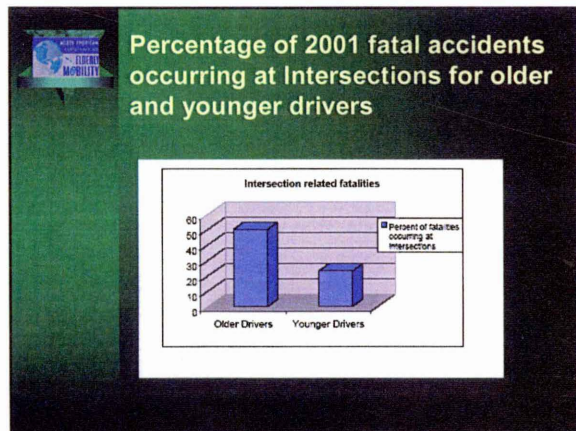


Percent of State Population over 65

1. Florida 18%
2. Pennsylvania 16%
3. West Virginia 15%
4. Iowa 15%
5. North Dakota 15%

States with the highest number of older drivers killed (2001)


1. Florida 268
2. Texas 254
3. California 224
4. Pennsylvania 138
5. Michigan 123
6. New York 119
7. Georgia 116
8. North Carolina 112
9. Ohio 109
10. Illinois 101







Infrastructure Presentation Modules

- ◆ Traffic Signs
- ◆ Traffic Signals
- ◆ Pavement Markings
- ◆ Geometric Design
- ◆ Work Zones
- ◆ Railroad Grade Crossings



Best Practices from Around the World

Traffic Signs

Size Does Matter !!!?



Signs - We will talk about...

- Bigger Signs
- Larger Lettering
- Clearer Lettering
- Brighter Sheeting
- Internally Lit Signs
- Diagrammatic Signs
- Overhead Signs
- Advance Signs
- Supplemental Signs
- Street Name Signs




Bigger Signs



Bigger Signs - Regulatory




Mississippi DOT 2004 program



Bigger Signs - Warning



Bigger and Brighter Curve and Chevron Signs

Iowa DOT 2004 program



Bigger Signs - Warning



MD

Bigger Signs - Guide

6 inch lettering

8 inch lettering

Texas DOT 2004 program

Larger Lettering

20"/15" Freeway to Freeway Lettering

Maryland DOT – 20" lettering on all freeway Exit Direction Signs
Larger Copy at the decision point

Georgia
Signs upgraded as a part of preparation for the Olympics

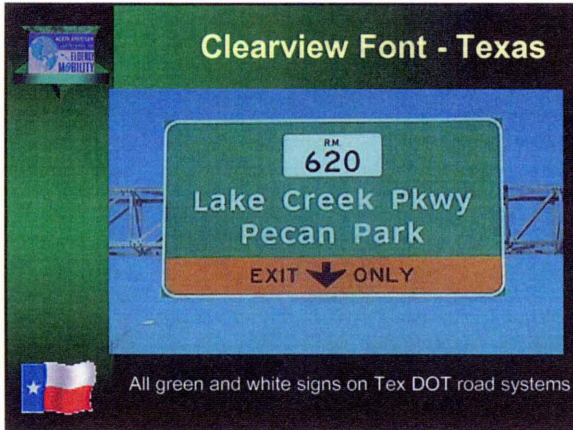
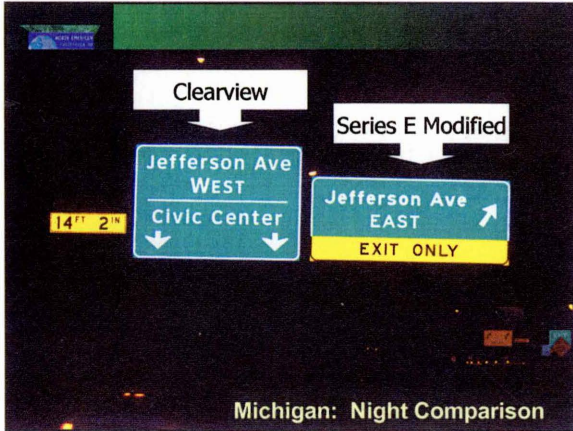
Clearer Lettering

using
Clearview Font

Series E Modified

Clearview

Michigan: Side-by-Side Comparison



Clearview font letters were developed specifically to :

- ◆ Accommodate the needs of older drivers
 - without increasing the capital letter height and the overall length and height of word messages
- ◆ Improve word pattern recognition
 - by using mixed case words of the same size composed of lower case letters
- ◆ Improve the speed and accuracy of destination recognition and the legibility distance of word messages
- ◆ Control or minimize the halation of words with reduced contrast sensitivity.

MUTCD - Interim Approval for Use of Clearview Font for Positive Contrast Legends on Guide Signs

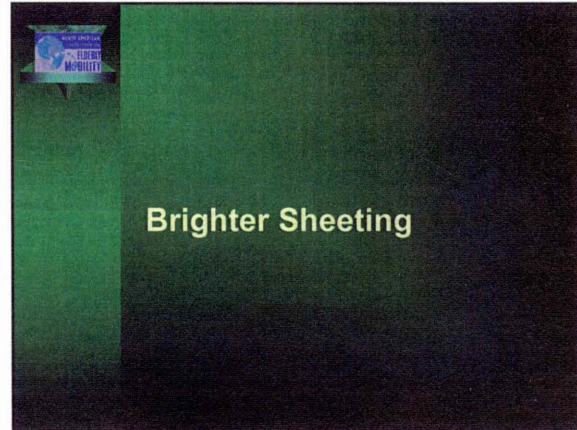
INFORMATION: MUTCD - Interim Approval for Use of Clearview Font for Positive Contrast Legends on Guide Signs September 2, 2004

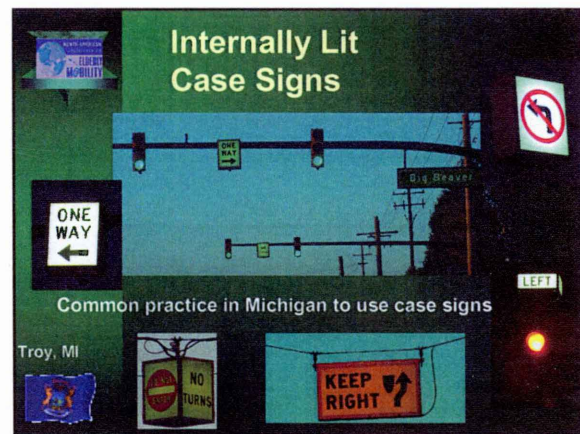
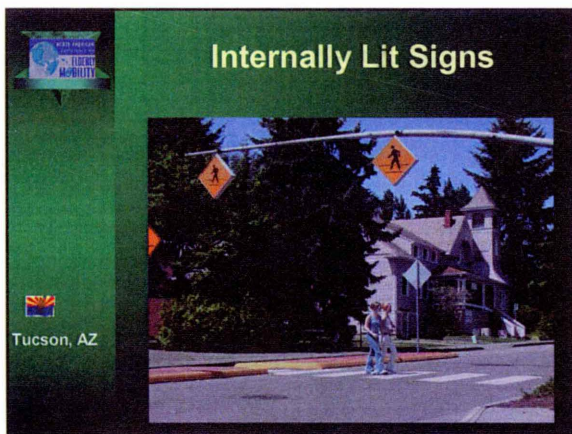
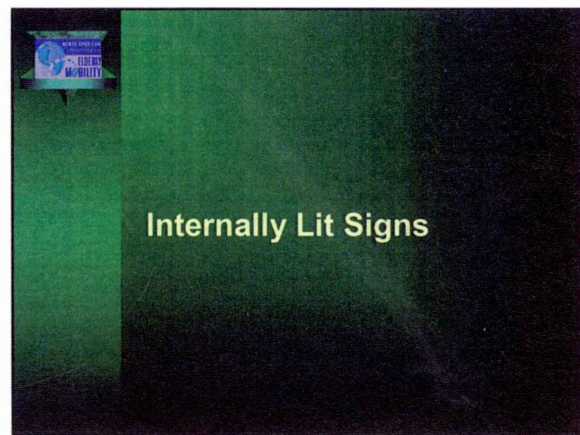
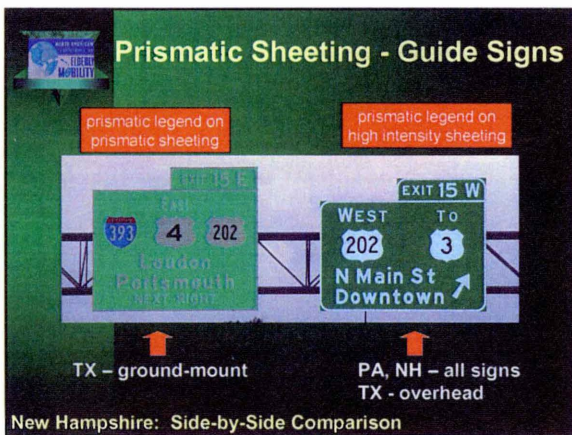
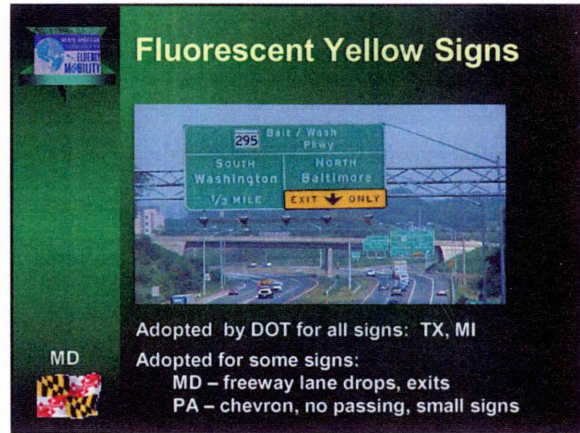
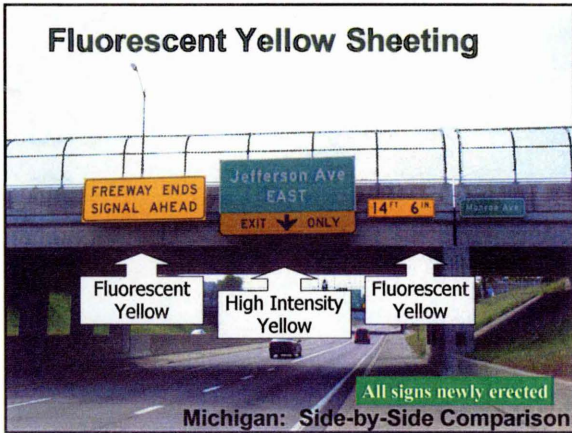
Regina S. McElroy for /s/ Vince P. Pearce
Director, Office of Transportation Operations HOTO-1

Division Administrators
Resource Center Directors
Federal Lands Highway Division Offices

Purpose: The purpose of this memorandum is to issue an Interim Approval for the optional use of the Clearview font for positive contrast legends on guide signs.


Research on the Clearview font: The Clearview font was developed through a decade of research starting in the early 1990s. The goal of the Clearview font was to increase legibility and reduce halation of highway sign legends in comparison to that of Standard Highway Signs (SHS) Alphabets (Highway Gothic font). This research development effort resulted in final design of





Other Ways to Increase Sign Conspicuity

Signs with Back Plates
-- Increased Visibility



Wisconsin

Reflective Sheeting on sign supports

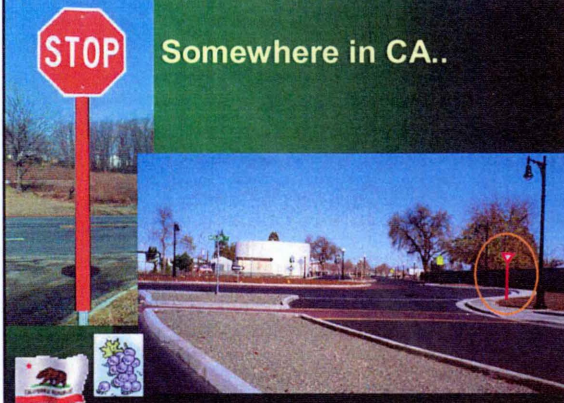


MI

Ingham County, MI:

- 2-way to 4-way Stop conversions
- remove sheeting after two years

Somewhere in CA..



Diagrammatic Signs

Diagrammatic Sign - Optional Lane



North Dakota

Compare to



Current MUTCD

Diagrammatic Sign - intersection

Nebraska DOT - in advance of all major intersections

Sign Placement

Overhead Signs

Overhead Signs - lane use

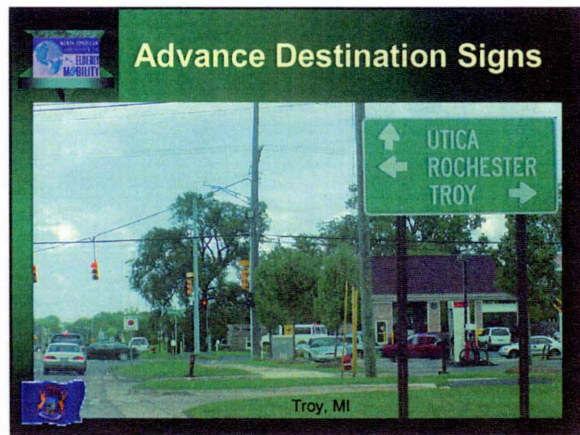
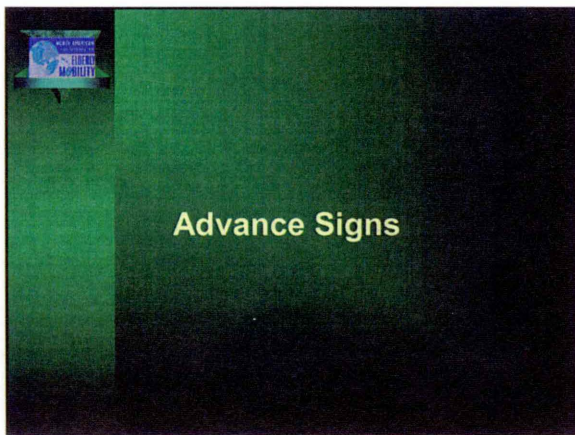
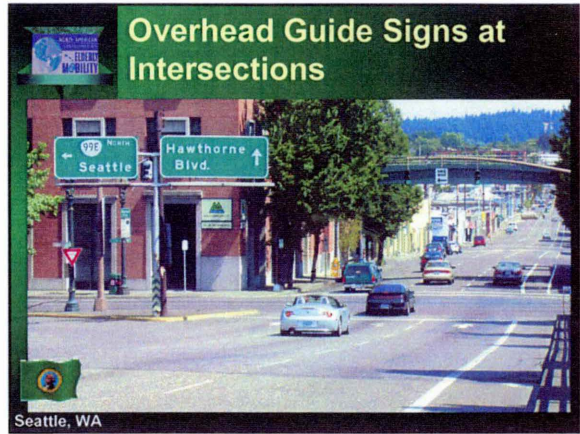
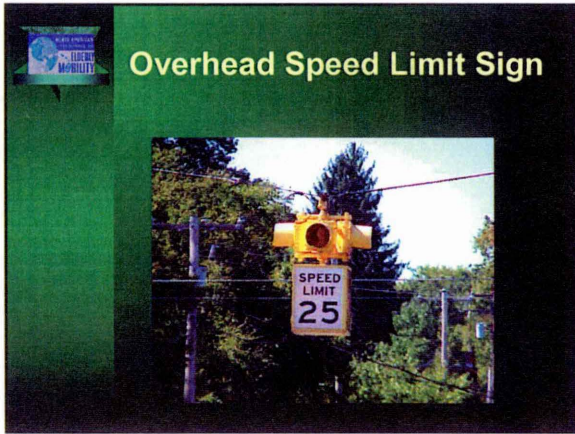
Florida

Overhead Signs - route numbering

Florida

Overhead Sign - route numbering

Street name + route markers
Hanover, MD



Advance Street Name Signs

Tyson's Corner VA

Advance Street Name - Supplemental Plaque

Tucson, AZ

PA

Advance Street Name - supplemental plaques

STOP Ahead sign

Intersection Ahead sign

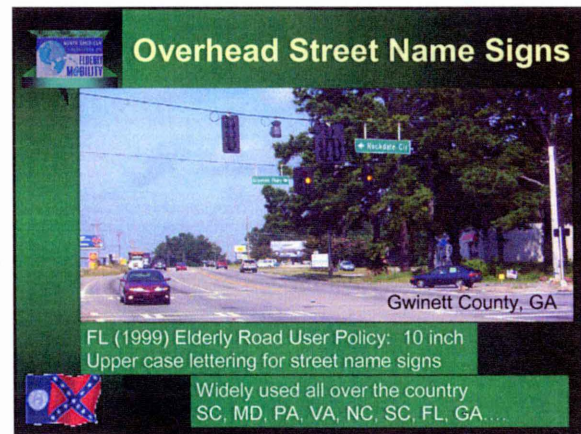
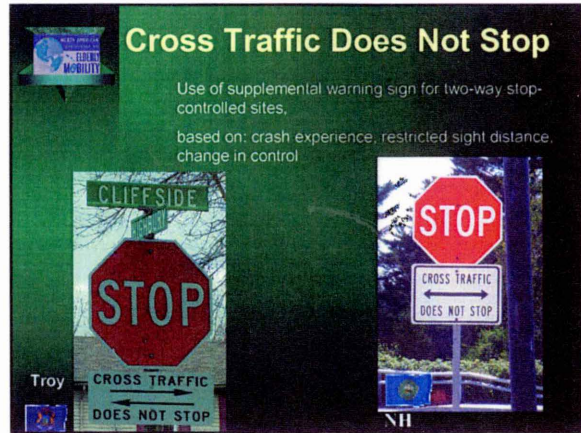
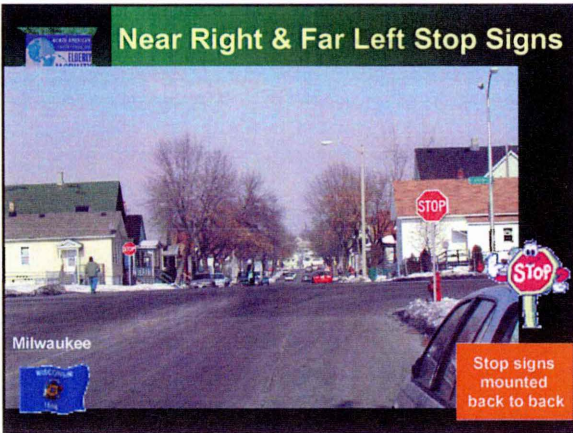
Ingham County, MI - all roads, 1980+

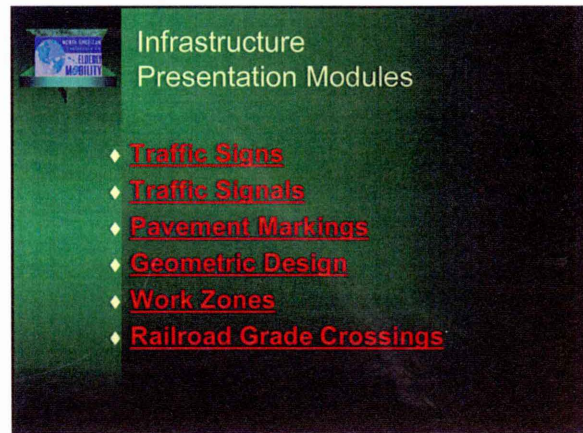
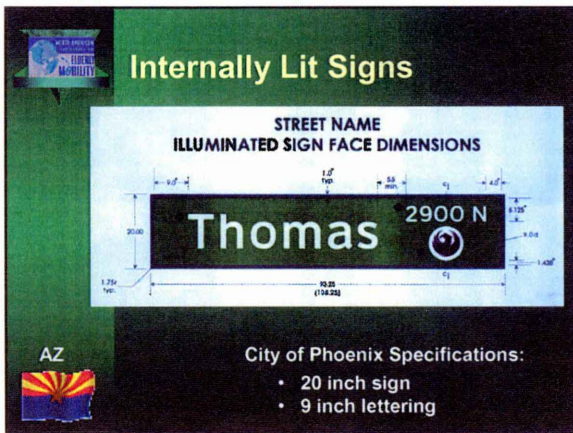
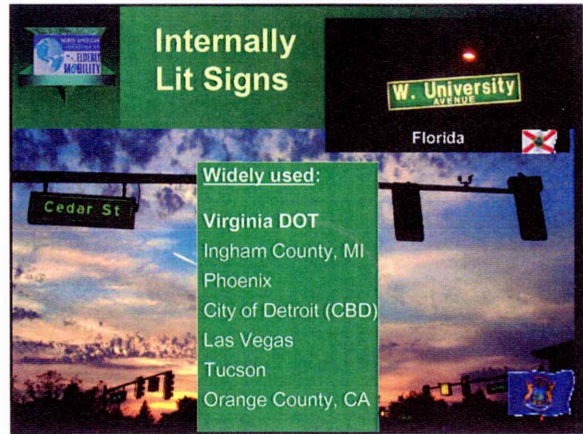
Supplemental Signs


Supplemental Signs More the better?

Double Indicate Stop Signs

Winston - Salem
North Carolina










Best Practices from Around the World

Traffic Signals

Brighter and More Visible

Place Signal Heads Where Motorists Will See Them





Place signals overhead

Results (5 locations):

- total crashes down 25%
- Right angle down 63%

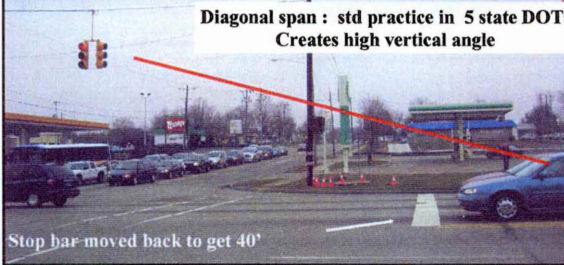
Kansas City, MO
50 - 100 intersections

Before: pedestal
After: mast arm + all-red


Minimize vertical angle at stop bar

Diagonal span : std practice in 5 state DOTs
Creates high vertical angle



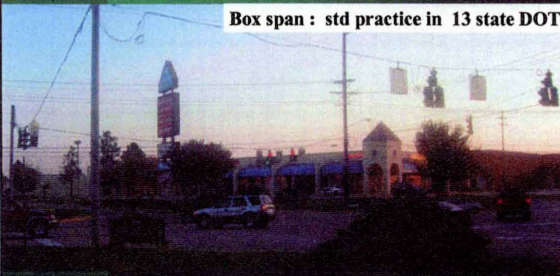
Stop bar moved back to get 40°

MUTCD: at least 40' from stop bar to signal
Caltrans, Oregon DOT : at least 70' from stop bar to signal




Place signals on far side of intersection

Box span : std practice in 13 state DOTs

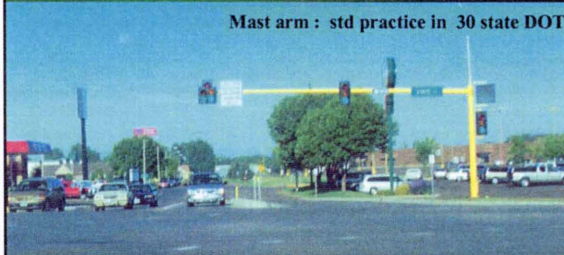


Louisiana DOT switched from diagonal span to box span in mid-90's



Place signals on far side of intersection

Mast arm : std practice in 30 state DOTs



North Dakota DOT

One Signal Face per Lane
centered over each lane
centered over the lane

Tyson's Corner, VA

One Signal Face per Lane
centered over each lane

Las Vegas

One Signal Face per Lane
centered over each lane

Grand Rapids, MI

Supplemental Signal Heads

Troy, MI


Illinois

Supplemental Signal Heads


Caltrans policy: 10' post-mount Left & Right

Supplemental Signal Heads


CA, WI, IL, MN, AZ, NV policy:
ALWAYS two signal indications for Left turn




Make signal Heads More Conspicuous




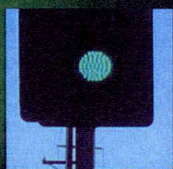
12" lens



States that always use 12": AZ, MI, ND ...



LED signals

Caltrans, NYC: converted all signals to LED in one year
Philadelphia: all signals LED since late 90's
Other DOT users: NY, ND, OR...




Add Back plates




6 Case Studies

Winston-Salem → Results (6 intersections): Targeted crashes down 52%




Add Back Plates




California


States that always add back plates: CA, ND, OR, AZ, NV, MN...




Add Back Plates




Caltrans policy: back plates on all beacons




Add Back Plates




North Carolina DOT common practice: back plates on box span




Red T Display




Winston-Salem → Results (12 intersections): Targeted crashes down 35%




Red T Display




CA – double red signal : on high-speed approaches into communities



Signal Operation




Add Left Turn Phase




13 Case Studies

Winston-Salem → Results: Targeted crashes down 65%




Prohibit permissive left turns



North Dakota DOT: Protected ONLY for speeds > 35 mph


Flashing Yellow Arrow for permissive left turn



Oregon DOT policy: all new permissive signals


LT Yield - Blankout Sign for permissive left turn

Illinois

Cullowhee, NC

Battery Back-up



Caltrans policy:
Battery back-up at all traffic signals

Provides minimum:

- 2 hours full
- + 4 hours flash

All-red clearance interval

We have no notes on who uses all-red


Picture?

Jurisdiction?

Infrastructure Presentation Modules

- ◆ Traffic Signs
- ◆ Traffic Signals
- ◆ Pavement Markings
- ◆ Geometric Design
- ◆ Work Zones
- ◆ Railroad Grade Crossings







Best Practices from Around the World

Pavement Markings

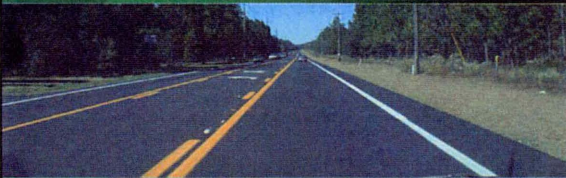
One step further than the MUTCD



Make the Markings More Conspicuous



All lines 6-inch



State DOT's that routinely use 6" longitudinal lines:
AL, AZ, FL, MI, NH (1980's), NC,
PA (lane lines), TN (Interstate)...



Edge lines 6-inch




Michigan DOT :
6" edge lines only



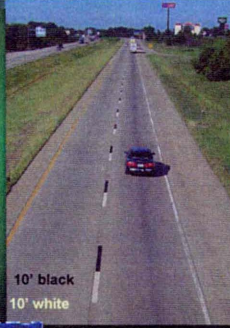

Contrast Pavement Markings on concrete pavement





Wisconsin DOT - 3M tape
300+ lane miles


Contrast Pavement Markings on concrete pavement



10" black
10" white




Penn DOT: 100+ miles




Contrast Pavement Markings on concrete pavement

Contrast Tape on US 59 between Toll Road and IH 45



Texas DOT allows tape and staggered paint

Texas DOT: all concrete pavement on and within I-610 around Houston



Make a Line that Works on a Wet Night



Raised Pavement Markers



Ohio DOT policy:

- use RPM on all roads
- replace on 2-4 yr cycle



Raised Pavement Markers

City of Farmington Hills, MI
RPMs on all Major Roads





Raised Pavement Markers

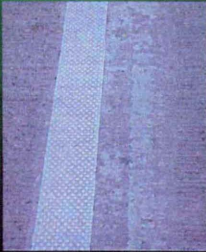



Day Night

Florida DOT: RPMs spaced at 40 feet
(Twice the number of markers required by MUTCD)




Wet-night performance: milled-in, retro-reflective tape




3-foot section between every other skip line, in lieu of RPM

Iowa DOT - pilot testing



Wet-night performance:
profiled thermoplastic



Alabama DOT - "Rain line"
Mississippi DOT - "Gulf line"

Discontinued due to cost/benefit

Wet-night performance:
painting the rumbles



1,100 lane miles

Mississippi rumble stripes – statewide pilot


Wet-night performance:
painting the rumbles



Paint on rumble
Paint on pavement

Michigan DOT: 100+ freeway miles

Wet-night performance:
when you want the bump,
but not the rumble




4-inch rumble:
• reflects at night
• no tire noise

Texas DOT / TTI - pilot testing

**Add Lines to Help
Guide the Motorist**

**Edge line provided
in parking areas**



Comparison photo

Lansing, MI

Pavement Marking Extension
edge line at freeway exit

North Dakota DOT - extends edge line at all off ramps

Pavement Marking Extension
into intersection

Maryland DOT - at double and triple left turns

Pavement Marking Extension
into intersection

Texas DOT

Common use at large intersections: NH, FL, TX, MD...

Pavement Marking Extension
into intersection


Illinois DOT - in-pavement lights

Delineate islands


Wisconsin DOT policy:
paint nose of all islands

Delineate islands with RPMs



Broward County, FL




Give Advance Notice





Signal Ahead markings


Irvine, CA





Yield Ahead Marking

Maryland



STOP Ahead marking


Ayrhill Road, Vienna, VA




Lane Merge Marking





Broward County, FL



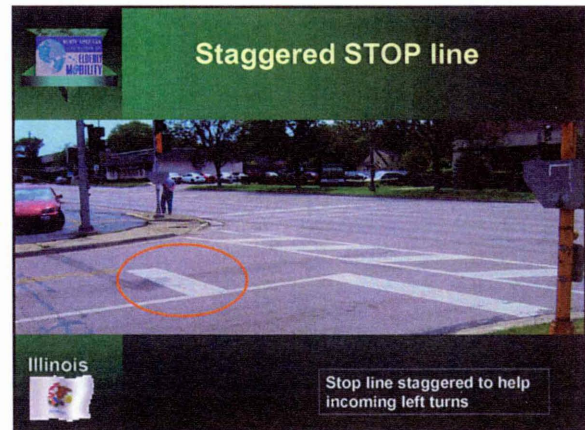
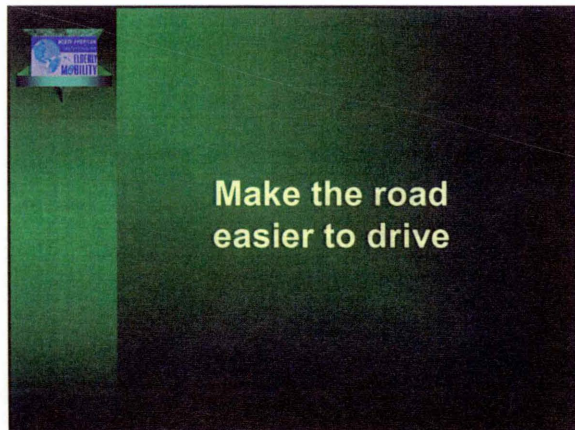
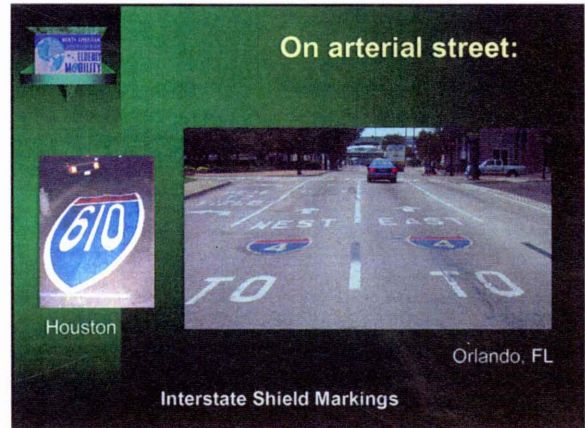
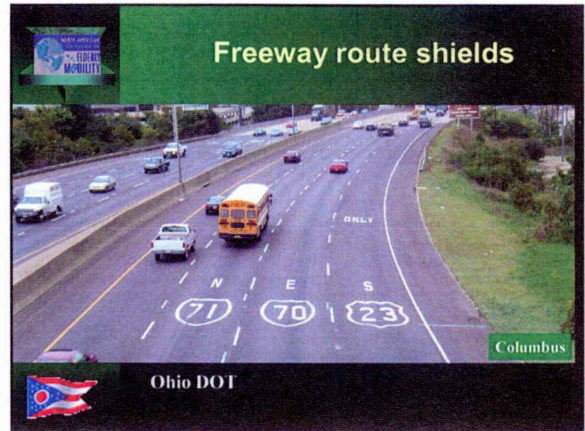
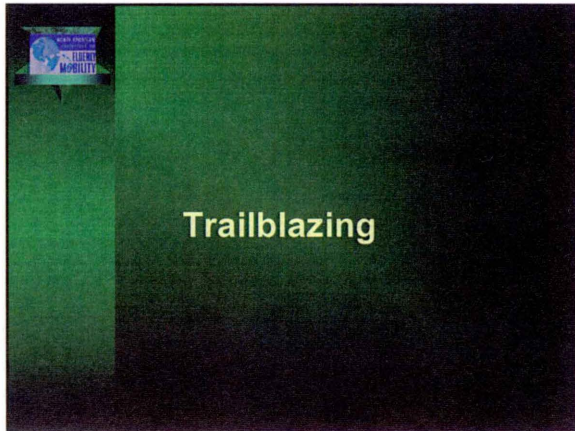
Lane Drop Marking



RIGHT TURN LANE ONLY




Michigan M-43





Infrastructure Presentation Modules


- ◆ [Traffic Signs](#)
- ◆ [Traffic Signals](#)
- ◆ [Pavement Markings](#)
- ◆ [Geometric Design](#)
- ◆ [Work Zones](#)
- ◆ [Railroad Grade Crossings](#)




Best Practices from Around the World

Road and Intersection Design


Safer, Less Complex



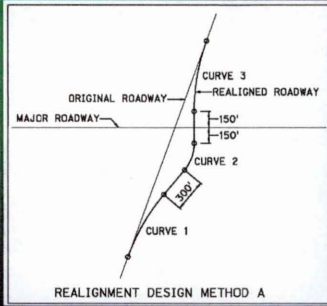
Intersection Design Features



Simplify the Turning Movement



Re-align Skewed Intersections



Nebraska DOT – 2004 policy to realign major intersections




4-lane to 3-lane conversion





LT – across one lane only



Iowa DOT has converted 20+ corridors



Separate the right turn traffic

Iowa - more and longer turn lanes

Separate the right turn traffic

Michigan DOT
Muskegon TSC

Wide shoulder allows drivers to exit mainline, then slow and make easy turn

Remove or Relocate the Left Turn

Michigan Indirect Left Turn

Troy MI

Michigan DOT common practice on boulevards

Roundabouts Eliminate Left-turn Head on Crashes

RDBT

Maryland DOT has installed 40+ modern roundabouts

Roundabouts at high speed rural intersections

Kansas DOT - one installed and two more coming


Improve Sight Distance for the Left Turn



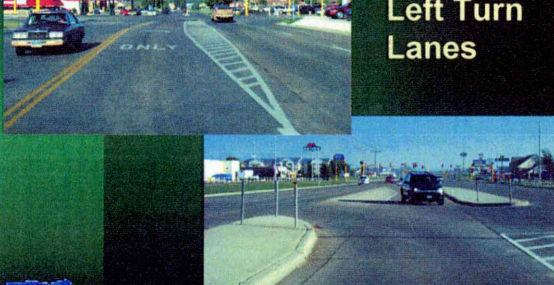
Offset Left Turn Lanes




Florida DOT practice - very wide offsets

Offset Left Turn Lanes




North Dakota DOT - since 1999 wherever possible





Offset Left Turn Lanes




Phoenix - applies the concept to undivided roads

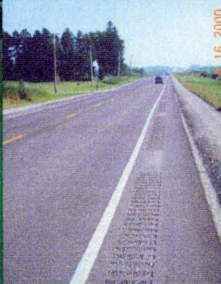
Roadway Design Features



Keep the Motorists on the Road




Milled shoulder rumble strip on non-freeway



43% of CY 03 fatalities were single vehicle run-off-road

Iowa DOT (2004) policy:
 4' paved shoulder with rumbles on most 2-lane highway



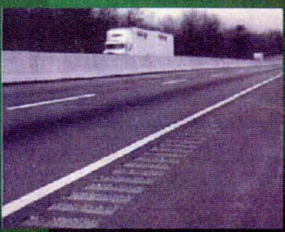
Centerline Rumbles



Elderly feedback to PennDOT:
Keeps motorists on track in snow, bad conditions

Pennsylvania DOT
250 locations, approx 1500 miles

SAFETY IMPLICATIONS of rumble offset distance



PA: 65% reduction in drift-off crashes

PA Turnpike has approx 500 miles of freeway with rumbles cut at 4" offset

Other states with close offset on freeway shoulders:

4" or less offset:

- Alaska (2" Lt, 6" Rt)
- Arizona (zero offset)
- Colorado (zero offset)
- Montana (4" -6")
- Nevada (0 -6")
- New Jersey (4")
- Texas (4" -8")
- Wyoming (4" LT)

6" offset:

- Connecticut (LT)
- Kansas
- Michigan
- Vermont (LT)
- Virginia
- Washington

Mill on Imperfect Pavement



Governor issued emergency proclamation to fast track project

Minnesota DOT - State Rte 23
50 miles, installed 2000

Mill and Chip Seal Combo



Michigan US-10 & M-47
28 miles, installed 2002

Improve Crash Survivability



Design crash cushions for expected speed

The following states, on a 70 mph road, install a crash cushion tested at or recommend for 70 mph:

- IL
- MO
- NY
- OR
- SC
- WA



In most other states, this crash cushion will be designed for 60 mph.



Infrastructure Presentation Modules

- ◆ [Traffic Signs](#)
- ◆ [Traffic Signals](#)
- ◆ [Pavement Markings](#)
- ◆ [Geometric Design](#)
- ◆ [Work Zones](#)
- ◆ [Railroad Grade Crossings](#)

NORTH AMERICAN CONFERENCE ON ELDERLY MOBILITY

Best Practices from Around the World

Work Zone Traffic Control

Work Zones

NORTH AMERICAN CONFERENCE ON ELDERLY MOBILITY

Fluorescent Orange Sheeting

Adopted for **SIGNING** by DOT in:
TX, NC, NY

NORTH AMERICAN CONFERENCE ON ELDERLY MOBILITY

Fluorescent Orange Sheeting

North Carolina DOT:

- all construction & maintenance projects, all roads
- includes roll ups and Type III barricades

NORTH AMERICAN CONFERENCE ON ELDERLY MOBILITY

Oversize Arrows

← 48" x 24"

Twice the MUTCD minimum

North Carolina DOT

NORTH AMERICAN CONFERENCE ON ELDERLY MOBILITY

Fluorescent Yellow Green Background

Iowa DOT (1999) - mobile operations only
- State trucks

Fluorescent Yellow Green Background



Iowa DOT

Pavement Markings



Florida DOT - 6-inch pavement marking
- RPM at 40-foot spacing

Temporary Traffic Signals



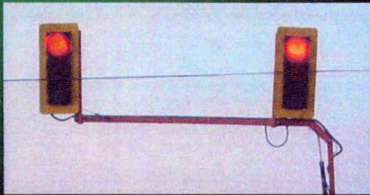
Michigan DOT - two signals overhead

Temporary Traffic Signals



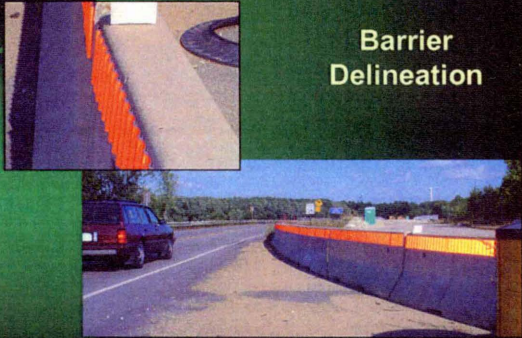
Caltrans - one signal overhead
- one signal at 10-foot

Temporary Traffic Signals

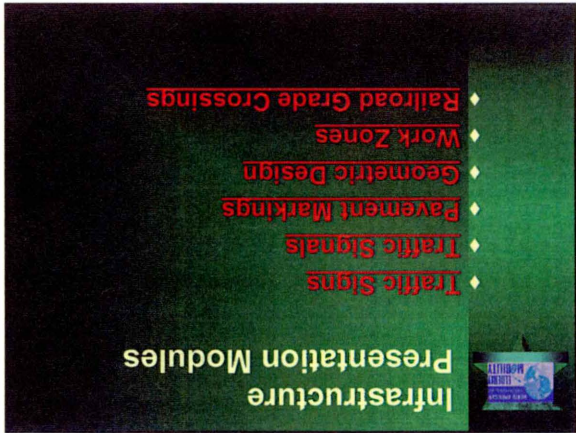


Why not specify back plate?

Barrier Delineation




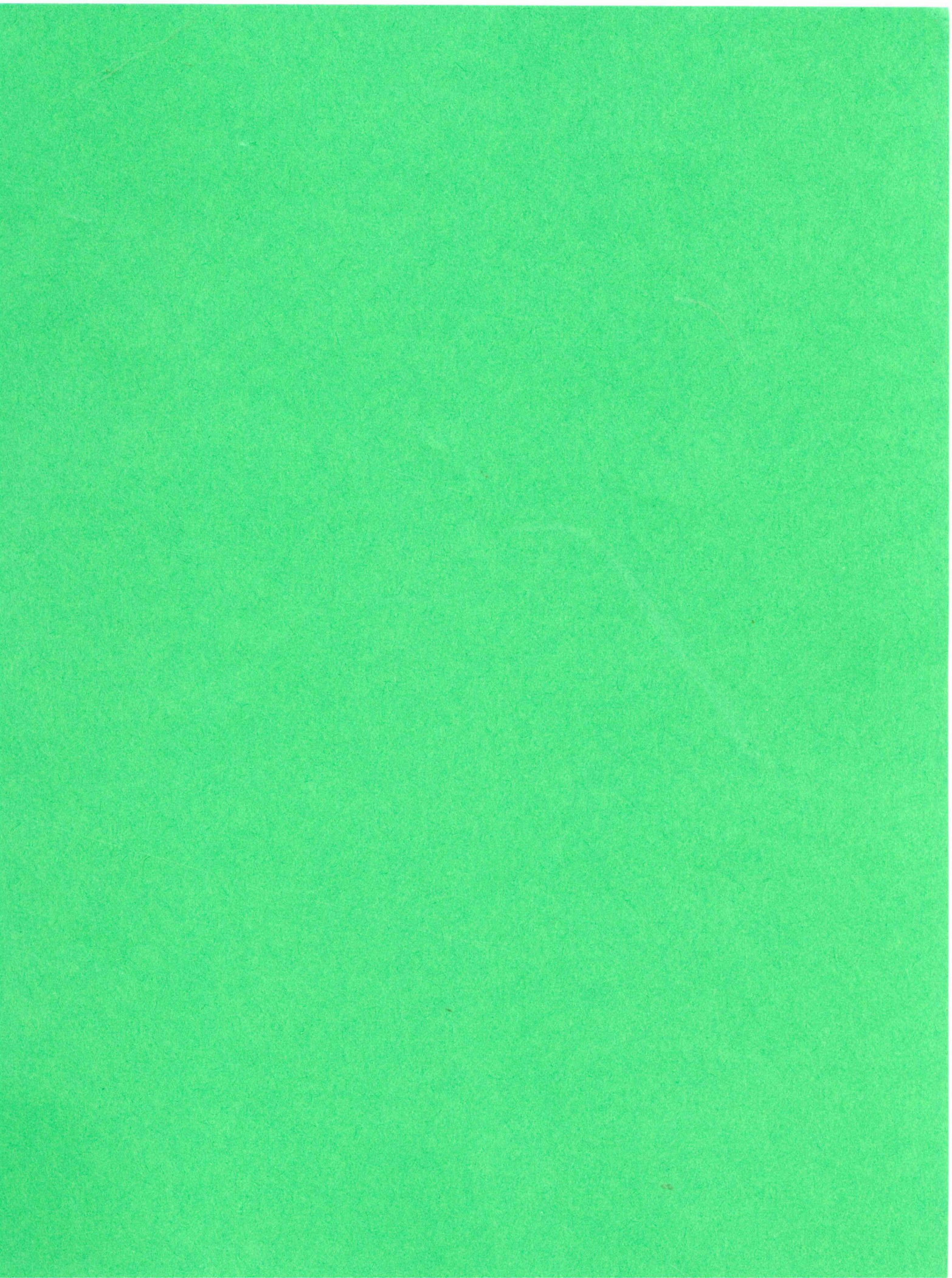
New Hampshire DOT - on targeted lane shift




Infrastructure Presentation Modules

- ◆ Traffic Signs
- ◆ Traffic Signals
- ◆ Pavement Markings
- ◆ Geometric Design
- ◆ Work Zones
- ◆ Railroad Grade Crossings







Best Practices from Around the World

Railroad Grade Crossings



Larger & Brighter Lights



OLD - 8" lens



NEW - 12" lens LED

Michigan DOT



Conspicuous crossing surface for high volume crossings



OLD - rubber



NEW - concrete


Michigan DOT practice (1998):
- cheaper by 50% & RRs love it



Crossbuck Conspicuity



OLD



NEW

- high-intensity sheeting
- sheeting on post
- sheeting on back of X-buck and back of posts

Michigan DOT



Pedestrian Accommodation

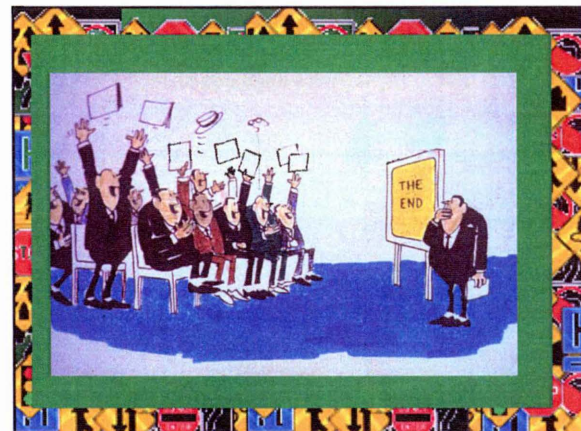


OLD



NEW

Michigan DOT RR crossing policy:
include sidewalk crossing as part of the project



Contacts – Elderly Mobility Best Practices

Design and Operational Roadway Improvements

John Abraham, NACEM Presentation

Detroit, Michigan - Sep 2004

Alabama

Linda Guin
FHWA
334 223-7377
Linda.Guin@fhwa.dot.gov

Arizona

Jennifer Brown
FHWA
602 379-3645
Jennifer.Brown@fhwa.dot.gov

Phoenix

Mike Cynecki
602 262-7217
mike.cynecki@phoenix.gov

Tucson

Richard Nassi
520 791-4259
Richard.nassi@tucsonaz.gov

California

James Elgin
Caltrans
530 225-3152
jim_elgin@dot.ca.gov

Irvine

Xx
Xx
xx

Florida

Mark Wilson
Florida DOT
850 414-4868
mark.Wilson@dot.state.fl.us

Clearwater

Ken Sides
727 562-4792
ksides@clearwater-fl.com

Georgia

Dana Robbins
FHWA
404 562-3642
Dana.Robbins@fhwa.dot.gov

Gwinnett County

Martin Bretherton
770 882-7412
brethema@co.gwinnett.ga.us

Illinois

Mike Staggs
FHWA
217 492-4630
Mike.Staggs@fhwa.dot.gov

Iowa

Tom Welch
Iowa DOT
515 239-1267
tom.welch@dot.state.ia.us

Kansas

Bob Alva
FHWA
785 267-7286
Robert.Alva@fhwa.dot.gov

Louisiana

John Broemmelsiek
FHWA
225-757-7614
John.Broemmelsiek@fhwa.dot.gov

Maryland

Mike Niederhauser
Maryland DOT
410 787-5813
mniederhauser@sha.state.md.us

Massachusetts**Cambridge**

Jeff Parenti
617 349-4715
jparenti@cambridgema.gov

Michigan

Dave Morena
FHWA
517 702-1836
David.Morena@fhwa.dot.gov

Farmington Hills

Kevin McCarthy
248 871-2570
KMcCarthy@ci.farmington-hills.mi.us

Ingham County

Dave Sonnenberg
517 676-9722
DAVES@inghamerc.org

Lansing

Andrew Kilpatrick
517 483-4247
akilpatr@ci.lansing.mi.us

Troy

John Abraham
248 524-3379
abrahamjk@ci.troy.mi.us

Mississippi

Teresa Pace
FHWA
601 965-4220
Teresa.Pace@fhwa.dot.gov

Missouri**Kansas City**

Sam Akula
816 513-9339
Sam_Akula@kcmo.org

Nebraska

John Perry
FHWA
402 437-5974

John.J.Perry@fhwa.dot.gov

Nevada**Las Vegas**

Mike Janssen
702 229-4866
mjanssen@ci.las-vegas.nv.us

New Hampshire

Martin Calawa
FHWA
603 228-3057, x 108
Martin.Calawa@fhwa.dot.gov

New York

Emmett McDevitt
FHWA
518 431-4125, x 231
Emmett.McDevitt@fhwa.dot.gov

North Carolina

Chris Howard
North Carolina DOT
919 250-4151
cbhoward@dot.state.nc.us

North Dakota

Steve Busek
FHWA
701 250-4343, x 112
Steven.Busek@fhwa.dot.gov

Ohio

Joe Glinski
FHWA
614 280-6844
Joseph.Glinski@fhwa.dot.gov

Oregon

Xxx
Oregon DOT
Xx
Xx

Pennsylvania

Art Breneman
Pennsylvania DOT
717 787-3620
abreneman@state.pa.us

Texas

Brian Stanford

Texas DOT

512 416-3122

bstanfo@dot.state.tx.us

Virginia

Mark Hagen

Virginia DOT

703 383-2872

xx

Wisconsin

Deborah Kozol

Wisconsin DOT

608 266-5096

Deborah.kozol@dot.state.wi.us

STATE LIBRARY OF IOWA



3 1723 02098 7624