# 2016 Design Standards

For Construction and Maintenance Operations on the State Highway System
Topic No. 625-010-003

State of Florida Department of Transportation
Office of Design
Mail Station 32
605 Suwannee Street
Tallahassee, Florida 32399-0450

### FDOT 2016 DESIGN STANDARDS

### NOTICE

The Design Standards are intended to support the various engineering processes for construction and maintenance operations on the State Highway System. They are established to ensure the application of uniform standards in the preparation of contract plans for construction of roadways and structures. These Standards may be used for maintenance operations or adopted by other authorities for use on projects under their jurisdiction.

It is the responsibility of the Engineer of Record using these Standards to determine the fitness for a particular use of each standard in the design of a project. The inappropriate use of and adherence to these standards does not exempt the engineer from the professional responsibility of developing an appropriate design.

### PATENTED DEVICES, MATERIALS AND PROCESSES

The use of any design, method, process, material or device either expressed or implied by these standards that are covered by patent, copyright, or proprietary privilege is the sole responsibility of the user. Any infringement on the rights of the inventor, patentee, assignee or licensee shall be the sole responsibility of the user. For additional information refer to Subsection 7–3 of the FDOT Standard Specifications for Road and Bridge Construction.

### DISTRIBUTION OF EXEMPT PUBLIC DOCUMENTS:

It is the policy of the Department to protect the State Highway System's infrastructure by defining the responsibilities for disclosure and use of sensitive documents showing the structural elements used in the design and construction of Department structures. Section 119.071(3)(b), Florida Statute (F.S.), provides that these sensitive documents are exempt from Chapter 119, F.S., Florida's public records law. In accordance with Section 119.071(3)(b), F.S., the Department has adopted Procedure 050-020-026, Distribution of Exempt Public Documents Concerning Department Structures and Security System Plans, to define the method and responsibilities for disclosure and use of these sensitive documents.

Structure is defined in Section 334.03(27), F.S., as "a bridge, viaduct, tunnel, causeway, approach, ferry slip, culvert, toll plaza, gate, or other similar facility used in connection with a transportation facility" which would include related pipes and pipe systems. However, for the purpose of the public records law and Procedure 050-020-026, the Department has determined that the term "structure" includes "bridges with an opening of more than 20 feet between undercopings of abutments or spring lines of arches or extreme ends of openings for multiple boxes, and those other bridges subject to safety inspection under Section 335.074, F.S." A roadway is not otherwise a structure for the purposes of Procedure 050-020-026.

Therefore, plans, blueprints, schematic drawings, and diagrams of structures owned by the Department are exempt from the public records provisions of Chapter 119, F.S. This exemption includes draft, preliminary, and final formats as described in Procedure 050-020-026 and includes paper, electronic, and other formats. The Department has provided for the limited release of such documents in Procedure 050-020-026.

Entities or persons outside the Department requesting or receiving copies of any portion of plans or other documents considered Exempt Documents under Procedure 050-020-026 must complete and submit a request form (Form No. 050-020-26). The form also advises the requestor that the entity or person receiving the documents shall maintain their exempt status. This procedure applies to all Department internal or contracted staff who have access to such Exempt Documents in their Department work. Refer to Procedure 050-020-026 for additional requirements.

The official version of the Design Standards is the PDF version and can be found at: http://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtm

# CERTIFICATION STATEMENT

I hereby certify that these Design Standards were compiled under my responsible charge from designs prepared, examined, adopted, and implemented by the Florida Department of Transportation in accordance with established procedures, and as approved by the Federal Highway Administration.

Manager, Traffic Data Section Transportation Statistics Office Steven J. Bentz



As To Planning Design Standards No.

17900

As To Roadway Design Standards Nos.

001-105 200-288 293-403 410-415 430, 461 500 505-535 546, 560 600-803 870-880 11200-11871 State Roadway Design Engineer Michael Shepard P.E. No. 56900



State Traffic Operations Engineer Mark C. Wilson P.E. No. 46780



As To ITS Design Standards Nos.

18100-18300

As To Structures Design Standards Nos.

> 289-292 404-405 420-425 470-484 501, 540 810-862 5200-6201 20005-21930

State Structures Design Engineer Robert V. Robertson, Jr.

P.E. No. 36160

ON PROPERTY OF THE PROPERTY OF

State Transportation Landscape Architect Jeffrey H. Caster LA0001592



As To Landscape Architecture Design Standards Nos.

544

Approved For USe On Federal Aid Projects

James Christian, Division Administrator

6:53:14 AM

- 1. The information shown on this index is intended solely for the purpose of clear sight development and maintenance at intersecting highways, roads, streets and driveways, and is not intended to be used to establish roadway and roadside safety except as related to clear sight corridors. An analysis of sight distance shall be documented for all intersections.
- 2. For the purpose of this Index, Minor Road is defined as all intersecting highways, roads, streets and driveways.
- 3. Details are based on the AASHTO 'A Policy On Geometric Design Of Highways And Streets, 2001', CHAPTER 9, INTERSECTION SIGHT DISTANCE, CASES B and F, and Department practices for channelized median openings (left turns from major road).
- 4. The minimum driver eye setback of 14.5' from the edge of the traveled way may be adjusted on any intersection leg only when justified by a documented, site specific field study of vehicle stopping position and driver eye position.
- 5. For SIGNALIZED INTERSECTIONS sight distances should be developed based on AASHTO 'Case D-Intersections With Traffic Signal Control'. 'At signalized intersections, the first vehicle stopped on one approach should be visible to the driver of the first vehicle stopped on each of the other approaches. Left turning vehicles should have sufficient sight distance to select gaps in oncoming traffic and complete left turns. Apart from these sight conditions, there are generally no other approach or departure sight triangles needed for signalized intersections. However, if the traffic signal is to be placed on two-way flashing operation (i.e. flashing yellow on the major road approaches and flashing red on the minor road approaches) under off peak or nighttime conditions, then the appropriate departure sight triangles for Case B, both to the left and to the right, should be provided for the minor road approaches. In addition, if right turns on a red signal are to be permitted from any approach, then the appropriate departure sight triangle to the left for Case B2 should be provided to accommodate right turns from that approach.
- 6. Where curvature, superelevation, adverse split profiles or other conditions preclude the use of standard tree sizes and spacing, proof of view and shadowing restraints must be documented and the size and location of trees in medians detailed in the plans.
- 7. Intersection sight distance values are provided for Passenger Vehicles, SU Vehicles and Combination Vehicles. Intersection sight distance based on the Passenger Vehicle is suitable for most intersections. Where substantial volumes of heavy vehicles enter the major road, such as from ramp terminals with stop control or roadways serving truck terminals, the use of tabulated values for SU Vehicles or Combination Vehicles should be considered. TREE SPACING TABLE \*\*

- 1. Details apply to both rural and urban intersections under stop sign control or flashing beacon control. For full signal controlled intersections see Design Note No 4. At intersections listed in the Department's High Crash Intersection Report, designers shall give attention to keeping to a minimum, objects that distract or affect sight distance.
- 2. Sight distance 'd' applies to normal and skewed intersections (intersecting angles between 60° and 120°), and where vertical and/or horizontal curves are not present. Sight distance 'd' is measured along the major road from the center of the entrance lane of the minor road to the center of the near approach lane (right or left) of the major road. Distances ' $d_1$ ' and ' $d_r$ ' are measured from the centerline of the entrance lane of the minor road to a point on the edge of the near side outer traffic lane on the major road. Distance 'dm' is measured from the centerline of the entrance lane of the minor road to a point on the median clear zone limit or horizontal clearance limit for the far side road of the major road.
- 3. A. The limits of clear sight define a corridor throughout which a clear sight window must be preserved. See WINDOW DETAIL, Sheet 2.
- B. Clear sight must be provided between vehicles at intersection stop locations, and vehicles on the major road within dimension 'd'.
- C. Since observations are made in both directions along the line of sight, the reference datum between roadways is 3'-6" above respective pavements.
- 4. Barrier systems within intersection sight corridors, where penetration into the sight window might occur, shall be located to provide the least adverse affect practical.
- 5. The corridor defined by the limits of clear sight is a restricted planting area. Drivers of vehicles on the intersecting road and vehicles on the major road must be able to see each other clearly throughout the limits of 'd' and 'da'. If in the Engineers judgement, landscaping interferes with the line of sight corridor prescribed by these standards the Engineer may rearrange, relocate or eliminate plantings. Plants within the restricted areas are limited to selections as follows:

5. (Cont.)

GENERAL NOTES

Ground Cover & Trunked Plants (Separate or Combined):

Ground Covers - Plant selection of low growing vegetation which at maturity does not attain a height greater than 18" below the sight line datum. For ground cover in combination with trees and palms; the following heights below the sight line datum will

24" for trees and palms ≤ 11" dia.; and, 18" for sabal palms >11" but ≤ 18" dia. (dia.-within Sight Window).

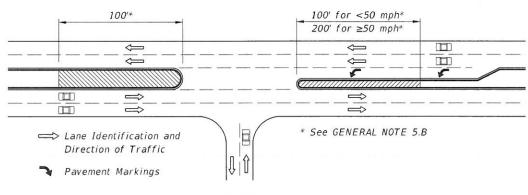
Trunked Plants - Plant selection of a mature trunk diameter 4" or less measured at 6" above the ground. Canopy or high borne foliage shall never be lower than 5' above the sight line datum. These selections shall be spaced no closer than 20'.

Trees - Trees can be installed with sod; pavers; gravel, mulch; ground covers or other Department-approved material. The clear sight window must be in conformance with the 'WINDOW DETAIL' modified to attain the height requirements listed in 'Ground Covers' above.

- A. Size and spacing shall conform to the Tree Spacing Table.
- B. Requirements for placement within medians at median openings and at unsignalized and signalized intersections:
- a. Horizontal clearance for the mature specimen shall be maintained as specified in Index 700. Specimens whose mature trunk diameter is greater than 18" shall not
- b. Where left turns from the major road are permitted, no trees shall be located within the distance 'dh', Sheet 2 of 6; and not less than the distances called for in (c) or (d), as applicable,
- c. For safety, these additional setbacks are required:
  - 1. Where no left turn lane is present, size and spacing shall conform to the Tree Spacing Table. No trees shall be permitted within 100' of the restricted median nose (measured from the edge of pavement),
  - 2. Where left turn lane(s) are present, the following requirements apply:
  - For low speed facilities (design speed less than 50 mph), size and spacing shall conform to the Tree Spacing Table. No trees shall be permitted within 100' of the restricted median nose (measured from the edge of pavement).
  - For high speed facilities (design speed 50 mph or greater), no trees shall be permitted within 200' of the restricted median nose. Beyond this limit, size and spacing shall conform to the Tree Spacing Table.

- Description Design Speed (mph) 30 35 40 45 50 55 60 Diameter (Inches) >4≤11 >11≤18 >4≤11 >11≤18 >4≤11 >11≤18 >4≤11 >11≤18 >4≤11 >11≤18 >4≤11 >11≤18 >4≤11 >11≤18 >4≤11 >11≤18 (Within Limits Of Sight Window) Minimum Spacing (c. to c. Of Trunk) 25 90 30 105 35 120 40 135 50 150 55 165
- \*\* Sizes and spacings are based on the following conditions:
- a. A single line of trees in the median parallel to but not necessarily colinear with the centerline.
- b. A straight approaching mainline, within skew limits as described in No. 2 above.
- c. 1. Trees and palms ≤ 11" in diameter casting a vertical 6' wide shadow band on a vehicle entering at stop bar location when viewed by mainline driver beginning at distance 'd'; see SHADOW DIAGRAM, Sheet 2.
- 2. Sabal palms with diameters > 11" ≤ 18" spaced at intervals providing a 2 second full view of entering vehicle at stop bar location when viewed by the mainline driver beginning at distance 'd'; see PERCEPTION DIAGRAM, Sheet 2.
- d. Trees with diameters ≤ 11" intermixed with trees with diameters > 11" ≤ 18" are to be spaced based on trees with diameters > 11" ≤ 18".

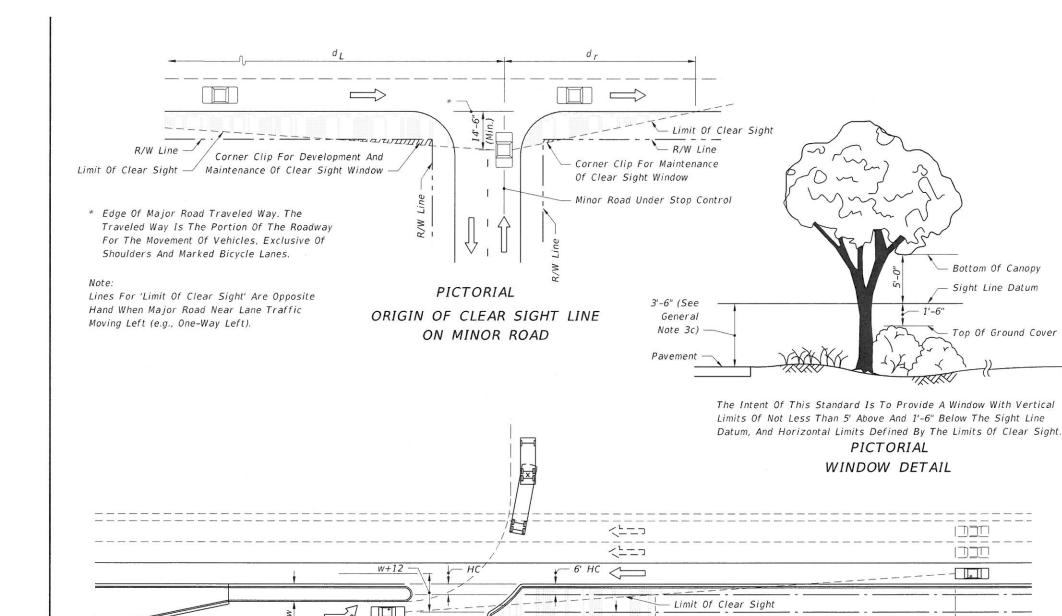
For any other conditions the tree sizes, spacings and locations shall be detailed in the plans; see Design Note 5.



Special Areas Limited to Ground Cover

∠ DESCRIPTION: REVISION 07/01/15





Min. Spacing Max. Trunk Dia 6' Shadow

# SHADOW DIAGRAM

### LEGEND

Areas Free Of Sight Obstructions

Restricted Unrestricted

Min. Spacing When

PERCEPTION DIAGRAM

SETTING SABAL PALM (STATE TREE) SPACING

Caliper > 11" ≤ 18"

(2 Sec. Min.)

### **PICTORIAL**

6' HC -

				d <sub>a</sub> (F	eet)				
Design Speed MPH	1 Lane Crossed			2 Lanes Crossed			3 Lanes Crossed		
	P	SU	Comb.	Р	SU	Comb.	Р	SU	Comb
30	245	290	330	265	320	365	290	350	395
35	285	335	385	310	370	425	335	410	460
40	325	385	440	355	425	485	385	465	525
45	365	430	495	400	475	545	430	525	590

 The d<sub>a</sub> values in this table were established by the method referenced in Design Note 2, and are applicable to urban, predominantly curbed roadways with design speeds of 45 mph or less and meeting the restricted conditions defined in Index No. 700. For horizontal clearance (HC) of 6', the values for  $d_b$  may be determined by the equation  $d_b = d_a$  (w/(w+12)). For roadways with nonrestricted conditions,  $d_a$  and  $d_b$  should be based on the geometry for the left turn storage and on clear zone widths (See Index No. 700).

Limit Of Median Sight Obstruction

For wide medians where the turning vehicle can approach the through lanes at or near 90°, use dy values from tables on sheets 5 or 6. (The clear sight line origin is assumed to be 14'-6" from the edge of the near lane.)

### CHANNELIZED DIRECTIONAL MEDIAN OPENINGS

LAST REVISION 07/01/15

≥ DESCRIPTION:

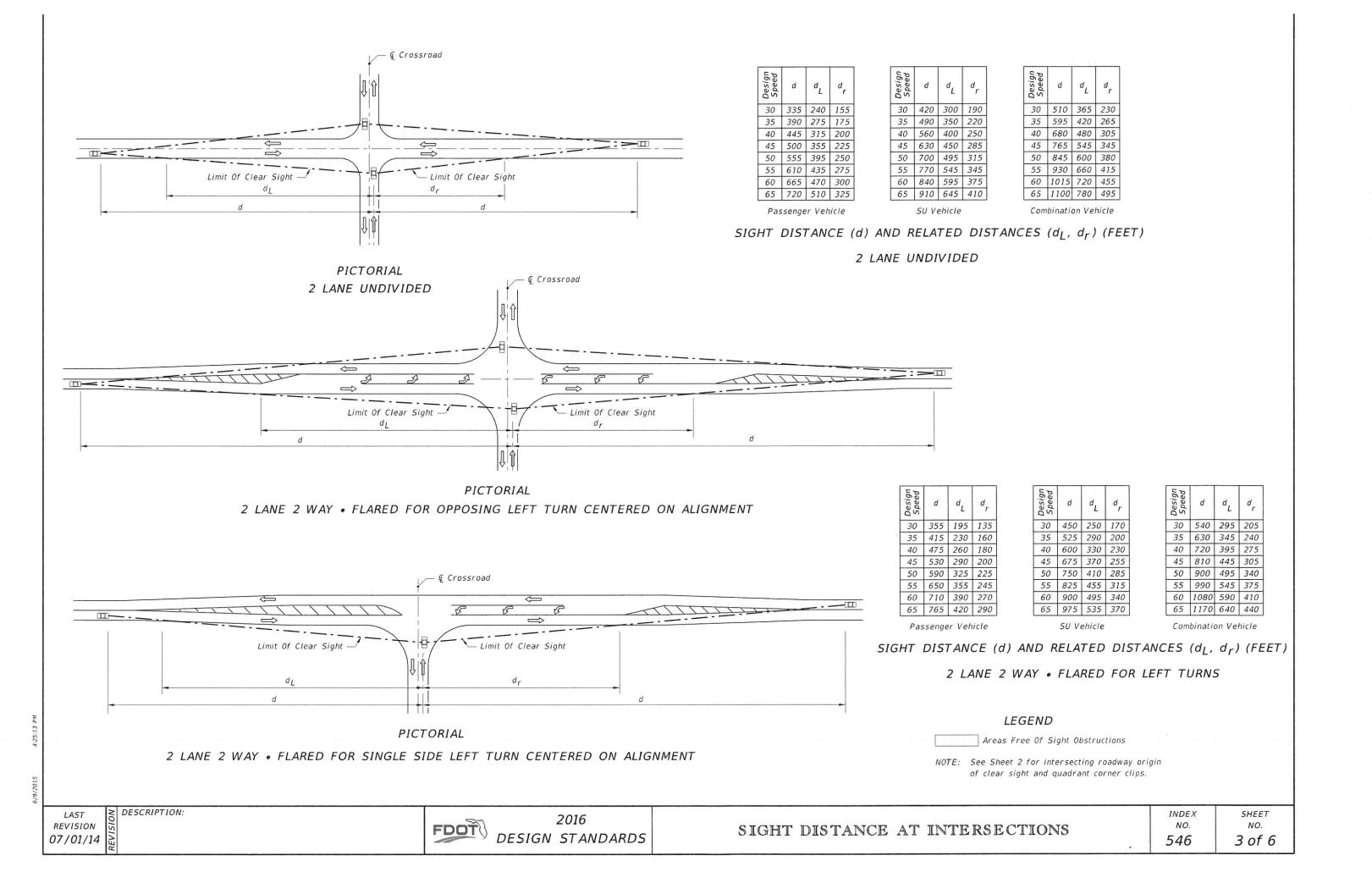
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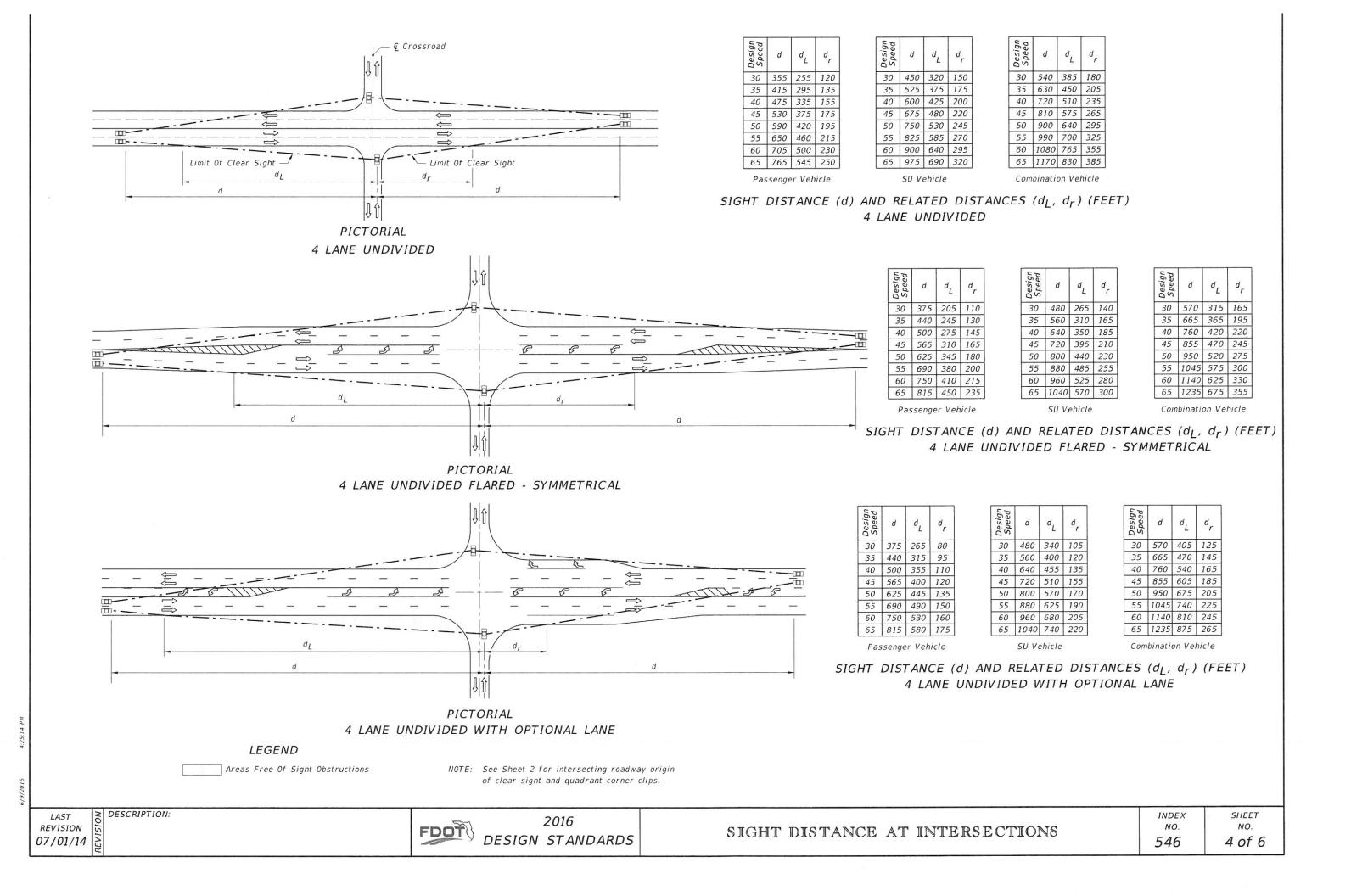
2016 DESIGN STANDARDS

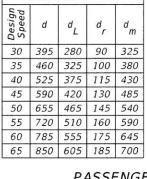
SIGHT DISTANCE AT INTERSECTIONS

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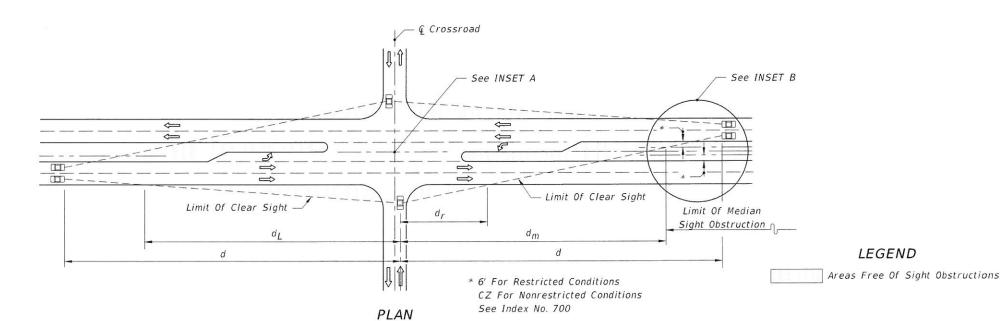






MEDIAN 22' OR LESS

25'-64' MEDIAN					
Design Speed	d	ďL	d <sub>v</sub>	d <sub>vL</sub>	
30	355	255	330	240	
35	415	295	390	280	
40	470	335	445	320	
45	530	375	500	360	
50	590	420	550	400	
55	650	460	610	440	
60	705	500	665	480	
65	765	545	720	520	

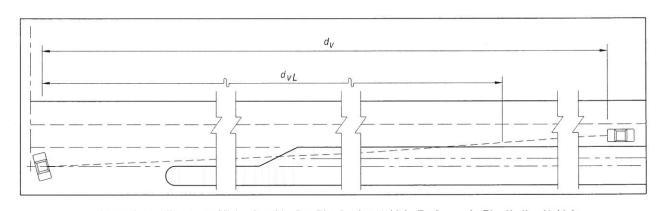


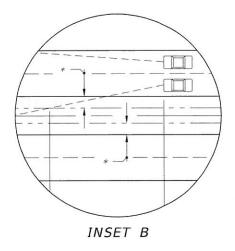
# **PICTORIAL**

# PASSENGER VEHICLE (P)

Design Speed	d	d <sub>L</sub>	d <sub>r</sub>	d <sub>m</sub>
30	540	385	110	460
35	630	450	125	535
40	720	510	145	615
45	810	575	160	685
50	900	640	180	760
55	990	700	195	840
60	1080	765	215	915
65	1170	830	230	990

	40'-€	54' ME	DIAN	
Design Speed	d	d <sub>L</sub>	d <sub>V</sub>	d <sub>vL</sub>
30	450	320	420	330
35	525	375	490	385
40	600	425	560	440
45	675	480	630	490
50	750	530	700	545
55	825	585	770	600
60	900	640	840	655
65	975	690	910	710





LEGEND

SINGLE-UNIT TRUCK (SU)

Design Speed	d	d <sub>L</sub>	d <sub>r</sub>	d m
30	615	435	120	520
35	720	510	140	605
40	820	580	160	690
45	925	655	180	780
50	1025	725	200	860
55	1130	800	220	950
60	1230	870	240	1035
65	1335	945	260	1120

	35'-5	O' ME	DIAN	
Design Speed	d	d <sub>L</sub>	d <sub>r</sub>	d <sub>m</sub>
30	670	475	105	585
35	780	555	120	680
40	890	630	140	780
45	1000	710	155	875
50	1110	790	170	970
55	1225	870	190	1070
60	1335	945	205	1165
65	1445	1025	225	1265

	64'	MED	IAN	
Design Speed	d	d <sub>L</sub>	d <sub>v</sub>	d <sub>VL</sub>
30	540	385	510	435
35	630	450	595	500
40	720	510	680	575
45	810	575	760	645
50	900	640	845	720
55	990	700	930	790
60	1080	765	1015	865
65	1165	825	1100	935

Where The Median Is Sufficiently Wide For The Design Vehicle To Pause In The Median Vehicle Length Plus 6' Min.) The Clear Line Of Sight To The Right ( $d_V$ ) Is Measured From The Vehicle Pause Location, i.e., Not From The Cross Road Stop Position; Distances  $d_r \& d_m$  Do Not Apply.

INSET A

Vehicle Length (Ft.)

30

45.5

55

# NOTES FOR 4-LANE DIVIDED ROADWAY

- 1. See Sheet 2 for origin of clear sight line on the minor road.
- 2. Values shown in the tables are the governing (controlling) sight distances calculated based on 'AASHTO Case B - Intersection with Stop Control on the Minor Road!

### INTERMEDIATE SEMI-TRAILERS (WB-40 & WB-50)

SIGHT DISTANCES (d) &  $(d_v)$  AND RELATED DISTANCES  $(d_L, d_r, d_m \& d_{VL})$  (FEET)

Vehicle Type

Passenger (P)

Single Unit (SU)

Large School Bus WB-40

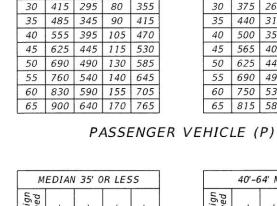
WB-50

### 4 LANE DIVIDED ROADWAY

≥ DESCRIPTION: 2016 FDOT REVISION DESIGN STANDARDS 07/01/14

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30 570 405 90 495 35 | 665 | 470 | 105 | 580 40 | 760 | 540 | 120 | 660

45 855 605 135 745 50 955 675 155 830 55 1050 745 170 915 60 1145 810 185 995 65 | 1240 | 880 | 200 | 1080

65 | 1400 | 990 | 235 | 1210

MEDIAN 22' OR LESS

	40'-6	4' ME	DIAN	
Design Speed	d	d <sub>L</sub>	d <sub>v</sub>	d <sub>vL</sub>
30	480	340	420	330
35	560	400	490	385
40	640	455	560	440
45	720	510	630	490
50	805	570	700	545
55	885	625	770	600
60	965	685	840	665
65	1045	740	910	710

25'-64' MEDIAN

 $d_L$ 

30 | 375 | 265 | 330 | 240

35 | 440 | 315 | 385 | 280

40 500 355 445 320

45 | 565 | 400 | 500 | 360

50 625 445 555 400

55 690 490 610 440

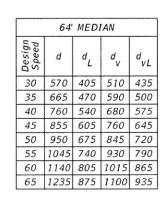
60 750 530 665 480

65 815 580 720 520

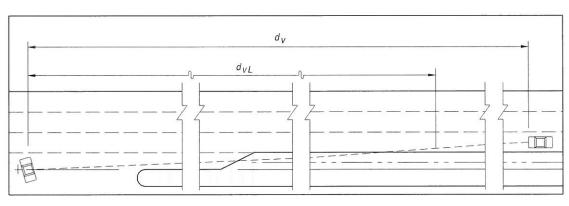
 $d_{V}$ 

### MEDIAN 30' OR LESS 35'-50' MEDIAN 30 650 460 110 560 30 700 495 95 625 35 755 535 130 655 35 815 580 115 725 40 930 660 130 825 40 865 615 145 745 45 970 690 165 835 45 | 1045 | 740 | 145 | 930 50 | 1080 | 765 | 185 | 930 50 | 1165 | 825 | 160 | 1035 55 | 1280 | 905 | 175 | 1140 55 | 1185 | 840 | 200 | 1025 60 | 1290 | 915 | 220 | 1115 60 | 1395 | 990 | 190 | 1240

SINGLE-UNIT TRUCK (SU)



— @ Crossroad See INSET A See INSET B Limit Of Clear Sight Limit Of Median Limit Of Clear Sight Sight Obstruction d (d<sub>X</sub> For One-Step Crossing) d (dx For One-Step Crossing) \* 6' For Restricted Conditions CZ For Nonrestricted Conditions PLAN See Index No. 700 **PICTORIAL** 



INSET A

Where The Median Is Sufficiently Wide For The Design Vehicle To Pause In The Median (Vehicle Length Plus 6' Min.) The Clear Line Of Sight To The Right  $(d_{V})$  Is Measured From The Vehicle Pause Location, i.e., Not From The Cross Road Stop Position; Distances d<sub>r</sub> & d<sub>m</sub> Do Not Apply.

# INSET B

LEGEND

Areas Free Of Sight Obstructions

### NOTES FOR 6-LANE DIVIDED ROADWAY

- 1. See Sheet 2 for origin of clear sight line on the minor road.
- 2. Values shown in the tables are the governing (controlling) sight distances calculated based on 'AASHTO Case B - Intersection with Stop Control on the Minor Road!

INTERMEDIATE SEMI-TRAILERS (WB-40 & WB-50)

65 | 1510 | 1070 | 210 | 1340

SIGHT DISTANCES (d), ( $d_V$ ) & ( $d_X$ ) AND RELATED DISTANCES ( $d_L$ ,  $d_r$ ,  $d_m$  &  $d_{vL}$ ) (FEET) 6 LANE DIVIDED

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2016 DESIGN STANDARDS

SIGHT DISTANCE AT INTERSECTIONS

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SHEET NO. 6 of 6

DESCRIPTION: