

***Design Standard Index 546 and
Index 700***



Benjamin Gerrell

FDOT

Central Office

Roadway Design

(850) 414-4318

benjamin.gerrell@dot.state.fl.us

Patrick Overton

FDOT

Central Office

Roadway Design

(850) 414-4824

patrick.overton@dot.state.fl.us

Design Standard Index 546 Sight Distance at Intersections



Benjamin Gerrell
FDOT

Central Office
Roadway Design
(850) 414-4318

benjamin.gerrell@dot.state.fl.us

Jeff Caster
FDOT

Central Office
Production Support Office
(850) 414-5267

jeff.caster@dot.state.fl.us

Good Morning, congratulations you have made it to the end of the 2013 Design Training Expo. I'll be presenting on an Index 546 research project.

Design Standard Index 546 Sight Distance at Intersections



Benjamin Gerrell
FDOT

Central Office
Roadway Design
(850) 414-4318

benjamin.gerrell@dot.state.fl.us

Good Morning, congratulations you have made it to the end of the 2013 Design Training Expo. I'll be presenting on an Index 546 research project.

Introduction

- ◆ This class is an overview of the **Landscaping of Highway Medians at Intersections Research** by **CUTR**. We will cover the following:
 - ✓ Need for Research and Background
 - ✓ Research Objectives and Methodology
 - ✓ Conclusion and Recommendations



We will briefly go over some research that the **Center for Urban Transportation Research** also known as **CUTR** (from the University of South Florida) is working on for us that could impact Index 546 in the next year. We'll cover the (Click) need for the research and some background, the (Click) research objectives and methodology, and finally we'll cover the (Click) conclusions and recommendations made by CUTR so far.

Need for Research and Background

◆ **Landscaping of Highway Medians at Intersections Research**

- ✓ Needed to validate current Index 546 criteria and/or
- ✓ Propose recommended changes to Index 546 median landscaping criteria with regard to intersection safety and operation. Based on the following:
 - Median width
 - Tree diameter
 - Tree spacing
 - Vehicle speed



This research project was (Click) needed to validate current Index 546 criteria and/or (Click) propose recommended changes to Index 546 median landscaping criteria with regard to intersection safety and operation.

They were charged with looking at things like (Click) median width, tree diameter, tree spacing, and vehicle speed.

Need for Research and Background

- ◆ Context Sensitive Solutions
 - ✓ Effective November 20, 2008
 - ✓ Collaborative, Interdisciplinary Approach
 - ✓ Develop a transportation facility that
 - Fits its physical setting and
 - Preserves
 - Scenic
 - Aesthetic
 - Historic
 - Environmental resources
 - Maintaining safety and mobility



FDOT is **striving** toward more **context sensitive designs**. [\(click\)](#) **Effective November 20, 2008**, it became **FDOT's policy** to use a **Context Sensitive Solutions (CSS)** approach on transportation projects and activities for **all modes appropriate to scale, cost, location, and schedule**, including **pedestrians, bicyclists, and transit**.

(It also **considers adjacent land uses, local densities, and nearby destinations**.)

According to the Federal Highway Administration (FHWA), **CSS** is a [\(click\)](#) **collaborative, interdisciplinary approach** that involves **all stakeholders** to [\(click\)](#) develop a transportation **facility** that fits its **physical setting** and [\(click\)](#) **preserves scenic, aesthetic, historic, and environmental resources**, while [\(click\)](#) **maintaining safety and mobility**.

CSS is an **approach** that **considers** the **total context** within which a **transportation improvement project will exist**. [\(click\)](#)

Need for Research and Background

- ◆ Highway Beautification and the Bold Landscaping Policy
 - ✓ Many Trees
 - ✓ \$30 Million/ Year for Highway Beatification



Highway Beautification and the Bold Landscaping Policy

Statewide policies to promote economic growth strive for ways to attract more businesses and visitors to Florida. One of the FDOT policies contributing to such a goal is to implement bold roadside beautification projects (FDOT 2011) which includes [\(click\)](#) installing trees at specially designated sites. [\(click\)](#) and designating 30 Million dollars per year for Highway Beatification

Need for Research and Background

- ◆ Roadway Design Bulletin 10-04
 - ✓ Trees placement within an intersection median
 - Horizontal Clearance
 - Mature specimen Index 700
 - Trunk diameter not greater than 18 inches
 - No left turn present
 - Tabular values for size and spacing
 - No trees 100 feet of median nose
 - Left turn present (signalized or not)
 - Low speed facilities
 - Design Speed less than 50 mph
 - No trees 100 feet of median nose
 - High speed facilities
 - Design Speed greater than 50 mph
 - No trees 200 feet of median nose



Roadway Design Bulletin 10-04 provided **some flexibility** regarding the [\(Click\)](#) **installation of trees in the median adjacent to left turn lanes.** [\(Click\)](#)

Horizontal clearance for the **mature specimen** shall be maintained as specified in **Index 700**. Specimens whose mature trunk diameter is greater than 18 inches shall not be permitted. [\(Click\)](#)

Where **no left turn lane is present, size and spacing shall conform to the tabular values.** **No trees** shall be permitted within **100' of the median nose** (measured from the edge of pavement). [\(Click\)](#)

Intersections where a **left turn lane is adjacent to the median** , signalized or not, the following requirements apply: [\(Click\)](#)

For **low speed facilities** Design speed less than 50 mph (size and spacing shall conform to the tabular values.)

No trees shall be permitted within **100' of the median nose** [\(Click\)](#)

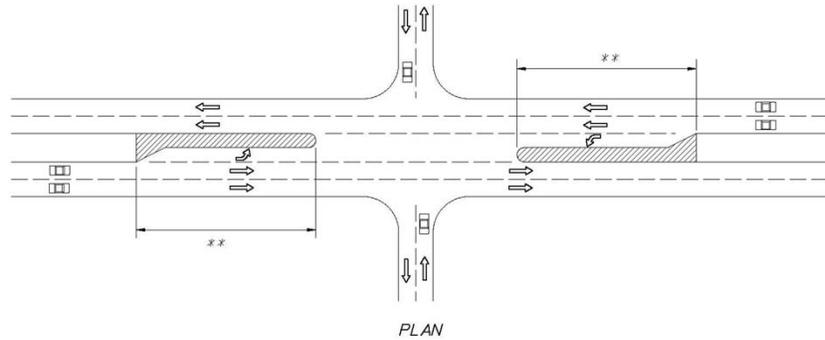
For **high speed facilities** Design speed 50 mph or greater (size and spacing shall conform to the tabular values.)

No trees are permitted within **200' of the median nose.** [\(Click\)](#)

(These **revisions did not change** the requirements to **provide intersection sight distance** or to maintain a clear sight window.)

Need for Research and Background

- ◆ Before Roadway Design Bulletin 10-04



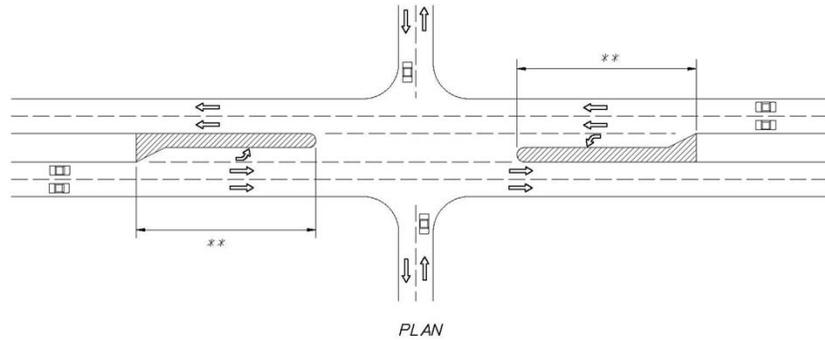
Special Areas Limited to Ground Cover

** For Signalized and unsignalized intersections, the median area along left turn lanes, including the taper, shall be limited to ground cover with height not greater than 18" below the sight line datum regardless of whether or not the area is within the limit of clear sight.

Before the release of the Roadway Design Bulletin (10-04) in 2010 [\(Click\)](#) [\(Click\)](#)

Need for Research and Background

- ◆ Before Roadway Design Bulletin 10-04



Special Areas Limited to Ground Cover

** For Signalized and unsignalized intersections, the median area along left turn lanes, including the taper, shall be limited to ground cover with height not greater than 18" below the sight line datum regardless of whether or not the area is within the limit of clear sight.



(Click) again

Landscaping in the median areas **adjacent to left turn lanes** was **limited to ground cover**, regardless of whether or not the area was within the **limit of clear sight**, and regardless of the **length of the turn lane**. (Click)

Need for Research and Background

- ◆ Before Roadway Design Bulletin 10-04

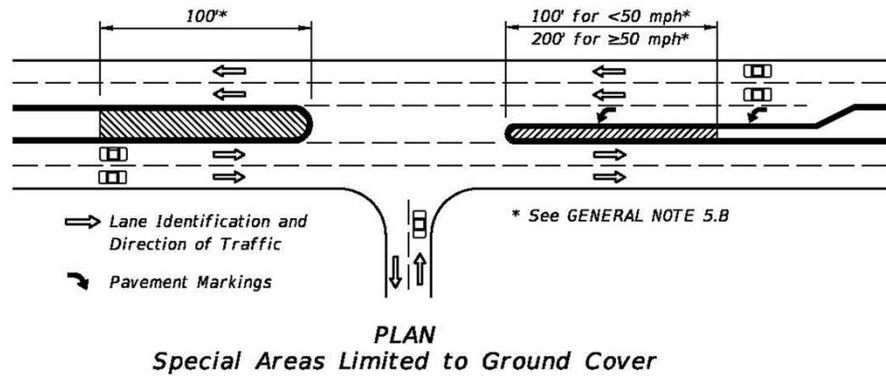


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This is Thomasville Road in Tallahassee looking north at Interstate 10 before the 2010 Bulletin. Notice there were no trees next to the long left turn lane to the West bound ramp on to I-10.

Need for Research and Background

- ◆ After Roadway Design Bulletin 10-04



After the 2010 Design Bulletin the figure on Sheet 1 of the Index changed. To allow trees within a 100' or 200' of the median depending on the speed and configuration of the intersection.

Need for Research and Background

- ◆ After Roadway Design Bulletin 10-04



2013
Design Training
EXPO

This is Thomasville Road after the 2010 design bulletin. Notice the nice trees and landscaping that has been added. The question at this point was if the tree setback, which was based on graphical analysis and physics, was too conservative? Can trees be closer to the median? And should the setback be the same for signalized and non-signalized intersections?

Research Objectives and Methodology

- ◆ Landscaping of Highway Medians at Intersections Research
 - ✓ Main Objectives
 - Review the current landscaping criteria
 - Provide a computational procedure to analyze landscaping configurations
 - Perform an empirical study of the safety performance of Standard Index 546



The **main objectives** of the research are to [\(Click\)](#) **review the current** landscaping **criteria** [\(Click\)](#)

Provide a computational procedure for analyzing different **configurations** [\(Click\)](#)

and **Perform an empirical study** on the **safety performance of Index 546** [\(Click\)](#)

Landscaping policies in other states

◆ AASHTO's landscaping policy for intersections two main parts

- ✓ Unobstructed view of the intersection
- ✓ Intersection approaches and does not strictly forbid landscaping



State	Median Tree Placement Criteria	Setback Restriction
California	<ul style="list-style-type: none"> •Barrier is required for speeds 45 mph or less •Mature trees (4" or greater in diameter) require an 11" or more wide median 	<ul style="list-style-type: none"> •Signalized Intersections: 100' from intersections •Unsignalized Intersections: <ul style="list-style-type: none"> ○25 mph - 150' from intersections ○30 mph - 200' from intersections ○35 mph - 250' from intersections
Louisiana	<ul style="list-style-type: none"> •Only allows shrubbery and ground cover in the clear sight triangle area with heights less than 2.5' above roadway surface •No trees allowed in the clear sight triangles 	<ul style="list-style-type: none"> •30 mph - 300' from median nose •40 mph - 400' from median nose •50 mph - 500' from median nose •55 mph - 550' from median nose
Michigan	<ul style="list-style-type: none"> •Allows shrubs/trees with a mature diameter of 4" or less at 4'-6" above the ground line •Trees to be planted at least 10' apart •The center of the trunk should be planted in the planning zone limits 	<ul style="list-style-type: none"> •40' (opposite travel lane side) from the median nose at median openings •70' (turn lane side) from the median nose at median openings •300' from the center point of intersections for all intersection •150' from the centerline of crossroads
New Jersey	<ul style="list-style-type: none"> •Only smaller trees not get greater than 6" in diameter can be planted within median •No required minimal tree spacing and generally closer because of the size of the trees 	<ul style="list-style-type: none"> Not allow trees to be planted within the sight triangle area for all intersections: •30 mph - 335' from decision point •40 mph - 445' from decision point •50 mph - 555' from decision point •60 mph - 665' from decision point
Ohio	<ul style="list-style-type: none"> •No trees in medians within intersection sight triangles areas •Low maintenance flowers, ground cover with 18" or less in height can be planted in sight triangle areas •A minimal clearance of 16' above the pavement should be maintained •4' - 6' minimal distance from curb face to trees 	<ul style="list-style-type: none"> Not allow trees to be planted within the sight triangle area for all intersections: •25 mph - 280' from decision point •30 mph - 335' from decision point •35 mph - 390' from decision point •40 mph - 445' from decision point •45 mph - 500' from decision point •50 mph - 555' from decision point
Oregon	<ul style="list-style-type: none"> •Trees can only be planted where posted speed is 35 mph or less •Curved/Raised median with 8' or wider •No planting higher than 24" above the pavement surface within intersection functional area •A minimum clear height of 10' from the pavement to the bottom of the branches 	<ul style="list-style-type: none"> Not allow trees to be planted within the intersection functional areas: •19 mph - 215 to 315' •25 mph - 335' to 490' •28 mph - 405' to 595' •31 mph - 485' to 710' •34 mph - 565' to 835' •37 mph - 605' to 960'
Texas	<ul style="list-style-type: none"> •Only low-growing varieties can be planted in the intersection areas •Most trees are within 2" - 3" inch caliper •Trees with mature caliper of 4" or greater cannot be planted within clear sight triangle areas. 	<ul style="list-style-type: none"> Not allow trees larger than 4" caliper to be planted within the sight triangle area for all intersections

A review was performed to gain a better understanding of the application of AASHTO's policy with respect to landscaping on medians at intersections. The literature review included revisions of other state's landscaping policies. 29 state policies were reviewed.

AASHTO's landscaping policy for intersections can be divided into two main parts. [\(Click\)](#)

- AASHTO's policy says that all drivers should have an unobstructed view of the intersection. [\(Click\)](#)

- The second part of the policy deals with the intersection approaches and does not strictly forbid landscaping.

Based on the second part of AASHTO's policy, many states have different criteria to determine significant visibility obstructions on the intersection approaches.

The table shown is an example of the criteria that was found in other states [\(Click 3 times\)](#)

The Median Tree Placement Criteria and Setback Restrictions are listed for each state. If you look at California and Louisiana you'll notice that their setback restrictions are more strict than ours. [\(Click\)](#)

Landscaping policies in other states

◆ AASHTO's landscaping policy for intersections two main parts

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The Median Tree Placement Criteria and Setback Restrictions are listed for each state. If you look at California and Louisiana you'll notice that their setback restrictions are more strict than ours. [\(Click\)](#)

Landscaping policy in Florida

Table 2-2. Detailed Median Landscaping Policy for Florida

Florida					
Median Trees Guidelines at Intersections	Ground Cover	Top of ground cover to sight line datum: Ground cover only, > 18" For ground cover in combination with trees and palms: > 24" for trees and palms ≤ 11" diameter > 18" for Sabal Palms >11" but ≤ 18" diameter			
	Setback Restrictions (Trees/Trunked Plants)	100' from pavement edge for design speeds < 50 mph 200' from pavement edge for design speeds ≥ 50 mph			
	Trunked Plants	Diameter ≤ 4" ≥5' above the sight line datum Minimal space: 20' Diameter ≤ 18" Distance to bottom of canopy 8'6"			
	Trees	Minimal tree spacing (center to center of trunk)	Speed (mph)	Diameter > 4" ≤ 11"	Diameter > 11" ≤ 18"
			30	22	91
35			27	108	
40			33	126	
45			40	146	
50			45	165	
55	52	173			
60	60	193			



They also developed more detailed tables for some of the states like this one for Florida including ground cover criteria and tables.

Research Objectives and Methodology

- ◆ Sight Distance and Index 546
 - ✓ Approach Sight Triangles
 - ✓ Departure Sight Triangles



Sight Distance and Index 546

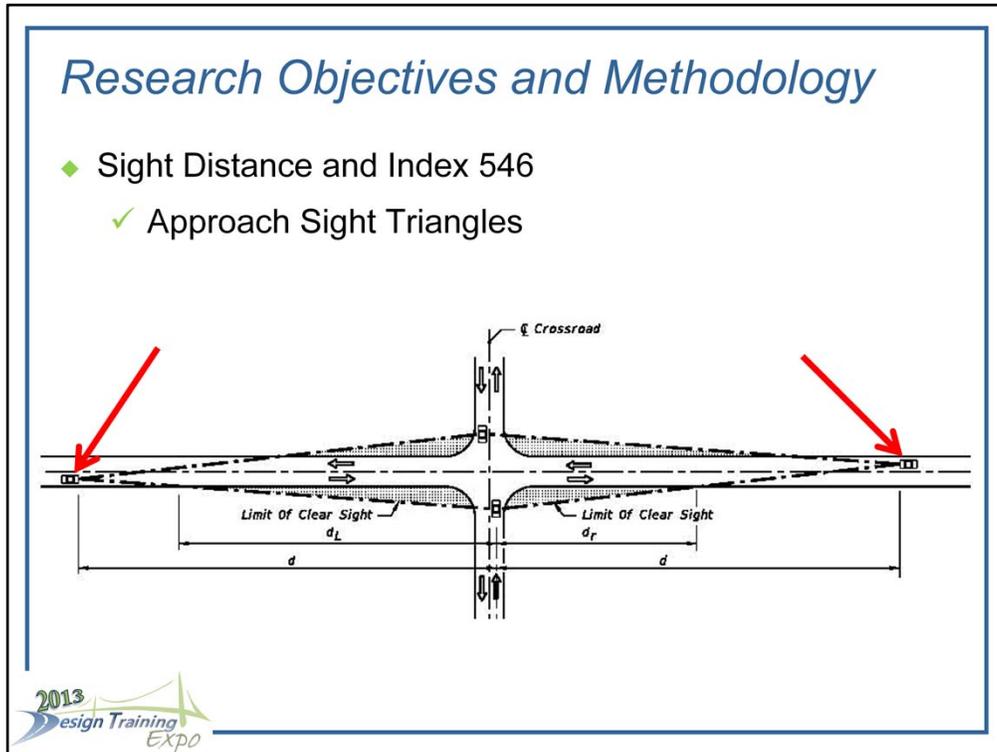
The driver of a vehicle **approaching or departing** an intersection should have an unobstructed view of the intersection, this includes any traffic control devices, landscaping, and must have sufficient lengths to anticipate and avoid potential collisions.

These **unobstructed views** form **triangular areas** known as **sight triangles**.

These **areas** should be **clear of obstructions** that might **block a driver's view** of conflicting **vehicles or pedestrians**. The **two types of sight triangles** are (Click) **approach sight triangles** and (Click) **departure sight triangles** (AASHTO 2004).

Research Objectives and Methodology

- ◆ Sight Distance and Index 546
 - ✓ Approach Sight Triangles

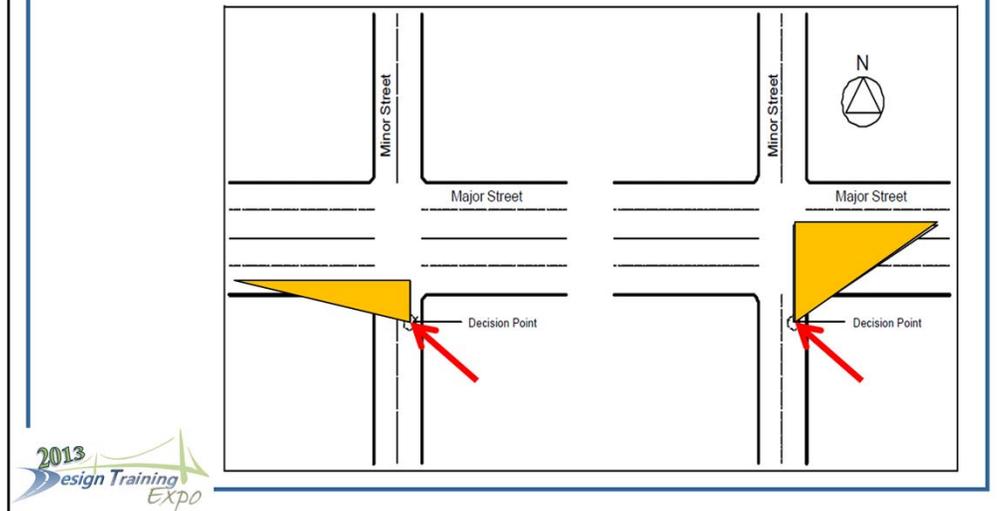


Approach sight triangles, shown in the Figure , **provide** the **driver** of a vehicle (Click) (Click) **approaching an intersection** an unobstructed view of any conflicting vehicles or pedestrians.

These **triangular** areas should be large enough that drivers can see approaching vehicles and pedestrians and have **sufficient time** to **slow or stop** thus avoiding a crash.

Research Objectives and Methodology

- ◆ Sight Distance and Index 546
 - ✓ Departure Sight Triangles



Departure sight triangles, shown in the Figure, provide adequate sight distance for a **stopped driver** on a **minor roadway** (Click) (Click) to depart from the intersection and enter or cross the major roadway.

These sight triangles should be provided in each quadrant of a controlled intersection.

*The FDOT Index-**546** is the FDOT's design standard for sight distance at intersections.

*The detailed SI-**546** of the FDOT's design standards was intended to **clearly specify the FDOT's interpretation of the AASHTO Greenbook**.

(The information shown in SI-546 is intended solely for the purpose of clear sight development and maintenance at intersecting highways, roads, and streets.)

*The index **controls spacing between trees**, size of **trunk diameter**, **height of ground cover**, and **height to the bottom of the tree canopy** within the **clear-sight window**.

Research Objectives and Methodology

- ◆ Studied intersections divided into 3 groups for controlled intersections (signalized or stop sign on minor road)
 - ✓ No median trees near the intersection
 - ✓ Median trees near the intersection (compliant with Index 546)
 - ✓ Median trees near the intersection (noncompliant with Index 546)



The studied intersections were divided into 3 groups for controlled intersections. [\(Click\)](#)
No median trees near the intersection [\(Click\)](#)
Median trees near the intersection, compliant with Index 546 [\(Click\)](#)
Median trees near the intersection , noncompliant with Index 546 [\(Click\)](#)

Research Objectives and Methodology

- ◆ Validation of FDOT Standard Index 546 on Computational Values
 - ✓ Sight Distance Tables

Design Speed	d	d_L	d_r
30	335	240	150
35	390	275	175
40	445	315	200
45	500	350	225
50	555	390	250
55	610	430	275
60	665	470	300
65	720	510	325

Passenger Vehicle

Design Speed	d	d_L	d_r
30	420	295	190
35	490	345	220
40	560	395	250
45	630	445	280
50	700	495	310
55	770	545	345
60	840	595	375
65	910	645	405

SU Vehicle

Design Speed	d	d_L	d_r
30	510	360	225
35	595	420	265
40	680	480	305
45	765	540	340
50	845	600	375
55	930	660	415
60	1015	720	450
65	1100	780	490

Combination Vehicle

**SIGHT DISTANCE (d) AND RELATED DISTANCES (d_L , d_r) (FEET)
2 LANE UNDIVIDED**



The research included confirming the validity of all Sight Distance Tables in the Index.

Research Objectives and Methodology

- ◆ Validation of FDOT Standard Index 546 on Computational Values
 - ✓ Sight Distance Tables

Design Speed	d	d_L	d_r	Design Speed	d	d_L	d_r	Design Speed	d	d_L	d_r
30	335	240	150	30	420	295	190	30	510	360	225
35	390	275	175	35	490	345	220	35	595	420	265
40	445	315	200	40	560	395	250	40	680	480	305
45	500	350	225	45	630	445	280	45	765	540	340
50	555	390	250	50	700	495	310	50	845	600	375
55	610	430	275	55	770	545	345	55	930	660	415
60	665	470	300	60	840	595	375	60	1015	720	450
65	720	510	325	65	910	645	405	65	1100	780	490

Passenger Vehicle

SU Vehicle

Combination Vehicle

SIGHT DISTANCE (d) AND RELATED DISTANCES (d_L , d_r) (FEET)
2 LANE UNDIVIDED



As a result of the research some of the distances in the Tables may change. [\(Click\)](#)

Research Objectives and Methodology

- ◆ Visibility Criteria
 - ✓ Restricted Visibility
 - 50 Percent visible area
 - Stopped vehicle profile
 - ✓ Unrestricted Visibility
 - 2 seconds minimum
 - Minimum tree spacing



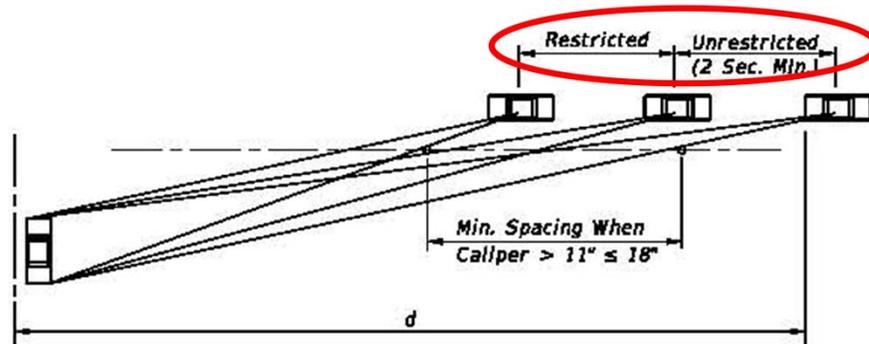
Visibility criteria are applied at intersection approaches that may pose visibility obstructions to the approach driver. [\(Click\)](#) The visibility criteria in Florida state that a vehicle is visible as long as [\(Click\)](#) **50 percent** of its visible area is free of obstruction.

In places where visibility is obstructed 50 percent or more, the landscape design should allow for [\(Click\)](#) two seconds of unobstructed visibility. This effects the minimum tree spacing in a median. [\(Click\)](#)

(Next)

(Additional visibility criteria in the *Florida Highway Landscape Guide* (Lott and Graham 1995) suggested that landscaping within the limits of the clear sight should not block more than 50 percent of a driver's view of a passenger car stopped on the minor approach. It also recommends that the driver on the major road should have a clear view of at least 66.6 percent of a passenger car stopped at the minor approach.)

Research Objectives and Methodology



**PERCEPTION DIAGRAM
SETTING SABAL PALM (STATE TREE) SPACING**



The Perception Diagram on Sheet 2 of the Index shows the [\(Click\)](#) restricted and unrestricted conditions.

Research Objectives and Methodology

- ◆ Validation of FDOT Standard Index 546 on Computational Values
 - ✓ Tree Spacing Table

TREE SPACING TABLE**

Description	Speed (mph)													
	30		35		40		45		50		55		60	
Diameter	(Inches)													
(Within Limits Of Sight Window)	>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
	(Feet)													
Minimum Spacing (c. to c. Of Trunk)	22	91	27	108	33	126	40	146	45	165	52	173	60	193



The research included confirming the validity of the Tree Spacing Table in the Index. [\(Click\)](#)

Research Objectives and Methodology

- ◆ Validation of FDOT Standard Index 546 on Computational Values
 - ✓ Tree Spacing Table

TREE SPACING TABLE**

Description	Speed (mph)													
	30	35	40	45	50	55	60							
Diameter	(Inches)													
(Within Limits Of Sight Window)	>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
	(Feet)													
Minimum Spacing (c. to c. Of Trunk)	22	91	27	108	33	126	40	146	45	165	52	173	60	193



As a result of the research some of the distances in the Table may change. [\(Click\)](#)

Conclusion and Recommendations

- ◆ Visibility Simulator Tools
 - ✓ Computational Tool
 - Evaluate visibility
 - More flexibility in the design of landscaping configurations
 - Change intersection plan views
 - Change tree spacing and configuration
 - Design Speeds
 - Vehicle path
 - Simulation
 - Measures performance
 - Output file



The Visibility Simulator Tool is a **Computational tool** developed to evaluate visibility measures of roadside landscaping configurations at intersections. [\(Click\)](#) It can be used to handle more flexibility in the design of landscaping configurations. [\(Click\)](#)

Different Intersection plan views can be imported into the tool [\(Click\)](#)

Tree spacing and configuration can be changed [\(Click\)](#)

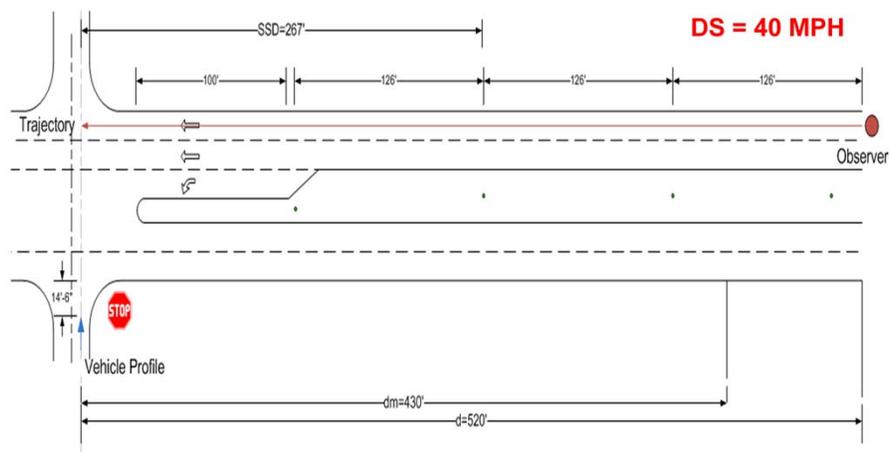
Design Speeds can be changed [\(Click\)](#)

The approaching vehicles path can change [\(Click\)](#)

The tool runs a simulation of the proposed configuration. [\(Click\)](#) Measures its performance and then provides an [\(Click\)](#) output file, which can be used to determine if the proposed configuration meets the criteria for restricted and unrestricted visibility.

Conclusion and Recommendations

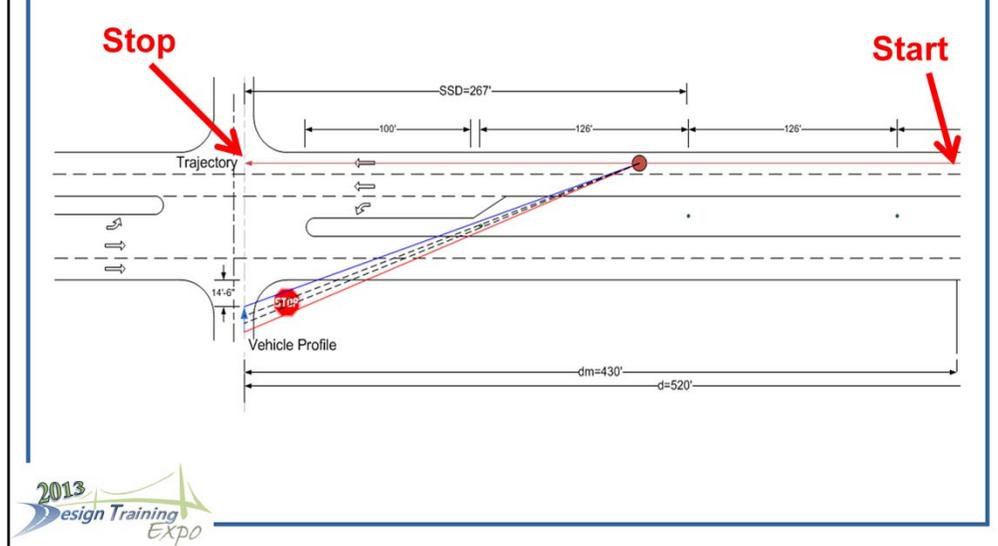
◆ Base Scenario in Visibility Simulator



This is an example of the Base Scenario in the Visibility Simulator Tool.
The major road is a 4-lane divided with a 22 ft wide median.
The design speed is 40mph
The tree diameters are 18 inches separated by 126 ft in the median
The setback from the median nose is 100 ft and
The Stopping Sight Distance is 267 ft
There is a car stopped on the minor road.

Conclusion and Recommendations

- ◆ Base Scenario in Visibility Simulator



This is a screen shot of the simulator in the middle of a simulation. The simulation begins with the approaching vehicle starting over 500 feet from the intersection ([Click](#)) And ends at the intersection ([Click](#))

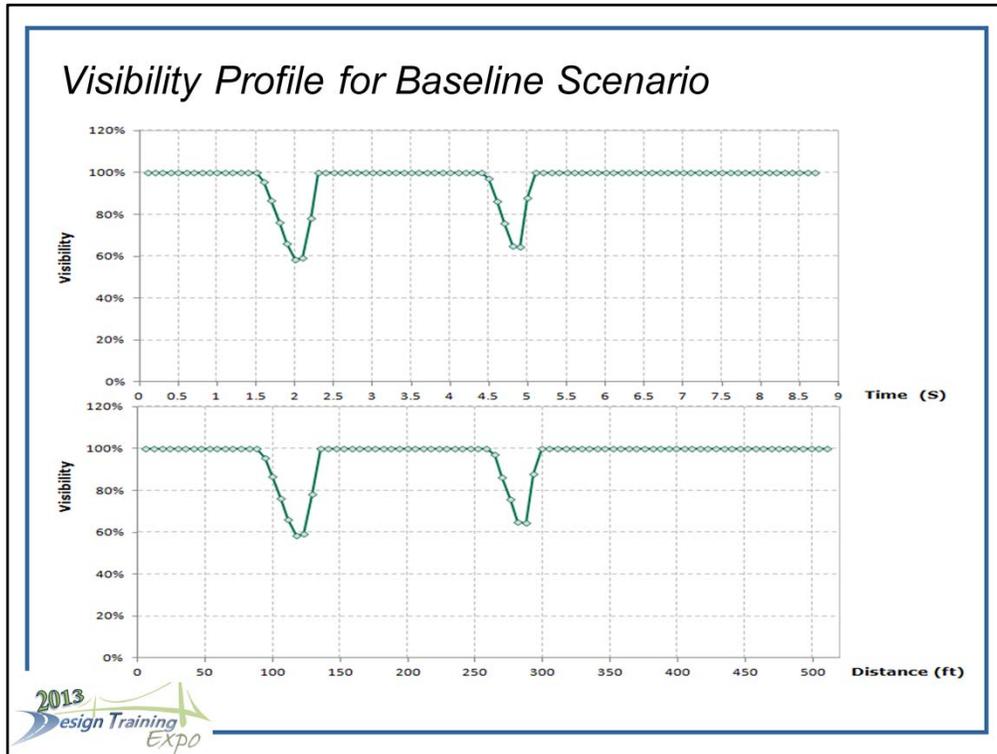
Conclusion and Recommendations

◆ Simulation Results for Baseline Scenario

	Time	Distance	Visibility
	8.7	510.4	100%
	Average Visibility	Unobstructed Visibility Time	Max Unobstructed Visibility Time
Total	96.51%	7.3	3.7
Before Threshold Distance	95.81%	3.5	2



The results of the simulation are presented in the table. The average visibility was 96.51 percent. The total time of unobstructed visibility was 7.3 seconds and the maximum interval time with unobstructed visibility was 3.7 seconds. In addition, the baseline tree configuration provides two seconds of sustained unobstructed visibility before the stopping sight distance (threshold distance).



The visibility profile of the simulation run is presented here. It can be observed that by following the tree spacing specifications established in Index-546 the two second unobstructed visibility window is achieved. This tool may be useful it testing varies tree and intersection configurations to see if they are compliant with Index 546.

Conclusion and Recommendations

- ◆ Final Draft Report being prepared
 - ✓ Validating Index 546
 - Tree Spacing Table (Sheet 1 of 6)
 - Sight Distance Tables (Sheets 2 to 6)
 - ✓ Recommended Setback from median nose
 - 150 feet for DS < 50 mph
 - 200 feet for DS \geq 50 mph



CUTR is currently preparing the Final Draft Report ([Click](#))

The Tree Spacing and Sight Distance Tables may change based on the recommendations ([Click](#))

The CUTR's recommended setback from the median nose is ([Click](#))

150 feet for low speed roads which is 50 feet more than the current criteria and ([Click](#))

200 feet for high speed roads the same as the current criteria.

Summary

- ◆ Design Standard Index 546 Sight Distance at Intersections
 - ✓ Landscaping of Highway Medians at Intersections Research
 - Need for Research
 - Validate current criteria and /or
 - Propose recommended changes
 - Research Objectives and Methodology
 - Review the current landscaping criteria
 - Provide a computational procedure to analyze landscaping configurations
 - Perform an empirical study of the safety performance of Standard Index 546



Summary

The Landscaping of Highway Medians at Intersections Research was [\(Click\)](#) needed to [\(Click\)](#) validate current Index 546 criteria and/or [\(Click\)](#) propose recommended changes to Index 546 median landscaping criteria. [\(Click\)](#)

Research Objectives and Methodology [\(Click\)](#)

Review the current landscaping criteria [\(Click\)](#)

Provide a computational procedure to analyze landscaping configurations [\(Click\)](#)

Perform an empirical study of the safety performance of Standard Index 546

Summary

- Conclusion and Recommendations
 - Visibility Simulator Tool
 - Handle flexibility in design of landscaping configurations
 - May be available in the future for design of medians with trees
 - Tables may change
 - Tree spacing
 - Sight Distance
 - Setbacks from medians may change
 - 150 feet for DS < 50 mph
 - 200 feet for DS \geq 50 mph



Conclusion and Recommendations

Visibility Simulator Tool ([Click](#))

Handle flexibility in design of landscaping configurations ([Click](#))

May be available in the future for design of medians with trees ([Click](#))

Tables may change([Click](#))

Tree spacing ([Click](#))

Sight Distance([Click](#))

Setbacks from medians may change ([Click](#))

150 feet for DS < 50 mph ([Click](#))

200 feet for DS \geq 50 mph ([Click](#))

So look for a Design Bulletin or revisions to the index 546.

Thank You!



Benjamin Gerrell
(850) 414-4318
benjamin.gerrell@dot.state.fl.us

What are your questions?

Index 546 Site Distance At Intersections



GENERAL NOTES

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.
2. Sight distance (s) applies to normal and skewed Intersections (Intersecting angles between 60° and 120°), and where vertical and/or horizontal curves are present. Sight distance (s) is measured along the major roadway from the center of the entrance lane of the minor roadway to the center of the rear approach lane (right or left) of the major roadway. Distances s_1 and s_2 are measured from the centerline of the entrance lane of the minor roadway to a point on the edge of the rear side outer traffic lane on the major roadway. Distance s_3 is measured from the centerline of the entrance lane of the minor roadway to a point on the median clear zone limit or horizontal clearance limit for the far side roadway of the major roadway.
3. a. The limits of clear sight define a corridor throughout which a clear sight window must be preserved. See WINDOW DETAIL, Sheet 6.
b. Clear sight must be provided between vehicles at intersection stop locations, and vehicles on the major roadway within dimension 'U'.
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. 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.

DESIGN NOTES

1. The information shown on this Index is intended solely for the purpose of clear sight development and maintenance of intersecting highways, roads and streets, 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. Details are based on the AASHTO 'A Policy On Geometric Design Of Highways And Streets, 2000', CHAPTER 3, Intersection Sight Triangles, CASES B and C, and Department practices for diamond median openings (left turns from major roadways).
3. 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.
4. 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

Description	Sight Distance (Inches)								
	30	35	40	45	50	55	60	65	
Diameter Within Limits Of Sight Window	<4in	4in-8in	>4in	4in-8in	>4in	4in-8in	>4in	4in-8in	>4in
Minimum Spacing (ft. No. of Trees)	22	27	33	39	45	51	57	63	69

Sizes and spacings are based on the following conditions:
 (a) A single line of trees in the median parallel to but not necessarily collinear with it.
 (b) A straight approaching vehicle, within skew limits as described in Note 2 above.
 (c) 1. Trees and poles 4" in diameter casting a vertical 6" wide shadow band on a vehicle at stop bar location when viewed by motorist driver beginning at distance 's'. See DIAGRAM, Sheet 6.
 2. Solid poles with diameter 4" to 6" spaced at intervals providing a 2 second fu entering vehicle at stop bar location when viewed by motorist driver beginning at see PERCEPTION DIAGRAM, Sheet 6.
 (d) Trees with diameter 4" in Intersected with trees with diameter 4" to 6" are to be on trees with diameter 4" to 6".

For any other conditions the tree sizes, spacings and locations shall be detailed in the plan Note No. 5.

SIGHT DISTANCE AT INTERSECTIONS

Names	Date	Approved By
Designed By	KRM/JVG 10/89	<i>James D. Milk</i> Roadway Design Engineer
Drawn By	BSD 10/89	Revision
Checked By	JVG/JAM 10/02	Sheet No
		Index No
	04	1 of 6
		546

GENERAL NOTES

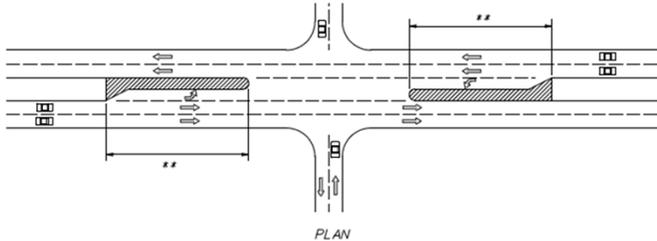
1. Details apply to both rural and urban intersections under stop sign control or flashing beacon intersections see Design Note No. 4.
2. Sight distance (d) applies to normal and skewed intersections (intersecting angles between 60° and/or horizontal curves are not present. Sight distance (d) is measured along the major roadway from the center of the near approach lane (right or left) of the major roadway to the centerline of the entrance lane of the minor roadway to a point on the median clear zone limit or horizontal curve.
3. a. The limits of clear sight define a
b. Clear sight must be provided between
c. Since observations are made in b respective pavements.
4. Barrier systems within intersection at least adverse affect practical.
5. The corridor defined by the limits a and vehicles on the major roadway. Judgment, landscaping interferes with relocate or eliminate plantings. Plants

Ground Cover & Trunked Plants
Ground Covers - Plant to
Height
For drop

DESIGN NOTES

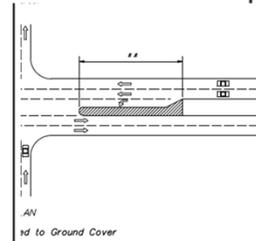
1. The information shown on this index is intended solely for the purpose of clear sight development and maintenance of intersecting highways, roads and streets, and is not intended to be used to establish roadway and roadside safety except as related to clear sight corridors. An analysis of sight distance shall be documented for all intersections.

4. 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 signals 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.'



Special Areas Limited to Ground Cover

** For Signalized and unsignalized intersections, the median area along left turn lanes, including the taper, shall be limited to ground cover with height not greater than 18" below the sight line datum regardless of whether or not the area is within the limit of clear sight.



hd to Ground Cover
is, the median area along left turn lanes, hd cover with height not greater than 18" below or not the area is within the limit of clear sight.

Sign Standards	Sheet No.
	1 of 6
T INTERSECTIONS	546







































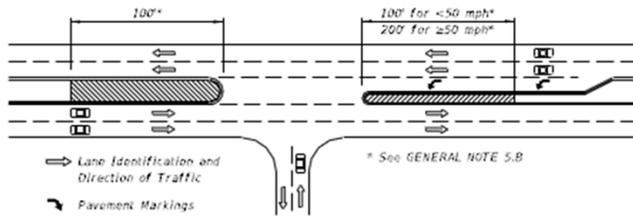
DESIGN NOTES

- The information shown on this sheet is intended solely for the purpose of clear sight development and maintenance at intersecting highways, roads and streets, and is not intended to be used to establish roadway and roadway safety, except as related to clear sight corridors. An analysis of sight distance shall be documented for all intersections.
- Details are based on the AASHTO's Policy on Geometric Design of Highways and Streets, 2002, CHAPTER 9, INTERSECTION SIGHT DISTANCE, LINES 2 and 7, and Department practices for (at least) median openings (left turns from major roadways).
- The minimum driver eye setback of 14.5' from the edge of the traveled way may be adjusted at any intersection leg only when justified by a documented, site specific field study of vehicle stopping position and driver eye position.
- 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. Start 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 one-way flashing operation (i.e. flashing yellow on the major road), approaches and flashing red on the minor road approaches control, the eye of minimum clearance from the approach to be provided for one to be seen the left for C_u.
- When curvature view of a minor approach is documented as:
- Intersection at combination leg suitable for no major road, a minimum radius, the consideration:

Des	Min
MINIMUM RADIUS	

- Sizes and spac
- a. A straight as
1. Trees and driver leg
2. Subal gain viewed by
3. Trees with a

For any other intersections with these markings and dimensions shown on this sheet, use design notes 1-4.



PLAN
Special Areas Limited to Ground Cover

SIGHT DISTANCE AT INTERSECTIONS

INDEX NO.	SHEET NO.
546	1

GENERAL NOTES

- Details apply to both rural and urban intersections under clear sight control or flashing amber control. For full signal controlled intersections see Design Note 4. In intersections listed in the Department's High-Crash Intersection Report, engineers shall give attention to keeping to a minimum signs that obstruct or affect sight distance.
- Sight distance is applied to normal and skewed intersections (intersecting angles between 60° and 120°) and where vertical and/or horizontal curves are not present. Sight distance is measured along the major roadway from the center of the entrance lane of the minor roadway to the center of the near approach lane (right or left) of the major roadway. Distances C_{u1} and C_{u2} are measured from the centerline of the entrance lane of the minor roadway to a point on the edge of the near side outer traffic lane on the major roadway. Distance C_{u3} is measured from the centerline of the entrance lane of the minor roadway to a point on the median clear zone (side or horizontal clearance limit) for the far side roadway of the major roadway.
- 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 into locations, and vehicles on the major roadway within dimension C_{u1} .
- Ground Cover & Trunked Plants (Separate or Combined)
Ground Cover - Plant selection of the growing vegetation when at maturity does not attain a height greater than 30" below the sight line datum. For ground cover in combination with trees and palms, the following heights below the sight line datum will apply:
30" for trees and palms \leq 11" dbh; and, 18" for tall palms $>$ 11" but \leq 18" dbh. (24"-min) Sight Windows.
Trunked Plants - Plant selection of a mature trunk diameter \leq 6" or less measured at 6" above the ground. Canopy or high branch foliage shall cover to lower than 3' above the sight line datum. These selections shall be spaced no closer than 20'.
Trees - Trees can be installed with soil, palm, grass, multi-ground covers or other appropriate approved materials. The clear sight window must be in conformance with the WINDOW DETAIL modified to attain the height requirements listed in Ground Cover's notes.
A. Size and spacing shall conform to the Tree Spacing Table.
B. Requirements for placement within median or median openings and at unsignalized

- within as specified in notes 1 through 18 inches
- trees shall be located the distances called for
- shall conform to the 75' 120' of the pavement.
- equipment apply:
- 30 mph size and 60 trees shall be no measured from the
- greater, no trees median legs. Beyond this Spacing Table.

