Highway Safety Manual Update

Joe Santos, State Safety Office, FDOT

Victor Muchuruza, Environmental Management Office, FDOT

Martha Hodgson, Systems Planning Office/ Environmental Management Office, FDOT

Alan El-Urfali, Traffic Operations, FDOT

Poll Slide #1

What influenced you to attend this session?

1. Recommended by a co-worker
2. My Boss
3. Interest in the topic
4. Related to my job

Poll Slide #2

Employer/representation

1. Federal Government
2. State Government
3. Local Government
4. Consultant
5. General Public

Poll Slide #3

Level of Understanding of the use of the HSM

1. I don't understand
2. I need more practice
3. I understand and can do this myself
4. I can do this and explain to someone else

Highway Safety Manual Update

- Statewide Update – Joe Santos
- Planning update – Martha Hodgson
- EMO Update – Victor Muchuruza
- Roadway Design Update – Jeremy Fletcher
- Traffic Operations Update – Alan El-Urfali
- Resources and References – Joe Santos
- Questions/Roundtable - All

Highway Safety Manual Update

Statewide Update

Joe Santos, PE, State Safety Engineer, State Safety Office, FDOT, Central Office (Tallahassee)

Highway Safety Manual Update

- Statewide Update – Joe Santos
  - CO HSM Core Team and District Champions
  - HSM Implementation Policy
  - HSM Training (WBT and Workshops)

Highway Safety Manual Update

Planning Update

Martha Hodgson, Systems Planning Office/Environmental Management Office, FDOT, Central Office (Tallahassee)

Safety Data for Interchange Access Requests (IARs)

- Past
  - Crash Rates
- Present
  - Crash Patterns
    - Location
    - Type
    - Review
- Stretch Goals
  - Interactive Highway Safety Design Model (IHSDM)
  - *Interchange Safety Analysis Tool-Enhanced (ISATe)*

Data

+

Tools

=

Improved Decision Making

Interchange Safety Analysis Tool-Enhanced (ISATe) Research

- Quantify the accuracy of the HSM's safety prediction methodology within ISATe Tool
  - Before and After testing
- Secondary outcomes
  - Data Requirements
  - Level of Effort

❖ Separate effort to develop methodology guidance for using HSM tools in IAR processes

Existing Guidance

- Interchange Access Request Users Guide
- Traffic Analysis Handbook

- Require
  - 3 years of data
  - Crash Types
  - Crash Locations
  - Review of data
  - No adverse impact on the safety of the interstate or crossroad
- Recommend
  - 5 years of data
  - HSM

Highway Safety Manual Update

Project Development and Environmental (PD&E) Update

Victor Muchuruza, Environmental Management Office, FDOT, Central Office (Tallahassee)

2016 Design Training Expo

Safety Analysis in PD&E Studies

- Safety is part of existing conditions analysis—evaluate existing safety performance

- Safety is one of the criteria in Comparative Alternatives Analysis

Procedural Guidance is included in the NEW Part 1, Chapter 5 Traffic Analysis Chapter (Under Final Approval)

Safety Analysis

- Analyze crash history to assess the existing safety performance and evaluate the potential safety implications of a project
- Assess future safety performance using predictive methods such as *HSM* methodologies and tools
- Exercise engineering judgment when analyzing, interpreting and presenting safety performance of a project in conjunction with other criteria
- Meaningfully present safety performance of a project to both technical and nontechnical audiences

Use of HSM in PD&E Studies

The following project development activities can benefit from the use of HSM:

- Define or refine purpose and need for the project
- Develop and refine project alternatives
- Analyze and evaluate project alternatives

It may be possible to estimate predicted crashes and expected crashes for the future

Use of HSM in PD&E Studies

- Estimating future crashes with and without safety improvements
- HSM's human factors fundamentals can help project analysts identify safety-specific needs for the projects and estimate the potential for safety improvements.
- Relative comparisons of magnitude of potential safety impacts based on change in crash frequency from CMFs

Alternatives Evaluation

- Appropriately use HSM to quantify the anticipated change in crash as the result of proposed improvements

- If Purpose and Need for a project is Safety
  - Eliminate alternatives that would have negligible or adverse effect on safety
  - The documentation to support the elimination of alternatives could include the information derived from the *HSM* methods
  - Propose mitigation to address safety impacts

Scoping HSM Safety Analysis

- Safety is part of Purpose and Need for the project
- Projects that claim a safety benefit
- Projects where there could be a substantial difference in safety for the alternatives analyzed
- Projects with existing safety issues

Highway Safety Manual Update

Roadway Design Update

Jeremy Fletcher, PE, Roadway Design Office, FDOT, Central Office (Tallahassee)

2016 Design Training Expo

Roadway Highlights

- Developing Roadway Processes
- New PPM Language and Tables
- I-10/I-95 Interchange Design Exceptions
- I-95 Express Design Exceptions
- Intersection Lighting Justification Process
- Florida Specific HSM Functions and CMFs
- Training

Roadway Tool: How we use it…

- Typical Section evaluations
  - Width Reallocations
  - Constrained urban areas
  - Complete Street retrofits
- Design Exceptions and Variations
- Justifications for:
  - Roadway improvements
  - Widening
  - Site specific safety issues

PPM Language

- ***PPM Section 23.4: Highway Safety Manual (HSM)***

The AASHTO Highway Safety Manual provides analytical tools and techniques for quantifying the potential effects on crashes as a result of decisions made in planning, design, operations and maintenance. The new techniques and knowledge in the HSM reflect the evolution in safety analysis from descriptive (historical) methods to quantitative, predictive analyses.

PPM Tables for HSM Analyses

Table 23.5.3 HSM Calibration Factors for Florida (2012)

FDOT Segment Calibration Factors		
Segment Type	**Abbreviation**	**Calibration Factor (C_x)**
Rural 2-lane, 2-way Undivided	R2U	1.00
Rural 4-lane Divided	R4D	0.68
Urban 2-lane Undivided	U2U	1.02
Urban 3-lane with a Center Two-Way Left Turn Lane	U32LT	1.04
Urban 4-lane Undivided	U4U	0.73
Urban 4-lane Divided	U4D	1.63
Urban 3-lane with a Center Two-Way Left Turn Lane	U52LT	0.70
FDOT Intersection Calibration Factors		
Rural 2-lane 3-Leg Stop-Controlled Intersection	R23ST	1.30
Rural 2-lane 4-Leg Stop-Controlled Intersection	R24ST	0.90
Rural 2-lane 4-Leg Signalized Intersection	R24SG	1.00
Rural Multilane 4-Leg Signalized Intersection	RM4SG	1.00
Urban 3-Leg Stop-Controlled Intersection	U3ST	0.98
Urban 3-Leg Signalized Intersection	U3SG	1.56
Urban 4-Leg Signalized Intersection	U4SG	1.00

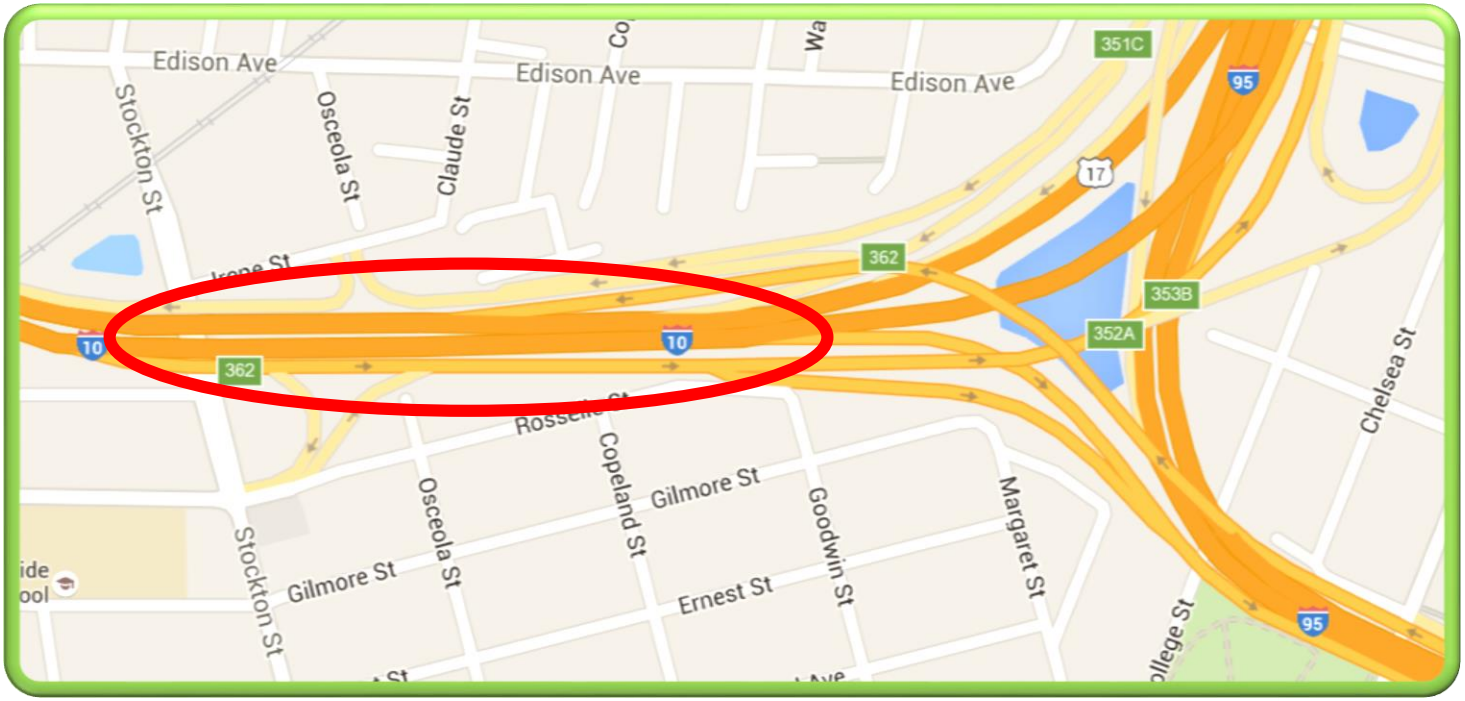
PPM Tables for HSM Analyses

Table 23.5.4 HSM Crash Distribution for Florida (2010-2014)

		Rural Roadways			Urban & Suburban Arterials					Freeways			All
Facility Type		2-lane Undivided (R2U)	4-lane Undivided (R4U)	4-lane Divided (R4D)	2-lane Undivided (U2U)	3-lane TWLTL (U32LT)	4-lane Undivided (U4U)	4-lane Divided (U4D)	5-lane TWLTL (U52LT)	Rural	Urban	Ramps	All Roadways & Ramps
Fatal	K	0.032	0.029	0.030	0.009	N/A	0.005	0.008	N/A	0.019	0.006	0.004	0.008
Incapacitating Injury	A	0.116	0.111	0.112	0.062	N/A	0.037	0.055	N/A	0.081	0.043	0.039	0.049
Non-incapacitating Injury	B	0.196	0.182	0.206	0.166	N/A	0.126	0.158	N/A	0.165	0.131	0.124	0.141
Possible (or minor) Injury	C	0.196	0.219	0.197	0.223	N/A	0.209	0.239	N/A	0.177	0.216	0.223	0.224
Property Damage Only	O	0.461	0.460	0.453	0.540	N/A	0.623	0.540	N/A	0.558	0.604	0.610	0.577

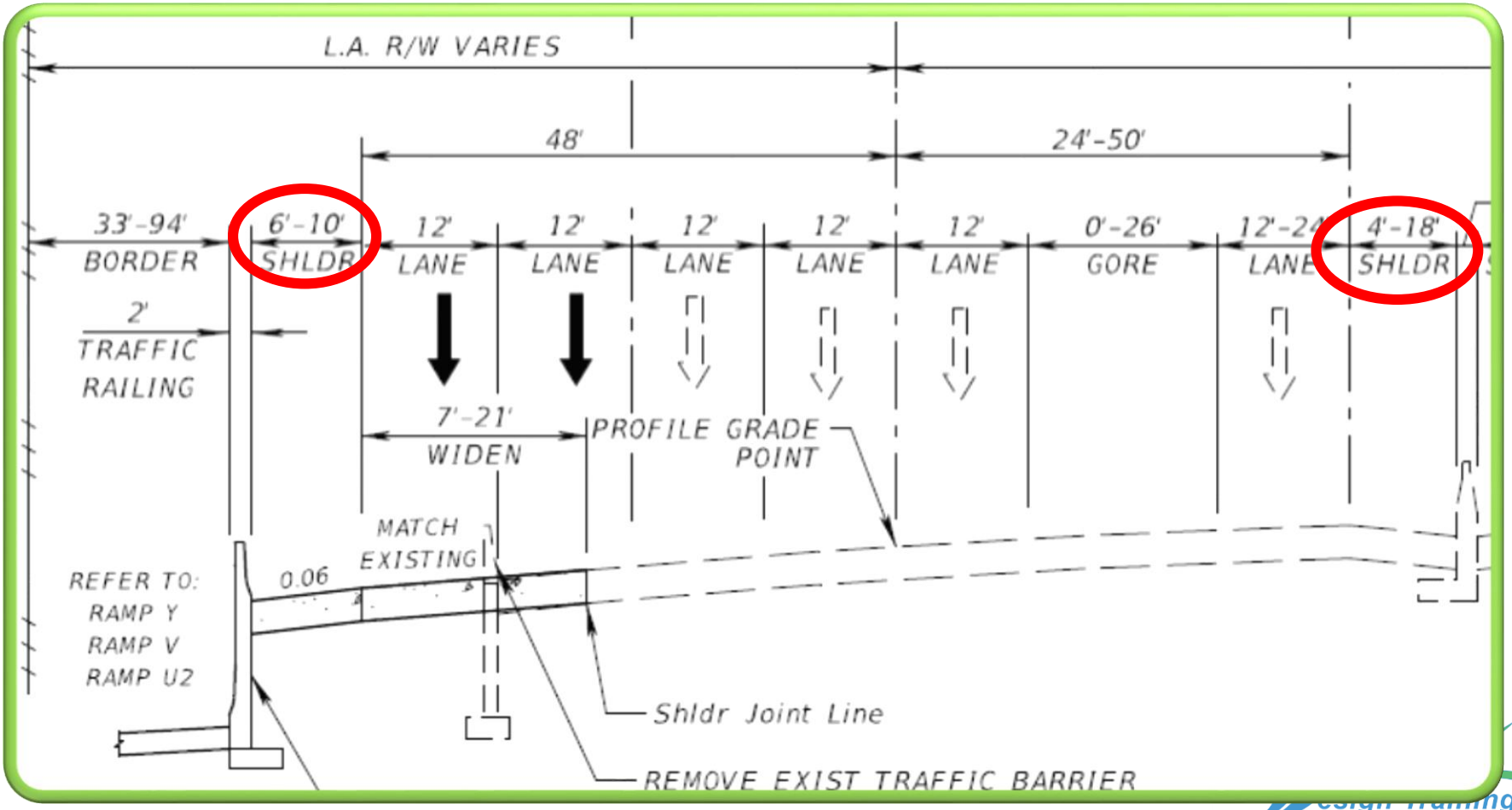
HSM I-10/I-95 Example

- Operational Improvements Project
  - Design Exception for Shoulder Width



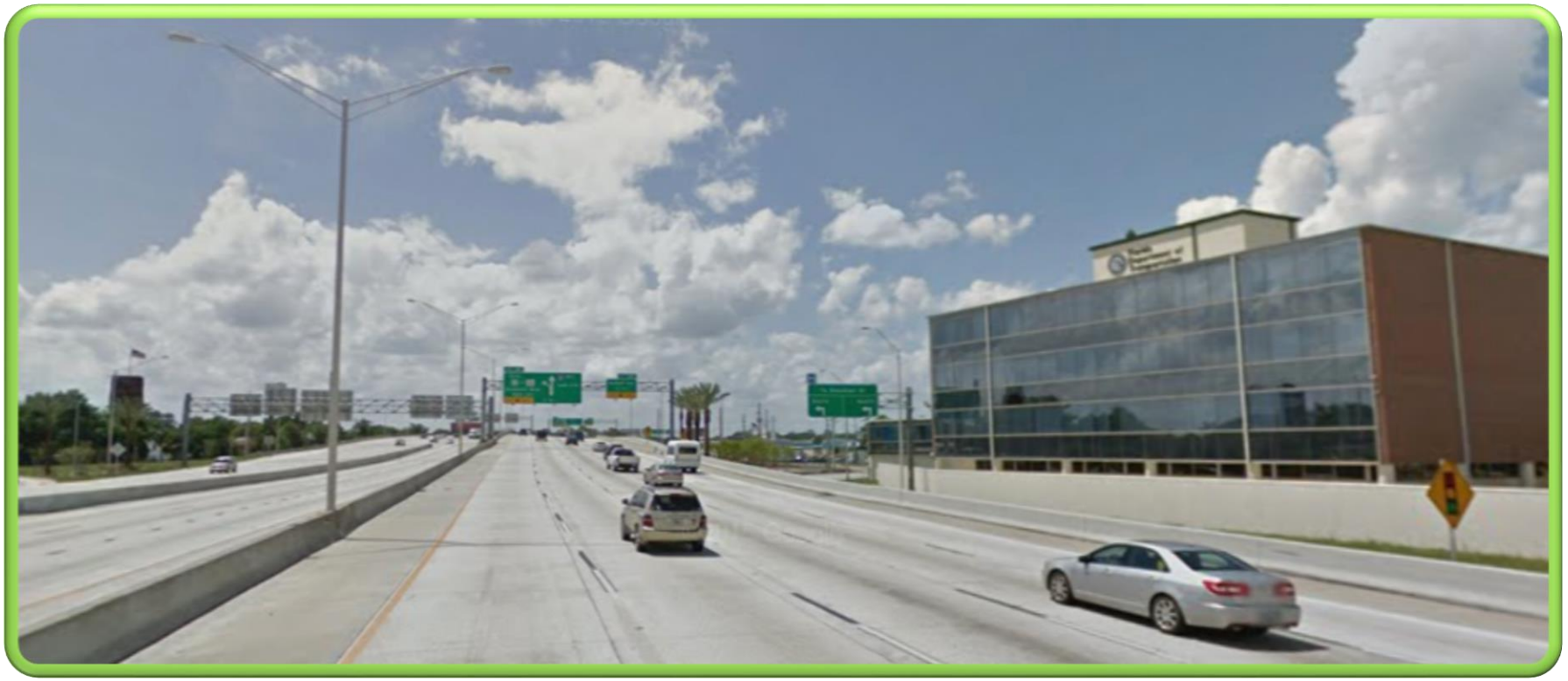
HSM I-10/I-95 Example

- I-10 Westbound (Looking East)
  - Substandard Inside and Outside Shoulder Width



HSM I-10/I-95 Example

- Existing Condition



HSM I-10/I-95 Example

- Single vehicle crashes…

HSM I-10/I-95 Example

- Multiple vehicle crashes…

HSM I-10/I-95 Example

- Calculating Mainline Shoulder Width CMFs
  - Use Weighted Average or Narrowest Width
  - Multi-Single Vehicle CMFs

Inside Shoulder Width CMF - 3

This segment has 12-foot paved shoulder.

$$CMF_{3,fs,ac,mv,fi} = \exp(ax[W_{is} - 6]) = \exp(-0.0172x[8.5-6]) = \mathbf{0.958}$$

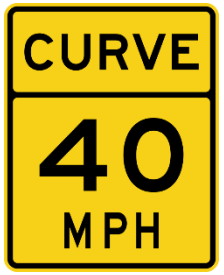
$$CMF_{3,fs,ac,mv,pdo} = \exp(ax[W_{is} - 6]) = \exp(-0.0153x[8.5-6]) = \mathbf{0.962}$$

$$CMF_{3,fs,ac,sv,fi} = \exp(ax[W_{is} - 6]) = \exp(-0.0172x[8.5-6]) = \mathbf{0.958}$$

$$CMF_{3,fs,ac,sv,pdo} = \exp(ax[W_{is} - 6]) = \exp(-0.0153x[8.5-6]) = \mathbf{0.962}$$

HSM I-10/I-95 Example

- Calculating Horizontal Curve CMFs for Ramps
  - Average Entry Speed for Curve ($V_{ent,\,i}$) in ft/s
    - Engineering Judgment
    - Posted Speed or Greater
    - Advisory Speed or Greater



Horizontal Curve CMF -1

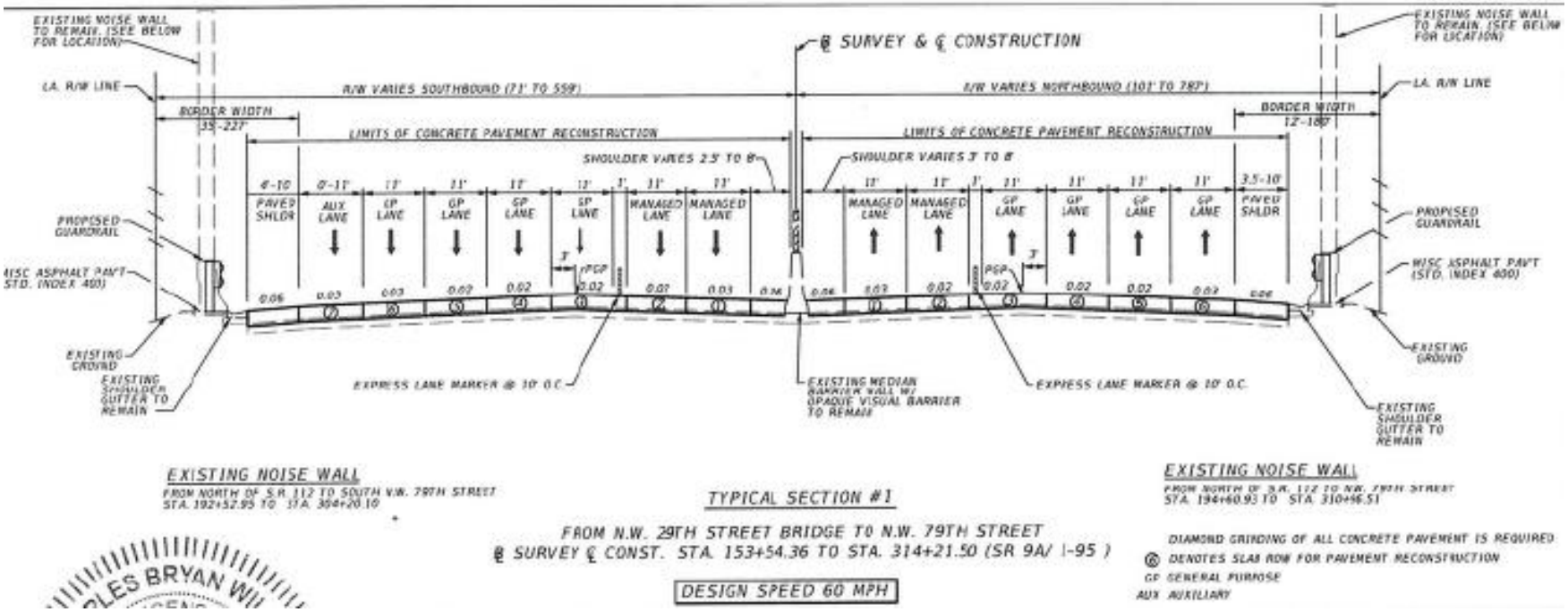
$$CMF_{1,\,rps,\,2ex,\,y,\,z} = 1.0 + ax\ (1{,}000/32.2)[\sum(v_{ent,I} / R_i)^2\ P_{c,i}]$$

$$\sum(v_{ent,I} / R_i)^2\ P_{c,I} = ((22/1650)^{2}*0.66) + ((22/2869)^{2}*0.14) + ((22/212)^{2}*0.19) = 0.0022$$

2016 Design Training Expo

HSM I-95 Express: Lane Widths

HSM I-95 Express: Typical Section



EXISTING NOISE WALL
FROM NORTH OF S.R. 112 TO SOUTH N.W. 79TH STREET
STA. 192+52.95 TO STA. 304+20.10

TYPICAL SECTION #1

FROM N.W. 29TH STREET BRIDGE TO N.W. 79TH STREET
℄ SURVEY ℄ CONST. STA. 153+54.36 TO STA. 314+21.50 (SR 9A/ I-95)

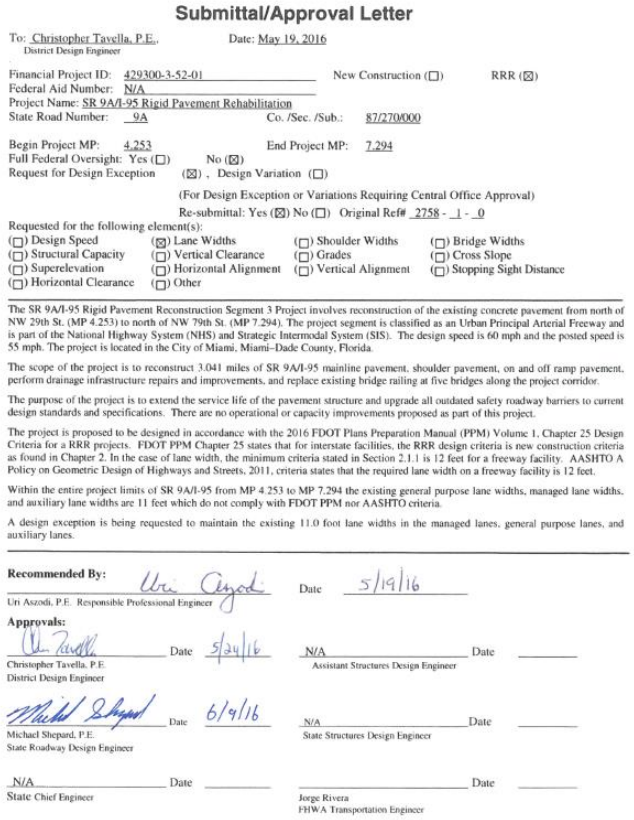
DESIGN SPEED 60 MPH

EXISTING NOISE WALL
FROM NORTH OF S.R. 112 TO N.W. 79TH STREET
STA. 194+60.93 TO STA. 310+96.51

DIAMOND GRINDING OF ALL CONCRETE PAVEMENT IS REQUIRED
Ⓡ DENOTES SLAB R&W FOR PAVEMENT RECONSTRUCTION
GP GENERAL PURPOSE
AUX AUXILIARY

HSM I-95 Express: Lane Width

- Dual Analysis using HCM and HSM
- High Crash Costs
- Very High R/W and Construction Costs



Submittal/Approval Letter

To: Christopher Tavella, P.E., District Design Engineer — Date: May 19, 2016

Financial Project ID: 429300-3-52-01 — New Construction (☐) — RRR (☒)
Federal Aid Number: N/A
Project Name: SR 9A/I-95 Rigid Pavement Rehabilitation
State Road Number: 9A — Co. /Sec. /Sub.: 87/270/000

Begin Project MP: 4.253 — End Project MP: 7.294
Full Federal Oversight: Yes (☐) No (☒)
Request for Design Exception (☒), Design Variation (☐)

(For Design Exception or Variations Requiring Central Office Approval)
Re-submittal: Yes (☒) No (☐) Original Ref# 2758 - 1 - 0

Requested for the following element(s):

(☐) Design Speed	(☒) Lane Widths	(☐) Shoulder Widths	(☐) Bridge Widths
(☐) Structural Capacity	(☐) Vertical Clearance	(☐) Grades	(☐) Cross Slope
(☐) Superelevation	(☐) Horizontal Alignment	(☐) Vertical Alignment	(☐) Stopping Sight Distance
(☐) Horizontal Clearance	(☐) Other		

The SR 9A/I-95 Rigid Pavement Reconstruction Segment 3 Project involves reconstruction of the existing concrete pavement from north of NW 29th St. (MP 4.253) to north of NW 79th St. (MP 7.294). The project segment is classified as an Urban Principal Arterial Freeway and is part of the National Highway System (NHS) and Strategic Intermodal System (SIS). The design speed is 60 mph and the posted speed is 55 mph. The project is located in the City of Miami, Miami–Dade County, Florida.

The scope of the project is to reconstruct 3.041 miles of SR 9A/I-95 mainline pavement, shoulder pavement, on and off ramp pavement, perform drainage infrastructure repairs and improvements, and replace existing bridge railing at five bridges along the project corridor.

The purpose of the project is to extend the service life of the pavement structure and upgrade all outdated safety roadway barriers to current design standards and specifications. There are no operational or capacity improvements proposed as part of this project.

The project is proposed to be designed in accordance with the 2016 FDOT Plans Preparation Manual (PPM) Volume 1, Chapter 25 Design Criteria for a RRR projects. FDOT PPM Chapter 25 states that for interstate facilities, the RRR design criteria is new construction criteria as found in Chapter 2. In the case of lane width, the minimum criteria stated in Section 2.1.1 is 12 feet for a freeway facility. AASHTO A Policy on Geometric Design of Highways and Streets, 2011, criteria states that the required lane width on a freeway facility is 12 feet.

Within the entire project limits of SR 9A/I-95 from MP 4.253 to MP 7.294 the existing general purpose lane widths, managed lane widths, and auxiliary lane widths are 11 feet which do not comply with FDOT PPM nor AASHTO criteria.

A design exception is being requested to maintain the existing 11.0 foot lane widths in the managed lanes, general purpose lanes, and auxiliary lanes.

Recommended By: Uri Ayod — Date 5/19/16
Uri Aszodi, P.E. Responsible Professional Engineer

Approvals:

Christopher Tavella, P.E. — Date 5/24/16
District Design Engineer

N/A — Date
Assistant Structures Design Engineer

Michael Shepard, P.E. — Date 6/4/16
State Roadway Design Engineer

N/A — Date
State Structures Design Engineer

N/A — Date
State Chief Engineer

Jorge Rivera — Date
FHWA Transportation Engineer

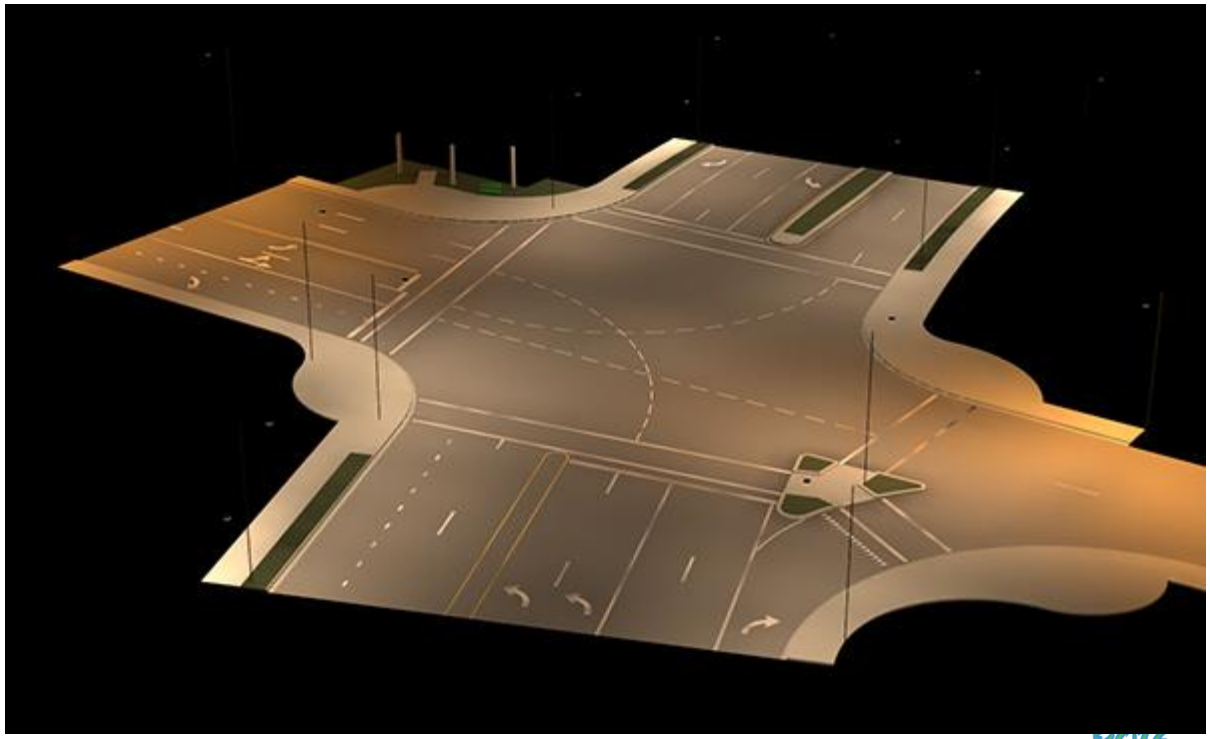
2016 Design Training Expo

Intersection Lighting Analysis

- FDOT Vision: Fatality Free-Let's reduce Nighttime Pedestrian Crashes.

Intersection Lighting Analysis

- HSM CMFs: Nighttime Pedestrian Crash Reductions (42%),
- 38% Reduction (All Nighttime Injury Crashes)



Intersection Lighting Proposal

- Prioritized using HSM Method from Chapter 7.
- Justified based on Benefit-Costs.
- Segments of Intersections Planned for Retrofits.
- LED Lighting is planned.
- District Distributions for funding calculated based on need.
- Justified lighting for over 2500 Intersections.

HSM Training Deliveries

- Two-Day Design Exception Course (4-Hour HSM)
  - FY 15/16 (FDOT Staff)
    - D-2, D-4, TPE (Consultant Delivery)
  - FY 16/17 (FDOT Staff)
    - D-1, D-3, D-5, D-6, D-7
- One-Day Design Exception Workshop
  - FY 16/17 (Consultants)
    - 5-District Workshops: Spring 2017, Remaining 3: Fall 2017
- HSM Webinars and Workshops (Fall ’16/Spring ‘17)

Roadway QA Contacts

Roadway Design / Quality Assurance / About Us

About Us

Jeremy Fletcher, P.E. P.S.M.
Quality Assurance Administrator
(850) 414-4320
Email: **Jeremy.Fletcher@dot.state.fl.us**

Benjamin Gerrell, P.E.
Quality Assurance Engineer
(850) 414-4318
Email: **Benjamin.Gerrell@dot.state.fl.us**

Brad Bradley, P.E.
Quality Assurance Engineer
(850) 414-4295
Email: **Brad.Bradley@dot.state.fl.us**

Taylor Carlquist
Quality Assurance Engineer
(850) 414-4317
Email: **Taylor.Carlquist@dot.state.fl.us**

Highway Safety Manual Update

Traffic Operations Update

Alan El-Urfali, PE, Traffic Operations, FDOT, Central Office (Tallahassee)

New MUTS Chapter

CHAPTER 5 DATA COLLECTION FOR TRANSPORTATION SAFETY STUDIES

5.1 PURPOSE

(1) The purpose of the ***Traffic Safety Studies*** chapter is to provide guidance on the data collection requirements for conducting a safety study including application of the Highway Safety Manual (HSM). This chapter is divided into urban/suburban arterials and rural roadways. It is further subdivided into segments and intersections within each of these sections. Classifying an area as urban, suburban, or rural is subject to the roadway characteristics, surrounding population, and land uses, and is at the user's discretion. The HSM provides guidance on urban and suburban classification by population in the *Part C – Introduction and Application Guidance*.

Table 5-1. Facility Types and Site Types Included in the HSM Predictive Method (Source: Highway Safety Manual, 2010, Table 3-2)

HSM Chapter	Undivided Roadway Segments	Divided Roadway Segments	Intersections			
			Stop Control on Minor Legs		Signalized	
			3-Leg	4-Leg	3-Leg	4-Leg
10. Rural Two-Lane highways	✓		✓	✓		✓
11. Rural Multi-Lane Highways[1]	✓	✓	✓	✓		✓
12. Urban and Suburban Aterials[2]	✓	✓	✓	✓	✓	✓

1. Methodology available for four lane divided and undivided. No methodology is currently available for six lane rural highways.
2. Methodology available for two lane undivided, three lane with center two way left turn lane, four lane divided and undivided, and five lane with center two way left turn lane. The methodology for six lane arterials is under development.

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

DATA COLLECTION RURAL MULTI-LANE ROADWAYS

750-020-05b
TRAFFIC ENGINEERING OPERATIONS
10/15

Gerneral Analysis Information		Site Information	
Segment Number		Roadway Name	
Segment Limits		Location	
Analysis Year		Project Number	

Notes

1) A roadway must have homogeneous characteristics in order to be analyzed as a single segment. If any characteristics change, including any of the data inputs in this spreadsheet, then the roadway must be analyzed as separate segments and this spreadsheet should be copied and filled out for each analysis ssegment independently.
2) Values in this spreadsheet may be copied and pasted directly into NCHRP 17-38 spreadsheets which are available from FDOT Safety Office upon request. Note that only values and not formulas should be copied.

Field Data Collection

Roadway type (divided / undivided)			
Length of segment, L (mi)			
AADT (veh/day)	$AADT_{MAX}$ =	89,300 (Divided) 33,200 (Undivided)	(veh/day)
Lane width (ft)			
Shoulder width (ft) - right shoulder width for divided [if differ for directions of travel, use average width]			
Shoulder type - right shoulder type for divided			
Median width (ft) - for divided only (if analyzing an undivided segment, place the text "Not Applicable" in the input box)			
Side Slopes - for undivided only (if analyzing a divided segment, place the text "Not Applicable" in the input box)			
Lighting (present/not present)			
Auto speed enforcement (present/not present)			
Calibration Factor, Cr			

Source: NCHRP 17-38 HSM Spreadsheets

750-020-05g
TRAFFIC ENGINEERING OPERATIONS
10/15

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

DATA COLLECTION URBAN/SUBURBAN ARTERIALS - INTERSECTIONS

Gerneral Analysis Information		Site Information	
Intersection Number		Roadway Name	
Intersection Name		Location	
Analysis Year		Project Number	

Notes

1) Values in this spreadsheet may be copied and pasted directly into NCHRP 17-38 spreadsheets which are available from FDOT Safety Office upon request. Note that only values, and not formulas should be copied.

2) 3ST= 3 leg stop control, 3SG= 3 leg signalized, 4ST = 4 leg stop control, 4SG = 4 leg signalized

Field Data Collection

Intersection type (3ST, 3SG, 4ST, 4SG)	
AADT $_{major}$ (veh/day) — $AADT_{MAX}$ = 67,700 veh/day)	
AADT $_{minor}$ (veh/day) — $AADT_{MAX}$ = 33,400 veh/day)	
Intersection lighting (present/not present)	
Calibration factor, C_i	
Data for unsignalized intersections only:	
Number of major-road approaches with left-turn lanes (0,1,2)	
Number of major-road approaches with right-turn lanes (0,1,2)	
Data for signalized intersections only:	
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]	
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]	
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]	
Type of left-turn signal phasing for Leg #1	
Type of left-turn signal phasing for Leg #2	
Type of left-turn signal phasing for Leg #3	
Type of left-turn signal phasing for Leg #4 (if applicable)	
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]	
Intersection red light cameras (present/not present)	
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only	
Maximum number of lanes crossed by a pedestrian (n_{lanesx})	
Number of bus stops within 300 m (1,000 ft) of the intersection	
Schools within 300 m (1,000 ft) of the intersection (present/not present)	
Number of alcohol sales establishments within 1,000 ft of the intersection	

Source: NCHRP 17-38 HSM Spreadsheets

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

750-020-05
TRAFFIC ENGINEERING OPERATIONS
10/15

COLLISION DIAGRAM - INTERSECTION

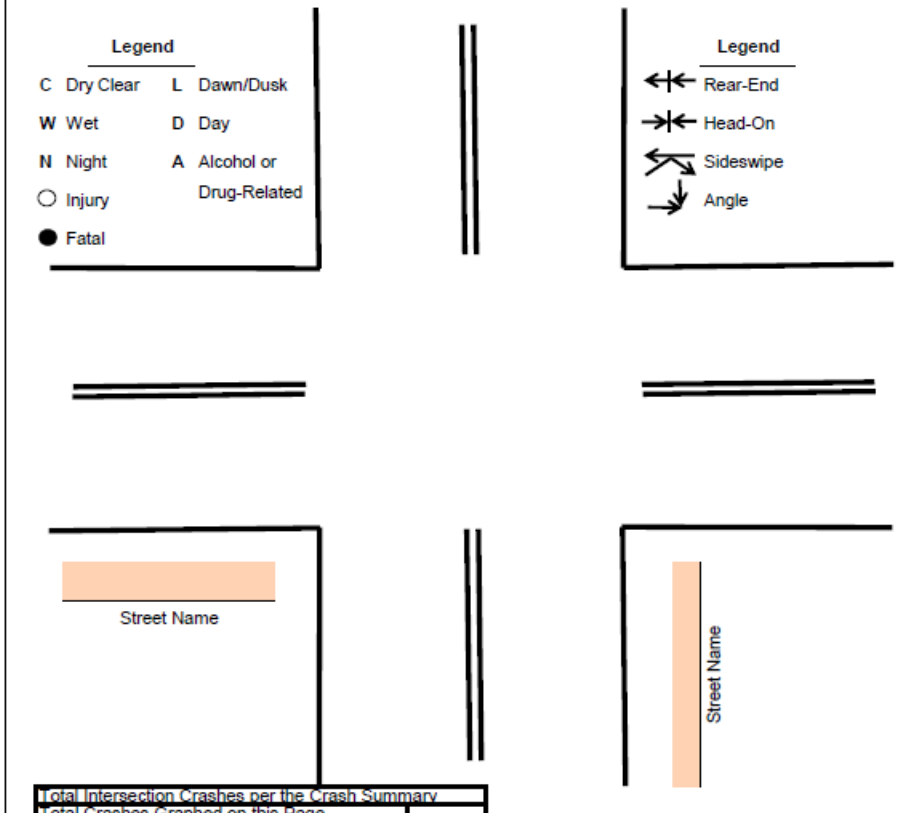
General Analysis Information		Site Information	
Intersection Number			
Intersection Name		Location	
Analysis Years		Project Number	

Notes

1) Collision diagram symbology illustrated in Figure 5-4 of Chapter 5 of the Highway Safety Manual should be used.

2) The legend may be used to clarify symbology that identifies total number of crashes, injuries, fatalities, pavement conditions, etc.

Field Data Collection



Total Intersection Crashes per the Crash Summary	
Total Crashes Graphed on this Page	
Total Injury Crashes	
Total Fatal Crashes	
Total PDO Crashes	

Source: Adapted from HSM Figure 5-4

CHAPTER 14 ROADWAY LIGHTING JUSTIFICATION PROCEDURE

14.1 PURPOSE

(1) The procedures for roadway lighting justification are based on FHWA guidelines contained in the ***August 2012 FHWA Lighting Handbook***. In Florida, the predictive methodologies contained in Part C of the ***Highway Safety Manual*** (HSM) are given priority and should be used for the lighting justification crash cost analysis where applicable. The safety impact of existing or proposed lighting projects can be quantified with predictive equations (safety performance functions – SPFs) available in the HSM. These formulas allow for the prediction of crash frequency for a given facility with and without lighting. The crash benefit of lighting installation is then converted to dollars and a benefit/cost (B/C) ratio and/or net present value (NPV) is computed using the cost of the lighting project.

Figure 14-1. Lighting Geometric and Operational Factors Form No. 750-020-20

State of Florida Department of Transportation

Form 750-020-20
TRAFFIC ENGINEERING
February 2015

LIGHTING GEOMETRIC AND OPERATIONAL FACTORS

Item No.	Classification Factor	Rating Factor "R"					Weight "W"	Enter "R" Here	Score "R"x"W"
		1	2	3	4	5			
	Geometric Factors (See Note 6)								
1	Number of Lanes	≤4	5	6	7	≥8	0.15	3	0.45
2	Lane Width (ft.)	>11.8	11.2 to 11.8	10.5 to 11.2	9.8 to 10.5	<9.8	0.35	2	0.7
3	Median Openings/mile	<4 or 1-way	4 to 8	8 to 12	12 to 15	>15 or No Median	1.40	2	2.8
4	Driveways and Entrances/mile	<32	32 to 64	64 to 97	97 to 129	>129	1.40	2	2.8
5	Horizontal Curve Radius (ft.)	>1969	1476 to 1969	738 to 1476	574 to 738	<574	5.90	5	29.5
6	Vertical Grades (%)	<3	3 to 4	4 to 5	5 to 7	>7	0.35	1	0.35
7	Sight Distance (ft.)	>689	492 to 689	295 to 492	197 to 295	<197	0.15	4	0.6
8	Parking	Prohibited	Loading	Off Peak	One Side	Both Sides	0.10	1	0.1
							Subtotal Geometric Factors		37.3 G
	Operational Factors								
9	Signalized Intersections (%)	80 to 100	70 to 80	60 to 70	50 to 60	0 to 50	0.15	2	0.3
10	Left Turn Lane	All Major Intersections or 1-way	Substantial Number of Major Intersections	Most Major Intersections	Half of the Intersections	Infrequent Number or TWTL (See Notes 1 & 3)	0.70	3	2.1
11	Median Width (ft.)	> 32	20 to 32	10 to 20	4 to 10	0 to 4	0.35	3	1.05
12	Operating or Posted Speed (mph) (See Note 5)	≤ 25	30	35	45	≥50	0.60	4	2.4
13	Pedestrian Activity Level (See Note 2)			Low	Medium	High	3.15	3	9.45
							Subtotal Environmental Factors		15.3 O
	Environmental Factors								
14	Percentage of Development Adjacent to Road (%) (See Note 4)	nil	nil to 30	30 to 60	60 to 90	>90	0.15	4	0.6
15	Area Classification	Rural	Industrial	Residential	Commercial	Downtown	0.15	4	0.6
16	Distance from Development to Roadway (ft) (See Note 4)	>200	150 to 200	100 to 150	50 to 100	<50	0.15	100	15
17	Ambient (off Roadway) Lighting	Nil	Sparse	Moderate	Distracting	Intense	1.38	3	4.14
18	Raised Curb Median	None	Continuous	At All Intersections (100%)	At Most Intersections (51% to 99%)	At Few Intersections (≤50%) (See Note 7)	0.35	4	1.4
							Subtotal Environmental Factors		21.74 E
	Collision Factors								
19	Night-to-Day Collision Ratio	<1	1.0 to 1.2	1.2 to 1.5	1.5 to 2.0	>2.0 (See Note 1)	5.55	3	16.65
							Subtotal Collision Factors		16.65 A

Notes: 1 Lighting Warranted
2 Pedestrian Activity Level
3 Two Way Left Turn Lane
4 Development defined as Commercial, Industrial or Residential Buildings
5 85th Percentile night speed should be used if available, otherwise posted Speed Limit shall be used
6 Worst case geometric factors for a segment of roadway shall apply
7 Also includes isolated medians (non-continuous) between intersections

G + O + E + A = Total Warranting Points	90.99
Warranting Condition	60.00
Difference ±	30.99 D

14.3.1 Net Present Value Computations using the HSM Methodology

(1) The NPV computations when the HSM methodology is applicable can be computed using the procedure outlined in this section. The use of a spreadsheet is required. Example spreadsheets can be downloaded from the MUTS website for the application of the HSM Methodology NPV calculations. NPV computations can be conducted using a six step process, outlined as follows:

(c) Step 2A: Compute the annual costs using FDOT costs contained in Chapter 23 of the Plans Preparation Manual (PPM) and shown in the table below. The following tables below illustrate the computation for two years of data, 2012 and 2013. This process is repeated for each year in the design life of the project.

Crash Severity	Comprehensive Crash Cost
Fatal (K)	$10,100,000
Severe Injury (A)	$818,636
Moderate Injury (B)	$163,254
Minor Injury (C)	$99,645
Property Damage Only (O)	$6,500

Highway Safety Manual Update

Resources and References

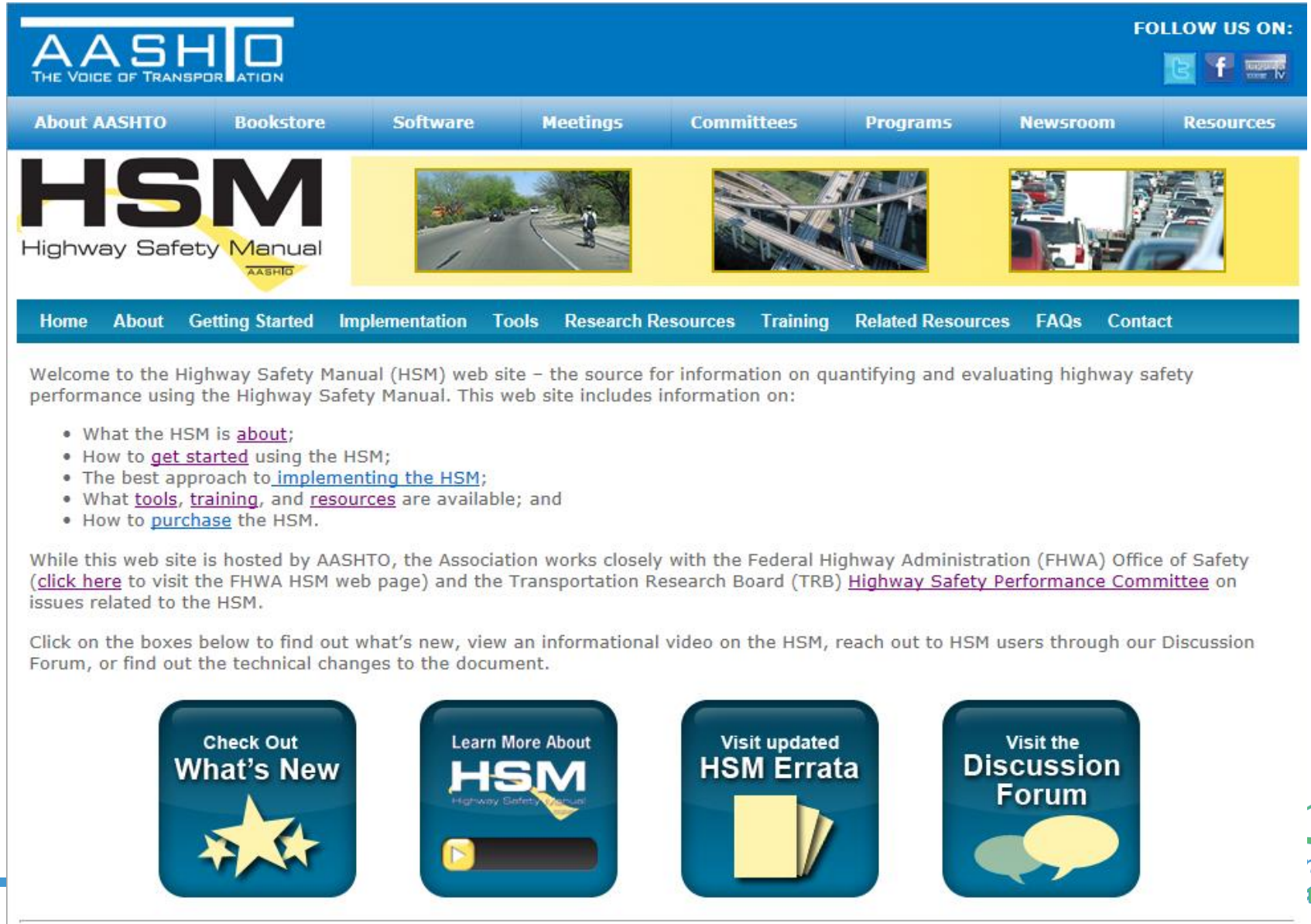
Joe Santos, PE, State Safety Engineer, State Safety Office, FDOT, Central Office (Tallahassee)

2016 Design Training Expo

HSM Websites

- AASHTO HSM, http://www.highwaysafetymanual.org/
  - About, Getting Started, Tools, Training, Resources
- FHWA HSM, http://safety.fhwa.dot.gov/rsdp/hsm.aspx
  - Outreach materials, Guidance, Case Studies
- FDOT HSM, http://www.dot.state.fl.us/safety/11A-SafetyEngineering/TransSafEng/HighwaySafetyManual.shtm
  - Crash Distribution, Calibration Factors, Organizational Chart, Implementation Summary, Implementation Plan Timeline, Presentations
- TRB, NCHRP 17-45, Freeways and Interchanges http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2512

HSM Websites – AASHTO HSM



HSM Websites – FHWA HSM

Highway Safety Manual

A new generation of highway safety analysis tools is being deployed to the transportation community through several innovative research efforts. The Highway Safety Manual (HSM) is published by the American Association of State Highway Transportation Officials (AASHTO). FHWA has developed supporting implementation tools including the Interactive Highway Safety Design Model (IHSDM) and the Crash Modification Factors (CMF) Clearinghouse. These tools will greatly advance state and local highway agencies' ability to incorporate explicit, quantitative consideration of safety into their planning and project development decision making.

The first edition of the HSM provides the best factual information and tools in a useful form to facilitate roadway planning, design, operations, and maintenance decisions based on precise consideration of their safety consequences. The primary focus of the HSM is the introduction and development of analytical tools for predicting the impact of transportation project and program decisions on road safety.

AASHTO's Highway Safety Manual Webpage

AASHTO's Highway Safety Manual webpage, highwaysafetymanual.org, serves as the official HSM website where you can find the most up to date information and new developments on the HSM.

HSM Outreach Materials
HSM Technical Support
Guidance
HSM Training
Case Studies
HSM Data Support
HSM Tools
Additional Resources

HSM Outreach Materials

- HSM Overview Brochure

HSM Websites – FDOT HSM

State Safety Office

State Safety Office / Safety Engineering / Highway Safety Manual

Highway Safety Manual

Welcome to the Florida Department of Transportation Highway Safety Manual (HSM) webpage on HSM statewide implementation efforts. This page will be focused on providing information on what implementation efforts have been done and are planned to do. Key information will include implementation plan timeline, management presentations, district projects, and training schedules. Also included on the site will be links to national implementation efforts of the HSM. We welcome you to visit the site often as this page will be frequently updated as the department moves forward with HSM implementation efforts.

Please feel free to contact Joe Santos, FDOT, Safety Engineer, **joseph.santos@dot.state.fl.us**, 850.414.4097 should you have any questions.

FDOT HSM User Guide 2015

FDOT Crash Distribution 2008-2012

FDOT Calibration Factors 2012

FDOT HSM Organizational Chart

FDOT HSM Implementation Summary

FDOT HSM Implementation Plan Timeline

National Training Activities

http://www.highwaysafetymanual.org/Pages/Training.aspx

Training

AASHTO > Highway Safety Manual > Training

Training is an important first step before using the HSM. Following is a brief description of the various training programs currently available to help state DOTs maximize the effectiveness of the HSM.

HSM Online Overview Course – (FHWA-NHI 380106) is now available free of charge through the National Highway Institute (NHI) web site.

HSM Training Guide – This guide focuses on identifying HSM training currently available to state and local agencies who are considering implementation of the HSM.

NHI HSM Training Courses – FHWA has developed training courses on specific parts of the HSM that are offered through the National Highway Institute (NHI).

Webinar Series – The FHWA HSM webinar series, which began in June 2010, was recorded.

Training Webinars – These webinars are available from the FHWA Resource Center.

US Roadway Safety.org – This web site has a searchable database for safety training courses.

HSM Training

- National Highway Institute (NHI),
- http://www.nhi.fhwa.dot.gov/training
  - FHWA-NHI-380106, Highway Safety Manual Online Overview
    - Free Web Based Training (WBT) course includes an introduction of terminology, examples of the Roadway Safety Management Process (Part B) and Predictive Methods (Part C), explains the relationship of Crash Modification Factors (CMFs) to decision making and quantitative safety analysis, and human factors
    - Length: 12 Hours

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CONTACT INFORMATION

Victor Muchuruza, PhD, PE, PTOE
FDOT, State Environmental Development Engineer
(850) 414-5269
victor.muchuruza@dot.state.fl.us

Jeremy W. Fletcher, P.E., P.S.M.
FDOT, Roadway Quality Assurance Administrator
(850) 414-4320
Jeremy.fletcher@dot.state.fl.us

Alan S. El-Urfali, P.E.
FDOT, State Traffic Services Program Engineer
(850) 410-5416 - Office
alan.el-urfali@dot.state.fl.us

Joe Santos, PE
FDOT, State Safety Engineer
(850) 414-4097
Joseph.santos@dot.state.fl.us

Martha Hodgson
FDOT, Systems Planning Office / Environmental Management Office
(850) 414-4804
martha.hodgson@dot.state.fl.us

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QUESTIONS?