# MIRE Data Collection Guidebook



**MIRE**
MODEL INVENTORY OF ROADWAY ELEMENTS
*Dictionary of Roadway Data Elements for Safety*

## FHWA Safety Program

U.S. Department of Transportation
**Federal Highway Administration**

**Safe Roads for a Safer Future**
*Investment in roadway safety saves lives*

http://safety.fhwa.dot.gov

# FOREWORD

The Federal Highway Administration's (FHWA's) Highway Safety Improvement Program (HSIP) is a data driven program that relies on crash, roadway, and traffic data for States to conduct effective analyses for problem identification and evaluation.  The FHWA developed the Model Inventory of Roadway Elements (MIRE) to provide a recommended listing and data dictionary of roadway and traffic data elements critical to supporting highway safety management programs.  MIRE is intended to help support the states' HSIPs and other safety programs.

The MIRE Management Information System (MIRE MIS) was a project to explore better means of collecting MIRE data elements, using and integrating the data and identifying optimal data file structures.  The resulting products include reports on the findings from the MIRE MIS Lead Agency Program, a suggested MIRE data file structure report, a report on performance measures states can undertake to assess the quality of their roadway inventory data and a report on collection mechanisms and gap analysis that will assist the states in conducting a more effective safety program.  The intent of the MIRE-MIS project is the integration of MIRE into States' safety management processes.

The *MIRE Data Collection Guidebook* is one of the products of the MIRE MIS effort.  The Guidebook builds upon the MIRE, Version 1.0 document to identify issues State's should be cognizant of when collecting information on specific MIRE elements.  The guidebook discusses methods of collecting the data and potential limitations of those methods.  This document will provide data managers and collectors with information regarding techniques for collecting MIRE data elements that will allow them to potentially collect the elements more efficiently.

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## SI* (MODERN METRIC) CONVERSION FACTORS

### APPROXIMATE CONVERSIONS TO SI UNITS

| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| **LENGTH** | | | | |
| in | inches | 25.4 | millimeters | mm |
| ft | feet | 0.305 | meters | m |
| yd | yards | 0.914 | meters | m |
| mi | miles | 1.61 | kilometers | km |
| **AREA** | | | | |
| $in^2$ | square inches | 645.2 | square millimeters | $mm^2$ |
| $ft^2$ | square feet | 0.093 | square meters | $m^2$ |
| $yd^2$ | square yard | 0.836 | square meters | $m^2$ |
| ac | acres | 0.405 | hectares | ha |
| $mi^2$ | square miles | 2.59 | square kilometers | $km^2$ |
| **VOLUME** | | | | |
| fl oz | fluid ounces | 29.57 | milliliters | mL |
| gal | gallons | 3.785 | liters | L |
| $ft^3$ | cubic feet | 0.028 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.765 | cubic meters | $m^3$ |
| NOTE: volumes greater than 1000 L shall be shown in $m^3$ | | | | |
| **MASS** | | | | |
| oz | ounces | 28.35 | grams | g |
| lb | pounds | 0.454 | kilograms | kg |
| T | short tons (2000 lb) | 0.907 | megagrams (or "metric ton") | Mg (or "t") |
| **TEMPERATURE (exact degrees)** | | | | |
| °F | Fahrenheit | 5 (F-32)/9 or (F-32)/1.8 | Celsius | °C |
| **ILLUMINATION** | | | | |
| fc | foot-candles | 10.76 | lux | lx |
| fl | foot-Lamberts | 3.426 | candela/$m^2$ | cd/$m^2$ |
| **FORCE and PRESSURE or STRESS** | | | | |
| lbf | poundforce | 4.45 | newtons | N |
| lbf/$in^2$ | poundforce per square inch | 6.89 | kilopascals | kPa |

### APPROXIMATE CONVERSIONS FROM SI UNITS

| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| **LENGTH** | | | | |
| mm | millimeters | 0.039 | inches | in |
| m | meters | 3.28 | feet | ft |
| m | meters | 1.09 | yards | yd |
| km | kilometers | 0.621 | miles | mi |
| **AREA** | | | | |
| $mm^2$ | square millimeters | 0.0016 | square inches | $in^2$ |
| $m^2$ | square meters | 10.764 | square feet | $ft^2$ |
| $m^2$ | square meters | 1.195 | square yards | $yd^2$ |
| ha | hectares | 2.47 | acres | ac |
| $km^2$ | square kilometers | 0.386 | square miles | $mi^2$ |
| **VOLUME** | | | | |
| mL | milliliters | 0.034 | fluid ounces | fl oz |
| L | liters | 0.264 | gallons | gal |
| $m^3$ | cubic meters | 35.314 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.307 | cubic yards | $yd^3$ |
| **MASS** | | | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.202 | pounds | lb |
| Mg (or "t") | megagrams (or "metric ton") | 1.103 | short tons (2000 lb) | T |
| **TEMPERATURE (exact degrees)** | | | | |
| °C | Celsius | 1.8C+32 | Fahrenheit | °F |
| **ILLUMINATION** | | | | |
| lx | lux | 0.0929 | foot-candles | fc |
| cd/$m^2$ | candela/$m^2$ | 0.2919 | foot-Lamberts | fl |
| **FORCE and PRESSURE or STRESS** | | | | |
| N | newtons | 0.225 | poundforce | lbf |
| kPa | kilopascals | 0.145 | poundforce per square inch | lbf/$in^2$ |

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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# ACRONYMS

| | |
|---|---|
| 3-D | Three-Dimensional |
| AADT | Annual Average Daily Traffic |
| AC | Asphalt Concrete |
| ADT | Average Daily Traffic |
| ASTM | American Society for Testing and Materials |
| ATR | Automatic Traffic Recorders |
| CRCP | Continuously Reinforced Concrete Pavement |
| DMI | Distance Measuring Instruments |
| DOT | Department of Transportation |
| ETL | Express Toll Lanes |
| FDE | Fundamental Data Elements |
| FHWA | Federal Highway Administration |
| FIPS | Federal Information Processing Standard |
| FRA | Federal Railroad Administration |
| GLC | Geographic Locator Codes |
| GPS | Global Positioning System |
| GSA | General Service Administration |
| HOT | High Occupancy Toll |
| HOV | High Occupancy Vehicle |
| HPMS | Highway Performance Monitoring System |
| HSIP | Highway Safety Improvement Program |
| HSM | Highway Safety Manual |
| INS | Inertial Navigation Systems |
| IRI | International Roughness Index |
| ITS | Intelligent Transportation System |
| JPCP | Jointed Plain Concrete Pavement |
| JRPC | Jointed Reinforced Concrete Pavement |

| | |
|---|---|
| LiDAR | Light Detection and Ranging |
| LRS | Linear Referencing System |
| MAP-21 | Moving Ahead for Progress in the 21$^{st}$ Century |
| MIRE | Model Inventory of Roadway Elements |
| MMUCC | Model Minimum Uniform Crash Criteria |
| MP | Milepost |
| MPH | Miles Per Hour |
| MPO | Metropolitan Planning Organization |
| NCHRP | National Cooperative Highway Research Program |
| NHS | National Highway System |
| OAV | Oblique Aerial View |
| PC | Point of Curve |
| PCC | Portland Cement Concrete |
| PMS | Pavement Management Systems |
| PSR | Present Serviceability Rating |
| PT | Point of Tangent |
| QA/QC | Quality Assurance/Quality Control |
| RR | Railroad |
| RTOR | Right Turn On Red |
| SOV | Single Occupancy Vehicle |
| SPI | Single Point Interchange |
| USC | United States Code |
| USGS | United States Geological Survey |
| VPD | Vehicles Per Day |

# EXECUTIVE SUMMARY

Quality data are the foundation for making important decisions regarding the design, operation, and safety of roadways. While crash data have been a consistent element of highway safety analysis, in recent years there has been an increased focus on the combination of crash, roadway, and traffic data to make more precise and prioritized safety decisions. The application of advanced highway safety analysis processes and tools requires a comprehensive inventory of roadway safety data combined with crash data to better identify and understand problems, prioritize locations for treatment, apply appropriate countermeasures, and evaluate the effectiveness of those countermeasures. Comprehensive roadway safety data include information on roadway and roadside features, traffic operations, traffic volumes, and crashes.

A group of experts conducted an international roadway data scan and recommended development of a list of roadway inventory and operations data elements as a companion to the Model Minimum Uniform Crash Criteria (MMUCC) *(1)*. To this end, the Federal Highway Administration (FHWA) developed the Model Inventory of Roadway Elements (MIRE), a data dictionary of recommended roadway and traffic data elements critical to supporting highway safety management *(2)*.

The purpose of the MIRE Data Collection Guidebook is to provide agencies with information to facilitate the collection of MIRE data. The potential for error exists in all data collection techniques. Agencies collecting data must exercise care to ensure that accurate and timely data collection can be performed safely and in a manner that ensures quality data.

This Guidebook is not intended to serve as a substitute for sound engineering judgment or provide a complete methodology for the collection of all required MIRE data. The Guidebook is intended to provide State and local jurisdictions with practical means to collect MIRE data that are not traditionally collected by agencies. Agencies can incorporate the Guidebook's recommendations into their current data collection methods.

# INTRODUCTION

Quality data are the foundation for making important decisions regarding the design, operation, and safety of roadways. While crash data have been a consistent element of highway safety analysis, in recent years there has been an increased focus on the combination of crash, roadway, and traffic data to make more precise and prioritized safety decisions. The application of advanced highway safety analysis processes and tools requires a comprehensive inventory of roadway safety data combined with crash data to better identify and understand problems, prioritize locations for treatment, apply appropriate countermeasures, and evaluate the effectiveness of the those countermeasures. Comprehensive roadway safety data include information on roadway and roadside features, traffic operations, traffic volumes, and crashes.

Federal safety programs support this data-driven approach to decision making. The Highway Safety Improvement Program (HSIP) is a core Federal-aid program whose purpose is to achieve a significant reduction in fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal land [23 United States Code (USC) 148 (b)(2)]. The HSIP focuses on performance and employs a data-driven, strategic approach to improving highway safety on all public roads. In July of 2012, the transportation legislation Moving Ahead for Progress in the 21st Century (MAP-21) was passed. MAP-21 calls for advancing the capabilities of States for safety data collection, integration, and analysis to support program planning and performance management and continues to support data improvement activities as an eligible HSIP expense [23 USC 148 (a)(4)(B)(xiv)]. Safety data means crash, roadway, and traffic data on a public road, and, includes, in the case of a railway-highway grade crossing, the characteristics of highway and train traffic, licensing, and vehicle data [23 USC 148 (a)(9)] *(3)*.

Even prior to MAP-21, the Federal Highway Administration (FHWA) recognized the importance of an integrated data system for safety. In 2003, a group of experts conducted an international roadway data scan and recommended development of a list of roadway inventory and operations data elements as a companion to the Model Minimum Uniform Crash Criteria (MMUCC) *(4, 5)*. To this end, the FHWA developed the Model Inventory of Roadway Elements (MIRE), a data dictionary of recommended roadway and traffic data elements critical to supporting highway safety management. The initial version of MIRE was released in 2007 *(5)*, and a revised version, MIRE Version 1.0, was released in late 2010 *(2)*. MIRE Version 1.0 consists of 202 data elements divided into the following categories:

    I. Roadway Segment Descriptors:

        a. Segment Location/Linkage Elements.

        b. Segment Roadway Classification.

        c. Segment Cross-Section.

        d. Roadside Descriptors.

e. Other Segment Descriptors.

f. Segment Traffic Flow Data.

g. Segment Traffic Operations/Control Data.

h. Other Supplemental Segment Descriptors.

II. Roadway Alignment Descriptors:

a. Horizontal Curve Data.

b. Vertical Grade Data.

III. Roadway Junction Descriptors:

a. At-Grade Intersection/Junctions.

b. Interchange and Ramp Descriptors.

FHWA recognizes that current trends of constrained resources, competing priorities, and reduced workforces will likely be the norm for the near future. In order to address these issues, States need to find better ways to identify, prioritize, and treat safety problems. One potential solution is for States to enhance their capabilities regarding the collection, maintenance, and use of roadway data as part of normal business practices.

## PURPOSE

The purpose of the MIRE Data Collection Guidebook is to provide agencies with information to facilitate the collection of MIRE data. This Guidebook focuses on the MIRE elements that are not already traditionally collected or for which accepted data collection guidance has not already been developed. This Guidebook provides detailed information on these elements. The information will help facilitate importing the MIRE data into new or existing databases. The potential for error exists in all data collection techniques. Agencies collecting data must exercise care to ensure that accurate and timely data collection can be performed safely and in a manner that ensures quality data.

This Guidebook is not intended to serve as a substitute for sound engineering judgment or provide a complete methodology for the collection of all MIRE data. The Guidebook is intended to provide State and local jurisdictions with practical means to collect MIRE data that are not traditionally collected by agencies. Agencies can incorporate the Guidebook's recommendations into their current data collection methods.

MAP-21 requires the Secretary to establish a subset of the MIRE that are useful for the inventory of roadway safety and ensure that States adopt and use the subset to improve data collection [23 USC (f)(2)]. In response, FHWA released the *MAP-21 Guidance on State Safety Data Systems,* which provides information on the set of roadway and traffic data elements States should be collecting on all public roads because they are fundamental to support a State's HSIP

*(3)*.  This set of elements is herein referred to as the MIRE Fundamental Data Elements (MIRE FDE).  The MIRE FDE include segment, intersection, and ramp data elements and were determined to be the basic set of data elements that an agency would need to conduct enhanced safety analyses to support a State's HSIP.  This guidance supersedes the *Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program* and the 2011 FDE *(6)*.  The MIRE FDE are based on the elements needed to apply the Highway Safety Manual (HSM) roadway safety management (Part B) procedures using network screening and analytical tools.  They are a subset of MIRE and are equivalent to some Highway Performance Monitoring System (HPMS) full extent elements that States submit for Federal-aid highways.  The MIRE FDE are divided into a full set of MIRE FDEs and a reduced set of MIRE FDEs for roads with an annual average daily traffic (AADT) less than 400 vehicles per day.  Table 1 and Table 2 summarize the MIRE FDE.

**Table 1. MIRE FDE for all public roads with AADT ≥ 400 vehicles per day (vpd).**

| FDE (MIRE Number)^ | |
|---|---|
| **Roadway Segment** | **Intersection** |
| Segment Identifier (12) | Unique Junction Identifier (120) |
| Route Number (8)[0] | Location Identifier for Road 1 Crossing Point (122) |
| Route/Street Name (9)[0] | Location Identifier for Road 2 Crossing Point (123) |
| Federal-aid/ Route Type (21)* | Intersection/Junction Geometry (126) |
| Rural/Urban Designation (20)* | Intersection/Junction Traffic Control (131) |
| Surface Type (23) | AADT (79) [for Each Intersecting Road] |
| Begin Point Segment Descriptor (10) | AADT Year (80) [for Each Intersecting Road] |
| End Point Segment Descriptor (11) | Unique Approach Identifier (139) |
| Segment Length (13) | **Interchange/Ramp** |
| Direction of Inventory (18) | Unique Interchange Identifier (178) |
| Functional Class (19)* | Location Identifier for Roadway at Beginning Ramp Terminal (197) |
| Median Type (54) | Location Identifier for Roadway at Ending Ramp Terminal (201) |
| Access Control (22)† | Ramp Length (187) |
| One/Two-Way Operations (91)* | Roadway Type at Beginning Ramp Terminal (195) |
| Number of Through Lanes (31)* | Roadway Type at Ending Ramp Terminal (199) |
| Average Annual Daily Traffic (AADT) (79)* | Interchange Type (182) |
| AADT Year (80) | Ramp AADT (191)* |
| Type of Government Ownership (4)* | Year of Ramp AADT (192) |
| | Functional Class (19)* |
| | Type of Government Ownership (4)* |

^ Model Inventory of Roadway Elements – MIRE Version 1.0 *(2)*.

* HPMS full extent elements required on all Federal-aid highways and ramps located within grade-separated interchanges, i.e., National Highway System (NHS) and all functional systems excluding rural minor collectors and locals.

[0] HPMS element required on all NHS, Interstate, Freeway & Expressways, Principal Arterials, and Minor Arterials.

† HPMS element required on all NHS, Interstate, Freeway & Expressways, and Principal Arterials

**Table 2. MIRE FDE for all public roads with AADT < 400 vpd.**

| FDE (MIRE Number)^ | |
|---|---|
| **Roadway Segment** | **Intersection** |
| Segment Identifier (12) | Unique Junction Identifier (120) |
| Functional Class (19)* | Location Identifier for Road 1 Crossing Point (122) |
| Surface Type (23) | Location Identifier for Road 2 Crossing Point (123) |
| Type of Government Ownership (4)* | Intersection/Junction Geometry (126) |
| Number of Through Lanes (31)* | Intersection/Junction Traffic Control (131) |
| Average Annual Daily Traffic (AADT) (79)* | |
| Begin Point Segment Descriptor (10) | |
| End Point Segment Descriptor (11) | |
| Rural/Urban Designation (20)* | |

^ Model Inventory of Roadway Elements – MIRE Version 1.0 *(2)*.

* HPMS full extent elements required on all Federal-aid highways and ramps located within grade-separated interchanges, i.e., NHS and all functional systems excluding rural minor collectors and locals.

This Guidebook will indicate the elements that are part of the FDEs in the element listing under *Considerations*. This guidance notwithstanding, FHWA still recommends that States collect as many of the MIRE data elements as possible on all public roadways.

# OVERVIEW OF COLLECTION METHODOLOGIES

This chapter will provide an overview of the methodologies to collect data related to the various MIRE elements.  Data collection and processing technologies are continually evolving.  As such, the information presented should be considered a snapshot of the currently available methodologies.

## DATA MINING

### Potential Data Sources

Highway agencies can use existing roadway inventories to extract information for the MIRE management information system.  These include HPMS and State-maintained roadway inventories.  Agencies can also use standalone information systems maintained for pavements, bridges, culverts, signs, signals, pavement markings, and other roadway hardware.  Other potential sources include previously recorded data, including as-built plans, construction records, videologs, and other off-line data sources.  The order in which to seek and utilize the existing information would vary by the data type and completeness and accuracy of the existing data.

### Concerns

The primary concern with the State-maintained roadway inventories and HPMS is that they do not include coverage of all MIRE data elements or include all public roads.  These inventories were created for other purposes.  They may contain data elements for MIRE's roadway location, linkage, and classification categories.  These databases may also contain basic elements that describe surface, lanes, shoulders, and medians.  However they often lack specific information such as surface friction, rumble strips, cross slope, and geometry of grades and curves.  Most available data inventories lack information on roadside features, roadside hardware, pavement marking, lighting, intersections, interchanges, ramps, circular intersections, and in-depth alignment features.  Furthermore, these inventories are primarily designed for facilities serving automobile and truck traffic, and therefore, lack facility or traffic information pertaining to pedestrians, bicycles, and motorcycles.

While supplementary data inventories could serve as a potential source of information for MIRE data, each highway agency should conduct their own evaluation to assess the feasibility of utilizing these sources for MIRE.  These supplementary sources are often collected and/or maintained by disparate groups within each agency.

Other key concerns while trying to use existing inventories for MIRE purposes are the accuracy and timeliness of available data.  The validity of the data will vary based on the method of collection, method of data mining, and the overall age of the datasets being used.

Nevertheless, inasmuch as possible, where existing inventories have data, it is suggested that they be used as appropriate.

## MANUAL COLLECTION (FOOT ON GROUND)

### Available Technologies and Methodologies

Backpack-based data collection method has been traditionally employed by transportation agencies for manual data collection.  Backpack-based data collection uses lightweight, mobile equipment that can be hand-held or carried on the back of a person in the field.  Typically, a differential Global Positioning System (GPS) is used for georeferencing to establish the location of each data element. Descriptive data for the objects of interest are recorded using image capturing devices or electronic devices by using hand-held, laptop, or pen-based computers.

### Emerging Technologies and Methodologies

Street level imagery gathered using pedestrian platforms is an emerging technology.  The pedestrian platforms often include a camera tower installed with multiple, high resolution cameras.  The camera tower is equipped with an actuator that can rise up or down, as needed, to provide a full, un-obstructed view for the cameras.  The standard camera tower in the system can be transferred between vehicle and pedestrian platforms, and it has a lowering mechanism for easy storage and transportation.

### Data Collection Efficiency

Manual methods are less efficient because the data collection process is slow and labor intensive, often resulting in high costs and less coverage of the road system.  However, the capital costs related to the equipment would be low.  Furthermore, the data collection effort can be affected by adverse weather and poor lighting conditions.  This method is accurate for data elements that involve visual identification and simple measurements such as number of lanes, total surface paved width, presence of rumble strips, median type, school zone indicator and junction type.  The manual method may be suitable for data elements that involve complex measurements such as intersection skew angle, curves and grades.  With good quality control at work, manual methods often do not require significant post-processing efforts.

### Concerns

The major concerns with the use of manual methods are as follows:

- Data collection by the backpack method is time-consuming because of the time involved in walking from one inventory element to another.

- Size and weight restrictions mean that the backpack data collection method does not offer many choices in terms of use of sensory equipment.

- The backpack input devices must operate on lightweight, long-life batteries and must tolerate rugged handling during field operations.

## GROUND-BASED IMAGING (MOBILE MAPPING)

### Available Technologies

Ground-based imaging, often referred to as a mobile mapping system, is a specially instrumented vehicle installed with high-definition cameras for image capture (see Figure 1-a). This process is synchronized with georeferencing tools that typically include a real-time differential GPS, distance measuring instruments (DMI), and inertial navigation systems (INS).

Multiple high-resolution cameras are typically mounted on the front and back, pointing downward to facilitate vertical and horizontal capture of images (see Figure 1-b). This facilitates precise documentation of all roadway features in all directions including the right-of-way, overhead signs, and roadside condition.

As the data is being collected, differential correction techniques are applied real-time to enhance the quality of location data gathered using the real-time differential GPS receivers. DMI and INS units are used in conjunction with GPS to maintain precise georeferencing especially when the GPS satellite signals are poor. Real-time differential correction is done when the base station calculates and broadcasts corrections for each satellite or land-based rovers as it receives the data. Using real-time differential corrections, location accuracy within one to two yards can be achieved. INS uses accelerometers and gyroscopes that measure vehicle speed, pitch, roll, and heading, which can be then used to calculate roadway geometric elements such as curvature, grade, and cross-slope during post-processing.

The mobile mapping system facilitates image capture and measurements at highway speeds ranging up to 70 miles per hour (mph). The system also allows adjustments to images for varying lighting and weather conditions. The system includes an image viewer to allow real-time monitoring of images for quality control purposes.

a. Data collection vehicle



b. Imaging cameras



c. Laser scanner.

**Figure 1. Ground-based imaging (including LiDAR).**

*Images courtesy of Mandli Communications, Inc.*

## Emerging Technologies

There have been advancements in both data collection and post-processing capabilities of mobile mapping systems.

Positioning and imaging sensor technologies have rapidly improved the spatiotemporal accuracy of collected records.  One such example is the use of real-time kinematic GPS, which has improved the positional accuracy to between one to two inches.  Another example is the application of stereovision technologies in mobile mapping.  Stereovision-based mobile mapping is an example of an emerging technology that allows the extraction of depth information from digital images to provide intuitive and more accurate 3-D mapping of geo-located objects *(7)*. This technology is capable of consistently delivering absolute 3-D point accuracies of about 1.6

inches (4 cm) in horizontal and 0.8 inches (2 cm) in vertical position.  Similarly, the post-processing capabilities are continuously evolving in the areas of data storage compression, spatial indexing and automated feature extraction with the application of technologies such as cloud computing and high-performance computing.

## Data Collection Efficiency

Ground-based imagery systems provide images with high resolution texture and color that are reasonably accurate for most roadway inventory elements.  Ground-based imagery could be better than Light Detection and Ranging (LiDAR) technologies in identifying boundaries and surface discontinuities.  These systems can collect images at highway speeds; however, the speed of data collection can be affected by traffic congestion, lower speed limits, and large numbers of intersections, interchanges and ramps.  The data collection effort is also adversely affected by unfavorable weather and poor lighting conditions, although the private vendors offer adjustments for captured images.

Ground-based imagery requires significant post-processing effort.  Automated image processing algorithms and real-time monitoring of image quality are on the rise and can help minimize post-processing efforts.

## Concerns

The major concerns with the use of ground-based imagery are as follows:

- Higher cost of data collection and reduction.

- Skilled crew is required for both data collection and post-processing. Specialized software is required for automatic or semi-automatic extraction of roadway features.

- Ground-based imaging systems in general take longer time for data collection than aerial imaging systems.  The data collection effort with ground-based imagery may be adversely affected by heavy traffic conditions.  Ground-based imagery can also be obstructed or blocked by passing vehicles.

- Ground-based imagery is not suitable during unfavorable weather and poor lighting conditions.

## GROUND-BASED IMAGING WITH LIDAR

### Available Technologies

Ground-based imaging system with LiDAR utilizes a motorized vehicle instrumented with laser scanners and georeferencing units such as differential GPS, INS and DMI.  The laser scanners are laser range-finding devices usually encased inside a rotating enclosure and mounted on the exterior of the vehicle.  The enclosure spins a full 360° rotation to capture the footprint of the scanned environment (see Figure 1-c).  These systems facilitate image capture and

measurements at highway speeds.  When no images are needed, the LiDAR units can be operated during day and night times.

The laser scan transmits optical pulses and collects back the pulses that reflect off from the surface object using a receiver.  The receiver measures the travel time of the pulse accurately from its start to its return.  The time of travel of optical pulses returning from the surface is then used to build a point file of 3-D coordinates with sub-centimeter precision.  The laser scan can measure the location of up to 8,000 surface points in one second.  Often multiple laser scans are used to obtain denser point clouds and very high spatial resolution.

### Emerging Technologies

Ground-based LiDAR systems are increasingly equipped with high-resolution imaging cameras.  Integrating imagery with point clouds augments the user interpretation and post-processing of the collected data to provide a better 3-D perception.  Similarly, there have been rapid advancements in positional and image sensing capabilities.

Another emerging technology is the potential use of spatial cloud computing concepts in geospatial applications *(8)*.  With rapid improvement in spatiotemporal accuracy of data, the demand for massive data storage, processing, and system capabilities have increased.  Cloud computing technologies have emerged to solve data storage and computing related challenges.  Through resource pooling, cloud computing provides massive data storage and intensive computing at lower life cycle costs.

### Data Collection Efficiency

Ground-based LiDAR systems are capable of providing 3-D corridor scenarios with very high spatial resolution.  At higher point cloud densities, LiDAR systems are typically accurate for roadway inventory purposes.  Data collection effort is not hampered by unfavorable weather and poor lighting; both the laser scans and georeferencing tools can still operate during nighttime without the camera.  While this may affect the color imagery of the scene, the positional accuracy or resolution of the point files remain unaffected.

Real-time survey capabilities facilitate high-quality data and minimize repetitions.  Fewer field staff is often necessary during post-processing.  LiDAR systems offer the ability to mine the data cloud of a corridor snapshot; i.e., it allows further investigation of the existing conditions.  LiDAR measurements can also be combined with building information models for future use.

### Concerns

The major concerns with the use of ground-based LiDAR are as follows:

- Ground-based LiDAR take longer time for data collection than airborne LiDAR.  The data collection effort with ground-based system may be adversely affected by heavy traffic conditions; occluding effect of passing vehicles may affect data completeness.

- Skilled personnel are required for both data collection and post-processing. Specialized software is required for automatic or semi-automatic extraction of roadway features.

- User interpretation and extraction of roadway features from point clouds of corridor scenarios can be inefficient and less intuitive without imagery data.

## AERIAL IMAGING

### Available Technologies

Aerial imagery using satellites holds potential for inexpensive, real-time collection of large-area roadway inventory elements. The images obtained from private vendors can yield geopositioning accuracy of close to 4 inches in planimetry (a concept that consists of identification and geolocation of land areas in the X-Y plane) and 10 inches in height through the use of a single ground control point. Aerial imagery involves significant post-processing efforts using appropriate software packages to extract the required information from the images along with the georeferences.

### Emerging Technologies

Oblique Aerial View (OAV) imagery is fast emerging as a supplement for orthoimagery (a map-quality aerial image corrected for topographic relief, lens distortion, and camera tilt). OAV is a continuous oblique concept that provides multiple, angled views of ground features thereby allowing the users to see these features in context with other surrounding features regardless of which angle is being viewed. The biggest difference between OAV images and normal oblique images used in orthoimagery is perspective, with the orthoimagery offering more of an overhead image of a ground feature compared to the OAV. OAV finds applications in image analysis by providing multiple angled views of ground features and helps mitigate some of the limitations of traditional orthoimagery. While several commercial vendors offer this technology, information on large-scale, network-level implementation is yet to be seen. Similarly, there are potential benefits with the emerging use of spatial cloud computing concepts in geospatial applications.

### Data Collection Efficiency

Aerial imagery offers quick and safer data collection over large swaths at lower cost; however, aerial images are not as accurate as ground-based images. Since aerial imagery is incapable of producing 3-D effects, it is suitable for data elements that can be identified and measured from plan view. Aerial imagery requires significant post-processing efforts. Aerial imagery datasets are readily available from both private vendors and public agencies.

### Concerns

The major concerns with the use of aerial imagery are as follows:

- Coverage is adversely affected by tree cover, over passes and other canopy effects.

- With aerial imagery, overlapping strips of images can cause accuracy related issues when adjusted for georeferencing.

- Measurement accuracy could be low.

## AERIAL IMAGING WITH LIDAR

### Available Technologies

Aerial imaging systems with LiDAR, also called *airborne laser swath mapping,* can collect data at high altitudes and thus can cover even remote locations relatively quickly.  LiDAR produces high-resolution 3-D surfaces whose accuracy depends on the density of cloud points.  The point cloud collected from LiDAR can be as dense as millions of points per square mile, depending on the point spacing (distance between two points), pulse repetition rate, flying height, and flying speed.  The airborne systems can produce elevation models with an accuracy of two inches and point spacing (indicator of horizontal accuracy) as small as one foot.  These accuracy standards may not be adequate for typical roadway inventory purposes.  Higher cloud density may have useful applications but involves considerable time and cost for data collection and processing.  With LiDAR, a significant data processing effort is required to generate digital elevation models using automated processes.  Several software packages are available in the market that process LiDAR cloud point data.

### Emerging Technologies

New generation of airborne laser scanners are fast growing in the market.  These scanners offer high pulse rate and point cloud data density for high-accuracy roadway inventory applications.  High resolution cameras are being used in conjunction with laser scanners during aerial surveys to facilitate integration of images with LiDAR data.  Similarly, there are potential benefits with the emerging use of spatial cloud computing concepts in geospatial applications.

Airborne LiDAR datasets are readily available for several parts of the US from public forestry, agriculture and geological agencies.  The United States Geological Survey (USGS) is currently coordinating efforts across multiple agencies towards a National LiDAR Dataset.  However, the feasibility of using these datasets for roadway inventory applications remains unknown.

### Data Collection Efficiency

Like aerial imagery, airborne LiDAR systems offer quick, cheaper and safer data collection over large swaths albeit at lower accuracy than ground-based LiDAR.  While airborne LiDAR can produce 3-D effects with denser point clouds, the coverage can be adversely affected by tree cover, over passes and other canopy effects.

### Concerns

The major concerns with the use of aerial imagery are as follows:

- Coverage is adversely affected by tree cover, over passes and other canopy effects.

- Significant data processing effort is required to generate digital elevation models.

## SUMMARY

All the data collection methods discussed above can be used to collect most of the MIRE elements; however, there are advantages and concerns with each method.  Airborne technologies may be cheaper and faster, but they do not provide information with desired accuracy for roadway inventory applications; these methods are not appropriate for collecting information on elements that require perspective from ground-level, such as signs.  On the other hand, ground-based methods provide accurate information but are more expensive and time-consuming; these methods have limitations in collecting information on sideslopes and width if the slope is too steep.  None of these methods can collect information on smaller objects for traffic control, such as the type of pedestrian signals. In most cases, significant post-processing efforts, including manual intervention and quality checks, are necessary.

In summary, each system has a different set of requirements for field data collection and subsequent back office work to extract asset results.  Several factors, including capabilities, accuracy, cost, operational efficiencies, quality control, and post-processing requirements should be taken into consideration when selecting an appropriate data collection method.  There should be a balance between the threshold accuracy of MIRE elements needed for safety analysis and the dollars spent on data collection and reduction.  Previous sections discuss the advantages and disadvantages of each data collection method.  Based on this discussion, considering both accuracy and effort needed for both data collection and post-processing effort, Table 3 presents the suggested data collection methodologies for MIRE data elements.

**Table 3. Suggested data collection methodologies for MIRE.**

| Data Element Type | Manual Methods | Ground-based Imagery | Ground-based LiDAR | Aerial imagery | Airborne LiDAR |
|---|---|---|---|---|---|
| Visual identification (e.g., surface type, rumble strip presence and type) | LP | P | P | MP | LP |
| Marking (e.g., edgeline presence, circular intersection-pedestrian facility) | LP | P | MP | P | MP |
| Plan view ID (e.g., sidewalk presence, interchange type) | LP | P | P | P | P |
| Plan view measurement (e.g., circular intersection - entry radius, grade length) | LP | P | P | P | P |
| Signs (e.g., speed limit, school zone indicator) | LP | P | P | LP | LP |
| Shape (e.g., curb type, interchange lighting) | LP | P | P | LP | MP |
| Overall | LP | P | P | MP | MP |

Notes: P = Preferable, MP = Moderately Preferable, LP = Less Preferable

# COLLECTION OF MIRE DATA ELEMENTS

This section presents each of the MIRE elements, along with specific guidance on how the elements can be collected and considerations for collection.  Several elements already have well-accepted data collection practices.  Part of the description includes references to those practices.  Each element includes the following information:

- **Definition**: definition of the data element as defined in MIRE Version 1.0.

- **Attributes**: list of attributes (coding) as defined in MIRE Version 1.0.

- **Accuracy Statement**: recommended accuracy for collecting the data element.  This is based on existing practices and research and was vetted with a technical working group consisting of researchers and practitioners.

- **Considerations**: where applicable, any special considerations regarding the definition or attributes.  This section also indicates if the data element is an FDE.

- **Existing Resources**: links to resources that describe existing data collection practices.  These include both National and State resources.  The resources provided are examples of current practices and do not include an exhaustive list of all available resources.

- **Collection Methods**: list of potential collection methods.  These are provided for elements that do not already have established data collection procedures.

- **Concerns with Collection Methods**: where applicable, concerns about data collection methods are listed to help the user determine the appropriate method for collection.  For example, concerns with using aerial imagery for data collection are the timeliness of the images and the quality of the image resolution.

# I. ROADWAY SEGMENT DESCRIPTORS

## I.A. Segment Location/Linkage Elements

## 1. County Name

### Description

Definition: The name of the county or equivalent entity where the segment is located.

Attributes:

- The county name or equivalent entity where the roadway segment is located.

Accuracy Statement: 90-100%.

### Considerations

None.

### Existing Resources

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

### Collection Methods

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

### Concerns with Collection Methods

None.

## 2. County Code

### Description

Definition: Census defined County Federal Information Processing Standard (FIPS) code or equivalent entity where the segment is located.

Attributes:

- The Census defined County FIPS code or equivalent entity where the roadway segment is located. If state-assigned codes are used, they should be convertible to the General Service Administration (GSA)/FIPS format.

Accuracy Statement: 90-100%.

### Considerations

None.

### Existing Resources

Established data collection methodologies can be found at:

National:

- HPMS Field Manual: http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.
- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

### Collection Methods

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

### Concerns with Collection Methods

None.

## 3. Highway District

*Description*

Definition: The highway district where the segment is located.

Attributes:

- Numeric district number (as defined by the State).

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Texas Department of Transportation (DOT) Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 4. Type of Governmental Ownership

*Description*

Definition: Type of governmental ownership.

Attributes:

- State Highway Agency.

- County Highway Agency.

- Town or Township Highway Agency.

- City or Municipal Highway Agency.

- State Park, Forest, or Reservation Agency.

- Local Park, Forest, or Reservation Agency.

- Other State Agency.

- Other Local Agency.

- Private (other than Railroad).

- Railroad.

- State Toll Authority.

- Local Toll Authority.

- Other Public Instrumentality (e.g., Airport, School, University).

- Indian Tribe Nation.

- Other Federal Agency.

- Bureau of Indian Affairs.

- Bureau of Fish and Wildlife.

- U.S. Forest Service.

- National Park Service.

- Tennessee Valley Authority.

- Bureau of Land Management.

- Bureau of Reclamation.

- Corps of Engineers.

- Air Force.

- Navy/Marines.

- Army.

- Other.

Accuracy Statement: 100%.

## Considerations

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

## Existing Resources

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

## Collection Methods

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

## Concerns with Collection Methods

None.

## 5. Specific Governmental Ownership

*Description*

Definition: The specific governmental owner of the segment.

Attributes:

- City name or equivalent entity (e.g., tribal jurisdiction).

Accuracy Statement: 90-100%.

*Considerations*

If codes are used instead of name, use the GSA Geographic Locator Codes (GLC) that can be found on the internet at: http://www.gsa.gov/portal/content/104507.  If State-assigned codes are used, they should be convertible to the GSA/FIPS format.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 6. City/Local Jurisdiction Name

*Description*

Definition: The name of the city or local jurisdiction/agency where the segment is located if applicable.

Attributes:

- The city name or equivalent entity (e.g., tribal jurisdiction).

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 7. City/Local Jurisdiction Urban Code

*Description*

Definition: The applicable Census urban area code of the city or local jurisdiction/agency where the segment is located.

Attributes:

- The Census urban code.

Accuracy Statement: 90-100%.

*Considerations*

See Census website: http://www.census.gov/2010census/.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 8. Route Number

### *Description*

Definition: The signed route number.

Attributes:

- Signed numeric value for the roadway segment.

Accuracy Statement: 100%.

### *Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.  Descriptive route name information should be included in Element 9. Route/Street Name.

### *Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

### *Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

### *Concerns with Collection Methods*

None.

## 9. Route/Street Name

### Description

Definition: The route or street name, where different from route number (Element 8).

Attributes:

- The alphanumeric route or street name.

Accuracy Statement: 100%.

### Considerations

This is an FDE for roads with AADT ≥ 400 vpd.

### Existing Resources

Established data collection methodologies can be found at:

    National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

    State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

### Collection Methods

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

### Concerns with Collection Methods

None.

## 10. Begin Point Segment Descriptor

*Description*

Definition: Location information defining the location of the beginning of the the segment.

Attributes:

- Begin point will be defined by the user agency (e.g., based on homogeneity of chosen attributes throughout the segment). Begin point segment descriptors can be either related to a Linear Reference System (LRS) (e.g., Route-beginning milepoint, Route-ending milepoint) or to a spatial data system (i.e., longitude/latitude for begin and end points). Street address could also possibly be used for urban areas. The descriptortypes used must be common across all MIRE files and compatible with crash data location coding.

Accuracy Statement: 0.01– 0.001 mile.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 11. End Point Segment Descriptor

*Description*

Definition: Location information defining the location of the end of the the segment.

Attributes:

- End point will be defined by the user agency (e.g., based on homogeneity of chosen attributes throughout the segment). End point segment descriptors can be either related to a Linear Reference System (e.g., Route-beginning milepoint, Route-ending milepoint) or to a spatial data system (i.e., longitude/latitude for begin and end points). Street address could also possibly be used for urban areas. The descriptortypes used must be common across all MIRE files and compatible with crash data location coding.

Accuracy Statement: 0.01– 0.001 mile.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 12. Segment Identifier

*Description*

Definition: Unique segment identifier.

Attributes:

- Derived from other elements (e.g., combination of route number, county location and beginning and ending milepoints).

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and roads with AADT < 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 13. Segment Length

*Description*

Definition: The length of the segment.

Attributes:

- Miles.

Accuracy Statement: 0.01– 0.001 mile.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 14. Route Signing

*Description*

Definition: The type of route signing on the segment.

Attributes:

- Not signed.

- Interstate.

- U.S.

- State.

- Off-interstate business marker.

- County.

- Township.

- Municipal.

- Parkway marker or forest route marker.

- None of the above.

Accuracy Statement: 90-100%.

See Figure 2 for examples of route signs included in this element.

Interstate Route Sign
M1-1

Off-Interstate Business Route Sign
M1-2 (Loop), M1-3 (Spur)

U.S. Route Sign
M1-4

State Route Sign
M1-5

County Route Sign
M1-6

Forest Route Sign
M1-7

**Figure 2. Route signs** *(14).*

### *Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

### *Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

### *Concerns with Collection Methods*

None.

**15. Route Signing Qualifier**

*Description*

Definition: The descriptive qualifier for the route sign.

Attributes:

- No qualifier or not signed.

- Alternate.

- Business route.

- Bypass.

- Spur.

- Loop.

- Proposed.

- Temporary.

- Truck route.

- None of the above.

See Figure 3 for examples of the types of signs for this element.
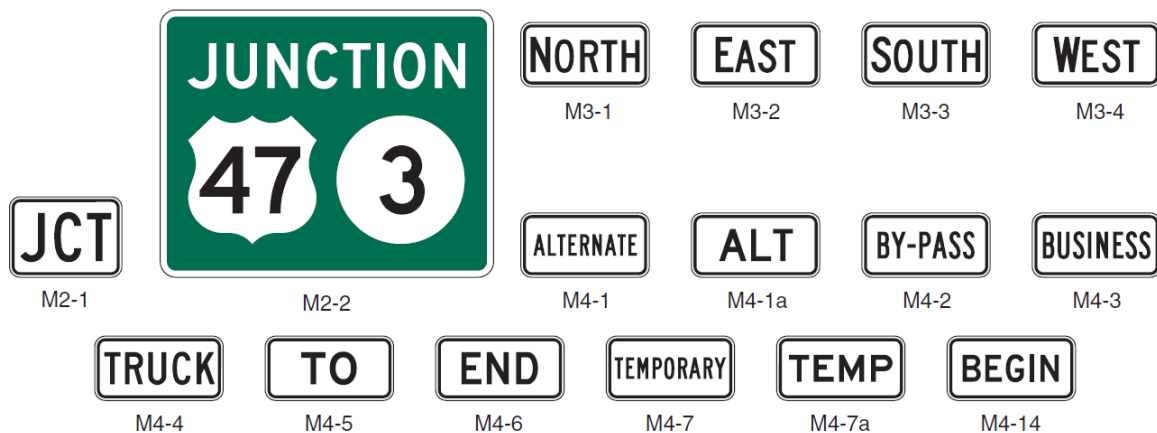
Accuracy Statement: 90-100%.



**Figure 3. Route sign auxiliaries *(14)*.**

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 16. Coinciding Route Indicator

*Description*

Definition: Indication of whether the route segment is a "primary" coinciding route (i.e., the route to which  crashes are referencedand which carries the attribute data) or a "minor" coinciding route which is not linked to crashes and does not include attribute data.  (Note that minor-route segments might not appear in the inventory since the primary route inventory information is the same for both routes.)

Attributes:

- Segment does not contain coinciding routes.

- Coinciding route – Primary (i.e., crashes linked to this route and attributes included for segment).

- Coinciding route – Minor (i.e., crashes not linked to this route).

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Oklahoma Road Inventory Manual: http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 17. Coinciding Route – Minor Route Information

*Description*

Definition: If this segment is a primary coinciding route segment, enter the route number for the minor route.

Attributes:

- Signed coinciding minor route number.

Accuracy Statement: 90-100%.

*Considerations*

Additional elements may be needed to handle instances of more than one coinciding minor route.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 18. Direction of Inventory

### Description

Definition: Direction of inventory if divided roads are inventoried in each direction.

Attributes:

- Reference compass direction if divided roads are inventoried in each direction usually due to different characteristics on each roadway.

- Both if inventory in only one direction.

Accuracy Statement: 100%.

### Considerations

This is an FDE for roads with AADT ≥ 400 vpd.

### Existing Resources

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Oklahoma Road Inventory Manual: http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

### Collection Methods

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

### Concerns with Collection Methods

None.

## I.B. Segment Classification

### 19. Functional Class

*Description*

Definition: The functional class of the segment.

Attributes:

- Interstate.

- Principal arterial other freeways and expressways.

- Principal arterial other.

- Minor arterial.

- Major collector.

- Minor collector.

- Local.

See Table 4 for additional details.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and roads with AADT < 400 vpd. Functional classification is the method of grouping the streets and highways into classes, or systems, according to the character of service they are intended to provide.

**Table 4. Functional classification systems *(15)*.**

| Functional System | Services Provided |
|---|---|
| Arterial | Provides the highest level of service at the greatest speed for the longest uninterrupted distance, with some degree of access control. |
| Collector | Provides a less highly developed level of service at a lower speed for shorter distances by collecting traffic from local roads and connecting them with arterials. |
| Local | Consists of all roads not defined as arterials or collectors; primarily provides access to land with little or no through movement. |

Characteristics of principal/major and minor arterials *(16)*:

- Principal/major arterials have higher level of service.  They have very high average daily traffic (ADT) and provide high speed corridors through or between large cities.

   - Example: main freeway system through densely populated cities.

- Minor arterials have lower ADTs.  They provide high speed corridors through or between medium sized population centers.

   - Example: main freeway system traversing the rural area between cities.

Characteristics of major and minor collectors *(16)*:

- Major collectors connect arterial roadways and high traffic generators.  In urban areas this may include education, commercial, health, and recreational centers.  In rural areas this may include consolidated schools, shipping points, county parks, important mining and agricultural areas, etc.  Major collectors also serve as the more important intracity or intracounty travel corridors that are not considered arterial.

   - Example: Segment that connects to a freeway and provides access to multiple stores and restaurants.

- Minor collectors in urban areas penetrate residential areas to connect local roads to major collectors and arterial roads.  Rural minor collectors serve smaller communities. They are spaced at intervals, consistent with population density, thereby collecting traffic from local roads and bringing all developed areas within a reasonable distance of a collector road.

   - Example: Segment that connects a grid of farming roads to a nearby population center.

## *Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual: http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual: http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

## *Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

## *Concerns with Collection Methods*

None.

**20. Rural/Urban Designation**

*Description*

Definition: The rural or urban designation based on Census urban boundary and population.

Attributes:

- Rural.

- Urban (population ≥ 5,000).

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

Rural areas are the areas outside the boundaries of small urban and urbanized areas (as designated by the Bureau of Census). They have a population of less than 5,000. Small urban areas are those urban places, as designated by the Bureau of the Census having a population of five thousand (5,000) or more and not within any urbanized area. Urban areas have a population equal to or greater than 5,000 *(16)*.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 21. Federal Aid/Route Type

*Description*

Definition: Federal-aid/National Highway System (NHS) route type.

Attributes:

- Route is non Federal-aid.

- Route is Federal-aid, but not on NHS (i.e., all non-NHS routes functionally classified as Interstate, Other Freeways & Expressways, Other Principal Arterials, Minor Arterials, Major Collectors, and Urban Minor Collectors).

- Route is on NHS.

- NHS connector to Major Airport.

- NHS connector to Major Port Facility.

- NHS connector to Major Amtrak Station.

- NHS connector to Major Rail/Truck Terminal.

- NHS connector to Major Inter City Bus Terminal.

- NHS connector to Major Public Transportation or Multi-Modal Passenger Terminal.

- NHS connector to Major Pipeline Terminal.

- NHS connector to Major Ferry Terminal.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
CollectionGuide.pdf *(17)*.

## Collection Methods

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

## Concerns with Collection Methods

None.

**22. Access Control**

*Description*

Definition: The degree of access control.

Attributes:

- Full access control – Preference given to through traffic movements by providing interchanges with selected public roads, and by prohibiting crossing at-grade and direct driveway connections (i.e., limited access to the facility).

- Partial access control – Preference given to through traffic movement.  In addition to interchanges, there may be some crossings at-grade with public roads, but, direct private driveway connections have been minimized through the use of frontage roads or other local access restrictions.  Control of curb cuts is not access control.

- No access control – No degree of access control exists (i.e., full access to the facility is permitted).

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual: http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual: http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual: http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## I.C. Segment Cross Section

### 23. Surface Type

*Description*

Definition: The surface type of the segment.

Attributes:

- Unpaved.

- Bituminous.

- JPCP – Jointed Plain Concrete Pavement.

- JRCP – Jointed Reinforced Concrete Pavement.

- CRCP – Continuously Reinforced Concrete Pavement.

- Asphalt-Concrete (AC) Overlay over Existing AC Pavement.

- AC Overlay over Existing Jointed Concrete Pavement.

- AC (Bi Overlay over Existing CRCP).

- Unbonded Jointed Concrete Overlay on Portland Cement Concrete (PCC) Pavements.

- Unbonded CRCP Overlay on PCC Pavements.

- Bonded PCC Overlays on PCC Pavements.

- Other.

Accuracy Statement: 100%

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.  Refer to local pavement management systems (PMS) database for determining the surface types.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

### *Collection Methods*

Ground-based imagery is used for collecting this data element.

### *Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**24. Total Paved Surface Width**

*Description*

Definition: The total paved surface width.

Attributes:

- Feet.

Accuracy Statement: ± 6 in.

*Considerations*

This element could be derived if all paved lane and paved shoulder widths are captured.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Airborne LiDAR with imagery.

- Ground-based imagery.

- Terrestrial LiDAR.

This element involves measurements during post-processing of data collected.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 25. Surface Friction

*Description*

Definition: The surface friction indicator for the segment.

Attributes:

- Measured skid number on the segment or general indication of wet-surface friction (e.g., high, medium, low).

Accuracy Statement: ± 10%.

*Considerations*

Agencies will decide how to code segments with no measured number or multiple skid numbers and whether one number is indicative of friction on entire segment.

This information is typically collected by an agency for asset management purposes.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- National Cooperative Highway Research Program (NCHRP) Web-Only Document 108: Guide for Pavement Friction: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w108.pdf *(18)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Surface friction measurement equipment is used for collecting this data element.  At the network level, the locked-wheel friction tester (American Society for Testing and Materials [ASTM] E 274) is the most appropriate.  This device is installed on a trailer which is towed behind the measuring vehicle at a typical speed of 40 mi/hr (64 km/hr).  Water (0.02 in [0.5 mm] thick) is applied in front of the test tire, the test tire is lowered as necessary, and a braking system is forced to lock the tire.  Then the resistive drag force is measured and averaged for 1 to 3 seconds after the test wheel is fully locked.  Measurements can be repeated after the wheel reaches a free rolling state again.

*Concerns with Collection Methods*

- Can only be used on straight segments (no curves, T-sections, or roundabouts).  Can miss slippery spots because measurements are intermittent.

## 26. Surface Friction Date

*Description*

Definition: Date surface friction was last measured or assigned.

Attributes:

- mm/dd/yyyy.

Accuracy Statement: 100%.

*Considerations*

This element is recorded when an agency collects surface friction information for asset management purposes.

*Existing Resources*

None.

*Collection Methods*

None.

*Concerns with Collection Methods*

None.

## 27. Pavement Roughness/Condition

*Description*

Definition: The numeric value used to indicate pavement roughness.

Attributes:

- International Roughness Index (IRI), reported as an integer to the nearest inch per mile.

Accuracy Statement: ± 10%.

*Considerations*

IRI is used to define a characteristic of the longitudinal profile of a traveled wheeltrack, and is a standardized pavement measurement indicating the overall smoothness of the roadway.

For a lower IRI value the pavement will ride smoother while for a higher IRI value the pavement will ride rougher.

This information is typically collected by an agency for asset management purposes.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

- Alabama DOT Level of Service Condition Assessment Data Collection Manual:
  http://www.dot.state.al.us/maweb/frm/ALDOT%20Condition%20Assessment%20Data%2 0Collection%20Manual.pdf *(19)*.

*Collection Methods*

Table 5 below shows the list of relevant ASTM/American Association of State Highway and Transportation Officials (AASHTO) standards that are used for IRI measurement.

**Table 5. List of relevant ASTM/AASHTO standards for IRI measurement.**

| Standard | Title | Purpose |
|---|---|---|
| AASHTO R43M/R43 | Standard Practice for Determination of International Roughness Index (IRI) to Quantify Roughness of Pavements | • Describes a method for estimating roughness for a pavement section.<br>• Proposes guidelines for a quality assurance plan. |
| AASHTO R56 | Standard Practice for Certification of Inertial Profiling Systems | • Describes minimum performance requirements for inertial profilers.<br>• Describes a certification procedure for test equipment. |
| AASHTO M328 | Standard Equipment Specification for Inertial Profiler | • Define the required attributes of an inertial profiling system. |
| AASHTO R57 | Standard Practice for Operating Inertial Profilers and Evaluating Pavement Profiles | • Describes the procedure for operating and verifying the calibration of an inertial profiler. |
| ASTM E 950 | Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with and Accelerometer Established Inertial Profiling Reference | • Covers the measurement and recording of the profile of vehicular-traveled surfaces with an accelerometer established inertial reference on a profile-measuring vehicle. |
| ASTM E 1170 | Standard Practices for Simulating Vehicular Response to Longitudinal Profiles of Traveled Surfaces | • Covers the calculation of vehicular response to longitudinal profiles of traveled surface roughness.<br>• Presents standard vehicle simulations (quarter, half, and full car) for use in the calculations. |
| ASTM E 1296 | Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements | • Covers the mathematical processing of longitudinal profile measurements to produce IRI. |
| ASTM E 2560 | Standard Specification for Data Format for Pavement Profile | • Describes a data file format for pavement profile. |

*Concerns with Collection Methods*

• There are apparent differences in the measurement and operational practices among State agencies that makes the nationwide comparability difficult.

**28. Pavement Roughness Date**

*Description*

Definition: Date pavement roughness (IRI) was collected.

Attributes:

- mm/dd/yyyy.

Accuracy Statement: 100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

This element is recorded when an agency collects pavement roughness information for asset management purposes.

*Concerns with Collection Methods*

None.

**29. Pavement Condition (Present Serviceability Rating)**

*Description*

Definition: Present Serviceability Rating (PSR) (descriptive scale).

Attributes:

- Code a PSR or equivalent value, to the nearest tenth (x.x), for all paved segments where IRI is not reported.  Code "0.0" for unpaved facilities.  User full range of values.

    o 4.0 – 5.0: Only new (or nearly new) superior pavements are likely to be smooth enough and distress free (sufficiently free of cracks and patches) to qualify for this category.  Most pavements constructed or resurfaced during the data year would normally be rated in this category.

    o 3.0 – 4.0: Pavements in this category, although not quite as smooth as those described above, give a first class ride and exhibit few, if any, visible signs of surface deterioration.  Flexible pavements may be beginning to show evidence of rutting and fine random cracks.  Rigid pavements may be beginning to show evidence of slight surface deterioration, such as minor cracks and spalling.

    o 2.0 – 3.0: The riding qualities of pavements in this category are noticeably inferior to those of new pavements, and may be barely tolerable for high-speed traffic.  Surface defects of flexible pavements may include rutting, map cracking, and extensive patching.  Rigid pavements in this group may have a few joint failures, faulting and/or cracking, and some pumping.

    o 1.0 – 2.0: Pavements in this category have deteriorated to such an extent that they affect the speed of free-flow traffic.  Flexible pavement may have large potholes and deep cracks.  Distress includes raveling, cracking, rutting and occurs over 50 percent of the surface.  Rigid pavement distress includes joint spalling, patching, cracking, scaling, and may include pumping and faulting.

    o 0.1 – 1.0: Pavements in this category are in an extremely deteriorated condition. The facility is passable only at reduced speeds, and with considerable ride discomfort. Large potholes and deep cracks exist.  Distress occurs over 75 percent or more of the surface.

Accuracy Statement: ± 0.2.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

- Alabama DOT Condition Assessment Data Collection Manual:
  http://www.dot.state.al.us/maweb/frm/ALDOT%20Condition%20Assessment%20Dat
  a%20Collection%20Manual.pdf *(19)*.

## Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Airborne LiDAR with imagery.

- Terrestrial LiDAR.

- Ground-based imagery.

This information is typically collected by an agency for asset management purposes.

## Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 30. Pavement Condition (PSR) Date

*Description*

Definition: Date PSR was last assigned.

Attributes:

- mm/dd/yyyy.

Accuracy Statement: 100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

*Collection Methods*

This element is recorded when an agency collects pavement condition information for asset management purposes.

*Concerns with Collection Methods*

None.

## 31. Number of Through Lanes

### Description

Definition: The total number of through lanes on the segment.  This excludes auxiliary lanes, such as collector-distributor lanes, weaving lanes, frontage road lanes, parking and turning lanes, acceleration/deceleration lanes, toll collection lanes, shoulders, and truck climbing lanes.

Attributes:

- Numeric.

Accuracy Statement: 100%.

### Considerations

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

### Existing Resources

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

- Aerial imagery.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**32. Outside Through Lane Width**

*Description*

Definition: Width of the outside (curb) through lane (i.e., not including parking area, bicycle lanes, gutter pan, etc.).  Lane width is measured from center of edgeline to center of centerline or to the center of the lane line (if multilane).  If edgeline striping is placed inside the edge of the pavement (within approximately one foot) to keep traffic from breaking the pavement edge, ignore the striping and measure from the pavement edge to the center of a single (or double) centerline stripe or to the center of the lane line (if multilane).  If there is no edgeline or centerline, estimate a reasonable split between the actual width used by traffic and the shoulder or parking lane based on State/local design guides.

Attributes:

- Feet.

See Figure 4 - Figure 6 depending on number of lanes and direction of inventory.

Accuracy Statement: ± 0.5 ft.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Ground-based imagery.

- Airborne LiDAR with imagery.

- Terrestrial LiDAR.

This element involves measurements during post-processing of data collected.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 33. Inside Through Lane Width

*Description*

Definition: Predominant lane width of all inside through lanes, not including outside through lane (see Element 32. Outside Through Lane Width).  For a two-lane road, leave this element blank.

Attributes:

- Feet.

See Figure 4 - Figure 6 depending on number of lanes and direction of inventory.

Accuracy Statement: ± 0.5 ft.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

This element involves measurements during post-processing of data collected.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

32  Outside Through Lane Width        49  Left Paved Shoulder Width

44  Right Shoulder Total Width        64  Right Sideslope Width

45  Right Paved Shoulder Width        66  Left Sideslope Width

48  Left Shoulder Total Width

**Figure 4. Illustration of cross section, two-lane roadway (2).**

32 Outside Through Lane Width  45 Right Paved Shoulder Width  55 Median Width

33 Inside Through Lane Width  48 Left Shoulder Total Width  64 Right Sideslope Width

44 Right Shoulder Total Width  49 Left Paved Shoulder Width  66 Left Sideslope Width
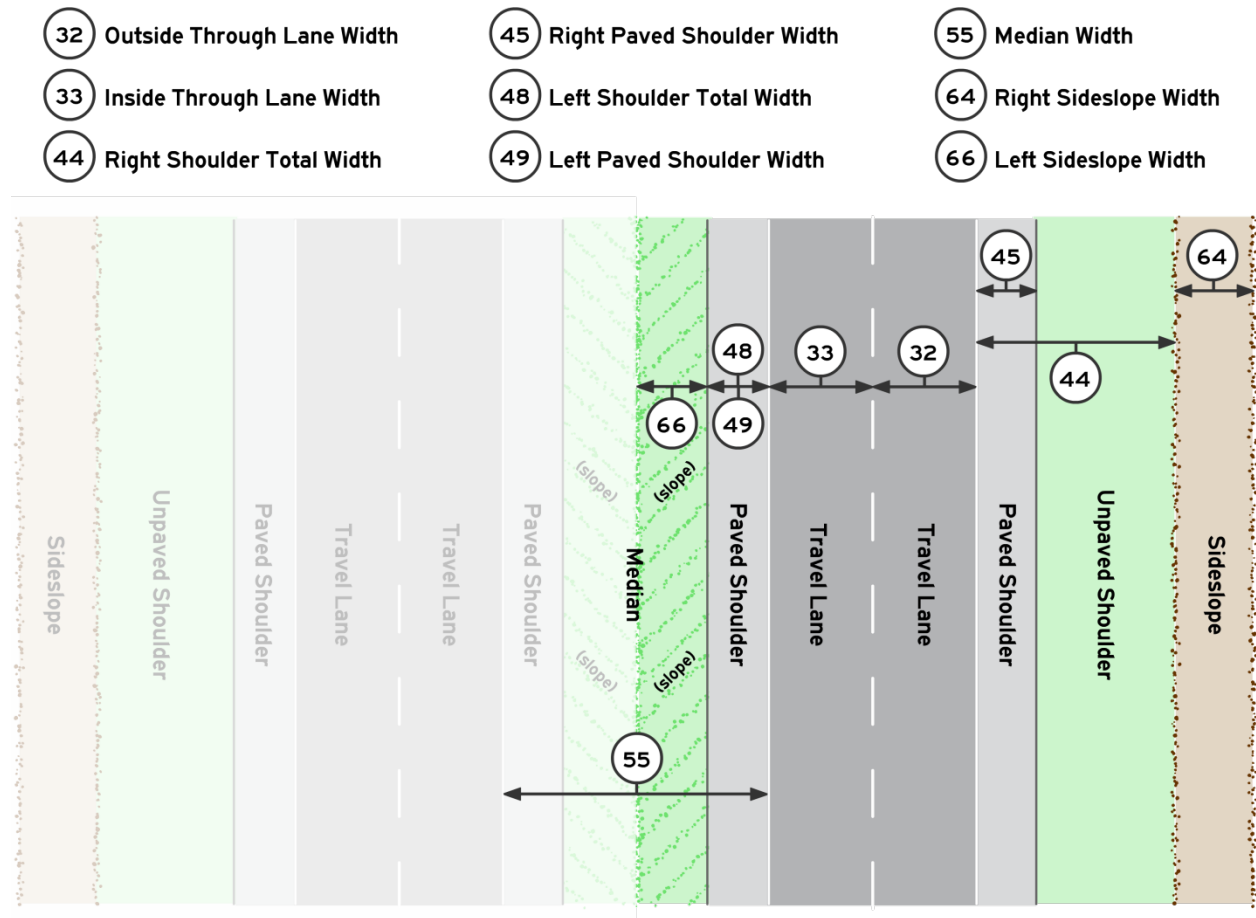
**Figure 5. Illustration of cross section, multilane divided roadway inventoried in two directions (each direction inventoried separately) *(2)*.**

| | | |
|---|---|---|
| (32) Outside Through Lane Width | (48) Left Shoulder Total Width | (60) Median Sideslope Width |
| (33) Inside Through Lane Width | (49) Left Paved Shoulder Width | (64) Right Sideslope Width |
| (44) Right Shoulder Total Width | (55) Median Width | (66) Left Sideslope Width |
| (45) Right Paved Shoulder Width | (57) Median Paved Shoulder Width | |
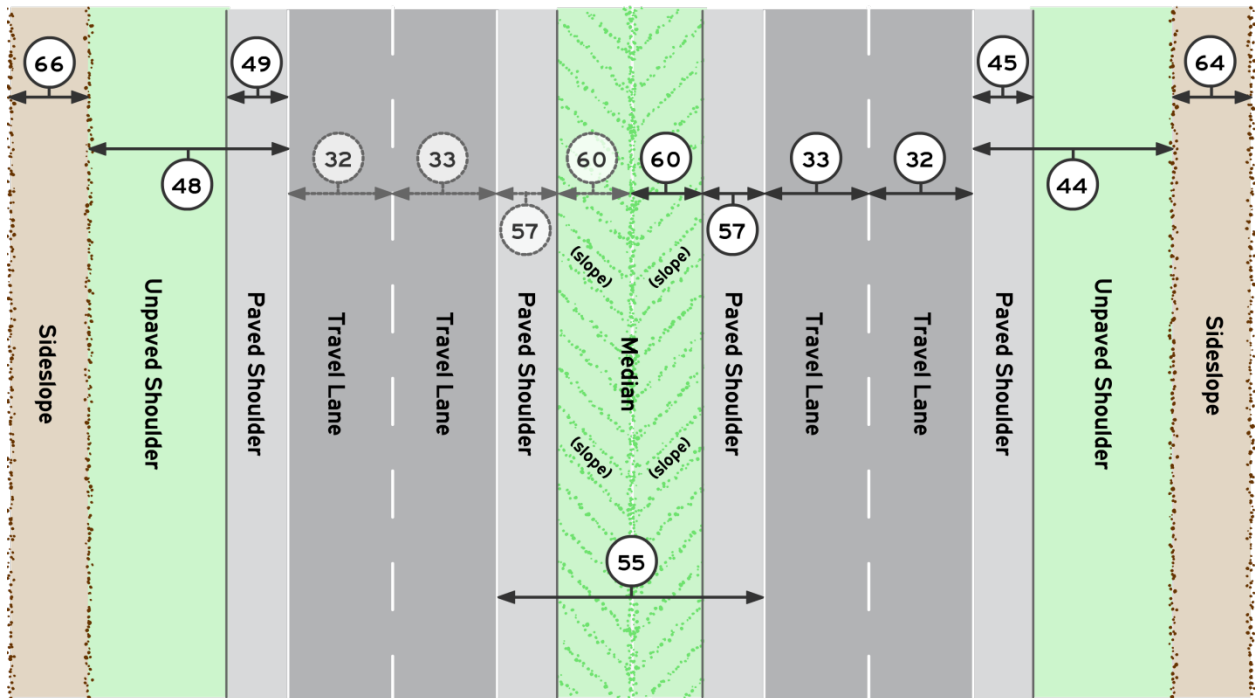
**Figure 6. Illustration of cross section, multilane divided roadway inventoried in one direction (both directions inventoried together)** *(2).*

## 34. Cross Slope

*Description*

Definition: The cross slope for each lane starting with the leftmost lane according to direction of inventory.

Attributes:

- Sign (+ or -) and percent.

Accuracy Statement: ± 12- 6 in horizontally per 1 ft. vertical.

*Considerations*

The cross slope is the percent of elevation change along the cross section of highway pavement. It helps in providing proper water drainage facility for the pavements.

Cross slope needs to be captured for each lane individually, thus multiple elements will be needed.  Should focus on major changes in the cross slope – average slope rather than the slope at every point.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

This element involves measurements during post-processing of data collected.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

### 35. Auxiliary Lane Presence/Type

*Description*

Definition: The presence or type of auxiliary lane present on the segment. Center two-way left turn lanes and high occupancy vehicle (HOV) lanes are not included here. They are included under Element 54. Median Type and Elements 37. HOV Lane Types and 38. HOV Lanes, respectively.

Attributes:

- Climbing lane.

- Passing lane.

- Exclusive continuous right turn lane.

- Other.

See Figure 7 and Figure 8 for additional details.

Accuracy Statement: 90-100%.



**Figure 7. Example of climbing lane** *(20).*

**Figure 8. Example of passing lane** *(21)*.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 36. Auxiliary Lane Length

*Description*

Definition: Length of auxiliary lane (noted in Element 35. Auxiliary Lane Presence/Type) if not full segment length.  Length does not include taper.

Attributes:

- Feet.

Accuracy Statement: .01 - .001 mi (52.8 – 5.28 feet).

*Considerations*

None.

*Existing Resources*

- None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

This element involves measurements during post-processing of data collected.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 37. HOV Lane Presence/Type

*Description*

Definition: Presence and type of high-occupancy vehicle (HOV) lane(s) on the segment.

Attributes:

- No HOV lanes.

- Has exclusive HOV lanes.

- Normal through lanes used as HOV at specified times.

- Shoulder/parking lanes used as HOV at specified times.

Accuracy Statement: 90-100%.

*Considerations*

Most HOV lanes can be located by aerial view based on pavement markings.  To designate HOV use at specified times ground-based imagery should be used to locate signs.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 38. HOV Lanes

### Description

Definition: The maximum number of HOV lanes in both directions on the segment.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

### Considerations

For more information on HOV lanes see Element 37. HOV Lane Presence/Type.

### Existing Resources

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

**39. Reversible Lanes**

*Description*

Definition: Number of reversible lanes on the segment.

Attributes:

- No reversible lanes.
- One reversible lane.
- Two reversible lanes.
- More than two reversible lanes.

Accuracy Statement: 90-100%.

*Considerations*

Reversible refers to the ability to change the direction of travel in a lane depending on traffic congestion. For example, a reversible lane may allow traffic to flow towards the center of a city in the morning and away from the city in the afternoon to reduce congestion for daily commuters.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 40. Presence/Type of Bicycle Facility

### Description

Definition: The presence and type of bicycle facility on the segment.

Attributes:

- None.

- Wide curb lane with no bicycle markings.

- Wide curb lane with bicycle markings (e.g., sharrows).

- Marked bicycle lane.

- Separate parallel bicycle path.

- Signed bicycle route only (no designated bicycle facility).
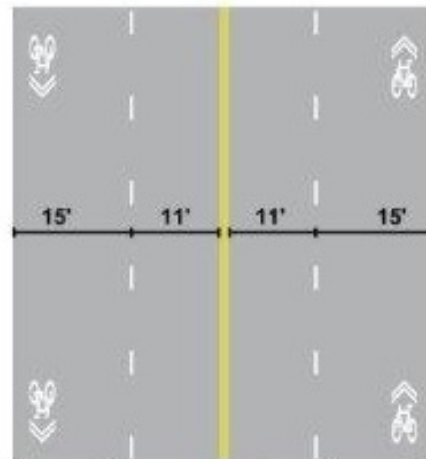
- Other.

See Figure 9 for additional details.
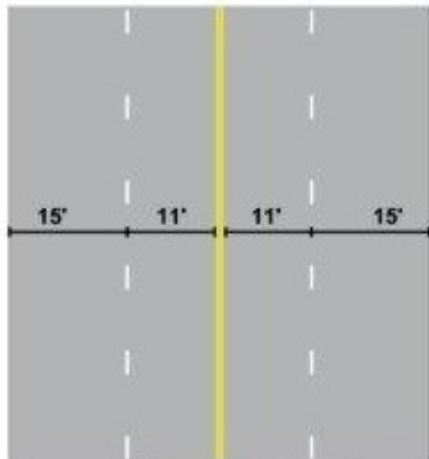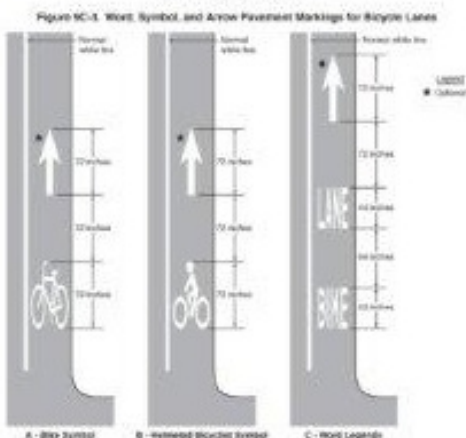
Accuracy Statement: 90-100%.

### Considerations

None.

Wide curb lane with no bicycle markings

Wide curb lane with bicycle markings (e.g., sharrows)

Marked bicycle lane

Separate parallel bicycle path

Signed bicycle route only (no designated bicycle facility)

**Figure 9. Illustration of presence/types of bicycle facilities** *(14).*

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

### 41. Width of Bicycle Facility

*Description*

Definition: The width of the bicycle facility; either the width of the marked bicycle lane or bicycle path.

Attributes:

- Feet.

Accuracy Statement: ± 1 ft.

*Considerations*

There is not a separate code for unknowns under each element.  In these cases, an agency can develop their own standardized means of recording this element through additional codes.  For instance, non-numeric or negative integers can be assigned for unmarked bicycle facilities.

When there is no bicycle facility (i.e., attribute for Element No. 40 is none), "NULL" should be assigned.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

This element involves measurements during post-processing of the data collected.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

**42. Number of Peak Period Through Lanes**

*Description*

Definition: The number of through lanes used in peak period in the peak direction.  This includes reversible lanes, parking lanes, or shoulders that legally are used for through traffic whether for single-occupancy vehicle (SOV) or HOV operation.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

For inventory covering both directions, code the total number of through lanes.  For directional inventory, code total number of lanes for this inventory direction.  This includes the number of reversible lanes that are in use for that direction in the peak period.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 43. Right Shoulder Type

*Description*

Definition: The predominant shoulder type on the right side of road in the direction of inventory.

Attributes:

- None.

- Surfaced shoulder exists – bituminous concrete (AC).

- Surfaced shoulder exists – Portland Cement Concrete surface (PCC).

- Stabilized shoulder exists (stabilized gravel or other granular material with or without admixture).

- Combination shoulder exists (shoulder width has two or more surface types; e.g., part of the shoulder width is surfaced and a part of the width is earth).

- Earth shoulder exists.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

Ground-based imagery is used for collecting this data element.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery

- Inadequate image capture and poor resolution.

**44. Right Shoulder Total Width**

*Description*

Definition: The total width of the right shoulder including both paved and unpaved parts measured from the center of the edgeline outward.  Do not include parking or bicycle lanes in the shoulder width measurement; code the predominant width where it changes back and forth along the roadway section; ensure that the total width of combination shoulders is reported. Include gutter pans on outside of shoulder in shoulder width.

Attributes:

- Feet.

See Figure 4 - Figure 6 depending on number of lanes and direction of inventory.

Accuracy Statement: ± 1 ft.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

This element involves measurements during post-processing of data collected.

***Concerns with Collection Methods***

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 45. Right Paved Shoulder Width

*Description*

Definition: The width of paved portion of right shoulder measured from the center of the edgeline outward.  Do not include parking or bicycle lanes in the paved shoulder width measurement; code the predominant width if it changes back and forth along the roadway section.  Include gutter pans on outside of shoulder in paved shoulder width.

Attributes:

- Feet.

See Figure 4 - Figure 6 depending on number of lanes and direction of inventory.

Accuracy Statement: ± 6 in.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual: http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual: http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

This element involves measurements during post-processing of data collected.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 46. Right Shoulder Rumble Strip Presence/Type

*Description*

Definition: Presence and type of rumble strips on the right shoulder.

Attributes:

- None.

- Milled beyond edgeline.

- Rolled beyond edgeline.

- Milled or rolled on/under edgeline (e.g., rumble stripes).

- Edgeline-rumble strip combination (e.g., raised/inverted thermoplastic profile marker).

See Figure 10 for illustration.

Accuracy Statement: 90-100%.

*Considerations*

Rumble strips can be defined as grooves in the roadway or rows of raised pavement markers placed on the roadway in such a manner that, as the tires of a vehicle contact them, they produce sound (noise) and vibration.  The noise and vibration produced by rumble strips is intended to alert inattentive drivers that they have drift from their lane, or to give advance notice of a change in the roadway, a stop or a danger spot ahead.

Shoulder rumble strips are an effective means of preventing off-road crashes and are primarily used to warn drivers when they have drifted from their lane.  A variation on this is the edgeline rumble stripe, which places the pavement marking within the rumble strip, improving the visibility of the marking.  This is more commonly used on roads with narrow shoulders.

**Figure 10. Right shoulder milled or rolled on/under edgeline *(22)*.**

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

- Ground-based imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

### 47. Left Shoulder Type

*Description*

Definition: Shoulder type on left side of roadway in direction of inventory.  For undivided roads and divided roads with one direction of inventory, this will be the outside shoulder on the opposing side.  Note that information on paved width of the inner (left) shoulder is included under median descriptors (see Element 49. Left Paved Shoulder Width).

Attributes:

- None.

- Surfaced shoulder exists - bituminous concrete (AC).

- Surfaced shoulder exists - Portland Cement Concrete surface (PCC).

- Stabilized shoulder exists (stabilized gravel or other granular material with or without admixture).

- Combination shoulder exists (shoulder width has two or more surface types; e.g., part of the shoulder width is surfaced and a part of the width is earth).

- Earth shoulder exists.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual: http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Ground-based imagery is used  for collecting this data element.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

## 48. Left Shoulder Total Width

### Description

Definition: Width of the left (outside) shoulder, including both paved and unpaved parts measured from the center of the edgeline outward.  See definition of Element 47. Left Shoulder Type above.  Do not include parking or bicycle lanes in the shoulder width measurement; code the predominant width where it changes back and forth along the roadway section; ensure that the total width of combination shoulders is reported. Include gutter pans on outside of shoulder in shoulder width.

Attributes:

- Feet.

See Figure 4 - Figure 6 depending on number of lanes and direction of inventory.

Accuracy Statement: ± 1 ft.

### Considerations

None.

### Existing Resources

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

This element involves measurements during post-processing of data collected.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 49. Left Paved Shoulder Width

### Description

Definition: The width of the paved portion of left (outside) shoulder measured from the center of the edgeline outward.  Do not include parking or bicycle lanes in the paved shoulder width measurement; code the predominant width where it changes back and forth along the roadway section. Include gutter pans on outside of shoulder in paved shoulder width.

Attributes:

- Feet.

See Figure 4 - Figure 6 depending on number of lanes and direction of inventory.

Accuracy Statement: ± 6 in.

### Considerations

None.

### Existing Resources

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

This element involves measurements during post-processing of data collected.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**50. Left Shoulder Rumble Strip Presence/Type**

*Description*

Definition: Presence and type of rumble strips on the left shoulder.

Attributes:

- None.

- Milled beyond edgeline.

- Rolled beyond edgeline.

- Milled or rolled on/under edgeline (e.g., rumble stripes).

- Edgeline -rumble strip combination (e.g., raised/inverted thermoplastic profile marker).

Figure 11 shows a left shoulder rumble strip.

Accuracy Statement: 90-100%.



**Figure 11. Left shoulder rumble strips *(23)*.**

*Considerations*

See Element 46. Right Shoulder Rumble Strip Presence for rumble strip definitions.

*Existing Resources*

None

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

- Ground-based imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**51. Sidewalk Presence**

*Description*

Definition: The presence of a paved sidewalk along the segment.

Attributes:

- None.

- Continous left-side.

- Discontinous left-side.

- Continous right-side.

- Discontinous right-side.

- Continuous both sides.

- Discontinous both sides.

Accuracy Statement: 90-100%.

*Considerations*

Discontinuous sidewalks have at least one gap in the paved sidewalk along the segment.

*Existing Resources*

Established data collection methodologies can be found at:

   State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 52. Curb Presence

### Description

Definition: The presence of curb along the segment.

Attributes:

- No curb.

- Curb on left.

- Curb on right.

- Curb on both sides.

Accuracy Statement: 90-100%.

### Considerations

Curb should be predominant along the section to be considered present.  For more detail on curbs see Element 53. Curb Type.

### Existing Resources

Established data collection methodologies can be found at:

> State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

### 53. Curb Type

*Description*

Definition: The type of curb present on the segment.

Attributes:

- No curb.

- Sloping curb – A curb that does not exceed a 4-inch height (for a slope steeper than 1V:1H) or a 6-inch height (for a slope equal to or flatter than 1V:1H).

- Vertical (barrier) curb – A curb that is steeper or taller than the ranges given for a sloping curb.

Accuracy Statement: 90-100%.

*Considerations*

It is difficult to distinguish curb height by using overhead aerial views.  Use of angled aerial or ground-based imagery is recommended.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

The aerial data collected depends on vegetation cover.  The data collection process for this element is labor-intensive and involves post-processing.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**54. Median Type**

*Description*

Definition: The type of median present on the segment.

Attributes:

- Undivided.

- Flush paved median (at least 4 ft in width).

- Raised median.

- Depressed median.

- Two-way left turn lane.

- Railroad or rapid transit.

- Divided, separate grades without retaining wall.

- Divided, separate grades with retaining wall.

- Other divided.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

One-way roads do not have medians.  This element can be difficult to identify by aerial imagery because raised, depressed, and flush medians look very similar from above.  An angled aerial image or ground-based image is often required to identify these attributes.

Undivided approaches have no separation of opposing traffic lanes.  Approaches with only yellow pavement markings less than 4-feet wide are included in this attribute.  If the median markings are greater than 4-feet wide and designed to keep opposing traffic apart then it is a flush paved median.  A depressed median does not have a curb and is lower than the traffic lanes.  The raised median attribute includes all raised barriers.

See Element 61. Median Crossover/Left Turn Lane Type and Element 153. Median Type at Intersection for more examples.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

## Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

This element collected needs to be tied back to linear referencing.

## Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**55. Median Width**

*Description*

Definition: The width of the median, including the inside shoulders (i.e., measured from center of edgeline to center of edgeline on inside edges of opposing through lanes).

Attributes:

- Feet.

See Figure 5 and Figure 6 depending on number of lanes and direction.

Accuracy Statement: ± 1 ft.

*Considerations*

This element involves measurements during post-processing of data collected.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- These methods for measurement involve post processing of data collected.

**56. Median Barrier Presence/Type**

*Description*

Definition: The presence and type of median barrier on the segment.

Attributes:

- None.

- Unprotected.

- Curbed.

- Rigid barrier system (i.e., concrete).

- Semi-rigid barrier system (i.e., box beam, W-beam strong post, etc.).

- Flexible barrier system (i.e., cable, W-beam weak post, etc.).

- Rigidity unspecified.

Accuracy Statement: 90-100%.

*Considerations*

Another example of semi-rigid barrier systems is metal guardrail and an example of flexible barrier system is a cable guardrail.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

### *Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- The aerial data collected depends on vegetation cover.

- The data collection process for this element is labor-intensive and involves post-processing.

**57. Median (Inner) Paved Shoulder Width**

*Description*

Definition: The width of the paved shoulder on the median (inner) side of the roadway on a divided roadway measured from the center of the edgeline outward.  Note that information on type, width, and paved width of non-median shoulders is included in section I.C.3. Shoulder Descriptors (See Element 47. Left Shoulder Type).  If the roadway is divided AND inventoried in two directions, this is already captured under Element 49. Left Shoulder Paved Width.

Attributes:

- Feet.

See Figure 6 for additional details.

Accuracy Statement: ± 6 in.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual: http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual: http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- This element involves measurements during post-processing of data collected.

## 58. Median Shoulder Rumble Strip Presence/Type

*Description*

Definition: Presence and type of median shoulder rumble strip.  If the roadway is divided AND inventoried in two directions, this is already captured under Element 50. Left Shoulder Rumble Strip Presence/Type.

Attributes:

- None.

- Milled beyond edgeline.

- Rolled beyond edgeline.

- Milled or rolled on/under edgeline (e.g., rumble stripes).

- Edgeline -rumble strip combination (e.g., raised/inverted thermoplastic profile marker).

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

### 59. Median Sideslope

*Description*

Definition: The sideslope in the median adjacent to the median shoulder or travel lane.  If the sideslope varies along the segment, code the predominant sideslope.  If the roadway is divided AND inventoried in two directions, this is already captured under Element 65. Left Sideslope.

Attributes:

- Numeric percent of the sideslope

- See

Figure 12 for illustration of median sideslopes.

Accuracy Statement: ± 12- 6 in. horizontally per 1 ft. vertical.
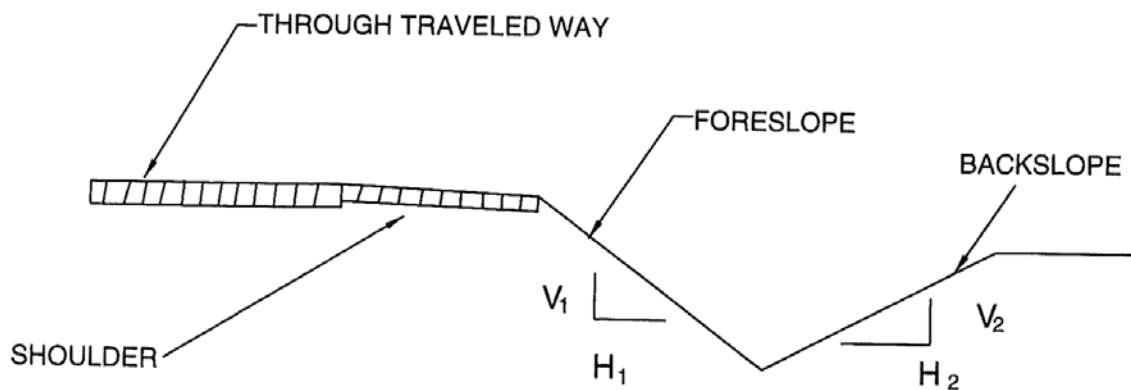


**Figure 12. Median sideslope *(24)*.**

*Considerations*

If using a numeric percent, this can be positive (if backslope) or negative (if foreslope).

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- This data element involves post-processing along with the use of curve-fitting and tracing techniques.

**60. Median Sideslope Width**

*Description*

Definition: The width of the median sideslope adjacent to the median shoulder or travel lane.  If width varies along the segment, code the predominant width.  If the roadway is divided AND inventoried in two directions, this is already captured under Element 66. Left Sideslope Width.

Attributes:

- Feet.

See Figure 6 for additional details.

Accuracy Statement: ± 1 ft.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- This data element involves post-processing along with the use of curve-fitting and tracing techniques.

## 61. Median Crossover/Left Turn Lane Type

*Description*

Definition: The presence and type of crossover/left turn bay in the median along the segment. Note: This element is intended to capture the typical median characteristic along the segment at non-intersection locations.  Information on intersection-related turn lanes will be coded in the Junction File.

Attributes:

- None.

- Median crossover, no left turn bay.

- Median crossover, left turn bay.

- Median crossover, directional left turn lane bays (to prevent crossing traffic from driveways).

- Two-way left turn lane.

See Figure 13 for additional details.

Accuracy Statement: 90-100%.

None



Median crossover, no left turn bay



Median crossover, left turn bay



Median crossover, directional left turn bays (to prevent crossing traffic from driveways)



Two-way left turn lane
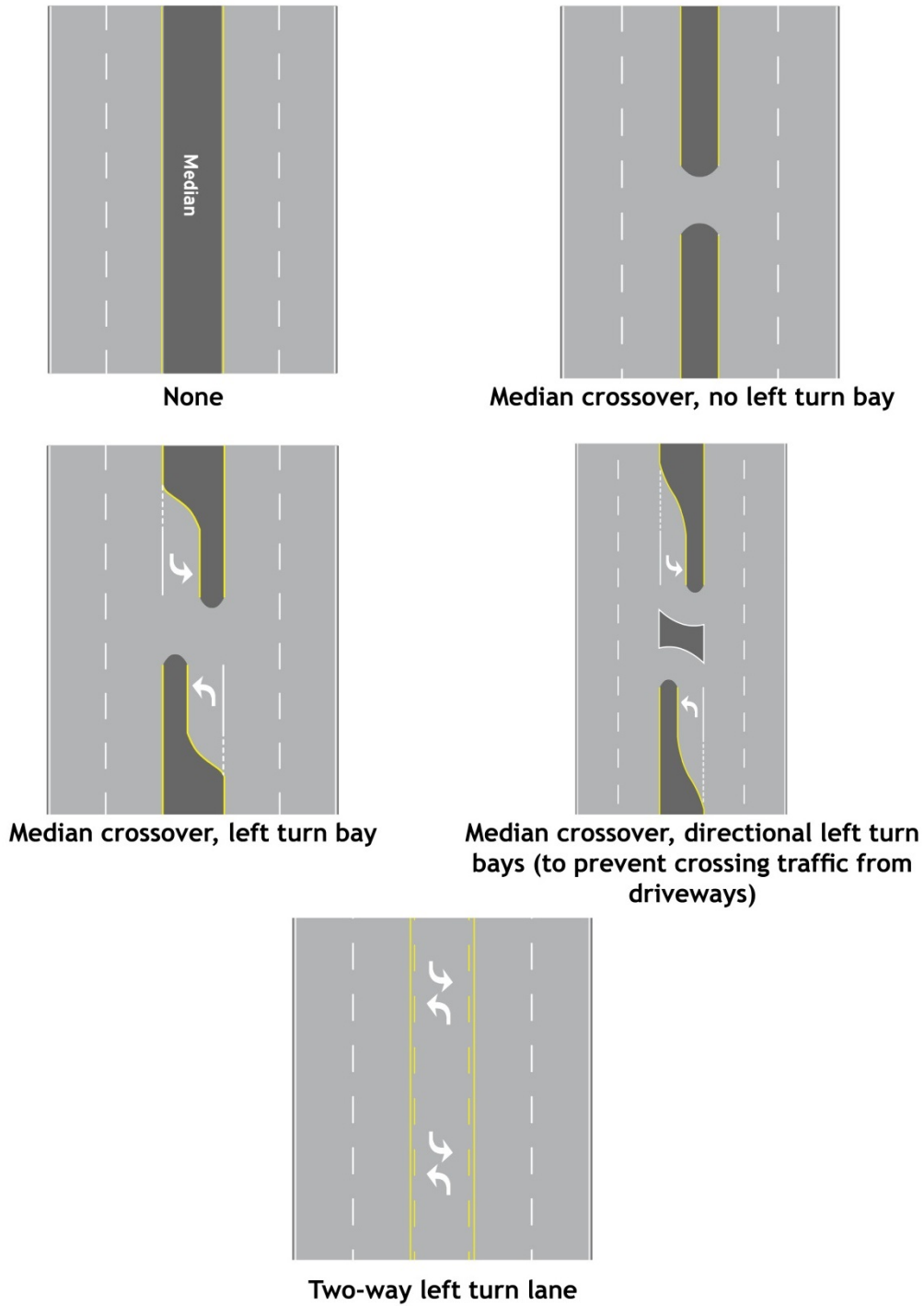
**Figure 13. Illustration of types of median crossover/left turn lanes *(2)*.**

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Georgia DOT HPMS Inventory Manual: http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_DataCollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## I.D. Segment Roadside Descriptors

### 62. Roadside Clearzone Width

*Description*

Definition: Predominate or average roadside clearzone width.  Clearzone is the total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area.

Attributes:

- Feet.

Accuracy Statement: ± 1 ft.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.
- This element involves measurements during post-processing of data collected.

## 63. Right Sideslope

*Description*

Definition: The sideslope (foreslope or backslope) on right side of roadway immediately adjacent to the travel lane, shoulder edge or drainage ditch in direction of inventory.  If sideslope varies within the section, code predominant sideslope.

Attributes:

- Numeric percent (Note: This can be positive (if backslope) or negative (if foreslope)).

- Not applicable – protected by roadside barrier.

- Not applicable – other (e.g., city center street).

Accuracy Statement: ± 12- 6 in. horizontally per 1 ft. vertical.

*Considerations*

This data element, if not steep, is also measurable using ground based technologies.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial imagery.

- Inadequate image capture and poor resolution.

- This element involves measurements during post-processing of data collected.

## 64. Right Sideslope Width

*Description*

Definition: The width of the sideslope on right side of roadway immediately adjacent to the travel lane, shoulder edge or drainage ditch in direction of inventory.  If the width varies along the segment, code the predominant width.

Attributes:

- Feet.

See Figure 4 - Figure 6 depending on number of lanes and direction of inventory.

Accuracy Statement: ± 1 ft.

*Considerations*

This data element, if not steep, is also measurable using ground based technologies.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial imagery.

- Inadequate image capture and poor resolution.

- This element involves measurements during post-processing of data collected.

## 65. Left Sideslope

### Description

Definition: The sideslope (foreslope or backslope) on left side of roadway immediately adjacent to the travel lane, shoulder edge or drainage ditch in direction of inventory.  If sideslope varies within the section, code the predominant sideslope.  For undivided roads and divided roads with one direction of inventory, this will be the outside shoulder on the opposing side.

Attributes:

- Numeric percent of the sideslope.  (Note: This can be positive (if backslope) or negative (if foreslope)).
- Not applicable – protected by roadside barrier.
- Not applicable – other (e.g., city center street).

Accuracy Statement: ± 12- 6 in horizontally per 1 ft. vertical.

### Considerations

This data element, if not steep, is also measurable using ground based technologies.

### Existing Resources

None.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial imagery.
- Inadequate image capture and poor resolution.
- This element involves measurements during post-processing of data collected.

## 66. Left Sideslope Width

*Description*

Definition: The width of the sideslope on left side of roadway immediately adjacent to the travel lane, shoulder edge, or drainage ditch in direction of inventory.  If the width varies along the segment, code the predominant width.

Attributes:

- Feet.

See Figure 4 - Figure 6 depending on number of lanes and direction of inventory.

Accuracy Statement: ± 1 ft.

*Considerations*

This data element, if not steep, is also measurable using ground based technologies.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial imagery.

- Inadequate image capture and poor resolution.

- This element involves measurements during post-processing of data collected.

**67. Roadside Rating**

*Description*

Definition: A rating of the safety of the roadside, ranked on a seven-point categorical scale from 1 (best) to 7 (worst).

Attributes:

- Rating — 1:
  - Wide clear zones greater than or equal to 30 ft. from the pavement edgeline.
  - Sideslope flatter than 1:4.
  - Recoverable.
- Rating — 2:
  - Clear zone between 20 and 25 ft. from pavement edgeline.
  - Sideslope about 1:4.
  - Recoverable.
- Rating — 3:
  - Clear zone about 10 ft. from pavement edgeline.
  - Sideslope about 1:3 or 1:4.
  - Rough roadside surface.
  - Marginally recoverable.
- Rating —  4:
  - Clear zone between 5 to 10 ft. from pavement edgeline.
  - Sideslope about 1:3 or 1:4.
  - May have guardrail (5 to 6.5 ft. from pavement edgeline).
  - May have exposed trees, poles, or other objects (about 10 ft. from pavement edgeline).
  - Marginally forgiving, but increased chance of a reportable roadside collision.
- Rating — 5:
  - Clear zone between 5 to 10 ft. from pavement edgeline.
  - Sideslope about 1:3.
  - May have guardrail (0 to 5 ft. from pavement edgeline).

- o   May have rigid obstacles or embankment within 6.5 to 10 ft. of pavement edgeline.

  - o   Virtually non-recoverable.

- Rating — 6:

  - o   Clear zone less than or equal to 5 ft.

  - o   Sideslope about 1:2.

  - o   No guardrail.

  - o   Exposed rigid obstacles within 0 to 6.5 ft. of the pavement edgeline.

  - o   Non-recoverable.

- Rating — 7:

  - o   Clear zone less than or equal to 5 ft.

  - o   Sideslope 1:2 or steeper.

  - o   Cliff or vertical rock cut.

  - o   No guardrail.

  - o   Non-recoverable with high likelihood of severe injuries from roadside collision.

See Figure 14 for additional details.

Accuracy Statement: ± 1 rating level.

### *Considerations*

This data element, if not steep, is also measurable using ground based technologies.

Typical Roadway with Roadside Hazard Rating Equal to 1.

Typical Roadway with Roadside Hazard Rating Equal to 2.

Typical Roadway with Roadside Hazard Rating Equal to 3.

Typical Roadway with Roadside Hazard Rating Equal to 4.

**Figure 14. Illustration of roadside ratings *(2).***

Typical Roadway with Roadside Hazard Rating Equal to 5.



Typical Roadway with Roadside Hazard Rating Equal to 6.



Typical Roadway with Roadside Hazard Rating Equal to 7.

**Figure 14. Illustration of roadside ratings (continued)** *(2).*

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial imagery.

- Inadequate image capture and poor resolution.

## 68. Major Commercial Driveway Count

### Description

Definition: Count of commercial driveways in segment serving 50 or more parking spaces.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

### Considerations

Commercial driveways provide access to a facility where commercial activities happen. Examples include shopping centers, grocery stores, gas stations, banks, restaurants, etc.  Each driveway in the segment is counted separately even if multiple driveways serve a single facility/parking lot.  If a single driveway serves multiple facilities of varying category (commercial, residential, and/or industrial/institutional) the driveway should be counted for the facility(s) that generate the most traffic.

Ground-based imagery is often required to discern the nature of the facility.

Major driveways provide access to a parking lot with more than 50 parking spaces.  Spaces can be counted in aerial imagery.  In cases where lots do not have pavement markings the data collector should use their best judgment in categorizing a driveway as major or minor.  An evaluation should include factors such as the purpose of the facility and degree of driveway usage.  For example, an automobile retail facility or junkyard may have space for 50 or more vehicles but the degree of driveway usage may be low enough to be categorized as minor driveways since the parking spaces are primarily used for grounding cars.  In other instances, such as industrial facilities (Industrial Driveways), the parking spaces may be fewer than 50 but the driveways handle significantly higher number of heavy trucks and can be categorized as major driveways.

Driveway vs. Intersection:

Some intersections are defined by an approach that appears to be a driveway in aerial and/or ground-based imagery.  Examples are private roads, alleyways, entrances/exits to shopping centers, rest stops, viewing areas, and rural recreational parking lots.  They often do not have road names and/or do not appear on road maps.  Where available, a list of intersections per segment would help prevent errors in driveway counts (Elements 68 – 74).

### Existing Resources

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- Classification of driveway by type of facility and size of parking lot can be subjective.

## 69. Minor Commercial Driveway Count

### Description

Definition: Count of commercial driveways in segment serving fewer than 50 parking spaces.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

### Considerations

For the definition of a commercial driveway and directions on what should be counted as a driveway refer to Element 68. Major Commercial Driveway Count.  Minor driveways serve facility parking lots with fewer than 50 spaces.

### Existing Resources

None.

### Collection Methods

Refer to Element 68. Major Commercial Driveway Count.

### Concerns with Collection Methods

Refer to Element 68. Major Commercial Driveway Count.

## 70. Major Residential Driveway Count

### Description

Definition: Count of residential driveways in segment serving 50 or more parking spaces.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

### Considerations

Residential driveways serve houses and apartments. Very few residential driveways fall in the "Major" category.

For directions on what should be counted as a driveway refer to Element 68. Major Commercial Driveway Count.

### Existing Resources

None.

### Collection Methods

Refer to Element 68. Major Commercial Driveway Count.

### Concerns with Collection Methods

Refer to Element 68. Major Commercial Driveway Count.

## 71. Minor Residential Driveway Count

### Description

Definition: Count of residential driveways in segment serving fewer than 50 parking spaces.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

### Considerations

Residential driveways serve houses and apartments.  Most residential driveways fall in the "Minor" category.

For directions on what should be counted as a driveway refer to Element 68. Major Commercial Driveway Count.

### Existing Resources

None.

### Collection Methods

Refer to Element 68. Major Commercial Driveway Count.

### Concerns with Collection Methods

Refer to Element 68.Major Commercial Driveway Count.

## 72. Major Industrial/Institutional Driveway Count

### Description

Definition: Count of industrial/institutional driveways in segment serving 50 or more parking spaces.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

### Considerations

Industrial driveways serve facilities where goods are manufactured or stored.  Examples include factories and warehouses.  Institutional driveways serve facilities run by a government body, organization, society, or foundation. Examples include government offices, office complex, schools, churches, and state parks.

For directions on what should be counted as a driveway refer to Element 68. Major Commercial Driveway Count.

### Existing Resources

None.

### Collection Methods

Refer to Element 68. Major Commercial Driveway Count.

### Concerns with Collection Methods

Refer to Element 68. Major Commercial Driveway Count.

## 73. Minor Industrial/Institutional Driveway Count

*Description*

Definition: Count of industrial/institutional driveways in segment serving fewer than 50 parking spaces.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

For the definition and examples of industrial/institutional driveways refer to Element 72. Major Industrial/Institutional Driveway.

For directions on what should be counted as a driveway refer to Element 68.Major Commercial Driveway Count.

*Existing Resources*

None.

*Collection Methods*

Refer to Element 68. Major Commercial Driveway Count.

*Concerns with Collection Methods*

Refer to Element 68. Major Commercial Driveway Count.

**74. Other Driveway Count**

*Description*

Definition: Count of "other" driveways in segment.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

"Other" driveways consist of driveways that do not fit into the categories of commercial, residential, or industrial/institutional.  (See Element 68. Major Commercial Driveway Count, Element 70. Major Residential Driveway Count, and Element 72. Major Industrial/Institutional Driveway Count for respective definitions.)

Examples of other driveways include farm field access points and access to parking lots for unknown facilities.

For directions on what should be counted as a driveway refer to Element 68. Major Commercial Driveway Count.

*Existing Resources*

None.

*Collection Methods*

Refer to Element 68. Major Commercial Driveway Count.

*Concerns with Collection Methods*

Refer to Element 68. Major Commercial Driveway Count.

## I.E. Other Segment Descriptors

## 75. Terrain Type

### Description

Definition: The basic terrain type for the segment.  This is a (less than desirable) surrogate for detailed data on curvature and grade of the road and the nature of the roadside.  This would be collected only in the absence of those elements.  See roadside descriptors above and alignment elements below.

Attributes:

- Mountainous – Any combination of grades and horizontal or vertical alignment that causes heavy vehicles to operate at crawl speeds for significant distances or at frequent intervals.

- Rolling – Any combination of grades and horizontal or vertical alignment that causes heavy vehicles to reduce their speeds substantially below those of passenger cars but that does not cause heavy vehicles to operate at crawl speeds for any significant length of time.

- Level – Any combination of grades and horizontal or vertical alignment that permits heavy vehicles to maintain the same speed as passenger cars; this generally includes short grades of no more than two percent.

Accuracy Statement: 90-100%.

### Considerations

Refer to section I.D. Segment Roadside Descriptors above and section II. Roadway Alignment Descriptors below.

### Existing Resources

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual: http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

## *Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

## *Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- The data collection for this element involves operator judgment.

### 76. Number of Signalized Intersections in Segment

*Description*

Definition: The number of at-grade intersections with a signal controlling traffic on the inventory route within the segment.  A signal that cycles through red, yellow, and green for all or a portion of the day should be counted as a signalized intersection.  Include at-grade intersections at entrances to shopping centers, industrial parks, and other large traffic generating enterprises.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**77. Number of Stop-Controlled Intersections in Segment**

*Description*

Definition: The number of at-grade intersections with a stop sign controlling traffic on the inventory route within the segment.  A continuously operating, flashing red signal should be counted as a stop sign control.  Include at-grade intersections at entrances to shopping centers, industrial parks, and other large traffic generating enterprises.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

   National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

   State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.
- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

**78. Number of Uncontrolled/Other Intersections in Segment**

*Description*

Definition: Number of at-grade intersections where traffic on the inventory route is not controlled by either a signal or a stop sign; or is controlled by other types of signing; or has no controls within the segment.  A continuously operating, flashing yellow signal should be considered as "other or no control."  Include at-grade intersections at entrances to shopping centers, industrial parks, and other large traffic generating enterprises.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## I.F. Segment Traffic Flow Data

### 79. Annual Average Daily Traffic (AADT)

*Description*

Definition: AADT value to represent the current data year.  For two-way facilities, provide the AADT for both directions; provide the directional AADT if part of a one-way couplet or for one-way streets.

Attributes:

- Vehicles per day.

Accuracy Statement: ± 5 - 10%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

AADT can be defined as the annualized average 24-hour volume of vehicles at a given point or section of highway.  It is normally calculated by determining the volume of vehicles during a given period, and dividing that number by the number of days in that period.  In general terms it is also known as "Traffic Count".

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Each State highway agency maintains a traffic counting program.  To comply with HPMS requirements, State highway agencies are required to take traffic volume counts on all Interstate, principal arterials and HPMS sample sections on a minimum three-year cycle.  On non-HPMS roadways, traffic counts should be taken at least every 6 years.  Traffic information can be obtained from State's traffic monitoring office and other monitoring sources including Metropolitan Planning Organizations (MPOs), cities, counties, Intelligent Transportation Systems (ITS), and other third-party sources.  A typical traffic counting program includes both

continuous measurements using Automatic Traffic Recorders (ATRs) and short counts for roadways respectively with high and low priority of safety consequences.

*Concerns with Collection Methods*

- Traffic count data may not meet the FHWA Traffic Monitoring Guide quality requirements.

- Sample traffic count data may not be representative geographically and temporally.

## 80. AADT Year

*Description*

Definition: Year of AADT.

Attributes:

- Year.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

This element is collected in conjunction with AADT or traffic count measurement.  Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on collection methods.

*Concerns with Collection Methods*

None.

## 81. AADT Annual Escalation Percentage

*Description*

Definition: Expected annual percent growth in AADT, with "AADT Year" as base year.  This will allow calculation of current year's AADT if "AADT Year" differs from current year.

Attributes:

- Percent.

Accuracy Statement: ± 1%.

*Considerations*

None.

*Existing Resources*

None

*Collection Methods*

This element is calculated from multi-year AADT values.  Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on collection methods.

*Concerns with Collection Methods*

- Available AADT values may not be adequate to determine this element.

## 82. Percent Single Unit Trucks or Single Truck AADT

*Description*

Definition: Percentage combination truck or combination truck AADT (Classes 4-7).

Attributes:

- Percent or numeric count.

See Figure 15 for additional details on FHWA vehicle classes to be considered for AADT determination.
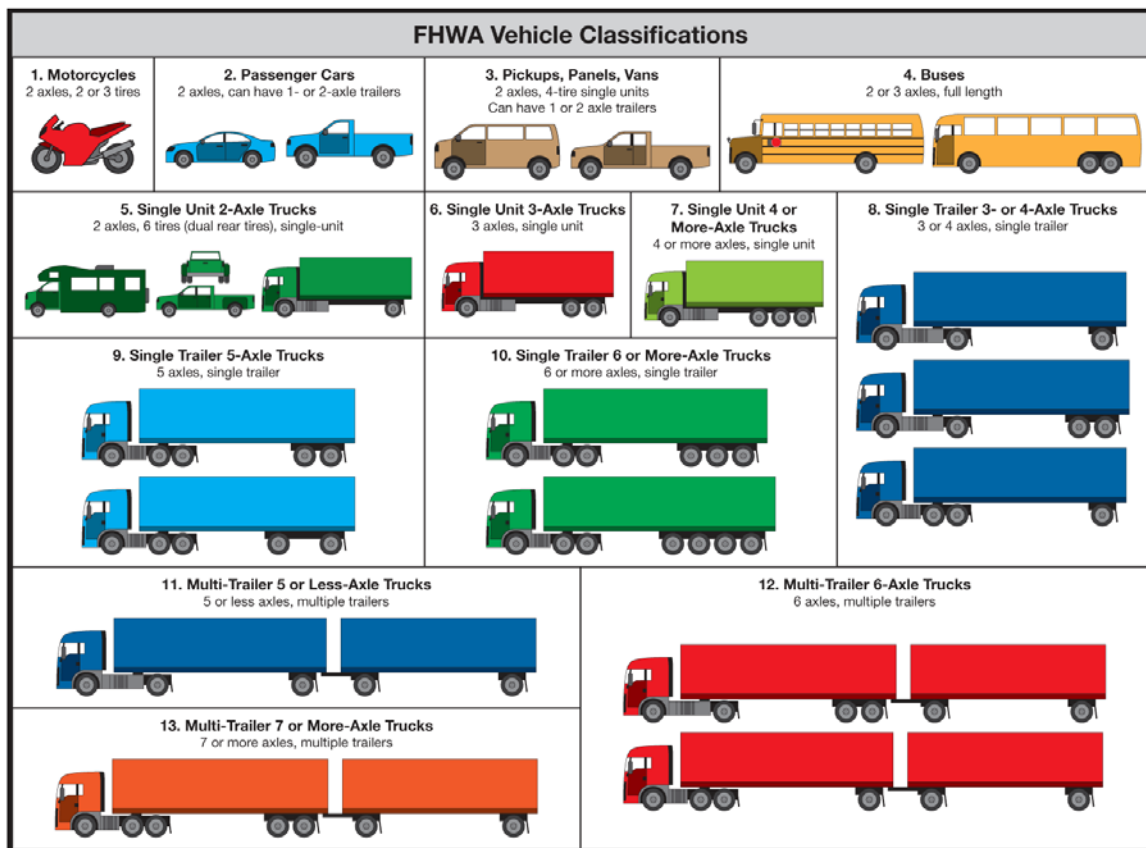


**Figure 15. FHWA vehicle classification** *(25).*

Accuracy Statement: ± 5 - 10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

### Collection Methods

This element is calculated from AADT values.  Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on collection methods.

### Concerns with Collection Methods

- Traffic count data may not meet the FHWA Traffic Monitoring Guide quality requirements.

- Sample traffic count data may not be representative geographically and temporally.  For example, percent single unit trucks derived from peak-hour sample data may not represent daily values.

**83. Percent Combination Trucks or Combination Truck AADT**

*Description*

Definition: Percentage combination truck or combination truck AADT (Classes 8-13).

Attributes:

- Percent or numeric count.

See Figure 15 for additional details on FHWA vehicle classes to be considered for AADT determination.

Accuracy Statement: ± 5 - 10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

*Collection Methods*

This element is calculated from AADT values. Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on collection methods.

*Concerns with Collection Methods*

- Traffic count data may not meet the FHWA Traffic Monitoring Guide quality requirements.

- Sample traffic count data may not be representative geographically and temporally.  For example, percent combination trucks derived from peak-hour sample data may not represent daily values.

## 84. Percentage Trucks or Truck AADT

*Description*

Definition: Percentage truck or truck AADT (includes tractor-semis and trucks with 6+ wheels).  Note that this can be derived if both Element 82. Percent Single Unit Trucks Or Single Truck AADT and Element 83. Percent Combination Trucks Or Combination Truck AADT are captured.

Attributes:

- Percent or numeric count.

See Figure 15 for additional details on FHWA vehicle classes to be considered for AADT determination.

Accuracy Statement: ± 5 - 10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

This element is calculated from AADT values. Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on collection methods.

*Concerns with Collection Methods*

- Traffic count data may not meet the FHWA Traffic Monitoring Guide quality requirements.

- Sample traffic count data may not be representative geographically and temporally. For example, truck counts taken during peak hours may not represent daily values.

## 85. Total Daily Two-Way Pedestrian Count/Exposure

### Description

Definition: Total daily pedestrian flow along roadway in both directions (unless directional segment).  This is a (less than desirable) surrogate for crossing pedestrian counts.

Attributes:

- Average daily count (numeric).

Accuracy Statement: 10%.

### Considerations

None.

### Existing Resources

Established data collection methodology can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

### Collection Methods

For high-priority roadway segments, site-specific statistical sampling using short term counting is recommended.  For low-priority roadway segments, pedestrian volume adjustment factors, determined based on statistical short term counting, can be applied.

### Concerns with Collection Methods

- Inadequate duration and frequency of data collection.

## 86. Bicycle Count/Exposure

*Description*

Definition: The total daily bicycle flow in both directions along the roadway (unless directional segment).

Attributes:

- Average daily count (numeric).

Accuracy Statement: 10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodology can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

*Collection Methods*

For high-priority roadway segments, site-specific statistical sampling using short term counting is recommended.  For low-priority roadway segments, bicycle volume adjustment factors, determined based on statistical short term counting, can be applied.

*Concerns with Collection Methods*

- Inadequate duration and frequency of data collection.

## 87. Motorcycle Count or Percentage

*Description*

Definition: Motorcycle daily count or percentage of AADT.

Attributes:

- Percent or numeric count.

Accuracy Statement: ± 5 - 10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

*Collection Methods*

Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on collection methods. Motorcycle adjustment factors, determined based on statistical short term counting, can be applied to AADT.

*Concerns with Collection Methods*

Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on concerns with collection methods.

## 88. Hourly Traffic Volumes (or Peak and Offpeak AADT)

### Description

Definition: Hourly traffic volumes (or peak and offpeak AADT).

Attributes:

- Numeric count.

Accuracy Statement: ± 5 - 10%.

### Considerations

None.

### Existing Resources

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

### Collection Methods

Continuous traffic monitoring sites are the best sources of hourly traffic volume.  If continuous data is not available, short term traffic counts can be used.  If either traffic count is not available, hourly counts on the same route or a similar route with similar traffic characteristics in the same area can be used.

### Concerns with Collection Methods

- Inadequate duration and frequency of data collection.

**89. K-Factor**

*Description*

Definition: The K-factor is the 30th highest hourly volume (i.e., the design hour volume) for a year, as a percentage of the annual average daily traffic.

Attributes:

- Percent.

Accuracy Statement: ± 5 - 10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual: http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.
- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.
- Highway Capacity Manual, http://books.trbbookstore.org/hcm10.aspx *(26)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Continuous traffic monitoring sites are the best sources of hourly traffic volume.  If continuous data are not available, short term traffic counts can be used.  If either traffic count is not available, hourly counts on the same route or a similar route with similar traffic characteristics in the same area can be used.

The Highway Capacity Manual provides additional guidance on how to collect and calculate this element if sufficient traffic data is not available.

*Concerns with Collection Methods*

- Inadequate duration and frequency of data collection.

**90. Directional Factor**

*Description*

Definition: Proportion of peak hour traffic in the predominant direction of flow.

Attributes:

Numeric Accuracy Statement: ± 5 - 10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

  National:

- HPMS Field Manual: http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

  State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Continuous traffic monitoring sites are the best sources of hourly traffic volume.  If continuous data are not available, short term traffic counts can be used.  If either traffic count is not available, hourly counts on the same route or a similar route with similar traffic characteristics in the same area can be used.

*Concerns with Collection Methods*

- Inadequate duration and frequency of data collection.

## I.G. Segment Traffic Operations/Control Data

### 91. One/Two-Way Operations

*Description*

Definition: Indication of whether the segment operates as a one- or two-way roadway.

Attributes:

- One-way.

- Two-way.

- One direction of travel for divided roadways.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

In aerial and ground-based imagery a segment is determined to be one-way or two-way based on pavement markings and signs.  Roadway pavement striping between lanes is white when both lanes are traveling the same direction (one-way) and yellow when they are opposing (two-way).  Other pavement markings may include arrows painted on the lane to specify direction of traffic.  Signs at intersections that say "One Way" or "Do Not Enter" clearly define the road as one-way.  Also, road maps often show directional indicators if a roadway is one-way.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 92. Speed Limit

### Description

Definition: The daytime regulatory speed limit for automobiles posted or legally mandated on the greater part of the section.

Attributes:

- mph.

- No posted or legally mandated speed limit.

Accuracy Statement: 90-100%.

### Considerations

This information may already be available with an agency for roadways under its jurisdiction.

If multiple speed limits are posted within the segment choose the speed limit that covers the greater portion of the segment.

### Existing Resources

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

## 93. Truck Speed Limit

*Description*

Definition: The regulatory speed limit for trucks posted or legally mandated on the greater part of the section (i.e., differential speed limit).

Attributes:

- mph.

Accuracy Statement: 90-100%.

*Considerations*

If multiple truck speed limits are posted within the segment choose the truck speed limit that covers the greater portion of the segment.  Only code if the speed limit for trucks is different than the limit for automobiles.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.
- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.
- Inadequate image capture and poor resolution.

## 94. Nighttime Speed Limit

*Description*

Definition: The regulatory speed limit for vehicles at night posted or legally mandated on the greater part of the section (i.e., differential speed limit).

Attributes:

- mph.

Accuracy Statement: 90-100%.

*Considerations*

Only code if the speed limit is different at night than during the day.

If multiple nighttime speed limits are posted within the segment choose the nighttime speed limit that covers the greater portion of the segment.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**95. 85th Percentile Speed**

*Description*

Definition: Traffic speed exceeded by 15 percent of the vehicles in the flow for this section.

Attributes:

- mph.

Accuracy Statement: ± 5-10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

State:

- Texas DOT Traffic Data and Analysis Manual: http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

- Spot Speed Manual: http://www.ecs.umass.edu/masssafe/PDFS%20for%20Site/Spot%20Speed%20Manual.pdf *(28)*.

*Collection Methods*

Continuous traffic monitoring sites using automatic traffic recorders are the best sources of hourly traffic volume.  If continuous data are not available, short term traffic counts can be used.  If either traffic count is not available, hourly counts on the same route or a similar route with similar traffic characteristics in the same area can be used.  In addition, speed detection radars can be used to sample vehicular spot speeds.

*Concerns with Collection Methods*

- Inadequate duration and frequency of data collection.

**96. Mean Speed**

*Description*

Definition: The arithmetic mean (average) of all observed vehicle speeds in the segment (i.e., the sum of all spot speeds divided by the number of recorded speeds).

Attributes:

- mph.

Accuracy Statement: ± 5-10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10).*

State:

- Texas DOT Traffic Data and Analysis Manual: http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12).*

- Spot Speed Manual: http://www.ecs.umass.edu/masssafe/PDFS%20for%20Site/Spot%20Speed%20Manual.pdf *(28).*

*Collection Methods*

Continuous traffic monitoring sites using automatic traffic recorders are the best sources of hourly traffic volume.  If continuous data are not available, short term traffic counts can be used.  If either traffic count is not available, hourly counts on the same route or a similar route with similar traffic characteristics in the same area can be used. In addition, speed detection radars can be used to sample vehicular spot speeds.

*Concerns with Collection Methods*

- Inadequate duration and frequency of data collection.

## 97. School Zone Indicator

*Description*

Definition: Indication of whether the segment contains a school zone.

Attributes:

- Yes.

- No.

Accuracy Statement: 90-100%.

*Considerations*

A school zone is a designated roadway segment approaching, adjacent to, and beyond school buildings or grounds, or along which school related activities occur *(14)*.

The optional signs shown in Figure 16 may be used with the School Zone sign to provide additional information.

School zones can also be identified by the reduced speed limit signs paired with the S4-3P sign shown in Figure 16 found along a roadway.
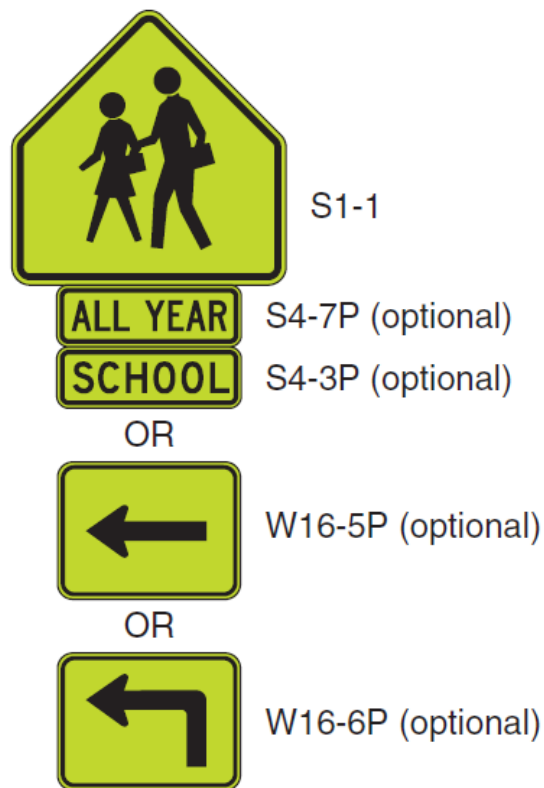


**Figure 16. School zone with mandatory and optional signs *(14)*.**

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

## 98. On-Street Parking Presence

*Description*

Definition: Time-based parking restrictions.

Attributes:

- Permitted 24 hrs/day.

- Prohibited 24 hrs/day.

- Permitted during specified times.

See Figure 17 for examples of parking restriction signs.

Accuracy Statement: 90-100%.

**Parking Prohibited At All Times**



**Parking Permitted/Prohibited At Specified Times**

**Figure 17. Signs for parking prohibitions (14).**

*Considerations*

On-street parking that is permitted 24 hrs/day does not require signing.  "No Parking" signs are present where on-street parking is prohibited at all times.  These signs have time restrictions if parking is permitted (or prohibited) during specific times of the day.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

## 99. On-Street Parking Type

*Description*

Definition: Type of on-street parking present on the segment.

Attributes:

- No parking allowed or none available.

- Head-in/back-out angle parking on one side.

- Head-in/back-out angle parking on both sides.

- Back-in/head-out angle parking on one side.

- Back-in/head-out angle parking on both sides.

- Parallel parking on one side.

- Parallel parking on both sides.

See Figure 18 for additional details.

Accuracy Statement: 90-100%.
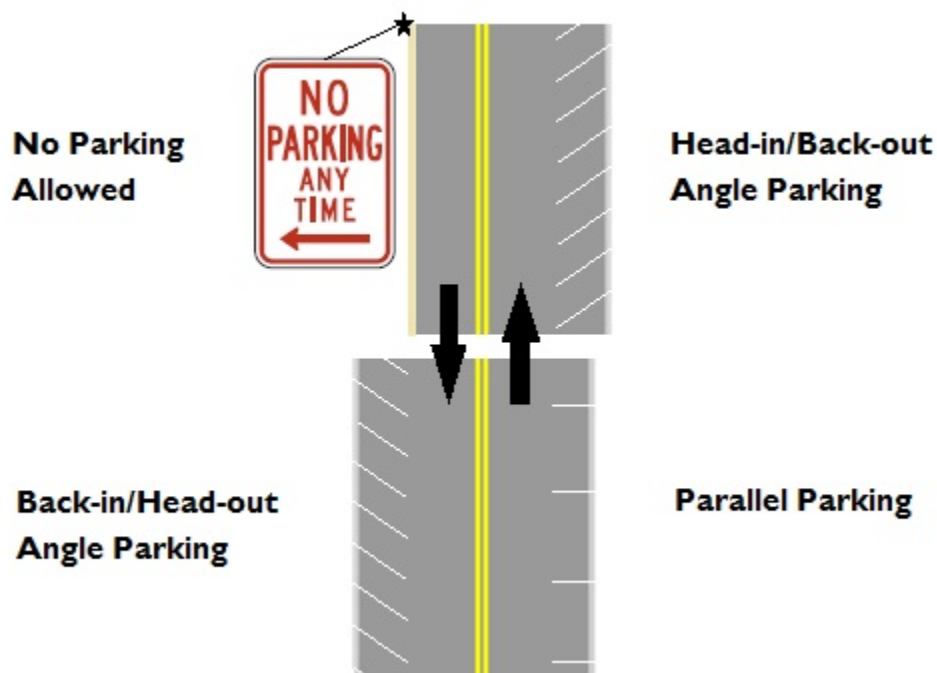


**Figure 18. Illustration of on-street parking type** *(14).*

*Considerations*

Perpendicular parking must be covered as a part of 'angle parking'.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**100. Roadway Lighting**

*Description*

Definition: The type of roadway lighting present on the segment.

Attributes:

- None.

- Spot on one side.

- Spot on both sides.

- Continuous on one side.

- Continuous on both sides.

Accuracy Statement: 90-100%.

*Considerations*

Spot lighting refers to isolated locations within the segment being lighted such as single intersections or crosswalks.  Continuous lighting requires a longer section of roadway to have lighting such as a series of intersections, stretches of roadway with high ADT, and sections of roadway that are enclosed for an extended period such as tunnels.

The data collection process for this element is labor-intensive and involves post-processing. This element can also be derived based on rules.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- The aerial data collected depends on vegetation cover

### 101. Toll Facility

*Description*

Definition: Presence and typed of toll facility on the segment.

Attributes:

- No toll.

- Toll paid in one direction only, non-high-occupancy toll (non-HOT) lanes.

- Toll paid in both directions, non-HOT lanes.

- Toll paid in one direction, HOT lanes.

- Toll paid in both directions, HOT lanes.

See Figure 19 for additional details.
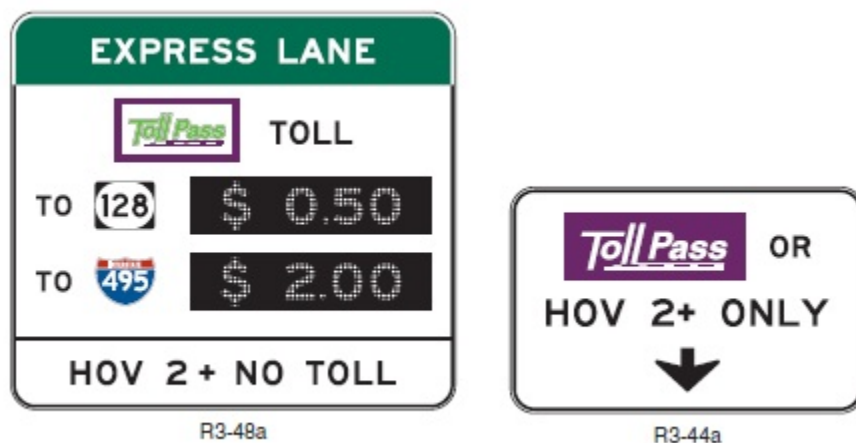


**Figure 19. Signs for HOT lanes** *(14)*.

Accuracy Statement: 90-100%.

*Considerations*

Note that HOT lanes are different than express toll lanes (ETLs).  HOT lanes give SOVs access to HOV lanes for a price.  HOVs can use HOT lanes without paying the toll.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual: http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

### *Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

### *Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**102. Edgeline Presence/Width**

*Description*

Definition: Presence and width of edgeline.

Attributes:

- No marked edgeline.
- 4 inch marked edgeline.
- 6 inch marked edgeline.
- 8 inch marked edgeline.
- Greater than 8 inch marked edgeline.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 103. Centerline Presence/Width

*Description*

Definition: Presence and width of centerline.

Attributes:

- No marked centerline.
- 4 inch marked centerline.
- 6 inch marked centerline.
- 8 inch marked centerline.
- Greater than 8 inch marked centerline.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

**104. Centerline Rumble Strip Presence/Type**

*Description*

Definition: Presence and type of centerline rumble strips on the segment.

Attributes:

- None.

- Milled adjacent to centerline.

- Rolled adjacent to centerline.

- Milled or rolled on/under centerline (e.g., rumble stripes).

- Centerline-rumble strip combination (e.g., raised/inverted thermoplastic profile marker).

See Figure 20 for center line rumble strip images.



**Figure 20. Centerline rumble strips (milled)** *(23)*.

Accuracy Statement: 90-100%.

*Considerations*

See Element 46. Right Shoulder Rumble Strip Presence/Type for rumble strip definitions.

Center line Rumble Strips are an effective countermeasure to prevent head-on collisions and opposite-direction sideswipes, often referred to as cross-over or cross-center line crashes. They are primarily used to warn drivers whose vehicles are crossing center lines of two-lane, two-way roadways.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**105. Passing Zone Percentage**

*Description*

Definition: Percent of segment length striped for passing.

Attributes:

- Percent.

Accuracy Statement: ± 5 - 10%.

*Considerations*

Where there is a discernible difference in striped passing zones between the two directions of roadway, code the more restrive direction, i.e., the direction with the smallest percentage of striped passing zones.

*Existing Resources*

Established data collection methodologies can be found at:

> State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## I.H. Other Supplemental Segment Descriptors

### 106. Bridge Numbers for Bridges in Segment

*Description*

Definition: Bridge numbers from bridge file for bridges in segment.

Attributes:

- Bridge number for each bridge in the segment.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

- National Bridge Inventory, http://www.fhwa.dot.gov/bridge/nbi.cfm *(29)*.

*Collection Methods*

This information is readily available in the FHWA National Bridge Inventory.  See Element 6. Structure.

*Concerns with Collection Methods*

None.

## II. ROADWAY ALIGNMENT DESCRIPTORS

### II.A. Horizontal Curve Data

### 107. Curve Identifiers and Linkage Elements

*Description*

Definition: All elements needed to define location of each curve record and all elements necessary to link with other safety files.

Attributes:

- Route and location descriptors (e.g., route and beginning and ending milepoints or route and beginning and ending spatial coordinates).  Must be consistent with other MIRE files for linkage.
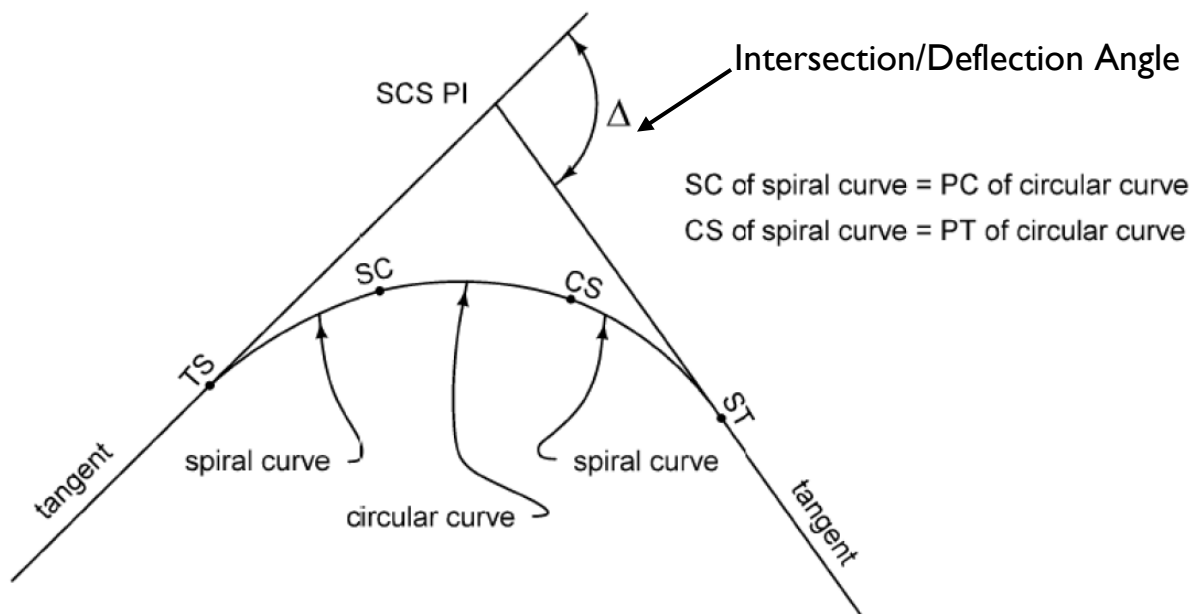
Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- This data element requires manual intervention, significant post-processing effort, and quality assurance/quality control.

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 108. Curve Feature Type

*Description*

Definition: Type of horizontal alignment feature being described in the data record.

Attributes:

- Horizontal angle point (i.e., joining of two tangents without a horizontal curve).

- Independent horizontal curve.

- Component of compound curve (i.e., one curve in compound curve).

- Component of reverse curve (i.e., one curve in a reverse curve).

See Figure 21 for additional details.

Accuracy Statement: 90-100%.
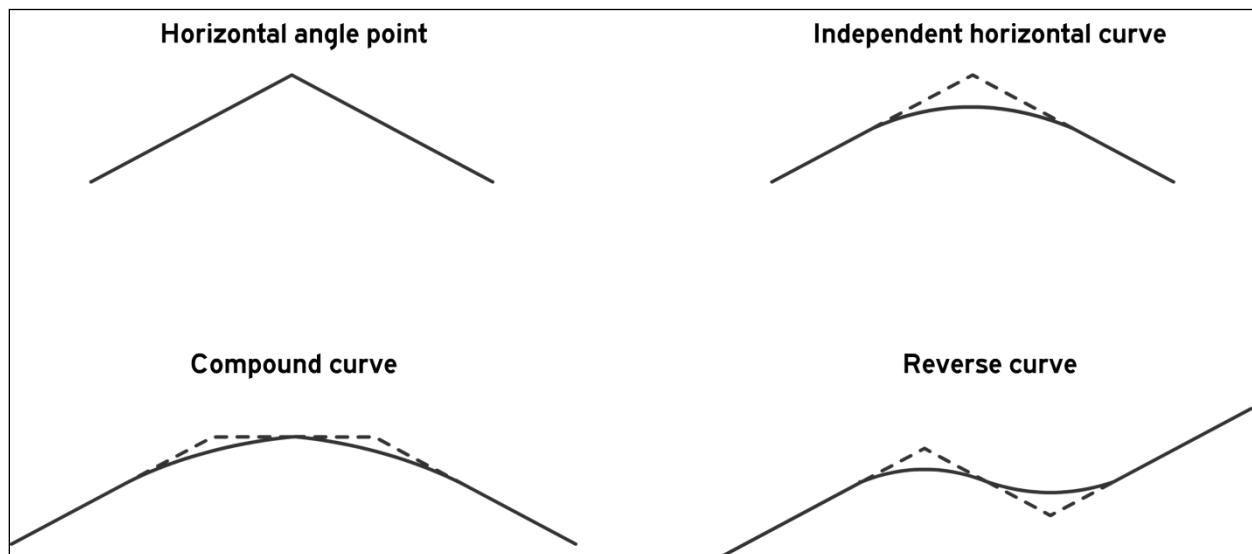


**Figure 21. Illustration of types of curve features *(2)*.**

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**109. Horizontal Curve Degree or Radius**

*Description*

Definition: Degree or radius of curve.

Attributes:

- Numeric, feet if radius.

Accuracy Statement: .01 - .001 mi. or 52.8 – 5.28 ft.

See Figure 22 for additional details where 'R' is the Radius of circular curve measured in feet. 'D' is the degree of curvature (or the angle subtended by an arc of 100 feet radius).
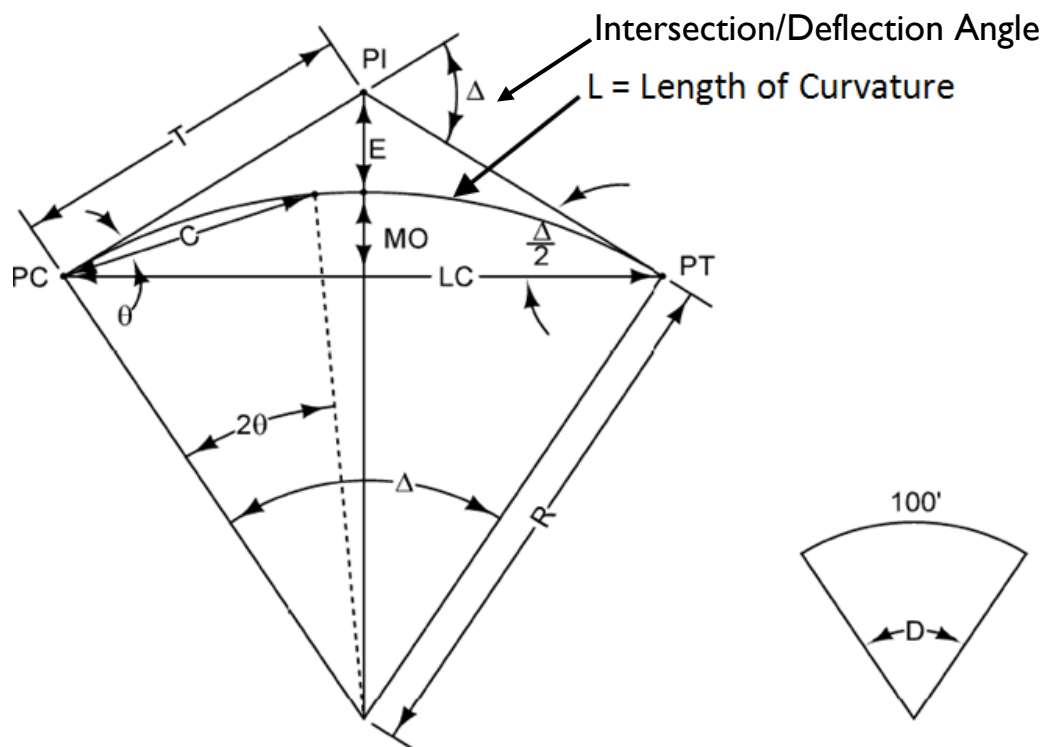
**Figure 22. Components of a simple horizontal curve.**

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

## Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

## Concerns with Collection Methods

- This data element requires post-processing along with the use of curve fitting or tracing techniques.

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 110. Horizontal Curve Length

*Description*

Definition: Length of curve including spiral.

Attributes:

- Feet.

See Figure 22 for additional details where length of the horizontal curve, L, is the total length in feet of the circular curve from point of curve (PC) to point of tangent (PT) measured along its arc.

Accuracy Statement: .01 - .001 mi. or 52.8 – 5.28 ft.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- This data element requires post-processing along with the use of curve fitting or tracing techniques.

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 111. Curve Superelevation

*Description*

Definition: Measured superelevation rate or percent.

Attributes:

- Rate/percent.

Accuracy Statement: ± 0.5 - 0.25%.

*Considerations*

Superelevation can be defined as the banking of the roadway along a horizontal curve so drivers can safely and comfortably maneuver the curve at reasonable speeds.  A steeper superelevation rate is required when speeds increase and horizontal curves become tighter.

Superelevation is expressed as a decimal, representing the ratio of the pavement slope to width, ranging from 0 to 0.12 feet/foot.  The adopted criteria allow for the use of maximum superelevation rates from 0.04 to 0.12.  Maximum superelevation rates for design are established by policy by each State.

*Existing Resources*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- This data element requires post-processing along with the use of curve fitting or tracing techniques.

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 112. Horizontal Transition/Spiral Curve Presence

*Description*

Definition: Presence and type of transition from tangent to curve and curve to tangent.

Attributes:

- No transition.

- Spiral transition.

- Other transition.

See Figure 23 for additional details.



**Figure 23. Placement of spiral curve.**

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 113. Horizontal Curve Intersection/Deflection Angle

*Description*

Definition: The angle between the two intersecting tangents in the direction of inventory (sometimes called the "deflection angle").  Code only for Horizontal Angle Points; not applicable if there is a curve joining the tangents.

Attributes:

- Degrees (absolute value).

See Figure 22 and Figure 23 for additional details where delta ( $\Delta$ ) is the intersection angle.

Accuracy Statement: 1.0 degree.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 114. Horizontal Curve Direction

*Description*

Definition: Direction of curve in direction of inventory.

Attributes:

- Right.

- Left.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## II.B. Vertical Grade Data

### 115. Grade Identifiers and Linkage Elements

*Description*

Definition: All elements needed to define location of each vertical feature and all elements necessary to link with other safety files.

Attributes:

- Route/linear reference system descriptors (e.g., route and beginning and ending milepoints or route and beginning and ending spatial coordinates). Must be consistent with other MIRE files for linkage.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- This data element requires manual intervention, significant post-processing effort, and quality assurance/quality control.
- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 116. Vertical Alignment Feature Type

### Description

Definition: Type of vertical alignment feature being described in the data record.

Attributes:

- Vertical angle point (i.e., joining of two vertical gradients without a verticle curve).

- Vertical gradient.

- Sag vertical curve (i.e., vertical curve that connects a segment of roadway with a segment of roadway that has a more positive grade).

- Crest vertical curve (i.e., vertical curve that connects a segment of roadway with a segment of roadway that has a more negative grade).

See Figure 24 for additional details.



VPC = Vertical Point of Curvature.
VPT = Vertical Point of Tangency.
VPI = Vertical Point of Intersection
g1, g2 = vertical gradients
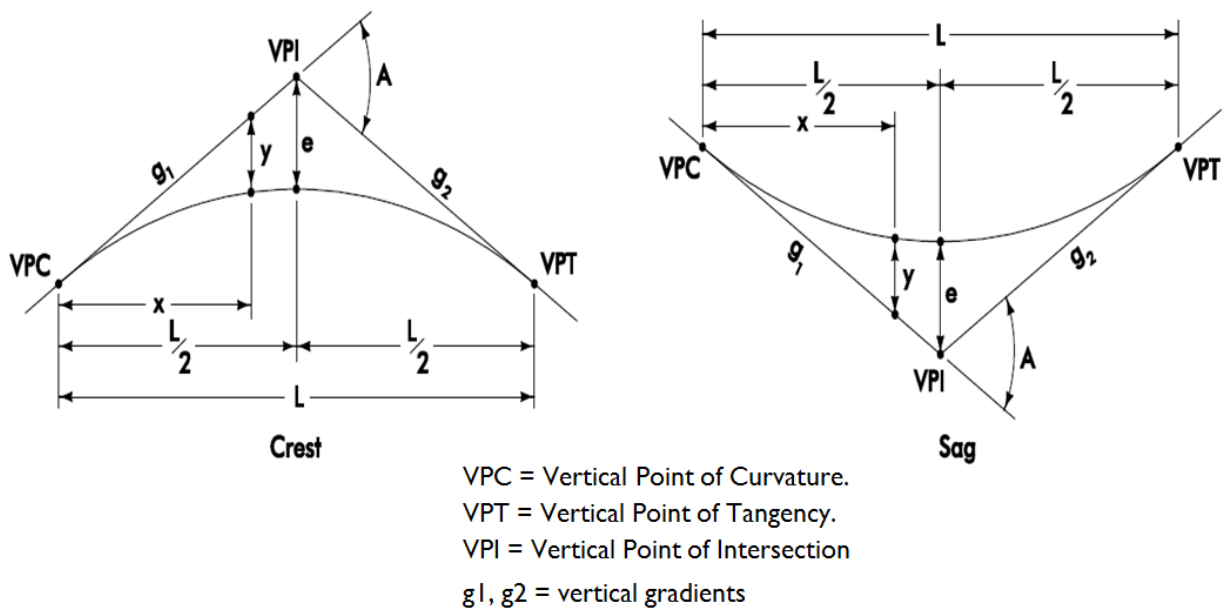
**Figure 24. Vertical curves.**

Accuracy Statement: 90-100%.

### Considerations

None.

### Existing Resources

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 117. Percent of Gradient

### Description

Definition: Percent of gradient.  Leave blank if record concerns a sag or crest vertical curve.

Attributes:

- Percent.

Accuracy Statement: ± 0.5 - 0.25%.

### Considerations

None.

### Existing Resources

Established data collection methodologies can be found at:

National:

- HPMS Field Manual:
  http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/hpms2013.pdf *(9)*.

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 118. Grade Length

### Description

Definition: Grade length if Element 116. Vertical Alignment Feature Type is "Vertical gradient."
Length does not include any portion of a vertical curve.  Leave blank if record concerns a sag or crest vertical curve.

Attributes:

- Feet.

Accuracy Statement: .01 - .001 mi. or 52.8 – 5.28 ft.

### Considerations

None.

### Existing Resources

Established data collection methodologies can be found at:

　State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 119. Vertical Curve Length

### Description

Definition: Vertical curve length if 116. Vertical Alignment Feature Type is "Sag vertical curve" or Crest vertical curve."

Attributes:

- Feet.

See Figure 24 where 'L' = Total length of vertical curve.

Accuracy Statement: .01 - .001 mi. or 52.8 – 5.28 ft.

### Considerations

None.

### Existing Resources

None

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

# III. ROADWAY JUNCTION DESCRIPTORS

## III.A. At-Grade Intersection/Junctions

### 120. Unique Junction Identifier

*Description*

Definition: A unique junction identifier.

Attributes:

- User defined (e.g., node number, LRS of primary route, etc.).

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd. This is often referred to as Intersection ID.

*Existing Resources*

None.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.  If this element is not available, an agency can generate a unique alpha-numeric identifier for a given junction based on its geographical location.

*Concerns with Collection Methods*

None.

## 121. Type of Intersection/Junction

*Description*

Definition: Type of Junction being described in the data record.

Attributes:

- Roadway/roadway (not interchange related).
- Roadway/roadway (interchange ramp terminal).
- Roadway/pedestrian crossing (e.g., midblock crossing, pedestrian path or trail).
- Roadway/bicycle path or trail.
- Roadway/railroad grade crossing.
- Other.

Accuracy Statement: 90-100%.

*Considerations*

If the type of intersection/junction cannot be distinguished between roadway/pedestrian crossing and roadway/bicycle path then choose the roadway/pedestrian crossing attribute.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 122. Location Identifier for Road 1 Crossing Point

### Description

Definition: Location of the center of the junction on the first intersecting route (e.g. route-milepost).  Note that if the Junction File is a spatial data file, this would be the coordinates and would be the same for all crossing roads.

Attributes:

- Route and location descriptors (e.g., route and milepoint or route and spatial coordinates).

Accuracy Statement: 100%.

### Considerations

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

The location identifier format must be consistent with other MIRE files for linkage.

Manual intervention along with a significant post-processing effort and quality control/quality assurance (QA/QC) are necessary for collecting this data element.

### Existing Resources

Established data collection methodologies can be found at:

State:

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 123. Location Identifier for Road 2 Crossing Point

### Description

Definition: Location of the center of the junction on the second intersecting route (e.g. route-milepost).  Note that in a spatial data system, this would be the same as Element 122. Location Identifier For Road 1 Crossing Point.  Not applicable if intersecting route is not an inventoried road (i.e., a railroad or bicycle path).

Attributes:

- Route and location descriptors (e.g., route and milepoint or route and spatial coordinates).

Accuracy Statement: 100%.

### Considerations

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

Manual intervention along with a significant post-processing effort and quality control/quality assurance (QA/QC) is necessary for collecting this data element.

Must be consistent with other MIRE files for linkage.

### Existing Resources

None.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 124. Location Identifier for Additional Road Crossing Points

### Description

Definition: Location of the center of the junction on the third and subsequent intersecting route (e.g. route-milepost). Note that in a spatial data system, this would be the same as Element 122. Location Identifier For Road 1 Crossing Point. Not applicable if intersecting route is not an inventoried road (i.e., a railroad or bicycle path).

Attributes:

- Route and location descriptors (e.g., route and milepoint or route and spatial coordinates). Must be consistent with other MIRE files for linkage.

Accuracy Statement: 90-100%.

### Considerations

Manual intervention along with a significant post-processing effort and quality control/quality assurance (QA/QC) is necessary for collecting this data element.

### Existing Resources

None.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 125. Intersection/Junction Number of Legs

### Description

Definition: The number of legs entering an at-grade intersection/junction.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

### Considerations

The intersection legs are the approach segments to a junction (See Element 121.Type Of Intersection/Junction ).

The approach segments could be at an offset from the point of intersection (See Element 130.Intersection/Junction Offset Distance).

### Existing Resources

None.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 126. Intersection/Junction Geometry

*Description*

Definition: The type of geometric configuration that best describes the intersection/junction.

Attributes:

- T-Intersection.

- Y-Intersection.

- Cross-Intersection (four legs).

- Five or more legs and not circular roundabout.

- Other circular intersection (e.g., rotaries, neighborhood traffic circles).

- Non-conventional intersection (e.g., superstreet, median U-turn, displaced left turn).

- Midblock pedestrian crossing.

See Figure 25 for additional details.

Accuracy Statement: 100%.
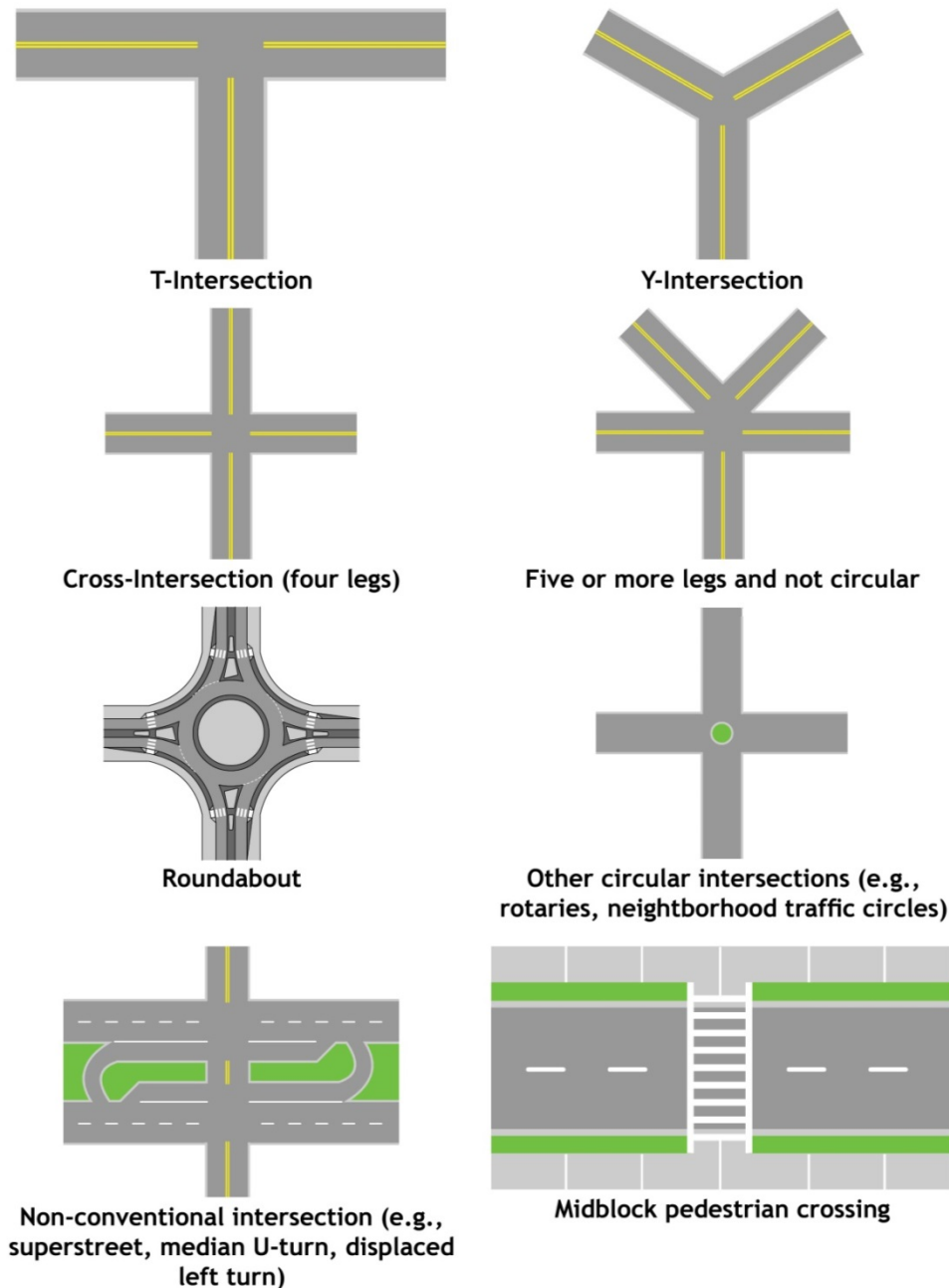
**Figure 25. Illustration of types of intersection/junction geometry *(2)*.**

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

Attribute Descriptions

- T-Intersection – An intersection with three legs and an intersection angle of 90 degrees.
  - Skewed T-Intersection – The intersection angle is skewed.

- Y-Intersection – An intersection with three legs that does not meet the T-intersection definition.

- Four-Leg Intersection – Consists of 4 legs/approaches in the following variations:

    o Approaches intersect at right angles.

    o Approaches intersect at non-right angles and the opposite angles are equal.

    o Approaches intersect with non-right and different angles.

    o Approaches to the intersection are offset from the point of intersection.

- Roundabout – An intersection in which traffic merges from multiple roadways into a counter-clockwise circle where normally all turns are right-turns.

- Circular Intersection – An intersection with a circular island where all turns are right-turns. It includes roundabout, rotaries, and traffic circles. Traffic circles, or rotaries are much larger than modern roundabouts. The traffic circles or rotaries differ from modern roundabouts in their control or entry/yield patterns, operational characteristics such as weaving patterns, deflection or intersection entry angles, speeds, circle diameters, pedestrian crossing, presence of splitter islands, and parking characteristics.

### *Existing Resources*

None.

### *Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

### *Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 127. School Zone Indicator

### Description

Definition: An indication of whether the intersection/junction is in a school zone.

Attributes:

- Yes.

- No.

See Figure 16 for additional details.

Accuracy Statement: 90-100%.

### Considerations

Refer to Element 97. School Zone Indicator for more details.

### Existing Resources

None.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

### Concerns with Collection Methods

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**128. Railroad Crossing Number**

*Description*

Definition: Railroad (RR) crossing number if a RR grade crossing (for linkage to National Highway-Rail Crossing Inventory).

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

A unique identifier assigned to each highway-railroad crossing.  It is a United States DOT Crossing Inventory number, normally referred to as an FRA (Federal Railroad Administration) number. Additional information can be obtained from Federal Railroad Administration Office of Safety Analysis.

*Existing Resources*

Established data collection methodologies can be found at:

    State:

- Texas DOT Traffic Data and Analysis Manual:
  http://onlinemanuals.txdot.gov/txdotmanuals/tda/index.htm *(12)*.

*Collection Methods*

This information is readily available in the Highway-Rail Crossing Inventory maintained by the FRA Office of Safety Analysis,
http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/query/HRCrossinginv.aspx

*Concerns with Collection Methods*

None.

## 129. Intersection Angle

*Description*

Definition: The measurement in degrees of the smallest angle between any two legs of the intersection. This value will always be within a range of 0 to 90 degrees (i.e., for non-zero angles, always measure the acute rather than the obtuse angle).

Attributes:

- Degrees.

See Figure 26 for additional details.

Accuracy Statement: 1-5 degrees.
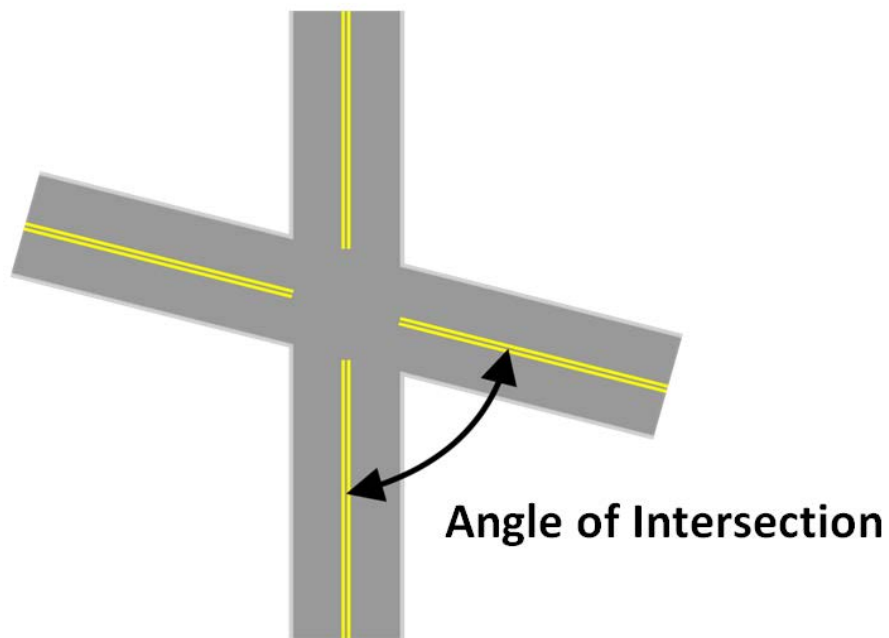


**Figure 26. Illustration of intersecting angle *(2)*.**

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 130. Intersection/Junction Offset Distance

*Description*

Definition: Offset distance between the centerlines of the intersecting legs (minor road) at the intersection.  When the intersection legs are not offset, the value of this data item should be zero.

Attributes:

- Numeric (Note that "zero" should be entered if crossing road centerlines are not offset).

See Figure 27 for additional details.

Accuracy Statement: .01-.001 mile.
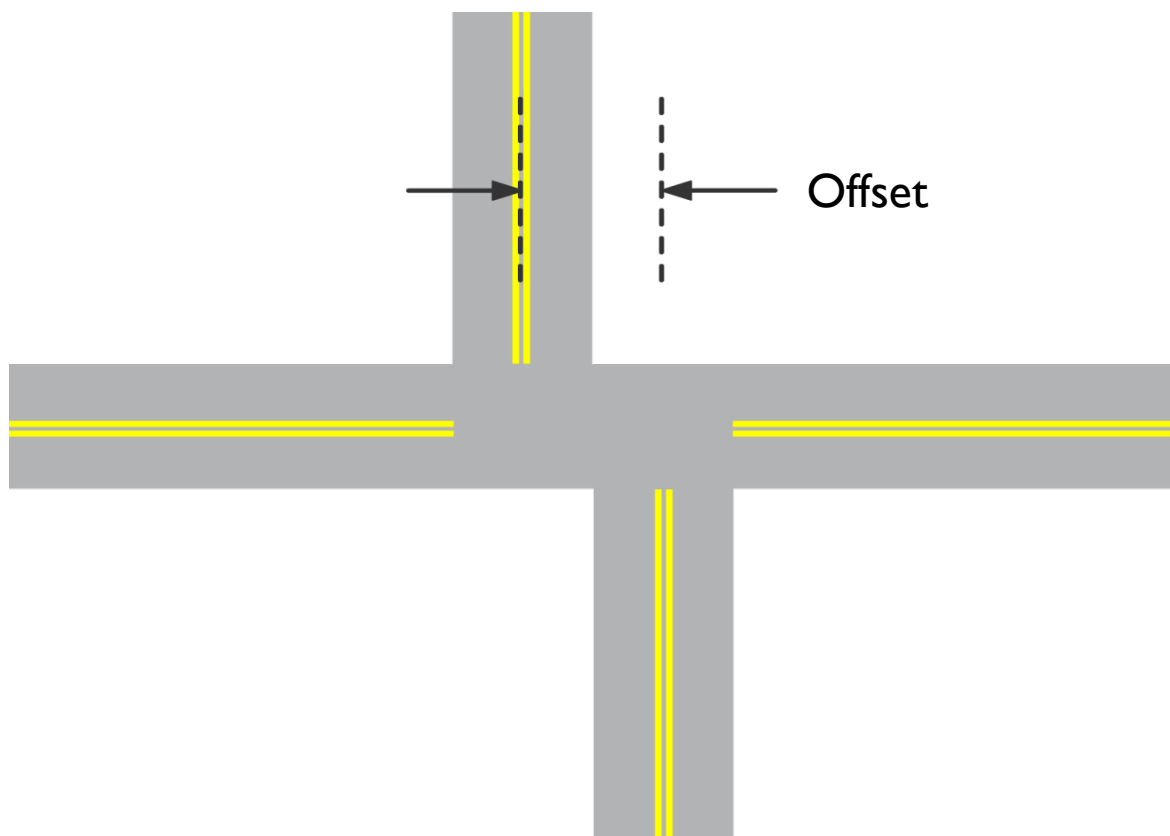


**Figure 27. Illustration of intersection/junction offset distance.**

*Considerations*

A maximum offset distance is required to distinguish which offset legs belong to a given intersection.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 131. Intersection/Junction Traffic Control

*Description*

Definition: Traffic control present at intersection/junction.

Attributes:

- Uncontrolled.

- Two-way stop.

- All-way stop.

- Yield sign.

- Signalized (with ped signal).

- Signalized (w/o ped signal).

- Railroad crossing, gates and flashing lights.

- Railroad crossing, flashing lights only.

- Railroad crossing, stop-sign controlled.

- Railroad crossing, crossbucks only.

- Other.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd and for roads with AADT < 400 vpd.

Possible 'Other' attributes includes roundabouts and fire signals.  Amber/red flashing intersection control beacons can be considered two-way stop controlled, and red/red flashing intersection control beacons can be considered all-way stop controlled.  Agencies can consider adding a comment field to indicate whether a flasher is present.

Signalized traffic control consists of the typical red, yellow, and green light combination. Signalized with pedestrian signal means there is a traffic light and a Walk/No Walk signal at the intersection.  For more examples of pedestrian signals at signalized intersections see Element 158. Pedestrian Signalization Type and Element 159. Pedestrian Signal Special Features.

*Existing Resources*

- Sign and/or signal inventories if available.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Inadequate image capture and poor resolution may cause difficulties in identifying the correct type of traffic control method used, especially for pedestrian signals.

- Poorly maintained pavement markings or signs may result in incorrect identification of the traffic control method.

- Timeliness of the aerial and ground-based imagery.

**132. Signalization Presence/Type**

*Description*

Definition:  Presence and type of signalization at intersection/junction.

Attributes:

- No signal.

- Uncoordinated fixed time.

- Uncoordinated traffic actuated.

- Progressive coordination (with several signals along either road).

- System coordination (e.g., real-time adapative systemwide).

- Railroad crossing signal (includes signal-only and signal and gates).

- Other.

Accuracy Statement: 90-100%.

*Considerations*

This element describes how the intersection traffic signals change over time.  An uncoordinated signal is not affected by any other signal and changes using a timer (fixed time) or is triggered by traffic approaching the intersection (traffic actuated).  The progressive coordination attribute describes a timed signal that is part of a sequence of other timed signals along the roadway.  Similarly, the system coordination attribute describes a traffic actuated signal that also receives feedback from other intersections in the area.  The railroad crossing signal describes a signal that is activated by the approach of a train.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

This information is typically available from the highway agency's traffic operations department that handles traffic signal inventory including type, timing and coordination.

*Concerns with Collection Methods*

None.

## 133. Intersection/Junction Lighting

### Description

Definition: Presence of lighting at intersection/junction.

Attributes:

- Yes.

- No.

Accuracy Statement: 90-100%.

### Considerations

This element includes overhead lights and street lamps that illuminate the intersection to improve visibility.

This does not refer to traffic signal lights.

### Existing Resources

None.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- The aerial data obtained will depend on vegetation cover.  This data element collection is labor-intensive and involves manual post-processing.

## 134. Circular Intersection – Number of Circulatory Lanes

### Description

Definition: Number of circulatory lanes in circular intersection.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

This element captures the number of lanes that continue all the way around the intersection. Figure 28is an example of a circular intersection with one circulatory lane.

### Considerations

None.

### Existing Resources

None.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 135. Circular Intersection – Circulatory Lane Width

*Description*

Definition: Width of the roadway between the central island and the outer edge of the circulatory lane in a circular intersection.

Attributes:

- Feet.

See Figure 28 for additional details.

Accuracy Statement: ± 1 ft.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 136. Circular Intersection – Inscribed Diameter

*Description*

Definition: Distance between the outer edges of the circulatory roadway of a circular intersection.

Attributes:

- Feet.

See Figure 28 for additional details.

Accuracy Statement: ± 1 ft.
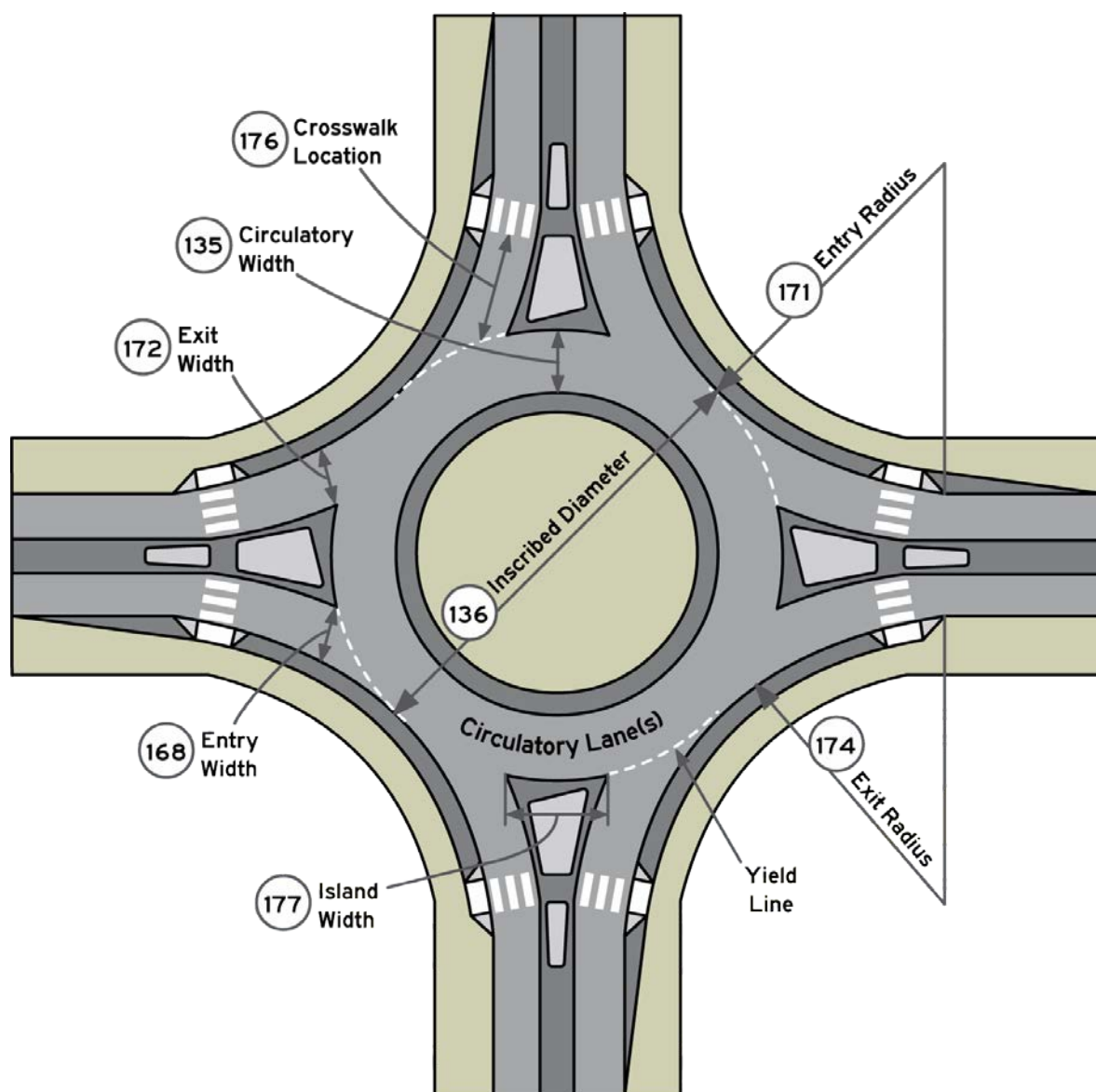


**Figure 28. Illustration of circular intersection *(2)*.**

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 137. Circular Intersection – Bicycle Facility

*Description*

Definition: Presence and type of bicycle facility at circular intersection.

Attributes:

- None.

- Separate cycle path.

- Circulatory bike lane.

See Figure 29 for additional details.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

None



Separate parallel bicycle path
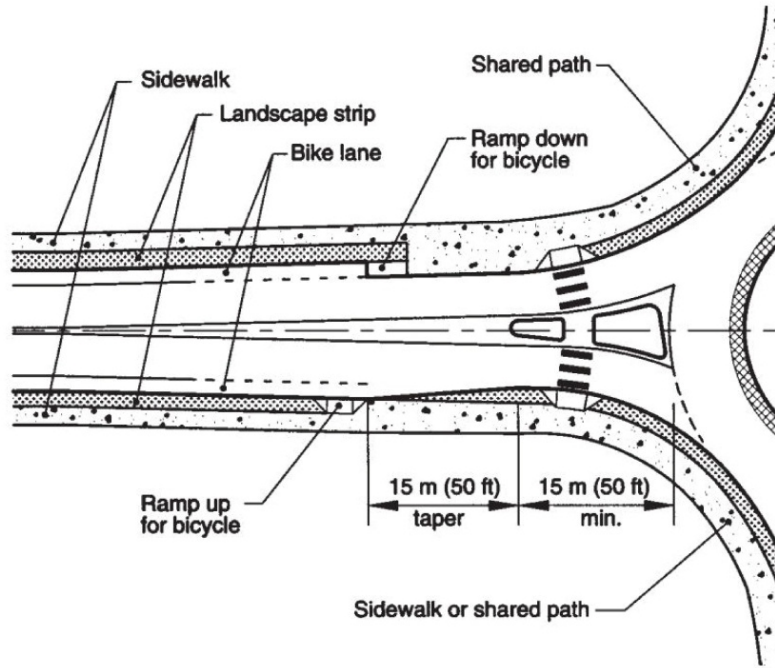


Circulatory bike lane
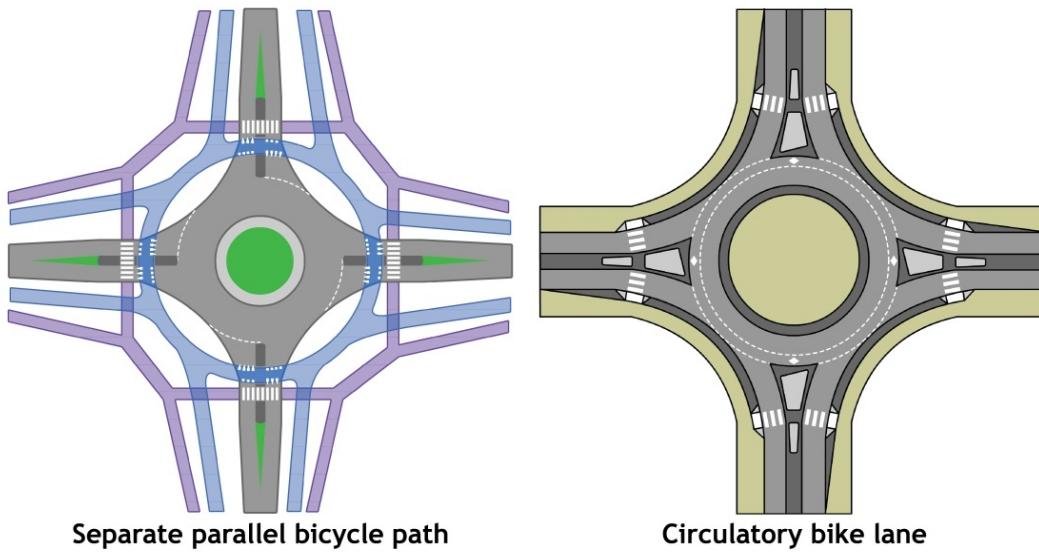
**Figure 29. Illustration of types of bicycle facilities at circular intersections *(2)*.**

## 138. Intersection Identifier for this Approach

### Description

Definition: The unique numeric identifier assigned to the intersection that includes this approach is (see Element 120. Unique Junction Identifier).  This element provides linkage to the basic intersection information and to all other approaches.

Attributes:

- The intersection identifier entered in Element 120. Unique Junction Identifier.

Accuracy Statement: 90-100%.

### Considerations

None.

### Existing Resources

None.

### Collection Methods

See Element 120. Unique Junction Identifier.

### Concerns with Collection Methods

See Element 120. Unique Junction Identifier.

## 139. Unique Approach Identifier

### Description

Definition: A unique identifier for each approach of an intersection.

Attributes:

- Any identifier that is unique for each approach within a single intersection (e.g., sequential numbers or letters, compass directions, "clock hours").  See Figure 30 for additional details.

Accuracy Statement: 100%.



A, 1, North, 12:00, 0°

D, 4, West, 9:00, 270°

B, 2, East, 3:00, 90°

C, 3, South, 6:00, 180°
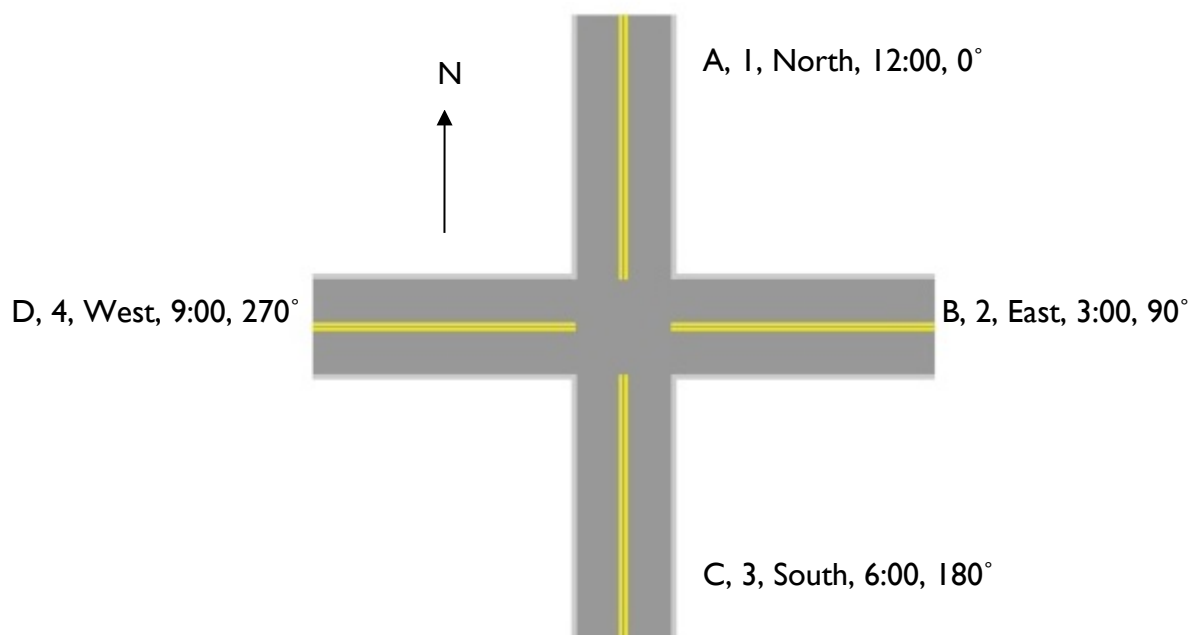
**Figure 30. Illustration of unique approach identifiers.**

### Considerations

This is an FDE for roads with AADT ≥ 400 vpd.

It is important for each leg/approach in an intersection to have a unique ID.  A similar option to those listed above is to set North/12:00 as 0° and identify each approach by the angle at which it enters the intersection.

### Existing Resources

None.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction. If this element is not available, an agency can generate a unique alpha-numeric identifier for a given approach based on its geographical location.

*Concerns with Collection Methods*

None.

## 140. Approach AADT

*Description*

Definition: The AADT on the approach leg of the intersection/junction.

Attributes:

- Vehicles per day.

Accuracy Statement: ± 5 - 10%.

*Considerations*

AADT can be defined as the annualized average 24-hour volume of vehicles at a given point or section of highway.  It is normally calculated by determining the volume of vehicles during a given period, and dividing that number by the number of days in that period.  In general terms it is also known as "Traffic Count".

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

*Collection Methods*

Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on collection methods.

*Concerns with Collection Methods*

Refer to Element 79. Annual Average Daily Traffic (AADT) for more information of concerns with collection methods.

## 141. Approach AADT Year

*Description*

Definition: The year of the AADT on the approach leg of the intersection/junction.

Attributes:

- Year.

Accuracy Statement: 100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Refer to Element 80. AADT Year for more information on collection methods.

*Concerns with Collection Methods*

None.

**142. Approach Mode**

*Description*

Definition: Intended modes for the approach.

Attributes:

- Vehicles only or shared use (e.g., vehicles, peds, bikes).

- Pedestrians only.

- Bicycles only.

- Pedestrians and bicycles.

- Railroad.

- Other.

Accuracy Statement: 90-100%.

*Considerations*

This element captures the type of traffic using the approach.  Vehicle roadways and railroad tracks are fairly easy to distinguish using aerial imagery.  Pedestrian and bicycle crossings may require the use of ground-based imagery to identify signs or pavement markings distinguishing the mode of travel.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 143. Approach Directional Flow

### Description

Definition: Indication of one-way or two-way flow on approach.

Attributes:

- One-way.

- Two-way.

Accuracy Statement: 90-100%.

### Considerations

See Element 91.One/Two Way Operations.

### Existing Resources

Established data collection methodologies can be found at:

State:

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**144. Number of Approach Through Lanes**

*Description*

Definition: Total number of through lanes on approach (both directions if two-way, one direction if one-way).

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.
- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 145. Left Turn Lane Type

*Description*

Definition: Type of left turn lane(s) that accommodate left turns from this approach.

Attributes:

- No left turn lanes.

- Conventional left turn lane(s).

- U-turn followed by right turn.

- Right turn followed by U-turn.

- Right turn followed by left turn (e.g., jughandle near side).

- Right turn followed by right turn (e.g., jughandle far side).

- Left turn crossover prior to intersection (e.g., displaced left turn).

- Other.

See Figure 31 for additional details.

Accuracy Statement: 90-100%.

**Conventional Left Turn Lanes**          **Jughandle**

**No Left Turn Lanes**          **Right Turn Followed by Left Turn**
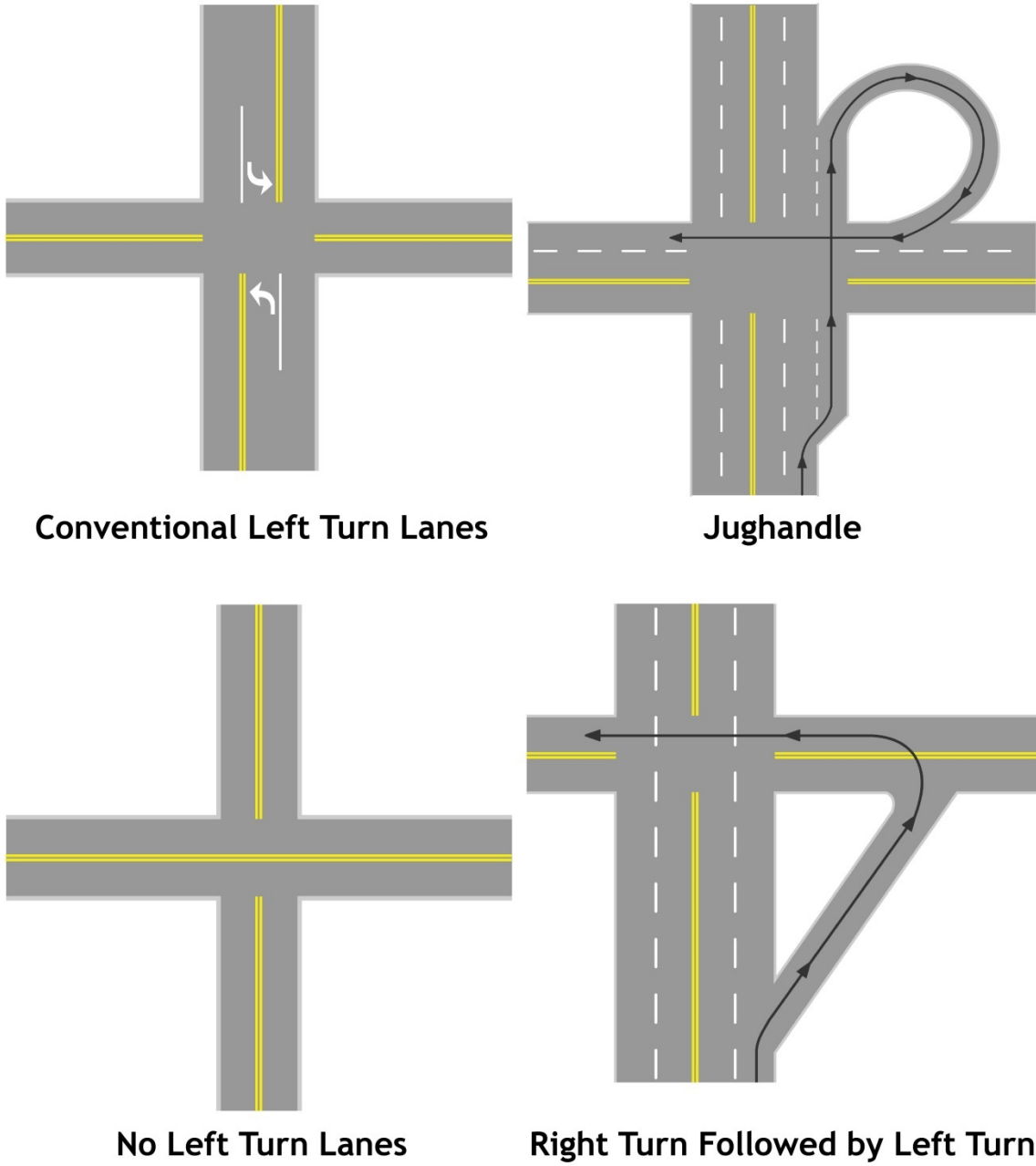
**Figure 31. Illustration of left turn lane types** *(2).*
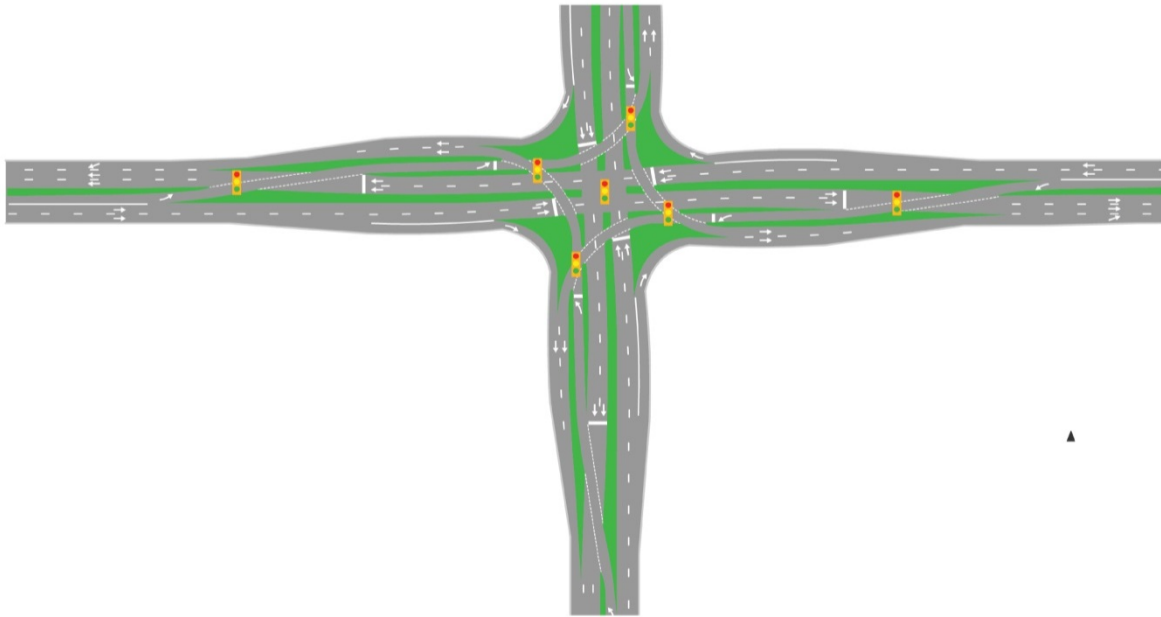
**Left Turn Prior to Intersection**
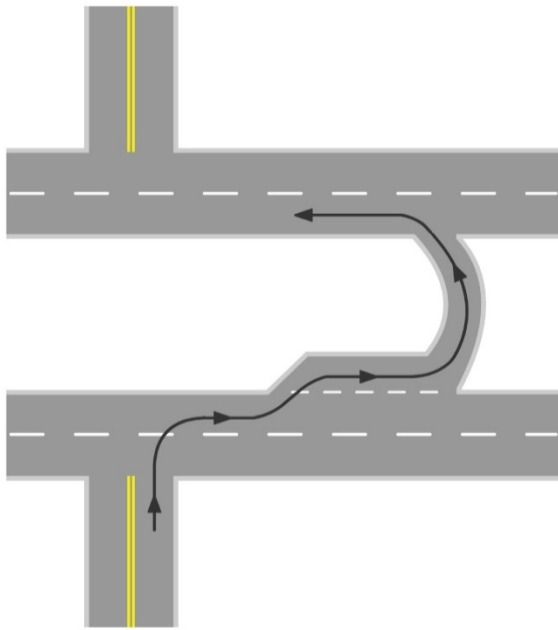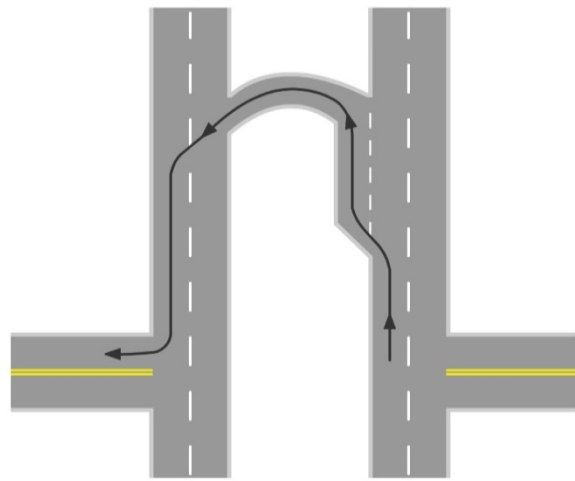


**Right Turn Followed by U-turn          U-turn Followed by Right Turn**

**Figure 31. Illustration of left turn lane types (continued) *(2)*.**

*Considerations*

None.

## *Existing Resources*

Established data collection methodologies can be found at:

State:

- Georgia DOT HPMS Inventory Manual: http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_DataCollectionGuide.pdf *(17)*.

## *Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

## *Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**146. Number of Exclusive Left Turn Lanes**

*Description*

Definition: Number of exclusive left turn lanes that accommodate left turns from this approach.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

Only left turns can be made from an exclusive left turn lane.  These lanes usually have a left-facing turn arrow painted on the pavement or on a sign at the intersection.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Georgia DOT HPMS Inventory Manual: http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**147. Amount of Left Turn Lane Offset**

*Description*

Definition: Amount of offset between conventional left turn lane(s) on this approach and opposing approach. Offset refers to direction (plus or minus) and distance between the centerline of the left turn lane on this approach and the centerline of the left turn lane on the opposing approach. The direction is positive if the left turn lane on this approach is to the left of the opposing left turn lane and negative if vice versa. If the opposing left turn lanes are aligned, enter "0".

Attributes:

- Sign (+ or -) and distance (feet).

Accuracy Statement: ± 6 in.

See Figure 32 for additional details.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.
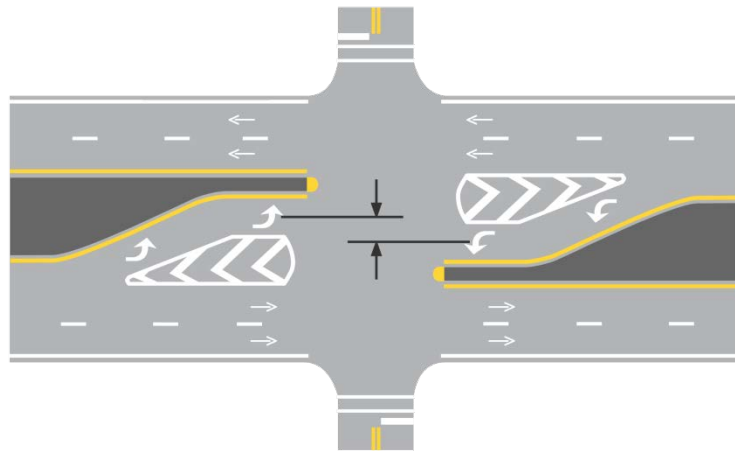
Positive Offset
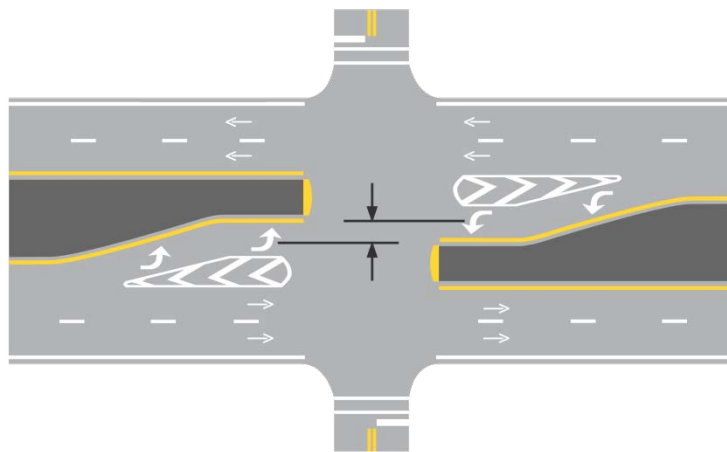


Negative Offset
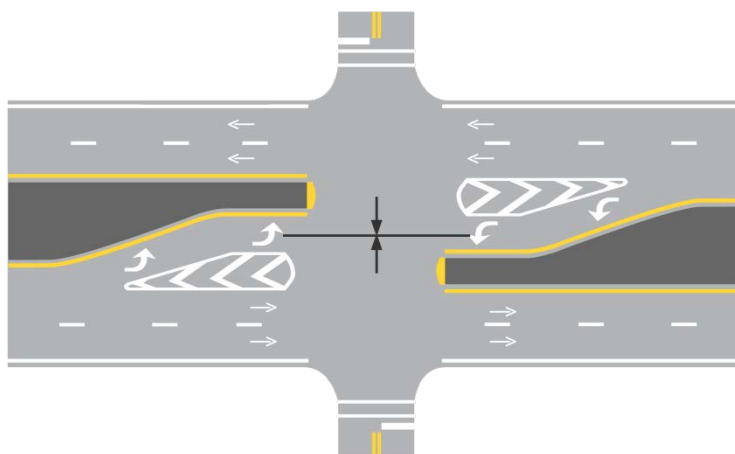


Zero Offset

**Figure 32. Illustration of positive, negative, and zero offset distance** *(2).*

## 148. Right Turn Channelization

*Description*

Definition: Right turn channelization on approach.

Attributes:

- None.

- Painted island with receiving lane.

- Painted island without receiving lane.

- Raised island with receiving lane.

- Raised island without receiving lane.

Figure 33 shows examples of raised island with a receiving lane and without a receiving lane.

Accuracy Statement: 90-100%.



**Figure 33. Right turn channelization by raised island** *(21).*

*Considerations*

Right turn channelization exists when exclusive right turn lanes (see Element 150.Number Of Exclusive Right Turn Lanes) are separated from through or exclusive left turn lanes by an island.

This island can be painted (pavement markings on a flush surface) or raised (raised surface with curbs).

The channelization islands serve the purpose of delineating the area in which vehicles can operate, reducing the area of vehicle conflict, incorporating a smaller (safer) angle of merge for vehicles, and providing pedestrian refuge.

This element can be difficult to identify by aerial imagery because raised and painted islands look very similar from above. Figure 34 shows an example of a painted channelization island that might not be distinguishable by aerial imagery, an angled aerial image, or ground-based image is often required to identify these attributes.



**Figure 34. Right turn channelization by painted island with receiving lane (27).**
*Google Maps™*

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 149. Traffic Control of Exclusive Right Turn Lanes

*Description*

Definition: Traffic control of exclusive right turn lanes on approach.

Attributes:

- Signal.

- Yield sign.

- Stop sign.

- No control (e.g., free flow).

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**150. Number of Exclusive Right Turn Lanes**

*Description*

Definition: Number of exclusive right turn lanes on approach.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

Only right turns can be made from an exclusive right turn lane.  These lanes usually have a right-facing turn arrow painted on the pavement or on a sign at the intersection.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

### 151. Length of Exclusive Left Turn Lanes

*Description*

Definition: Storage length of exclusive left turn lane(s) (not including taper).

Attributes:

- Feet.

Figure 35 illustrates the length measurement.

Accuracy Statement: .01 - .001 mi or 52.8 – 5.28 ft.
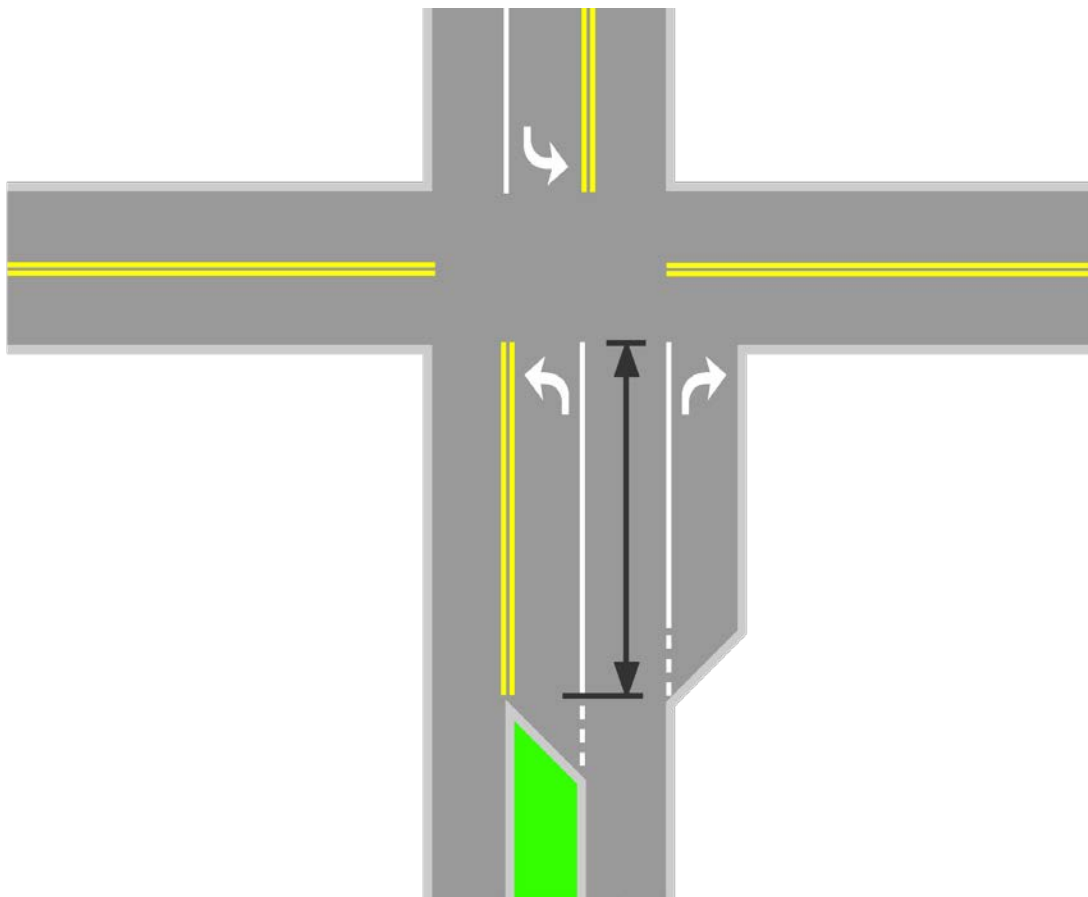


**Figure 35. Illustration of exclusive left turn lane length *(2)*.**

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**152. Length of Exclusive Right Turn Lanes**

*Description*

Definition: Storage length of exclusive right turn lane(s) (not including taper).

Attributes:

- Feet.

Figure 36 illustrates the measurement for the right turn lane length.

Accuracy Statement: 0.01 - 0.001 mi or 52.8 – 5.28 ft.
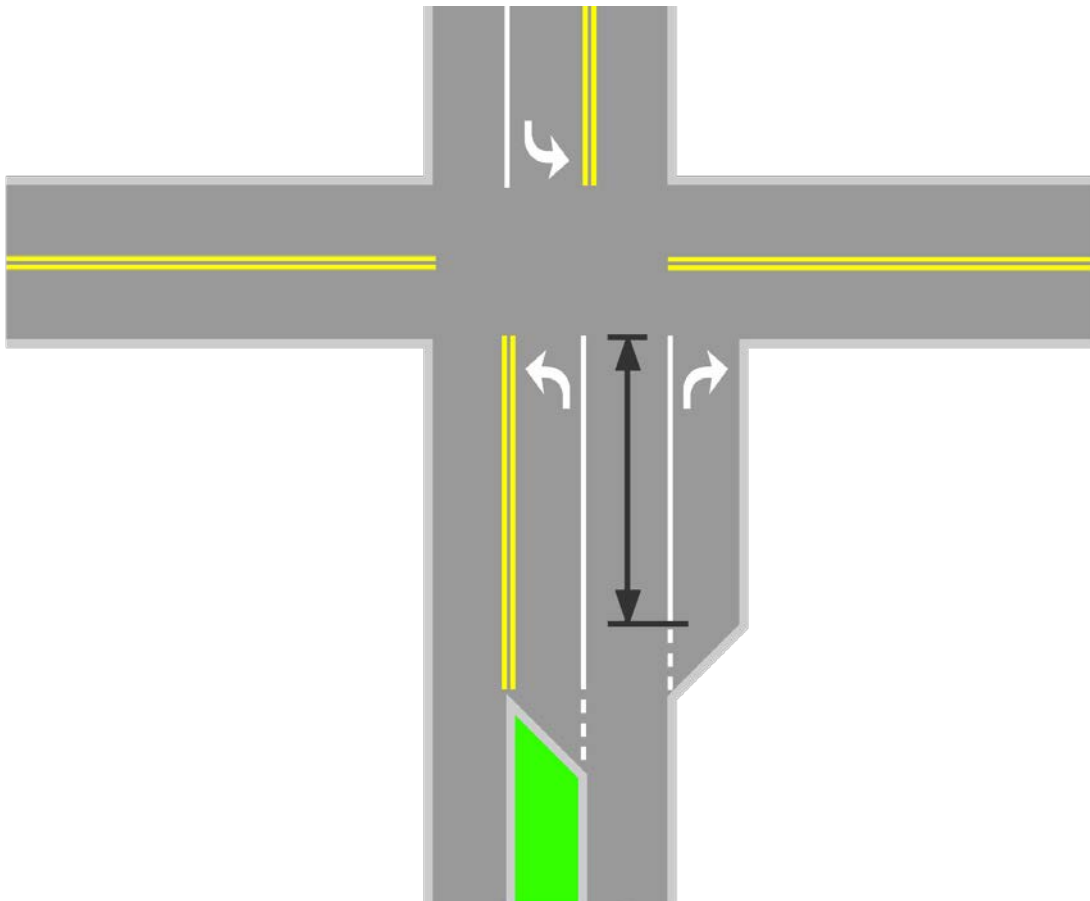


**Figure 36. Illustration of exclusive right turn lane length *(2)*.**

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**153. Median Type at Intersection**

*Description*

Definition: Median type at intersection separating opposing traffic lanes on this approach. Pedestrian refuge islands are also captured in Element 157. Crosswalk Presence/Type.

Attributes:

- Undivided.

- Flush paved median (at least 4 feet in width).

- Raised median with curb.

- Depressed median.

- Two-way left turn lane.

- Railroad or rapid transit.

- Other divided.

Figure 37 shows example of median types.

Accuracy Statement: 90-100%.

*Considerations*

Based on the definition, median type only applies to two-way approaches.  This element can be difficult to identify by aerial imagery because raised, depressed, and flush medians look very similar from above.  An angled aerial image or ground-based image is often required to identify these attributes.

Undivided approaches have no separation of opposing traffic lanes.  Approaches with only yellow pavement markings less than 4 feet wide are included in this attribute.  If the median markings are greater than 4 feet wide and designed to keep opposing traffic apart then it is a flush paved median.  A depressed median does not have a curb and is lower than the traffic lanes.

**Figure 37. Illustration of median type** *(20, 27)*.

## Existing Resources

Established data collection methodologies can be found at:

State:

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data
  CollectionGuide.pdf *(17)*.

## Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 154. Approach Traffic Control

### Description

Definition: Traffic control present on approach.  Pedestrian signalization is captured in Element 158. Pedestrian Signalization Type.

Attributes:

- Uncontrolled.

- Stop sign.

- Yield sign.

- Signalized.

- Railroad crossing, gates and flashing lights.

- Railroad crossing, flashing lights only.

- Railroad crossing, stop-sign controlled.

- Railroad crossing, crossbucks only.

- Other.

Accuracy Statement: 90-100%.

### Considerations

See Element 131. Intersection/Junction Traffic Control for additional attribute descriptions.

### Existing Resources

Established data collection methodologies can be found at:

> State:

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

## 155. Approach Left Turn Protection

*Description*

Definition: Presence and type of left turn protection on the approach.

Attributes:

- Unsignalized.

- Signalized with no left turn protection (i.e., permissive).

- Protected, all day.

- Protected, peak hour only.

- Protected permissive, all day.

- Protected permissive, peak hour only.

- Other.

Figure 38  provides examples of left turn protection.

Accuracy Statement: 90-100%.



**Figure 38. Examples of left turn protection (27).**
*Google Maps™*

*Considerations*

- Permitted – Approaches that are signalized with no left turn protection are called permissive because traffic is permitted to turn left after yielding to opposing through traffic and pedestrians.  This attribute is recognized in ground-based imagery by a standard red, yellow, and green traffic signal.

- Protected – Traffic turning left is protected from opposing traffic.  This is often denoted by a red, yellow, and green turn arrow signal or a turn only sign posted on a standard traffic signal.

- Protected-Permitted – One phase of the traffic signal allows protected left turns and another phase allows permitted left turns.  Signals consist of a standard traffic signal with an added green turn arrow.  Some signals also have a yellow turn arrow.

These aspects of the element can be determined by ground-based imagery.  The signal timing can be collected from agency signal management databases.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**156. Signal Progression**

*Description*

Definition: Signal progression on approach.

Attributes:

- No signal.

- Uncoordinated fixed time.

- Uncoordinated traffic actuated.

- Progressive coordination (with several signals along either road).

- System coordination (e.g., real-time adapative systemwide).

- Railroad crossing signal (includes signal-only and signal and gates).

- Other.

Accuracy Statement: 90-100%.

*Considerations*

See Element 132. Signalization Presence/Type.

*Existing Resources*

Established data collection methodologies can be found at:

> State:

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

*Collection Methods*

This information is typically available from the highway agency's traffic operations department that handles traffic signal inventory including type, timing and coordination.

*Concerns with Collection Methods*

None.

## 157. Crosswalk Presence/Type

*Description*

Definition: Presence and type of crosswalk crossing this approach leg.

Attributes:

- Unmarked crosswalk.

- Marked crosswalk.

- Marked crosswalk with supplemental devices (e.g., in-street yield signs, in-pavement warning lights, pedestrian bulb outs, etc.).

- Marked crosswalk with refuge island.

- Marked with refuge island and supplemental devices (e.g., in-street yield signs, in-pavement warning lights, pedestrian bulb outs, etc.).

- Pedestrian crossing prohibited at this approach.

- Other.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 158. Pedestrian Signalization Type

*Description*

Definition: Type of pedestrian signalization for crossing this approach.

Attributes:

- None.

- Activated by traffic signal (e.g., recall).

- Pushbutton actuated.

- Other.

Accuracy Statement: 90-100%.

*Considerations*

The presence of pushbuttons can be identified with ground-based imagery.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**159. Pedestrian Signal Special Features**

*Description*

Definition: Special features for pedestrian signals for crossing this approach.

Attributes:

- None.

- Accessible pedestrian signal (i.e., audible tones/messages for blind or low-vision pedestrians).

- Countdown pedestrian signal.

- Both accessible and countdown features.

- Other.

Accuracy Statement: 90-100%.

*Considerations*

It is possible to recognize a countdown pedestrian signal with ground-based imagery as a signal will be present to show the countdown sequence.  However, signals with audible tones must be collected from agency signal management databases.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**160. Crossing Pedestrian Count/Exposure**

*Description*

Definition: Count or estimate of average daily pedestrian flow crossing this approach (Note: only applicable to approaches with vehicular traffic).

Attributes:

- Numeric.

Accuracy Statement: 10%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10).*

*Collection Methods*

For high-priority roadway segments, site-specific statistical sampling using short term counting is recommended.  For low-priority roadway segments, pedestrian volume adjustment factors based on statistical short-term counting can be applied.

*Concerns with Collection Methods*

- Inadequate duration and frequency of data collection.

## 161. Left/Right Turn Prohibitions

*Description*

Definition: Signed left or right turn prohibitions on this approach.

Attributes:

- No left turns permitted at any time.

- No left turn permitted during certain portions of the day.

- No right turns permitted at any time.

- No right turns permitted during certain portions of the day.

- No right or left turns permitted at any time.

- No right or left turns permitted during certain portions of the day.

- No U-turns.

 Figure 39 provides an example of no turns permitted during certain portions of the day.



**Figure 39. No left turn permitted during certain portions of the day *(30).***

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Georgia DOT HPMS Inventory Manual: http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_DataCollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**162. Right Turn-On-Red Prohibitions**

*Description*

Definition: Prohibition of right turns-on-red (RTOR) from this approach.

Attributes:

- RTOR allowed at all times.

- RTOR prohibited at all times.

- RTOR prohibited during certain portions of the day.

See Figure 40 for examples of RTOR prohibition signs.

Accuracy Statement: 90-100%.



**All Times**                         **Certain Portions of the Day**

**Figure 40. Signs prohibiting RTOR** *(27)*.
*Google Maps™*

*Considerations*

This element only applies to approaches with signalized traffic control.  Appropriate signs must be present on the approach to use the RTOR prohibited attributes.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Georgia DOT HPMS Inventory Manual:
  http://www.dot.ga.gov/informationcenter/statistics/Documents/GDOT_HPMS_Data CollectionGuide.pdf *(17)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

## 163. Left Turn Counts/Percent

### Description

Definition: Count or estimate of average daily left turns, or percent of total approach traffic turning left.  (Note: This could also be captured for peak-periods only or by hour of day.)

Attributes:

- Count or percent.

Accuracy Statement: ± 5 - 10%.

### Considerations

None.

### Existing Resources

None.

### Collection Methods

For high-priority roadway segments, site-specific statistical sampling using short term counting is recommended.  For low-priority roadway segments, left turn adjustment factors, determined based on statistical short term counting, can be applied to AADT.

### Concerns with Collection Methods

- Inadequate duration and frequency of data collection.

## 164. Year of Left Turn Counts/Percent

### Description

Definition: Year of count or estimate of average daily left turns or percent of total approach traffic turning left.

Attributes:

- Year.

Accuracy Statement: 100%.

### Considerations

None.

### Existing Resources

None.

### Collection Methods

This element is collected in conjunction with Element 163. Left Turn Counts/Percent.

### Concerns with Collection Methods

None.

## 165. Right Turn Counts/Percent

### Description

Definition: Count or estimate of average daily right turns, or percent of total approach traffic turning right. (Note: This could also be captured for peak-periods only or by hour of day.)

Attributes:

- Count or percent.

Accuracy Statement: ± 5 - 10%.

### Considerations

### None.Existing Resources

None.

### Collection Methods

For high-priority roadway segments, site-specific statistical sampling using short term counting is recommended. For low-priority roadway segments, right turn adjustment factors, determined based on statistical short term counting, can be applied to AADT.

### Concerns with Collection Methods

- Inadequate duration and frequency of data collection.

## 166. Year of Right Turn Counts/Percent

### Description

Definition: Year of count or estimate of average daily right turns or percent of total approach traffic turning right.

Attributes:

- Year.

Accuracy Statement: 100%.

### Considerations

None.

### Existing Resources

None.

### Collection Methods

This element is collected in conjunction with Element 165 Right Turn Counts/Percent.

### Concerns with Collection Methods

None.

## 167. Transverse Rumble Strip Presence

*Description*

Definition: Presence of transverse rumble strips on approach.

Attributes:

- Yes.

- No.

See Figure 41 for one example of a transverse rumble strip.

Accuracy Statement: 90-100%.



**Figure 41. Transverse rumble strip *(31)*.**

*Considerations*

Transverse rumble strips consist of intermittent narrow, transverse areas of rough-textured, or slightly raised or depressed road surface that extend across the travel lanes to alert drivers to

unusual vehicular traffic conditions.  Through noise and vibration, they attract the attention of road users to features such as unexpected changes in alignment and conditions requiring a reduction in speed or a stop.

When the color of a transverse rumble strip used within a travel lane is not the color of the pavement, the color of the rumble strip shall be white, black, or orange.

### Existing Resources

None.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

- Ground-based imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**168. Circular Intersection – Entry Width**

*Description*

Definition: Full width of entry on this approach where it meets the inscribed circle.

Attributes:

- Feet.

See Figure 28 for additional details.

Accuracy Statement: ± 1 ft.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**169. Circular Intersection – Number of Entry lanes**

*Description*

Definition: Number of entry lanes into circular intersection on this approach, not including right turn only or auxiliary lanes.

Attributes:

- Numeric.

See Figure 42 for an illustration a one and two-lane entry lane.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.
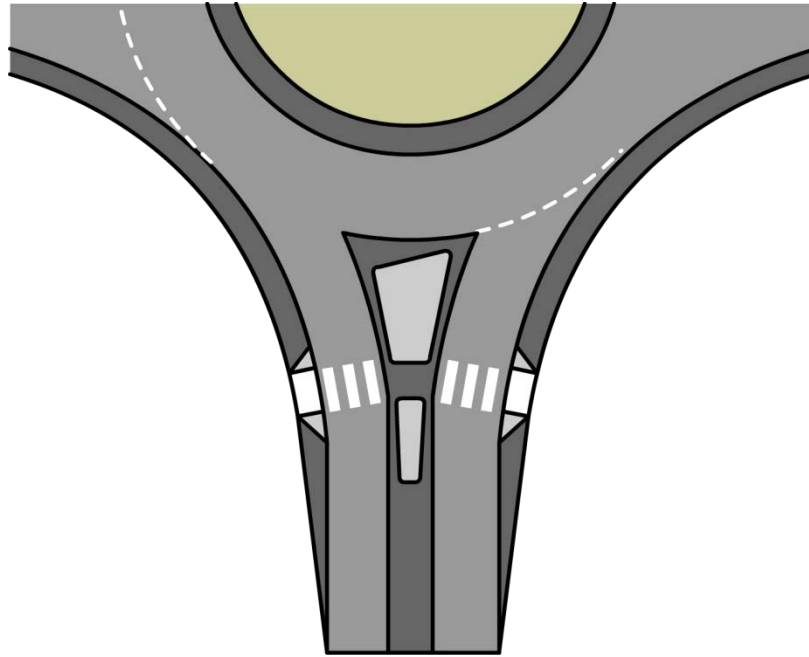
**One Lane**
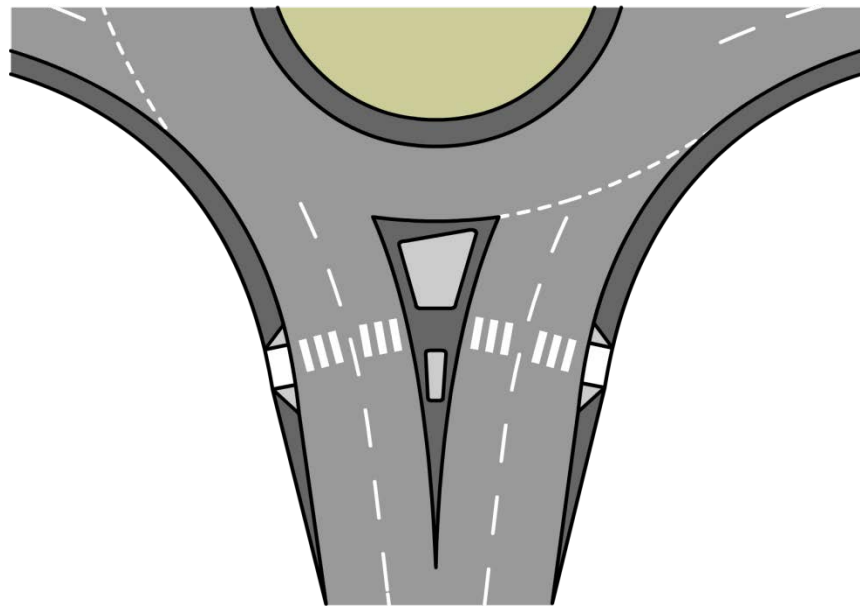


**Two Lanes**

**Figure 42. Illustration of circular intersection exit and entry lanes *(2)*.**

**170. Circular Intersection – Presence/Type of Exclusive Right Turn Lane**

*Description*

Definition: Presence and type of exclusive right turn lane(s) on this approach.

Attributes:

- None.

- Exclusive right turn bypass/slip lane with separating island.

- Exclusive right turn bypass/slip lane without separating island.

See Figure 43 for examples of exclusive right turn lane with and without a separating island.

Accuracy Statement: 90-100%.

*Considerations*

The separating island can be painted or raised.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.
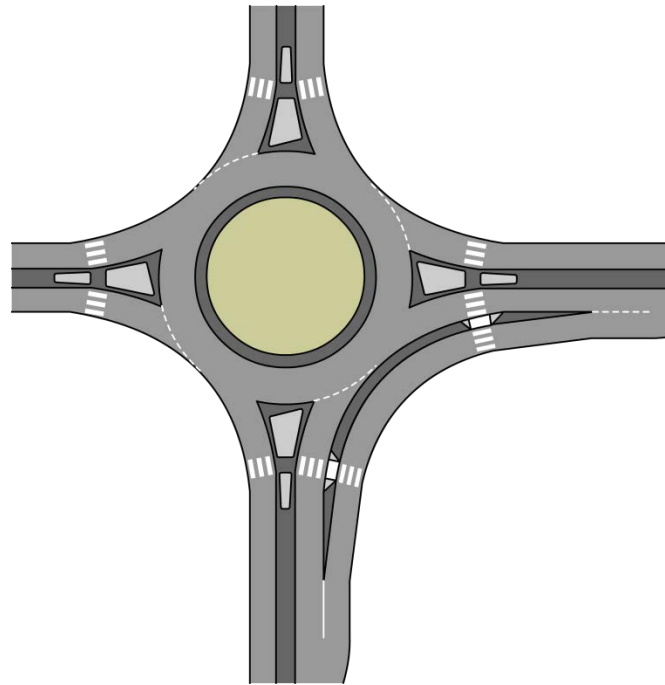
**With Island**
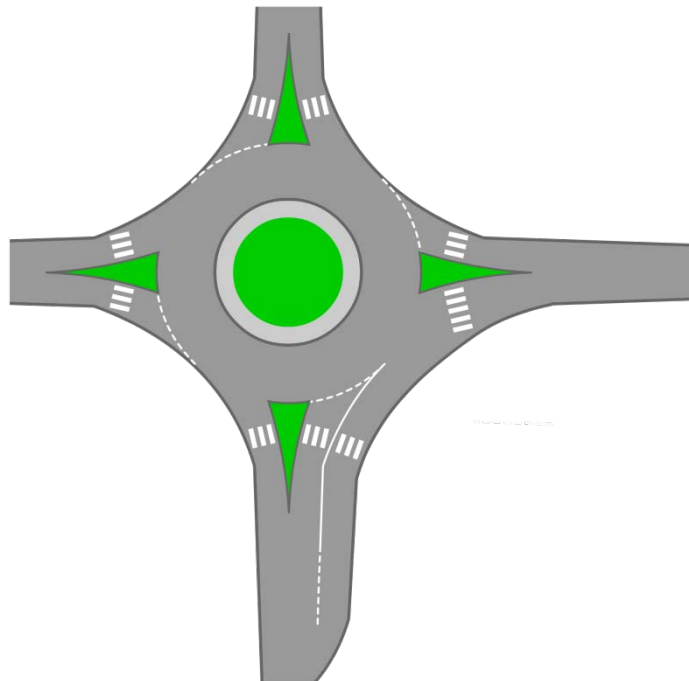


**Without Island**

**Figure 43. Illustration of circulatory intersection exclusive right turn lanes *(2)*.**

## 171. Circular Intersection – Entry Radius

*Description*

Definition: Minimum radius of curvature of the curb on the right side of the entry.

Attributes:

- Feet.

See Figure 28 for additional details.

Accuracy Statement: 0.01 - 0.001 mi or 52.8 – 5.28 ft.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 172. Circular Intersection – Exit Width

### Description

Definition: Full width of exit on this approach where it meets the inscribed circle.

Attributes:

- Feet.

See Figure 28 for additional details.

Accuracy Statement: ± 1 ft.

### Considerations

None.

### Existing Resources

None.

### Collection Methods

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

### Concerns with Collection Methods

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## 173. Circular Intersection – Number of Exit Lanes

*Description*

Definition: Number of exit lanes from roundabout on this approach leg.

Attributes:

- Numeric.

See Figure 42 for additional details.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**174. Circular Intersection – Exit Radius**

*Description*

Definition: Minimum radius of curvature of the curb on the left side of the approach, when facing the intersection.

Attributes:

- Feet.

See Figure 28 for additional details.

Accuracy Statement: 0.01 - 0.001 mi or 52.8 – 5.28 ft.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**175. Circular Intersection – Pedestrian Facility**

*Description*

Definition: Type of facility for pedestrians crossing this approach.

Attributes:

- Marked crosswalk with raised island.

- Marked crosswalk with flush island.

- Marked crosswalk with no island.

- Unmarked crosswalk with raised island.

- Unmarked crosswalk with flush island.

- Unmarked crosswalk with no island.

- Pedestrian crossing prohibited at this approach.

- Other.

Accuracy Statement: 90-100%.

*Considerations*

For more details on crosswalks see Element 157.Crosswalk Presence/Type.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**176. Circular Intersection – Crosswalk Location**

*Description*

Definition: Location of marked pedestrian crosswalk line (measured as the distance between the yield line and crosswalk markings closest to the intersection).

Attributes:

- Feet.

See Figure 28 for additional details.

Accuracy Statement: 0.01 - 0.001 mi or 52.8 – 5.28 ft.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

**177. Circular Intersection – Island Width**

*Description*

Definition: Width of raised or painted island separating entry and exit legs (measured at the inscribed circle).  If no island is present, record width as zero.

Attributes:

- Feet.

See Figure 28 for additional details.

Accuracy Statement: ± 1 ft.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

## III.B. Interchange and Ramp Descriptors

### 178. Unique Interchange Identifier

*Description*

Definition: A unique identifier for each interchange.

Attributes:

- User defined (e.g., node number, LRS of primary route, exit numbers, etc.).

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.  If this element is not available, an agency can generate a unique alpha-numeric identifier for a given interchange based on its geographical location.

*Concerns with Collection Methods*

None.

## 179. Location Identifier for Road 1 Crossing Point

### Description

Definition: Location of midpoint of interchange (e.g., crossing route) on the first intersecting route (e.g. route-milepost, spatial coordinates). Note that if the Junction File is a spatial data file, this would be the coordinates and would be the same for all crossing roads.

Attributes:

- Route and location descriptors (e.g., route and milepoint or spatial coordinates).  Must be consistent with other MIRE files for linkage.

See point A in Figure 44 for additional details.
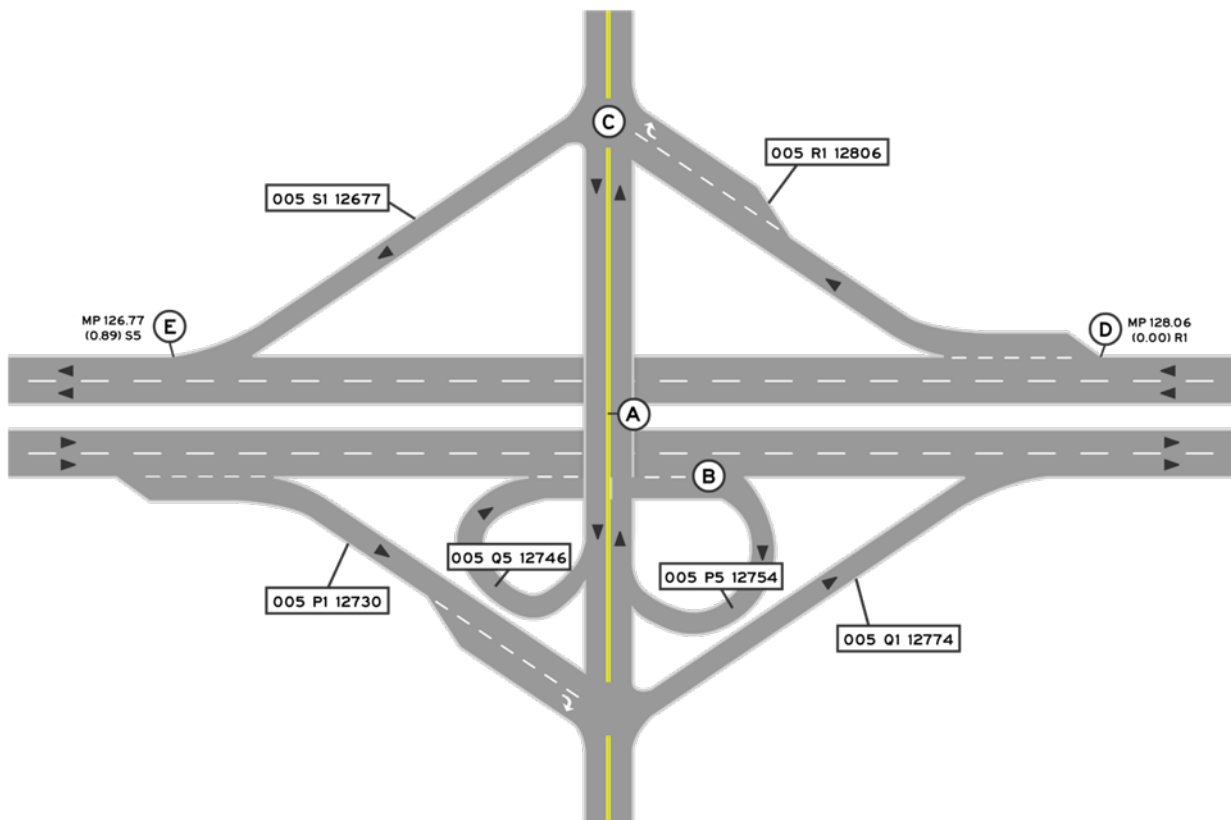


**Figure 44. Illustration of ramp descriptors *(2)*.**

Accuracy Statement: 90-100%.

### Considerations

None.

### Existing Resources

None.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

**180. Location Identifier for Road 2 Crossing Point**

*Description*

Definition: Location of midpoint of interchange (e.g., crossing route) on the second intersecting route (e.g. route-milepost).  Note that if the Interchange File is a spatial data file, this would be the same coordinates as in 179. Location Identifier For Road 1 Crossing Point, the previous element.

Attributes:

- Route and location descriptors (e.g., route and milepoint orspatial coordinates).  Must be consistent with other MIRE files for linkage.

See point A in Figure 44 for additional details.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

**181. Location Identifier for Additional Crossing Points**

*Description*

Definition: Location on the third and subsequent intersecting route (e.g. route-milepost). Note that if the Interchange File is a spatial data file, this would be the same coordinates as in Element 180 for all additional routes.

Attributes:

- Route and location descriptors (e.g., route and milepoint or spatial coordinates). Must be consistent with other MIRE files for linkage.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.

*Concerns with Collection Methods*

None.

## 182. Interchange Type

*Description*

Definition: Type of interchange.

Attributes:

- Diamond.

- Full cloverleaf.

- Partial cloverleaf.

- Trumpet.

- Three-leg directional.

- Four-leg all-directional.

- Semi-directional.

- Single entrances and/or exits (partial interchange).

- Single point interchange (SPI).

- Other (e.g., double crossover diamond, displaced left turn, diverging diamond).

See Figure 45 for additional details.

Accuracy Statement: 100%.
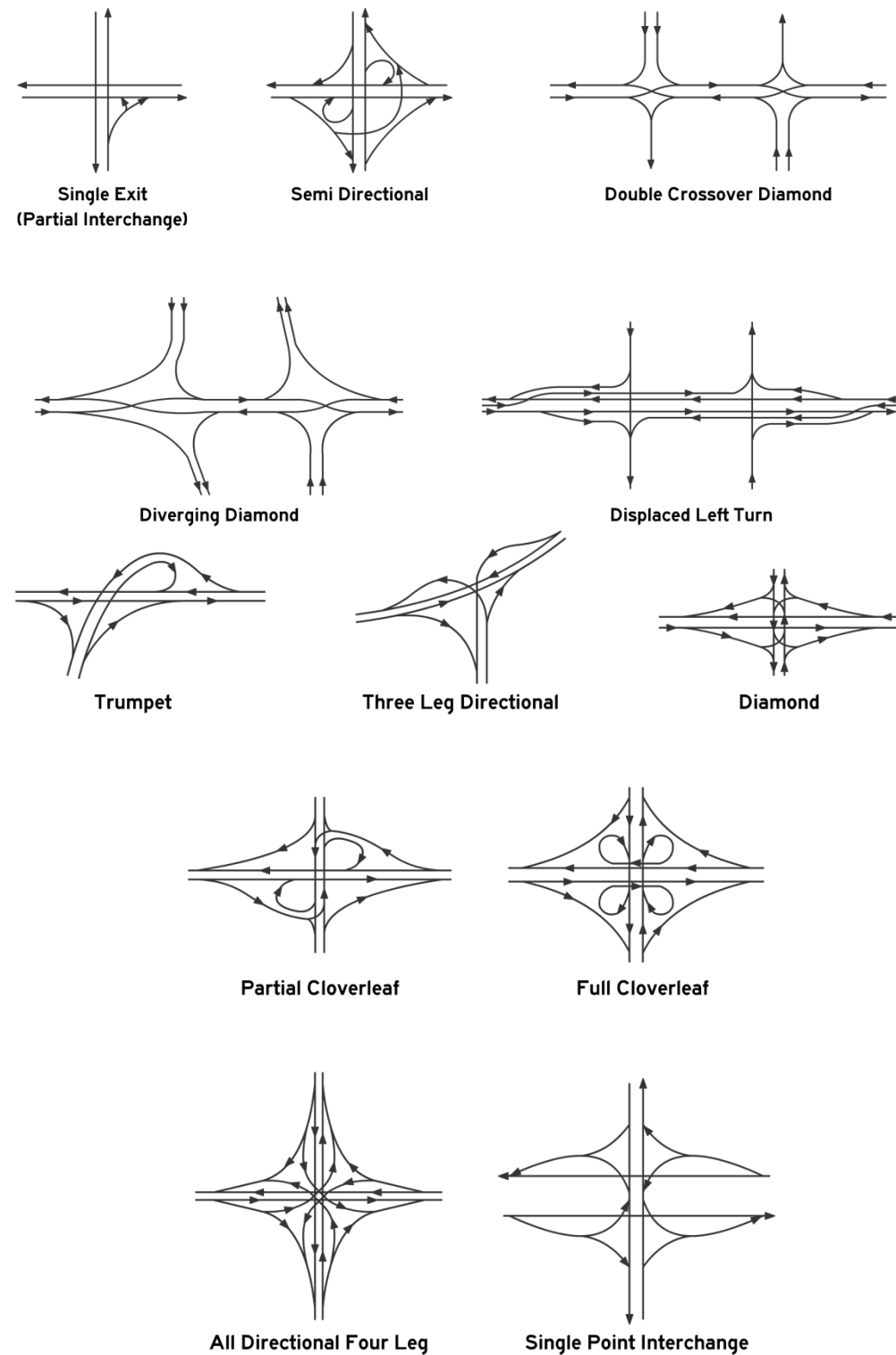
**Figure 45. Illustration of types of interchanges (2).**

## Considerations

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

- Oklahoma Road Inventory Manual:
  http://192.149.244.31/griplite/help/2010_RoadInvManual.pdf *(11)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**183. Interchange Lighting**

*Description*

Definition: Type of interchange lighting.

Attributes:

- None.

- Full interchange-area lighting (high mast).

- Full interchange-area lighting (other).

- Partial interchange lighting.

- Other.

Accuracy Statement: 90-100%.

*Considerations*

High mast full interchange-area lighting means that the entire interchange has overhead lighting. Other full interchange-area lighting means that there are multiple types of lighting for the interchange such as ground or wall lighting in enclosed roadways.

This data element can also be derived based on rules.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- The aerial data collected depends on vegetation cover.

- The data collection process for this element is labor-intensive and involves post-processing

**184. Interchange Entering Volume**

*Description*

Definition: Sum of entering volumes for all routes entering interchange.  For each entering route, this would be counted at a point prior to the first exit ramp.

Attributes:

- Average daily volume.

Accuracy Statement: ± 5 - 10%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

For high-priority roadway segments, site-specific statistical sampling using short term counting is recommended.  For low-priority roadway segments, volume adjustment factors, determined based on statistical short term counting, can be applied to AADT.

*Concerns with Collection Methods*

- Inadequate duration and frequency of data collection.

**185. Interchange Identifier for this Ramp**

*Description*

Definition: The unique numeric identifier assigned to the interchange that this ramp is part of. See Element 178. Unique Interchange Identifier above.  This provides linkage to the basic interchange information and to all other ramps.

Attributes:

- The interchange identifier entered in Element 178.  Unique Interchange Identifier.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

- The data collection process for this element requires manual intervention, significant post-processing effort, and QA/QC.

## 186. Unique Ramp Identifier

*Description*

Definition: An identifier for each ramp that is part of a given interchange.  This defines which ramp the following elements are describing.

Attributes:

- Alphanumeric (e.g., each set of interchange ramps could begin with "1" or "A", each ramp could be indentified by it's route and exit number, etc.).

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

There is no additional collection needed for this element as this information is already available with an agency for roadways under its jurisdiction.  If this element is not available, an agency can generate a unique alpha-numeric identifier for a given ramp based on its geographical location.

*Concerns with Collection Methods*

None.

## 187. Ramp Length

### Description

Definition: Length of ramp.  In the case of ramp connecting to an at-grade intersection, this would be measured from painted nose of gore to intersection curb line.  In the case of ramp connecting to another ramp or a freeway, this would be measured from painted nose of gore to painted nose of gore.

Attributes:

- Feet.

See Figure 46 for additional details.

Accuracy Statement: 0.01 - 0.001 mi or 52.8 – 5.28 ft.
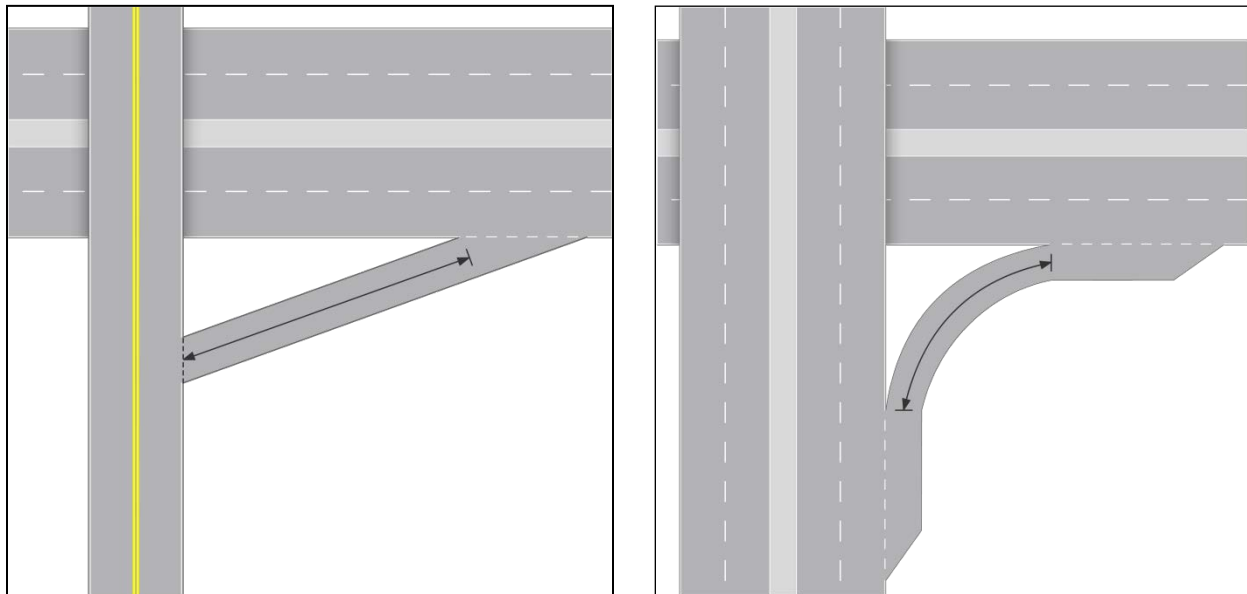


**Figure 46. Illustration of ramp length for freeway and intersection ramp connections (2).**

### Considerations

This is an FDE for roads with AADT ≥ 400 vpd.

A gore is defined as the area downstream from the intersection of the shoulders of the main line and exit ramp. The painted nose refers to the point where the main line and ramp lanes separate.

### Existing Resources

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**188. Ramp Acceleration Lane Length**

*Description*

Definition: Length of acceleration lane, not including taper.  For tapered ramps, this would be measured from point of tangency of the last ramp curve to the point where the ramp lane width becomes less than 12 feet.  For parallel ramps, this would be measured from nose of painted gore to beginning of taper.

Attributes:

- Feet.

See Figure 47 for additional details.

Accuracy Statement: 0.01 - 0.001 mi or 52.8 – 5.28 ft.
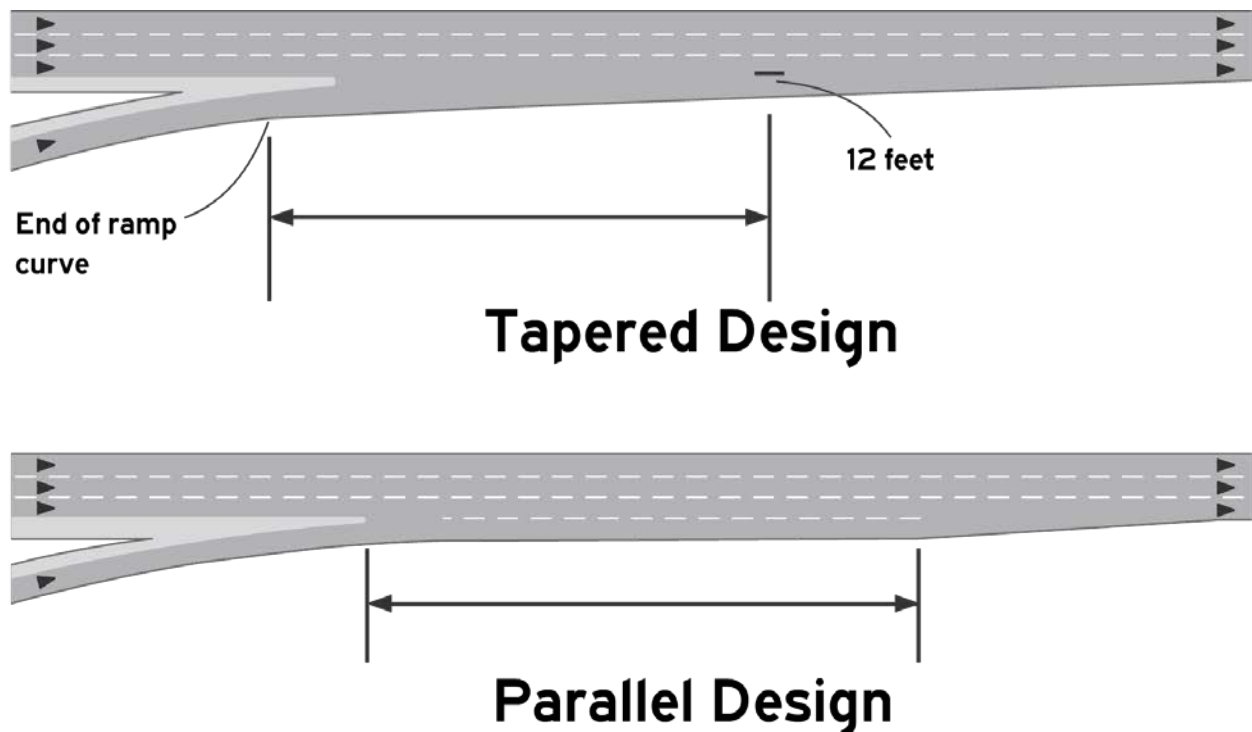


**Figure 47. Illustration of acceleration lane length for tapered and parallel designs (2).**

*Considerations*

Note that this element is for on-ramps only.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

### 189. Ramp Deceleration Lane Length

*Description*

Definition: Length of deceleration lane, not including taper.  For tapered ramps, this would be measured from the point where the ramp lane width becomes 12 feet to the point of curvature of the initial ramp curve.  For parallel ramps, this would be measured from end of taper to nose of painted gore.

Attributes:

- Feet.

See Figure 48 for additional details.

Accuracy Statement: 0.01 - 0.001 mi or 52.8 – 5.28 ft.



12 feet

Beginning of ramp curve

## Tapered Design
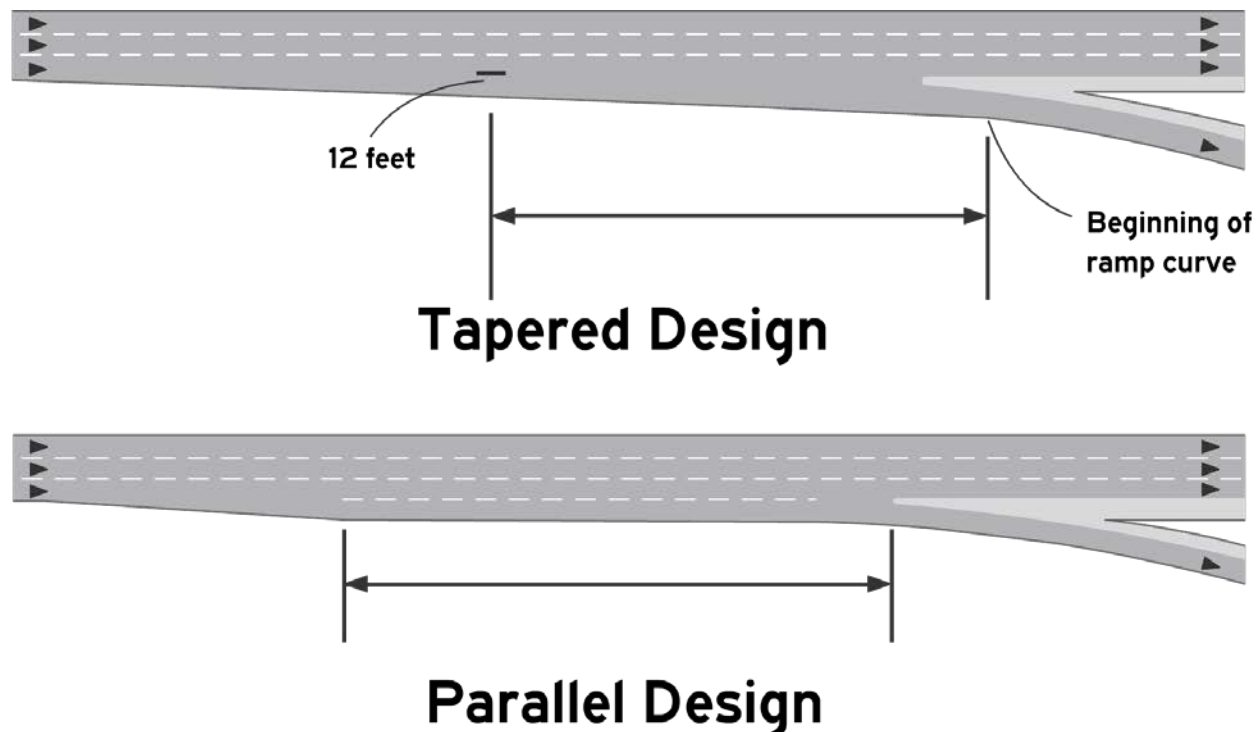
## Parallel Design

**Figure 48. Illustration of deceleration lane length for tapered and parallel designs (2).**

*Considerations*

Note that this element is for off-ramps only.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**190. Ramp Number of Lanes**

*Description*

Definition: Maximum number of lanes on ramp.

Attributes:

- Numeric.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

**191. Ramp AADT**

*Description*

Definition: AADT on ramp.

Attributes:

- Numeric.

Accuracy Statement: ± 5 - 10%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

Refer to Element 79. Annual Average Daily Traffic (AADT) for AADT definition.

*Existing Resources*

Established data collection methodologies can be found at:

National:

- Traffic Monitoring Guide: http://www.fhwa.dot.gov/ohim/tmguide/index.htm *(10)*.

*Collection Methods*

Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on collection methods. Ramp volume adjustment factors, determined based on statistical short term counting, can be applied to AADT.

*Concerns with Collection Methods*

Refer to Element 79. Annual Average Daily Traffic (AADT) for more information on concerns with collection methods.

## 192. Year of Ramp AADT

*Description*

Definition: Year of AADT on ramp.

Attributes:

- Year.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

None.

*Collection Methods*

This element is collected in conjunction with Element 191. Ramp AADT.

*Concerns with Collection Methods*

None.

**193. Ramp Metering**

*Description*

Definition: The presence and type of any metering of traffic entering mainline.

Attributes:

- Pretimed.

- Traffic actuated.

- No metering.

- Not applicable (i.e., ramp does not feed into mainline).

 See Figure 49 for additional details.

Accuracy Statement: 90-100%.



**Figure 49. Presence of ramp metering *(27)*.**
*Google Maps™*

*Considerations*

The presence of ramp metering can be determined with ground-based imagery.  If metering is present a sign with an amber signal will be posted at the ramp entrance to prevent traffic acceleration.  A red and green (or red, yellow, and green) signal located near the mainline will control the traffic flow during times of mainline congestion.  The signal is regulated by a timer (pretimed) or by the presence of traffic (traffic actuated).  This difference is not noticeable in imagery so another source is required to determine these attributes.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**194. Ramp Advisory Speed Limit**

*Description*

Definition: The advisory speed limit on the ramp.

Attributes:

- Numeric.

- No advisory limit (i.e., limit will be the same as on the connecting roadways).

See Figure 50 for additional details.

Accuracy Statement: 90-100%.



**Figure 50. Ramp advisory speed limit signs *(14)*.**

*Considerations*

Advisory speed limit signs are yellow in color and are labeled "RAMP" or "EXIT" above the speed limit number.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**195. Roadway Type at Beginning Ramp Terminal**

*Description*

Definition: A ramp is described by a beginning and ending ramp terminal in the direction of ramp traffic flow or the direction of inventory.  This element describes the type of roadway intersecting with the ramp at the beginning terminal.

Attributes:

- Freeway.

- Non-freeway (surface street).

- Other Ramp.

- Frontage road.

- Other.

See Figure 44 for additional details.  For point B, Ramp 005 P5 12754, Roadway Type at Beginning Ramp Terminal = Freeway.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook: http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.
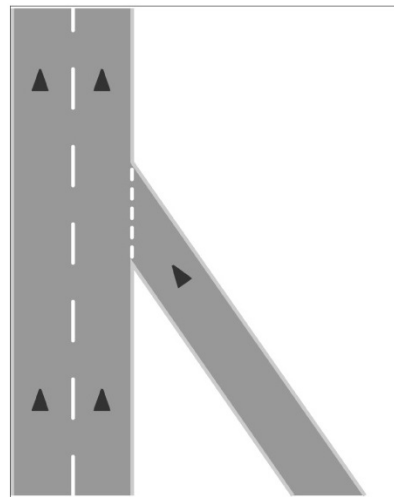
*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:
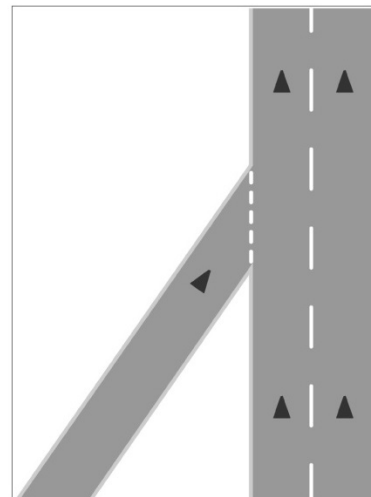
- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

## 196. Roadway Feature at Beginning Ramp Terminal

*Description*

Definition: The feature found at the beginning terminal of the ramp.

Attributes:

- Acceleration Lane.
- Deceleration Lane.
- Weaving lane (e.g., the weaving area joining two ramps under an overpass in a cloverleaf interchange).
- Signalized intersection.
- Stop/yield controlled intersection.
- Uncontrolled intersection.
- Another ramp.
- Other.

See Figure 44 for additional details.  For point B, Ramp 005 P5 12754, Roadway Feature at Beginning Ramp Terminal = Weaving Lane.

Accuracy Statement: 90-100%.

*Considerations*

For descriptions of acceleration or deceleration lane see Element 188. Ramp Acceleration Lane Length or Element 189.Ramp Deceleration Lane Length, respectively.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

**197. Location Identifier for Roadway at Beginning Ramp Terminal**

*Description*

Definition: Location on the roadway at the beginning ramp terminal (e.g. route-milepost for that roadway) if the ramp connects with a roadway at that point.

Attributes:

- Route and location descriptors (e.g., route and milepoint or spatial coordinates) for the roadway intersected at the beginning ramp terminal.  Must be consistent with other MIRE files for linkage.

See Figure 44 for additional details.  Point D has a Location Identifier for Roadway at Beginning Ramp Terminal = Route 005 MP 128.06.

Accuracy Statement: 100%.

*Considerations*

None.

*Existing Resources*

This is an FDE for roads with AADT ≥ 400 vpd.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.
- The data collection process for this element requires manual intervention, significant post-processing effort, and QA/QC.

**198. Location of Beginning Ramp Terminal Relative to Mainline Flow**

*Description*

Definition: Ramps can intersect with the traffic flow of a divided or undivided roadway on either of two sides. This defines the side of the roadway flow intersected by the ramp.

Attributes:

- Right side with respect to mainline traffic flow at intersecting point.

- Left side with respect to mainline traffic flow at intersection point.

- Ramp does not intersect mainline at this point (e.g., ramp intersects another ramp).

See Figure 51 for additional details.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

Right side with respect
to mainline traffic flow at
intersecting point

Left side with respect to
mainline traffic flow at
intersecting point

Ramp does not intersect mainline at
this point (e.g., ramp intersects another
ramp)
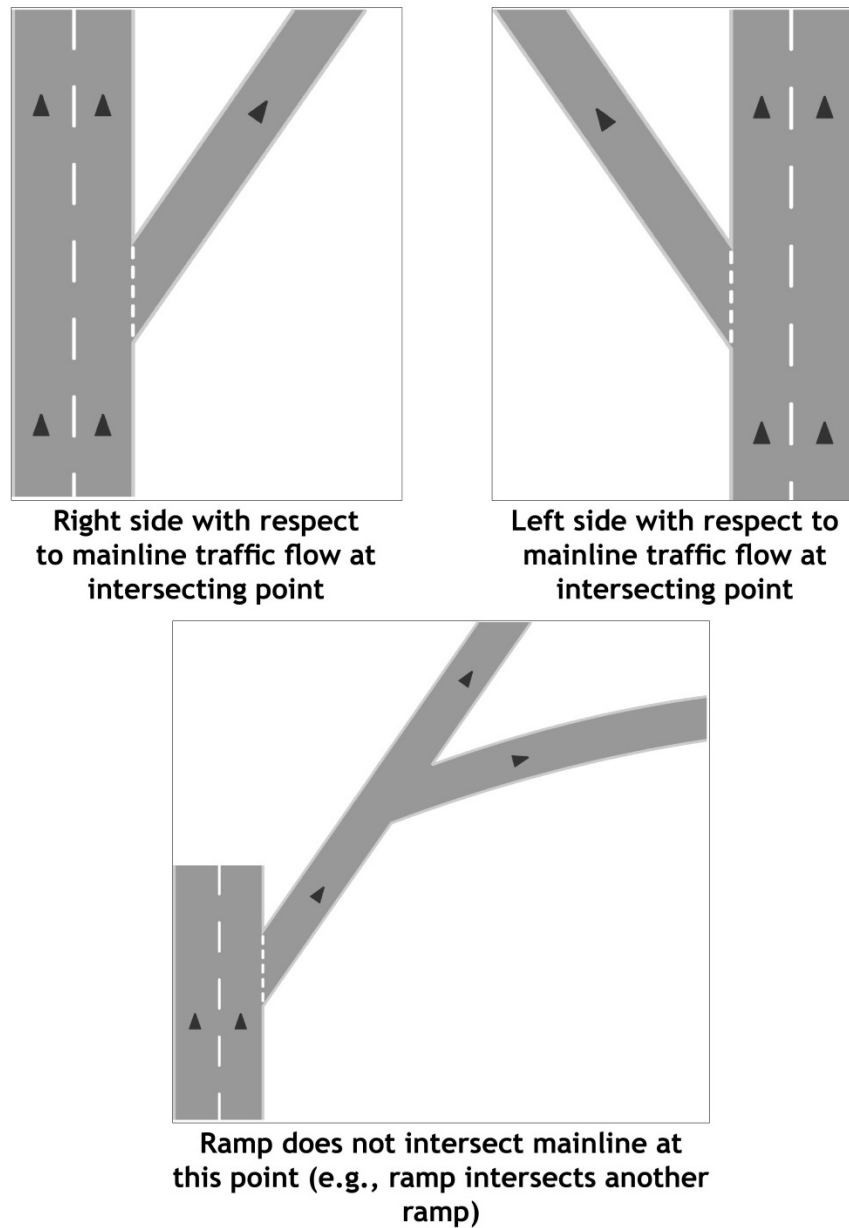
**Figure 51. Illustration of locations of beginning ramp terminal relative to mainline flow *(2)*.**

**199. Roadway Type at Ending Ramp Terminal**

*Description*

Definition: A ramp is described by a beginning and ending ramp terminal in the direction of inventory.  This element describes the type of roadway intersecting with the ramp at the ending terminal.

Attributes:

- Freeway.

- Non-freeway (surface street).

- Other Ramp.

- Frontage road.

- Other.

See Figure 44 for additional details.  For point C, Ramp 005 R1 12806, Roadway Type at Ending Ramp Terminal = Non-freeway.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

Established data collection methodologies can be found at:

State:

- Florida Roadway Characteristic Inventory Field Handbook:
  http://www.dot.state.fl.us/planning/statistics/rci/fieldhandbook/fullrpt.pdf *(13)*.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

**200. Roadway Feature at Ending Ramp Terminal**

*Description*

Definition: The feature found at the ending terminal of the ramp.

Attributes:

- Acceleration Lane.

- Deceleration Lane.

- Weaving lane (e.g., the weaving area joining two ramps under an overpass in a cloverleaf interchange).

- Signalized intersection.

- Stop/yield controlled intersection.

- Uncontrolled intersection.

- Another ramp.

- Other.

See Figure 44 for additional details.  For point C, Ramp 005 R1 12806, Roadway Feature at Ending Ramp Terminal = Signalized Intersection.

Accuracy Statement: 90-100%.

*Considerations*

For descriptions of acceleration or deceleration lane see Element 188.  Ramp Acceleration Lane Length or Element 189.Ramp Deceleration Lane Length , respectively.

*Existing Resources*

None

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Ground-based imagery.

- Terrestrial LiDAR.

*Concerns with Collection Methods*

- Timeliness of the ground-based imagery.

- Inadequate image capture and poor resolution.

**201. Location Identifier for Roadway at Ending Ramp Terminal**

*Description*

Definition: Location on the roadway at the ending ramp terminal (e.g. route-milepost for that roadway) if the ramp connects with a roadway at that point.

Attributes:

- Route and location descriptors (e.g., route and milepoint or spatial coordinates) for the roadway intersected at the ending ramp terminal. Must be consistent with other MIRE files for linkage.

See Figure 44 for additional details.  Point E has a Location Identifier for Roadway at Ending Ramp Terminal = Route 005 MP 126.77.

Accuracy Statement: 100%.

*Considerations*

This is an FDE for roads with AADT ≥ 400 vpd.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.
- Aerial imagery in conjunction with ground-based imagery.
- Terrestrial LiDAR.
- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.
- Inadequate image capture and poor resolution.

**202. Location of Ending Ramp Terminal Relative to Mainline Flow**

*Description*

Definition: Ramps can intersect with the traffic flow of a divided or undivided roadway on either of two sides. This defines the side of the roadway flow intersected by the ramp.

Attributes:

- Right side with respect to mainline traffic flow at intersecting point.

- Left side with respect to mainline traffic flow at intersection point.

- Ramp does not intersect mainline at this point (e.g., ramp intersects another ramp).

See for Figure 52 for additional details.

Accuracy Statement: 90-100%.

*Considerations*

None.

*Existing Resources*

None.

*Collection Methods*

Resources for collecting this data element in the order of increasing accuracy are as follows:

- Aerial imagery.

- Aerial imagery in conjunction with ground-based imagery.

- Terrestrial LiDAR.

- Airborne LiDAR with imagery.

*Concerns with Collection Methods*

- Timeliness of the aerial and ground-based imagery.

- Inadequate image capture and poor resolution.

Right side with respect
to mainline traffic flow at
intersecting point

Left side with respect to
mainline traffic flow at
intersecting point
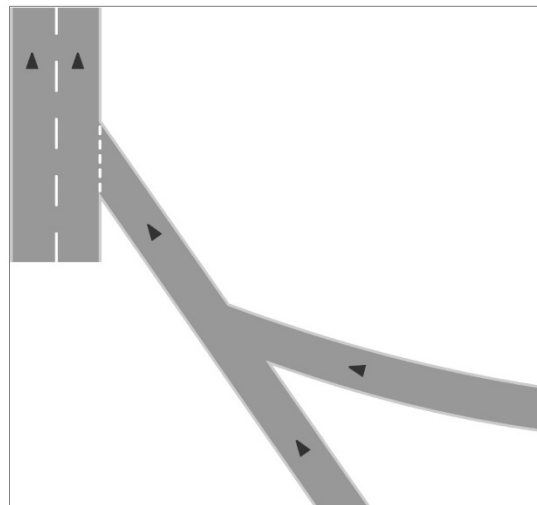
Ramp does not intersect mainline at
this point (e.g., ramp intersects another
ramp)

**Figure 52. Illustration of locations of ending ramp terminal relative to mainline flow (2).**

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