Intersection and Junction Fatalities in the Context of Access Management

By

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Introduction and Background

The impetus for this paper three sets of intersection fatality statistics for the same year collected from George E. (Ed) Rice, Jr., Federal Highway Administration (FHWA), Office of Safety, Kenneth Kobetsky, American Association of State Highway and Transportation Officials (AASHTO); and Edward Stollof, Institute of Transportation Engineers (ITE), for a presentation at a Transportation Research Board meeting in January 2008.

A more appropriate definition of targeted intersection-related crash types for safety improvements and comparisons by the transportation engineering and safety professions and organizations would help provide consistent, useful analyses for measuring, planning and coordinating safety efforts, especially when using fatality numbers from the same resources, in particular, the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) database. It is critical to understand and investigate the differences and source of differences in various numbers used and developed by each respective organization and staff. The outcome should be an agreement for a common set of elements that comprise what are being reported as intersection fatalities and, in a larger context, junction fatalities.

It appears that the difference in the "intersection fatality" statistics is the way access-related fatalities are reported with respect to junctions. This is a very important concept from a nomenclature standpoint. The word, "intersections" has been used generically and perhaps myopically by various organizations assessing safety status and progress with respect to this location-type classification of fatalities.

As this paper will demonstrate, there are upstream, downstream and proximity effects that have both access relationships and other relationships to junctions. The safety community needs to track annually not only intersection and intersection-related fatalities, but all-junction related fatalities, more comprehensively, at a subunit level, including access-related fatalities, interchange and highway-rail fatalities.

Objectives of Paper

The following are the objectives of this paper:

(1) Provide NHTSA 's General Estimating System (GES) and National Automotive Sampling System (NASS) definitions, coding processes and component elements of junction fatalities,

(2) Provide a review of the literature including how various organizations interpret the context in which intersection fatalities occur,

(3) Present an historical 10-year data review of the components of junction fatalities to answer the question: Have we increased or reduced junction fatalities in the United States over the past 10 years?

(4) Provide recommendations to achieve consistency in the reporting of junction, intersection and access fatalities.

Definitions

Definitions of an Intersection

AASHTO defines intersection as the general area where two or more roadways join or cross and is defined by both its functional and its physical areas. The functional area of an intersection extends both upstream and downstream from the physical intersection area and includes an auxiliary lanes and their associated channelization.[1] AASHTO specifically states that driveways should not be situated within the functional area of an intersection or in the influence area of an adjacent driveway.

The following are the standard elements of an intersection adopted by the GES, NASS, and other federal entities such as FHWA/the *Manual on Uniform Traffic Control Devices* [MUTCD], and the Uniform Vehicle Code.

1. *The area embraced within the prolongation or connection of the lateral curb lines, or, if none, then the lateral boundary lines of the roadways of two highways which join one another at, or approximately at, right angles, or the area within which vehicles traveling upon different highways joining at any other angle may come in conflict.*[2]

2. *The junction of an alley or driveway with a roadway or highway shall not constitute an intersection*[3].
3. *Where a highway includes two roadways (30) feet or more apart, then every crossing of each roadway of such divided highway by an intersecting highway shall be regarded as a separate intersection. In the event such intersecting highway also includes two roadways (30) feet or more apart, then every crossing of two roadways of such highways shall be regarded as a separate intersection.*[4]

The Arizona Department of Transportation (ADOT) and Maricopa Association of Governments (MAG) use a similar definition. They developed a technical memorandum that includes a table of common definitions and figures. **Figure 1** below shows the concept of what is included within the boundaries of an intersection according to the three criteria listed above.[5]

The GES and NASS definitions of an intersection are essentially the same definition as the Uniform Vehicle Code and MUTCD definitions. These definitions come from the definition of an intersection from the standpoint of enforcement of right-of-way and conflict. When states develop their own vehicle codes and their concomitant driver manuals there are answers to questions such as: To whom do we yield the right-of-way to when we are making a left turn within an intersection and an opposing vehicle is going through? When two people arrive at a junction at the same time, who has the right of way (or who can proceed first)?

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[1]A Policy on Geometric Design of Highways and Streets Fourth Edition, Washington, DC, USA: American Association of State Highway and Transportation Officials (AASHTO), 20011, Pages 559-560.
[2]Uniform Vehicle Code, Chapter 1-146(a); MUTCD, Section 1A, 13, No. 39);
[3](Uniform Vehicle Code, Chapter 1-146(c), MUTCD, Section 1A, 13, No. 39 (b))
[4](Uniform Vehicle Code, Chapter 1-146(b)
[5]Regional Transportation Safety Information Management System. (RTSIMS) Phase I Technical Memorandum No.4 Table of Common Definitions. Prepared by Lee Engineering, LLC the Maricopa Association of Governments

At this time, NHTSA combines what are commonly thought of as intersection fatalities and intersection-related fatalities into one reporting element called intersection fatalities. The NHTSA definition of an intersection fatality is as follows: "A crash is intersection-related if the first harmful event (FHE) occurs within the limits of an intersection or at an approach to or exit from an intersection only within a non-interchange area.

The first element of this definition is that the FHE must occur within the limits of an intersection. Who establishes these limits? Are limits not different for every geometric configuration and every location? Don't the limits of an intersection change when curb parking is restricted from streets during peak hours? The second element of this definition is that the FHE must occur at an approach to or exit from an intersection *only within a non-interchange area*. This element of the definition of intersection-related implies that the fatality can occur either upstream or downstream of the intersection (the shaded area in **Figure 1**). The one stated exclusion to the definition is that the fatality will not be reported if it occurs within an interchange area. Also, there is no statement regarding the extent to which access-related fatalities will be reported, if at all.

Figure 2 provides an illustration of two intersections in close proximity to each other. The shaded areas are the intersection component of the junction area.

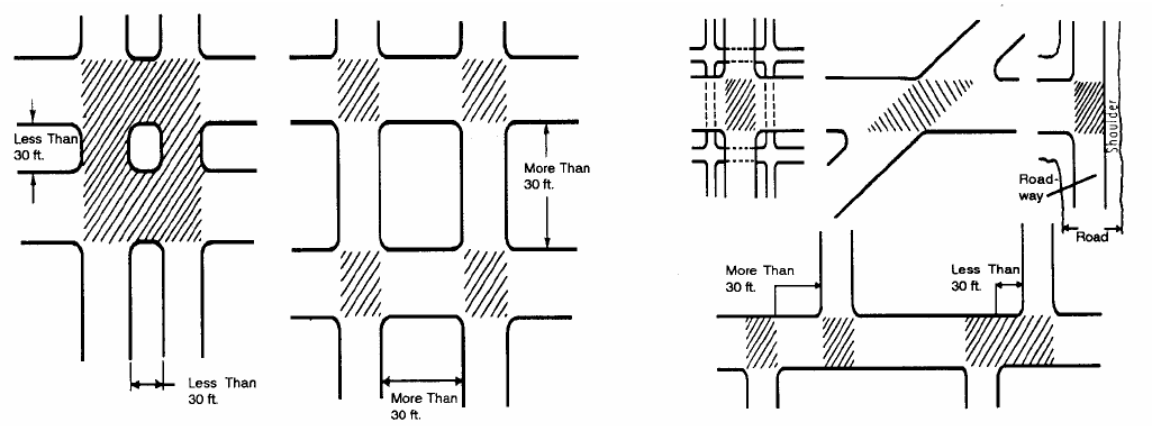

Figure 1: Definition of an Intersection

Figure courtesy of Maricopa Association of Governments, contained in Regional Transportation Safety Information Management System, Phase I Technical Memorandum No.4 Table of Common Definitions

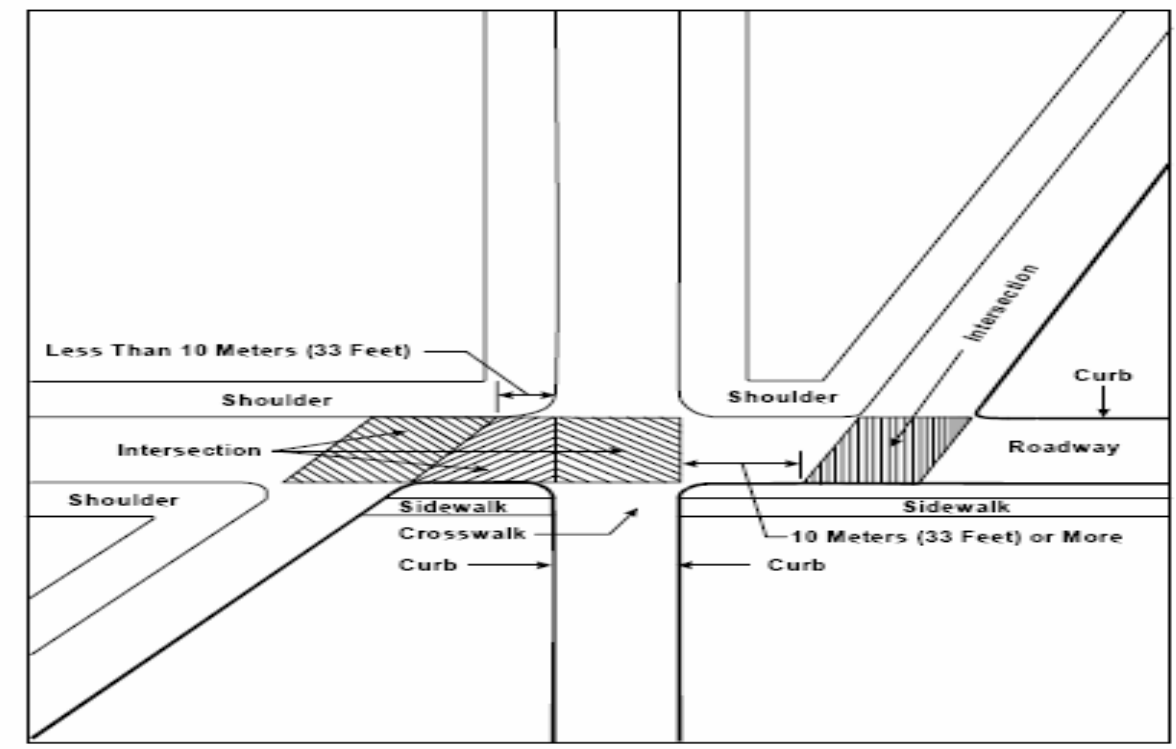

Figure 2: Intersection Area (Two intersections in close proximity)
Figure, Courtesy of Joe Bared, Power Point, Fatal Crashes. June 2008.

ANSI D16.1-1996 Manual on Classification of Motor Vehicle Traffic Accidents, Sixth Edition.

Definitions of Intersection-Related

The GES and the Model Minimum Uniform Traffic Control Criteria (MMUCC) Guidelines defines intersection-related to mean the FHE that (1) occurs on an approach to or exit from an intersection, and (2) results from an activity, behavior or control related to the movement of traffic units through the intersection. **Intersection-related** is entered on the police accident report (PAR) if the FHE occurs outside but near an intersection and involves a vehicle that was engaged or should have been engaged in making an intersection related maneuver. Many of the representative states included in a review of the literature have included a distance (radius) criteria from the center point of an intersection from at 50-feet (ft.), 100-ft., 250-ft., and 500-ft.

Intersection-Related Definition: Location of the crash next to an intersection and results from an action related to the movement of traffic units through the intersection.

For Intersection-Related definitions, the following studies were reviewed:

1. Desai conducted a study of fatal intersection crashes in the state of Florida. This study identified fatal intersection crashes based on two primary criteria. First, all the crashes that had the following site location codes were filtered out and identified as potential fatal intersection crashes: "At Intersection," "Influenced by an Intersection," and "Driveway Access."

   Driveways were included in the set of intersection crashes because many of the attributes (e.g. conflict points) and countermeasures would be very similar. In fact, many of the "driveway" crashes involved commercial business access points that are channelized, stop sign controlled, and indistinguishable from standard intersections between public roads. However, it was noted that there were numerous inconsistencies in definitions and coding used by different officers. Examples include differentiating between driveways and intersections, determining what crashes are influenced by an intersection, and distinguishing between an exit/entrance ramp and an intersection, for instance when a crash occurs at a signalized intersection at the end of an exit ramp. For this reason, a second criterion used was based on the proximity of the crash to a known intersection. A 100 feet radius was used for the proximity check.[6]

2. For the Rhode Island Department of Transportation's *2007 Five Percent Report*, crashes that occurred within 50-ft. of two intersecting links within the geographic information system (GIS)layers were then grouped and assigned to the corresponding intersection. Crashes that occurred outside of the 50-feet of

[6]Desai, Abhijeet H. "A Qualitative Study Of Fatal Intersection Crashes In The State Of Florida." Master's thesis submitted to the Department of Civil Engineering, Florida State University Famu-Fsu College of Engineering, 2005.

intersecting links were considered crashes occurring along a corridor and were eliminated from further consideration.[7]

3. Maryland's Department of Transportation *Five Percent Report* states that determining the number of intersection-related accidents on state-designated highways for each of the 23 counties starts with those accidents having been coded as being intersection-related by the investigating police officer. The route designations used in this selection have the prefixes of MD, US and IS. This count of intersections does not include driveway intersections, interchanges, or ramp merges on fully controlled access highways. [8]

4. Within the Indiana Department of Transportation's *2007 Five Percent Repor*t, a *road intersection is a portion of roads within the intersection impact zone. For the purpose of assigning crashes to particular locations, Indiana identifies the intersection impact zone as a circle around the intersection center with radius 250 ft. If the impact zones of adjacent intersections overlap then the midpoint between the intersections determines their impact zones boundaries*. [9]

5. The Utah Department of Transportation (UDOT) defines an intersection as *a crossing or meeting of two or more roads, at grade; an intersection may be controlled by a traffic signal, stop signs or yield signs, or it may be uncontrolled. The UDOT team developed an influence distance of 500 ft for the study. This distance corresponded to approach speeds of 40 miles per hour (mph). The 500-ft distance overestimates the influence area for intersections with approach speed limits less than 40 mph, and underestimates that for intersections with approach speeds greater than 40 mph. One impact of overstating an intersection's functional area may be to overestimate the number of crashes occurring at that intersection.*[10]

6. ADOT and the MAG have developed a consensus-based definition of Intersection-Related as follows:

   Intersection-Related: A traffic accident where the first harmful event (1) occurs on an approach to, movement through, or exit from an intersection (2) has resulted from an activity, behavior, or control related to the intersection.
   It was found in the workshop that ADOT traffic records staff does not just accept the "intersection-related" box being checked by the investigating officer, but rather looks at other crash factors to determine if it is entered into the ADOT crash database as intersection-related. Based on the information provided on the quality control measures used by ADOT in determining whether a crash is "intersection-related", the workshop participants agreed that "intersection-

[7] "Road Island 2007 Five Percent Report."
[8] "Maryland 2007 Five Percent Report."

[9] Tarko, Andrew P.., Purdue University, Steckler, Brad, Indiana Department of Transportation, et. al, for the Indiana Department of Transportation, Indiana 2007 Five Report, West Lafayette, Indiana, October 11, 2007.

[10] Cottrell, Ph.D., P.E., Wayne D. and Sichun Mu. **"**Utah Intersection Safety - Recurrent Crash Sites: Identification, Issues and Factors," Section 1.4, Definition of an Intersection. Master's thesis, Department of Civil and Environmental Engineering, University of Utah, December 2005.

related" crashes will be those identified based on the "intersection-related" variable in ADOT Crash Database. A distance-based threshold will not be required for this purpose. [11]

7. **Prior to the ADOT/MAG Consensus-based definition for intersection – related the following distance thresholds were used for identifying "intersection-related" crashes:**

    - ADOT. 250ft. (Provides data requesters with accidents within 250 ft. from the center of the intersection assuming that they will be closely examined for relationship to the intersection during analysis)
    - City of Chandler, AZ. 200 ft. (with exclusions)
    - Maricopa County, AZ. 100 ft. (for planning purposes. Traffic engineering may use a different threshold.)
    - City of Mesa, AZ. All Crashes except Crashes on Exiting Legs Crashes on the exiting legs of intersections are not included. Use "intersection-related" variable in Arizona Traffic Accident Report form and ALISS.
    - City of Phoenix, AZ. 150 ft.
    - City of Tempe, AZ. 200 ft.
    - City of Glendale, AZ. 200 ft. The City will still use intersection-related" variable in Arizona Traffic Accident Report form.
    - City of Scottsdale, AZ. 100 ft. Distance measured from the curb line extensions. [12]

What Do Safety Professionals Want to Show?

At the scene of the fatality crash, the police officers have a complex job of determining first, whether a crash is a junction or non-junction crash, and second, if a junction crash, whether the crash is to be considered an intersection crash.

Consider **Figure 3** from the *Washington State Police Traffic Collision Report Instruction Manual*. As an example, if a fatality occurred 100 ft. north of an intersection at a commercial driveway entrance, an officer could code as crash as a driveway crash. The officer could also code the crash as an intersection-related crash. However, from the definitions above, if the crash occurred along the approaches to the driveway, the officer would be required to code the crash as a driveway fatality and not as an intersection-related fatality.

In another example, suppose the driveway was located directly across from a median and one of the vehicles in the crash was located in the median. It is not inconceivable that the officer could use GES *crossover* relationship to junction code. The GES/state traffic record coders now must interpret the field data, graphics and explanations from the police officers notes. There is an order of precedence set within the GES/NASS coding system, but how often is that precedence understood by field traffic officers? How is set of complicated information communicated to the traffic officer on the street?

[11] RTSIMS.
[12] RTSIMS.

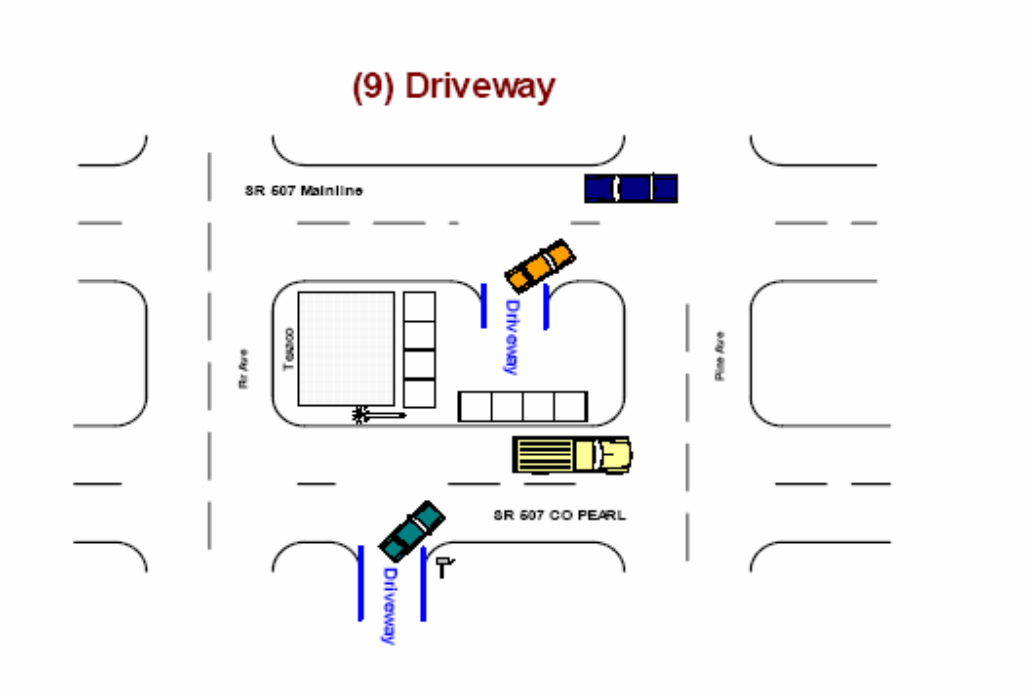

Figure 3: Seventh Edition, Revised 7/06. Source: Manual on Classification of Motor Vehicle Traffic Accidents Sixth Edition (ANSI D16.1-1996) National Safety Council.
http://www.wsp.wa.gov/reports/pctrmanl.pdf

We as the transportation safety professionals will ultimately decide how and what data variables are reported upon. As will be shown in the intersection and junction statistics over the past 10 years, there is an increase in the access-related fatalities and a leveling off in intersection fatalities. Does this mean the United States is decreasing in intersection fatalities, or are various types of traffic fatalities being miscoded or perhaps misclassified?

Within the geographic area of an intersection, there are a number of additional elements that are important for consideration. These additional elements are divided into three groups: junction elements, access elements, and other elements. Definitions for each set of elements will be provided below. Definitions are extracted from the:

- *Model Minimum Uniform Traffic Control Criteria (2003),* Element C-16
- *General Estimating System Coding and Editing Manual 2006. NHTSA. Variable A09, Relationship to Junction,*

- *ANSI D-16 (2003.* **ANSI-16, Manual On Classification of Motor Vehicle Traffic Accidents**, provides a common language for collectors and users of traffic crash data. The purpose of **ANSI D-20, Data Element Dictionary for Traffic Records Systems,** is to provide a common set of element coding instructions as these relate to traffic safety, driver licensing and vehicle registration.

Figure 4 provides a summary of the *General Estimating System Coding and Editing Manual (2006)* Relationship to Junction coding nomenclature. Relationship to Junction is defined as the location of the crash in relation to an interchange area junction, non-interchange junction or a driveway junction.

A09 RELATION TO JUNCTION (SPECIFIC LOCATION)

Screen Heading: Crash Data Questions

Screen Name: Relation To Junction (155-R)

Long Name: Select the attribute which describes the location of the first harmful event.

SAS Name: Accident.Rel_Jct

Oracle Name: GES.CrashData.JunctionRelID

Element Values:

Non-Interchange Area

Screen	Oracle	SAS	
1	26542	0	Non-Junction
2	26543	1	Intersection
3	26544	2	Intersection Related
4	26545	3	Driveway, Alley Access, Etc
5	26546	4	Entrance/Exit Ramp
6	26547	5	Rail Grade Crossing
7	26548	6	On A Bridge
8	19435	7	Crossover Related
9	26549	8	Other, Non-Interchange
10	26550	9	Unknown, Non-Interchange

Interchange Area

1	26551	10	Non-Junction
2	26552	11	Intersection
3	26553	12	Intersection Related
4	26554	13	Driveway, Alley Access, Etc.
5	26555	14	Entrance/Exit Ramp
6	26556	16	On A Bridge
7	19436	17	Crossover Related
8	26557	18	Other Location in Interchange
9	26558	19	Unknown, Interchange Area

Figure 4 GES Relationship to Junction

Junction Elements

Junction[13]

A junction, in general, is the area formed by the connection of two roadways. It includes: (1) all at-grade intersections; (2) connections between a driveway access or alley access and a roadway

[13] General Estimating System Coding and Editing Manual 2004. NHTSA. Variable A09, Relationship to Junction. Definitions from this section used throughout this paper.

that is not a driveway access or an alley access, (3) connections between two alley accesses or driveway accesses or (4) a connection between a driveway access and an alley access.

Unchannelized At-Grade Junctions[14]

At unchannelized at-grade junctions, the junction area is within twenty (20) feet beyond the crosswalk (whether marked or unmarked), a stop-line marking, a STOP sign or YIELD sign, whichever is farthest from the intersection. Whenever these limits are not present, projections of the boundaries of the traffic way can be used. The ***unshaded*** area in **Figure 5** shows the junction area around an at-grade intersection.

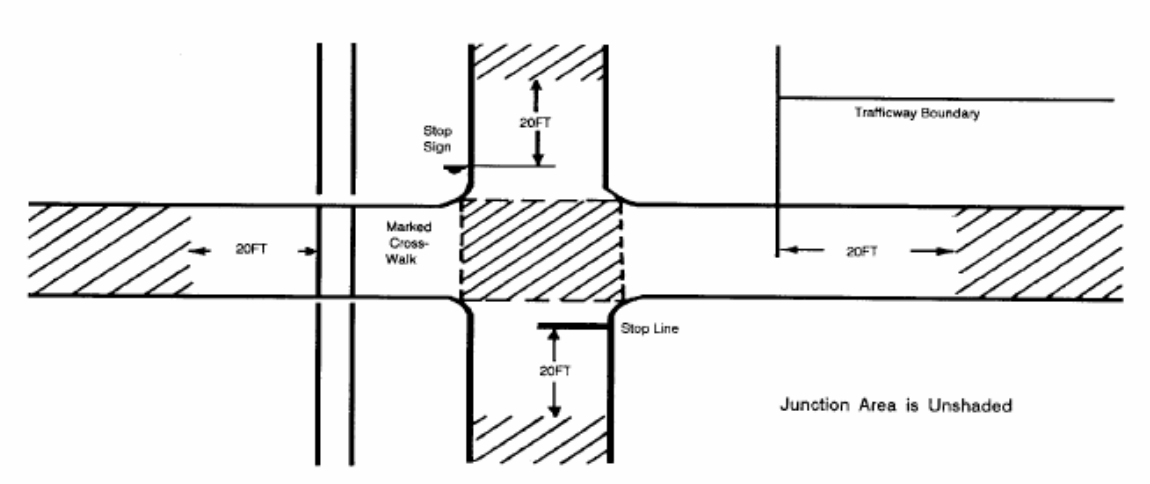

Figure 5: Unchannelized At-Grade Junction

Channelized Junctions[15]

At channelized junctions, the junction area is within twenty (20) feet beyond the gore of islands, or the point at which the turn lane attains full width. The *unshaded* area in **Figure 6** shows the junction area with respect to channelized at-grade junctions.

[14] RTSIMS.
[15] RTSIMS.

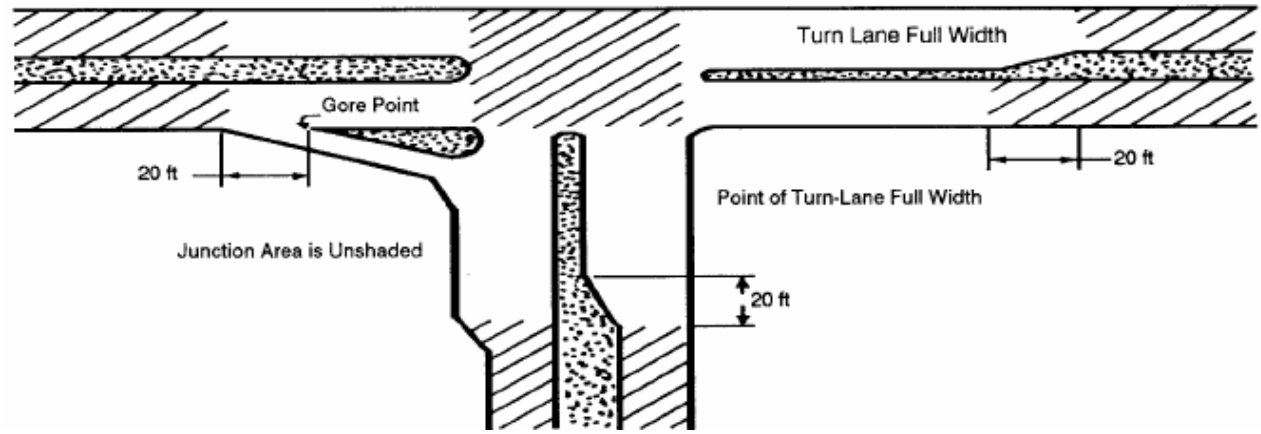

Figure 6: Channelized Junction

Other, non-interchange is a GES/NASS code for the FHE occurring: (1) while going into, within or coming out of a channel or (2) on a traffic island (when the police accident report indicates the vehicle entered or struck the island from within the channel). A channel refers to any traffic lane that is directed into a path different than the through lanes by a traffic island. An island is defined as a raised or painted paved surface. The channel begins and ends at the extension of the island's lateral boundaries unless the channel is preceded or followed by a merge area or divergence. Figure 7 shows examples from the 2004 General Estimating System Coding and Editing Manual. A channelized intersection is an at-grade intersection in which traffic is diverted into definite paths by raised or painted traffic islands.[16] The MMUCC definition indicates that the Other, Non-interchange definition *"includes crossings for bikes, snowmobiles, school, etc."*

[16] General Estimating System Coding and Editing Manual 2004. NHTSA. Variable A09, Relationship to Junction, Non-Interchange vs. Interchange. Page 56.

Figure A-10: Channel

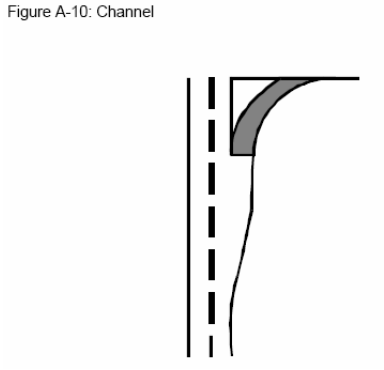

Figure A-11: Channel

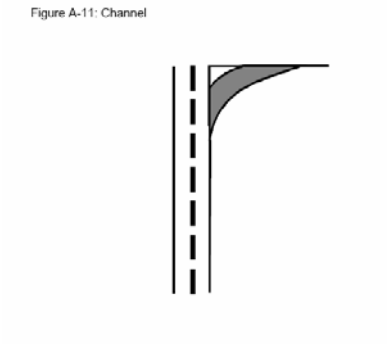

Figure A-12: Channel

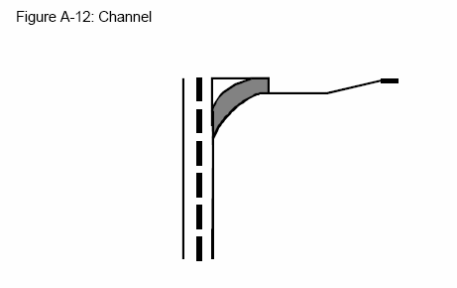

Figure A-13: Channel

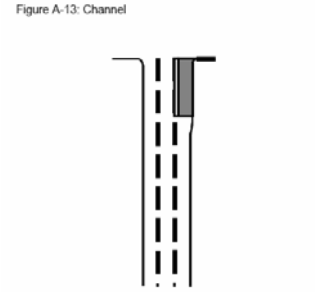

Figure 7 (Actual Figures A-10 to A-13, *GES Coding Manual*)
Examples of Non-Interchange, Channelized Intersection Paths

Access Elements

Alley Access
An Alley Access is generally an unnamed roadway providing access, in general, to the rear of houses or buildings, some of which may be further served by a driveway access.[17]

Driveway / Alley – Figure 8 provides an illustration of a driveway. *A roadway providing access to property adjacent to a traffic-way. Accident reports are coded with driveway, alley access when the FHE occurs on approaches or exits from the driveway or alley access junction when a road vehicle enters or exiting from the driveway or alley. Included are exits/entrances of parking lots. The GES/NASS coding manual indicates that the subunit classifications (driveway, alley access, entrance or exit ramp or rail grade crossing) takes precedence even if an intersection crash meets the criteria of intersection related (e.g. must have been entering or exiting the appropriate area.)*

Driveway access-related. *The crash results from an activity, behavior or control related to the movement of traffic units to or from the driveway access or alley.*[18] *A similar definition includes: "The first harmful event occurs on the trafficway, not on the driveway access portion of the trafficway."* [19]

Entrance or Exit Ramp
An entrance or exit ramp is a transition roadway: (1) which connects two roadways; (2) is used for entering or exiting through- traffic lanes; and (3) begins and ends at a gore or curb return. A ramp can connect two roadways which cross (either at-grade or with a grade separation) or two which do not cross (e.g., frontage roads). A ramp can form a channeled intersection. A ramp can also split into two ramps.[20]

Crossover
Crash located in the area of the median of a divided trafficway where motor vehicles are permitted to cross the opposing lanes of traffic or do a U-turn.[21]

[17] General Estimating System Coding and Editing Manual 2006. NHTSA. Variable A09, Relationship to Junction, Non-Interchange vs. Interchange. Page 62.
[18] ANSI D-16 (2003)
[19] Model Minimum Uniform Traffic Control Criteria (2003)
[20] ANSI D-16 (2003)
[21] Model Minimum Uniform Traffic Control Criteria (2003)

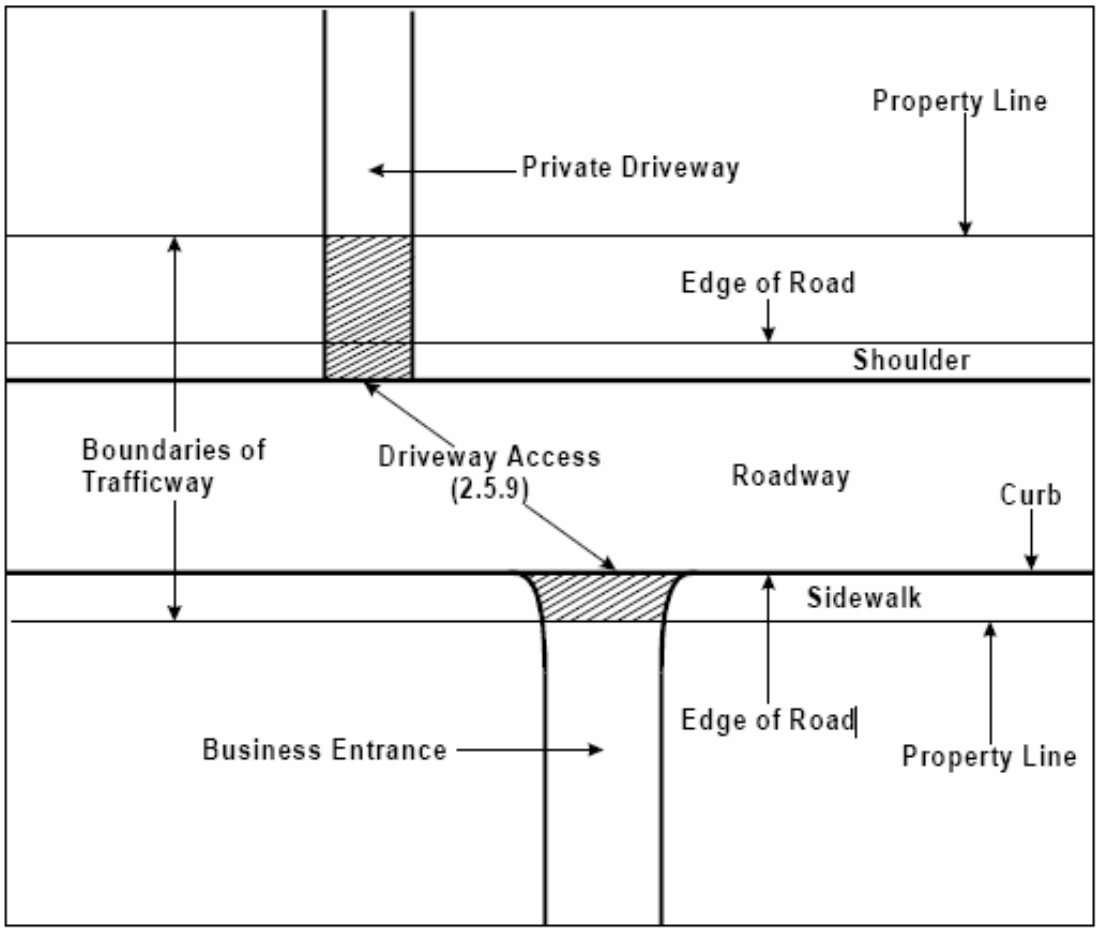

Figure 8: Driveway Access
Source: Figure Courtesy of Joe Bared, Power Point, Fatal Crashes. June 2008.

Other Elements

Interchange Area

Figure 9 shows a schematic diagram of an interchange area. An interchange is a system of interconnecting roadways in conjunction with one or more grade separations, providing for the movement of traffic between two or more roadways on different levels.[22] The interchange area is the area around a grade separation that involves at least two trafficways. Included within its boundaries are: (1) all ramps that connect the roadways and (2) each roadway entering or leaving the interchange to a point 30 meters beyond the gore or curb

[22] Model Minimum Uniform Traffic Control Criteria (2003)

return at the outermost ramp connection for the roadway. One may find included within an interchange area intersections, driveway accesses, and, of course, roadway sections that are non-junctions.[23]

Other Parts of an Interchange

This subunit refers to crashes where the FHE occurs within the boundaries of the interchange in an area other than those covered by the other interchange attributes. This would include crashes that occur in the median, roadside, gore, and off-roadway locations that are not intersection or ramp- related.[24]

Thru Roadway at Interchange

A crash would have this code when it is in an interchange area and it does NOT occur: 1) On an Entrance/Exit ramp; or 2) In an intersection or related to an intersection or other junction.

Interchange Junction

At an interchange, the junction area is within 100 ft. beyond the farthest gore or curb return of the turning roads in each direction. The painted or reflectorized separation or barrier lines are not considered as gores for this purpose.

Rail Grade Crossing

An intersection between a roadway and train tracks which cross each other at the same level (Grade).[25]

[23] General Estimating System Coding and Editing Manual 2006. NHTSA. Variable A09, Relationship to Junction, Non-Interchange vs. Interchange. Page 62.
[24] Model Minimum Uniform Traffic Control Criteria (2003)
[25] ANSI D-16 (2003)

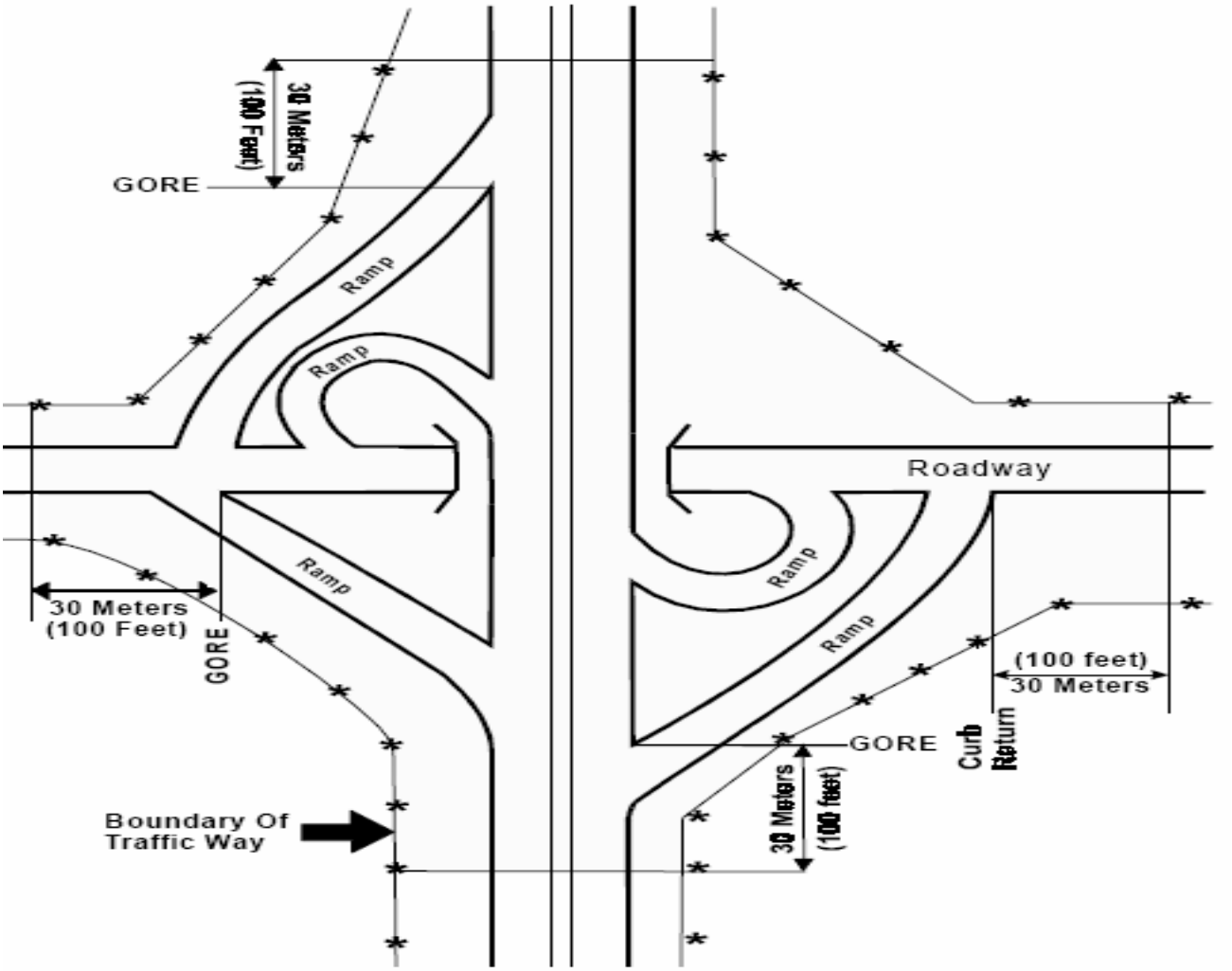

Figure 9: Example of Interchange Area,
Figure Courtesy of Joe Bared, Power Point, Fatal Crashes. June 2008.

HISTORICAL REVIEW OF JUNCTION FATALITIES STATISTICS IN THE UNITED STATES

Review and Analysis of FARS Database

Table 1 illustrates the number of junction fatalities between 1997 and 2006. This table is inclusive of each junction component in the GES and NASS. Table 1 does not include interchanges and rail grade crossings. For the purposes of nomenclature, they can be called "Other Junction Fatalities".

Table 2 collapses two columns from Table 1: the DW (driveways column) and the DW-REL (driveway-related column) to DWS (driveways). Another column is entitled, "OTHER ACCESS." This column includes "Entrance and Exit Ramp" and "Crossover Fatalities."

Table 3 is further simplified. It is entitled "Number of Junction Fatalities, 1997 – 2006. This table includes a column for Intersection/Intersection-Related Fatalities, a column for Access Fatalities (which includes all Driveway fatalities from Table 2 plus all "Other Access" Fatalities and Unknown Intersection Fatalities. The question needs to be raised: Is Table 3, with the columns for Intersection/Intersection-Related Fatalities and Access Fatalities, if explained appropriately understandable for presentation and adaptable for inclusion in the NHTSA annual *Traffic Safety Facts* publication?

Table 1: Elements of Junction Fatalities I: 1997 to 2006

	INT	INT REL	DW	ENT/EX	XO	DW-REL	INT UNK	Total
1997	7,826	1,267	560	192	41	-	103	9,989
1998	7,872	1,368	596	183	41	-	44	10,104
1999	7,605	1,319	645	219	68	-	72	9,928
2000	7,356	1,333	526	203	45	-	56	9,519
2001	7,400	1,522	559	237	41	-	60	9,819
2002	7,526	1,747	590	201	83	-	78	10,225
2003	7,568	1,794	470	118	43	474	74	10,541
2004	7,667	1,509	501	140	59	508	67	10,451
2005	7,656	1,582	539	151	46	527	33	10,534
2006	7,361	1,436	484	204	38	591	23	10,137

INT = Intersection, INT-REL = Intersection-Related, DW = Driveway, ENT/EX = Entrance or Exit Ramp, XO = Crossover, DW-REL = Driveway-Related, INT-UNK = Intersection Unknown

Table 2: Elements of Junction Fatalities II: 1997 to 2006

	INT/INT REL	DWYS	OTHER ACCESS	INT UNK	TOTAL
1997	9,093	560	233	103	9,989
1998	9,240	596	224	44	10,104
1999	8,924	645	287	72	9,928
2000	8,689	526	248	56	9,519
2001	8,922	559	278	60	9,819
2002	9,273	590	284	78	10,225
2003	9,362	944	161	74	10,541
2004	9,176	1,009	199	67	10,451
2005	9,238	1,066	197	33	10,534
2006	8,797	1,075	242	23	10,137

Table 3: Number of Junction Fatalities 1997 to 2006

	INT/INT REL	**ACCESS**	**INT UNK**	**TOTAL**
1997	9,093	793	103	9,989
1998	9,240	820	44	10,104
1999	8,924	932	72	9,928
2000	8,689	774	56	9,519
2001	8,922	837	60	9,819
2002	9,273	874	78	10,225
2003	9,362	1,105	74	10,541
2004	9,176	1,208	67	10,451
2005	9,238	1,263	33	10,534
2006	8,797	1,317	23	10,137

What Have We Just Accomplished?

For the purposes of the NHTSA annual *Traffic Safety Facts* Reports:

- The intersection and intersection-related subunits have been combined to form one category, Intersection. These intersection fatalities meet the pure definition of the GES/NASS and other organizations discussed in this paper. However, access fatalities are proximal to intersections and should be reported together with the pure intersection fatality counts.

- An "Access Fatality" subunit of Intersection Fatalities has been developed. The following junction fatalities have been subsumed under this major category:
    - Driveways (DW)
    - Other Non-Interchange, Driveway-Related (DR-REL)
    - Entrance/Exit Ramps (ENT/EX)
    - Crossovers (XO)

- There are a small number of Intersection Unknown fatalities. It is recommended that Intersection Unknown fatalities become a subunit of Intersection fatalities.

- The above three categories, Intersections (in the purist sense of the word), Access Fatalities and Unknown Intersection Fatalities would compromise what this author suggests as reporting as Total Intersection Influence Area Fatalities. Access Fatalities can and do have a significant influence on the fatalities that occur in the vicinity of intersection in the United States and should be accounted for on the context of the intersection environment.

- Under "Other Junction Fatalities," Interchange and Rail-Grade Crossing fatalities should be reported separately.

Analysis and Reporting

Total Junction Fatalities

Table 4 summarizes junction fatalities between 1997 and 2006 for each element. Total junction fatalities range from a low of 11,436 to a high of 12,028. This represents a difference of 592 fatalities. In 1997 there were 11, 670 fatalities and in 2006, the end of the analysis period, there were 11,509 fatalities. This represents a decrease of 161 fatalities or 1.4 percent over the 10 year period in terms of total junction fatalities.

Table 4: Junction Fatalities 1997 to 2006

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Intersection Fatalities	9,093	9,240	8,924	8,689	8,922	9,273	9,362	9,176	9,238	8,797
Access Fatalities	793	820	932	774	837	874	1,105	1,208	1,263	1,317
Intersection Unknown Fatalities	103	44	72	56	60	78	74	67	33	23
Total Intersection Influence Area Fatalities	9,989	10,104	9,928	9,519	9,819	10,225	10,541	10,451	10,534	10,137
Interchange Fatalities	1,282	1,197	1,404	1,584	1,313	1,386	1,226	1,230	1,180	1,083
Rail-Grade Crossing Fatalities	399	356	332	333	342	307	261	270	259	289
Total Other Junction Fatalities	1,681	1,553	1,736	1,917	1,655	1,693	1,487	1,500	1,439	1,372
Total Junction Fatalities	11,670	11,657	11,664	11,436	11,474	11,918	12,028	11,951	11,973	11,509
Total US Traffic Fatalities	42,013	41,501	41,717	41,945	42,196	43,005	42,884	42,836	43,510	42,642
% Total Junction Fatalities/US Fatalities	27.8%	28.1%	28.0%	27.3%	27.2%	27.7%	28.0%	27.9%	27.5%	27.0%
% Total Intersection only Fatalities/US Fatalities	21.6%	22.3%	21.4%	20.7%	21.1%	21.6%	21.8%	21.4%	21.2%	20.6%
% Total Intersection (larger definition including access) Fatalities/US Fatalities	23.8%	24.3%	23.8%	22.7%	23.3%	23.8%	24.6%	24.4%	24.2%	23.8%

Intersection Fatalities

As shown in **Table 4** and in Figure 10**,** between 1997 and 2006 the minimum and maximum number of intersection fatalities was 8,689 and 9,362. The difference between this range is 673 fatalities. The average number of intersection fatalities for the 1997-2006 10-year period is 9,071. As shown, there is a 3.2 percent reduction (296 fatalities) in intersection fatalities between 1997 and 2006 (9,093 to 8,797).

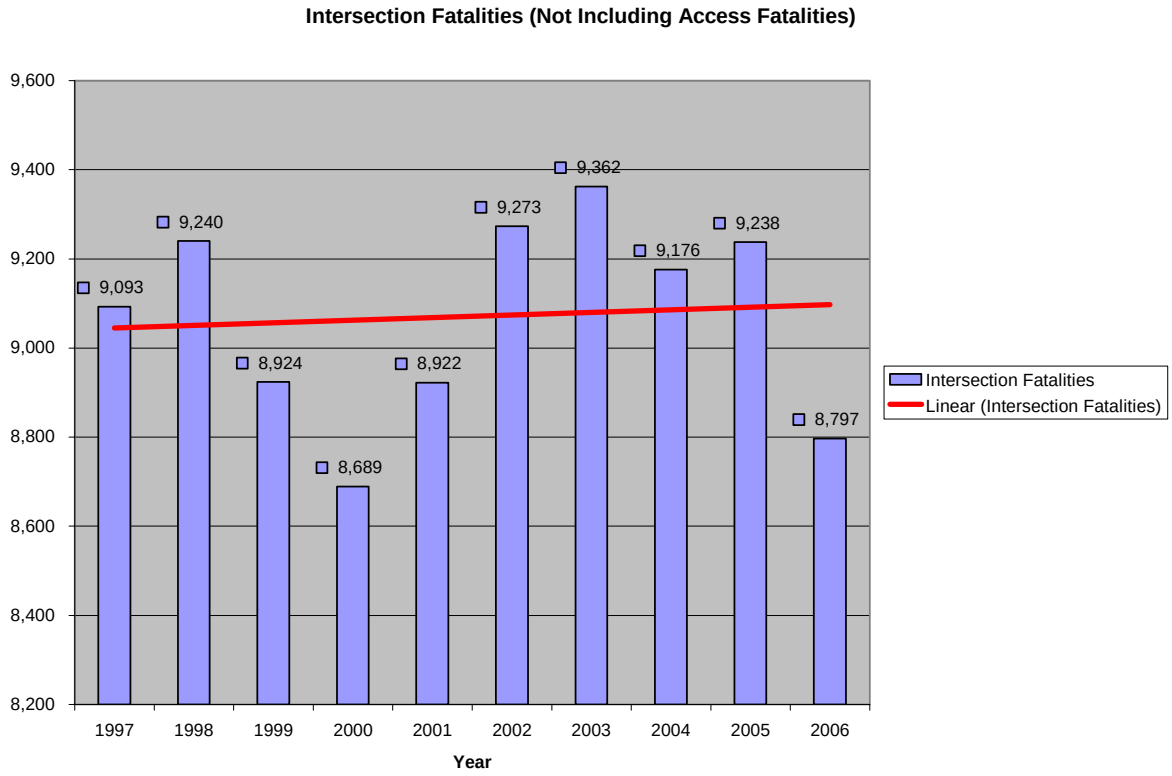

Figure 10: Intersection Fatalities (Not Including Access Fatalities) 1997 to 2006

Access Fatalities

As shown in **Table 4** and in **Figure 11**, Access Fatalities increase approximately 66 percent (521 fatalities) from 793 to 1,317 between 1997 and 2006. For 2006, if Access fatalities are included as part of the total Intersection Fatalities computation, they comprise 13 percent of the total. Clearly, there appears to be a trend of a slight decrease in real intersection fatalities and a significant increase in vicinal intersection Access Fatalities.

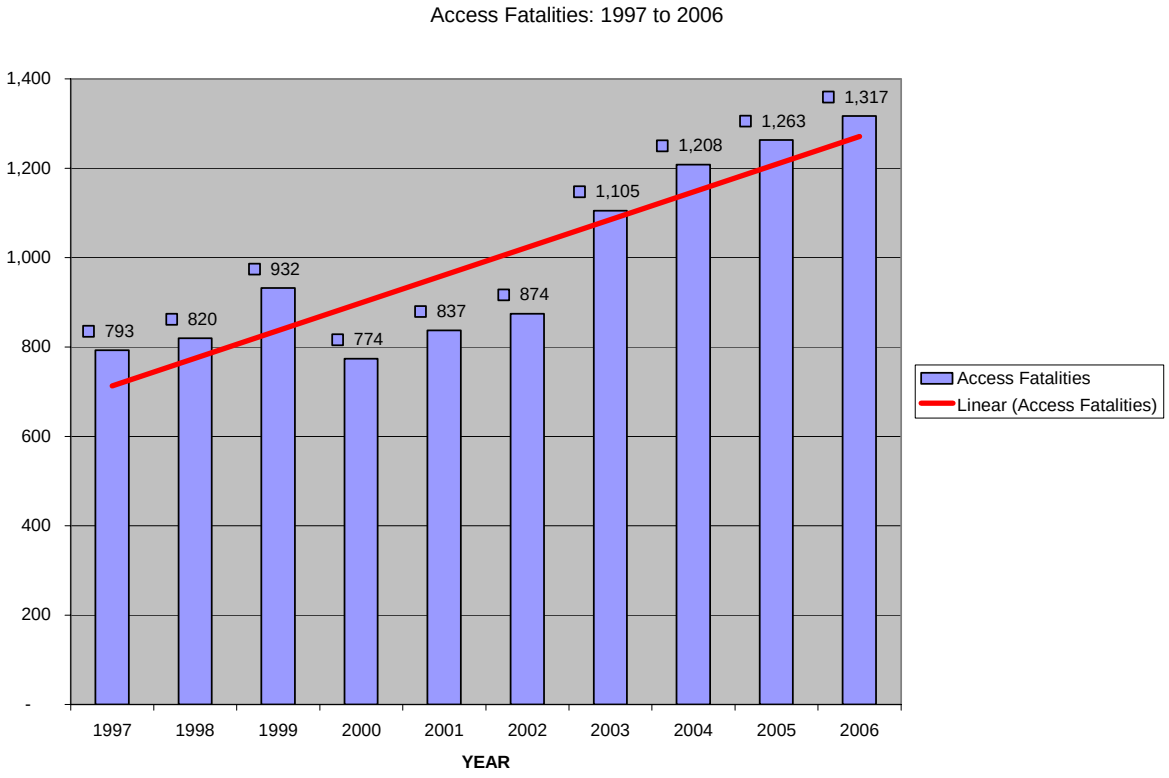

Figure 11: Access Fatalities 1997 to 2006

Other Junction Fatalities

Interchange Fatalities

The Florida Department of Transportation places special emphasis on access management in the vicinity of interchanges.[26] The GES/NASS includes seven separate elements within an interchange area. Historically, **Table 5** and **Figure 12** show that interchange fatalities range from a low of 1,083 in 2006 to a high of 1,584 in the Year 2000. This represents a difference of 501 fatalities or approximately 32 percent. Over the 10-year period from 1997 to 2006, there was a 15.5 percent (N=199) decrease in interchange fatalities. In six of the 10 years reviewed, the number of interchange fatalities was at or below the average interchange fatalities for the 10-year period. Since 2002, the number of interchange fatalities has consistently decreased annually from 1,386 to 1,083 (a decrease of approximately 5.5 percent per year).

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[26] Access Management: Balancing Access and Mobility, Answering Your Questions: Office of the State Transportation Planner, Systems Planning Office
www.fladot.com
http://www.accessmanagement.info/pdf/Q&A%20FL.pdf

This author believes that from a reporting standpoint, we should summarize the overall interchange area fatalities within the context of the relationship to junction charts in the *Traffic Safety Facts Annual Analysis*.

Table 5: Number of Junction Fatalities 1997 to 2006: Interchange Fatalities			
Year	Number		YBA
1997	1,282		*
1998	1,197		*
1999	1,404		
2000	1,584		
2001	1,313		
2002	1,386		
2003	1,226		*
2004	1,230		*
2005	1,180		*
2006	1,083		*
9706 Difference	(199)	-15.5%	
Average	1,289		
HI-LOW Difference	(501)	-31.6%	
YBA: Years Below Average			

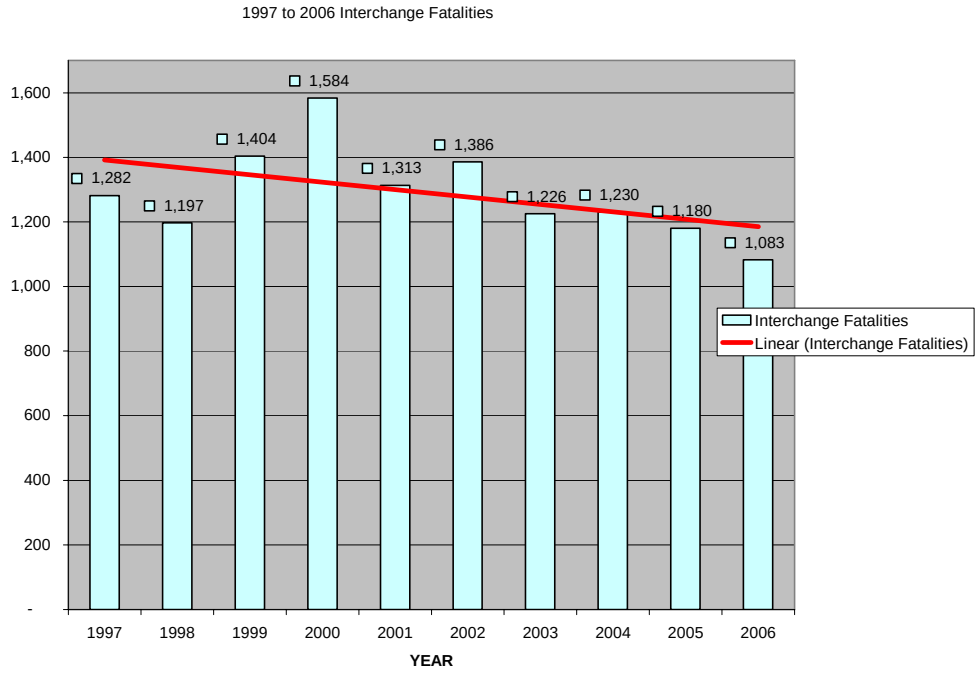

Figure 12: Interchange Fatalities 1997 to 2006

Rail Grade Crossing Fatalities

Table 6 and **Figure 13** show that rail grade crossing fatalities range from a low of 259 in 2005 to a high of 399 in the Year 1997. This represents a difference of 140 fatalities or approximately 35 percent. Over the 10-year period from 1997 to 2006, there was a 27.6 percent (N=110) decrease in rail grade crossing fatalities. In the last five of the 10 years reviewed, the number of rail grade crossing fatalities was at or below the average rail grade crossing fatalities for the 10-year period. Since 2002, the number of rail grade crossing fatalities has generally decreased annually from 307 to 289 (a decrease of approximately 1.1 percent per year).

Table 6: Number of Junction Fatalities 1997 to 2006: Rail Grade Crossings			
	Rail Grade Crossing		YBA
Year	Number		
1997	399	H	
1998	356		
1999	332		
2000	333		
2001	342		
2002	307		*
2003	261		*
2004	270		*
2005	259	L	*
2006	289		*
Average	315		
DIFF 1997-2005 (High -LOW)	(140)	-35.1%	
DIFF 2007-2006	(110)	-27.6%	
Maximum	399		
Minimum	259		
YBA: Years Below Average			

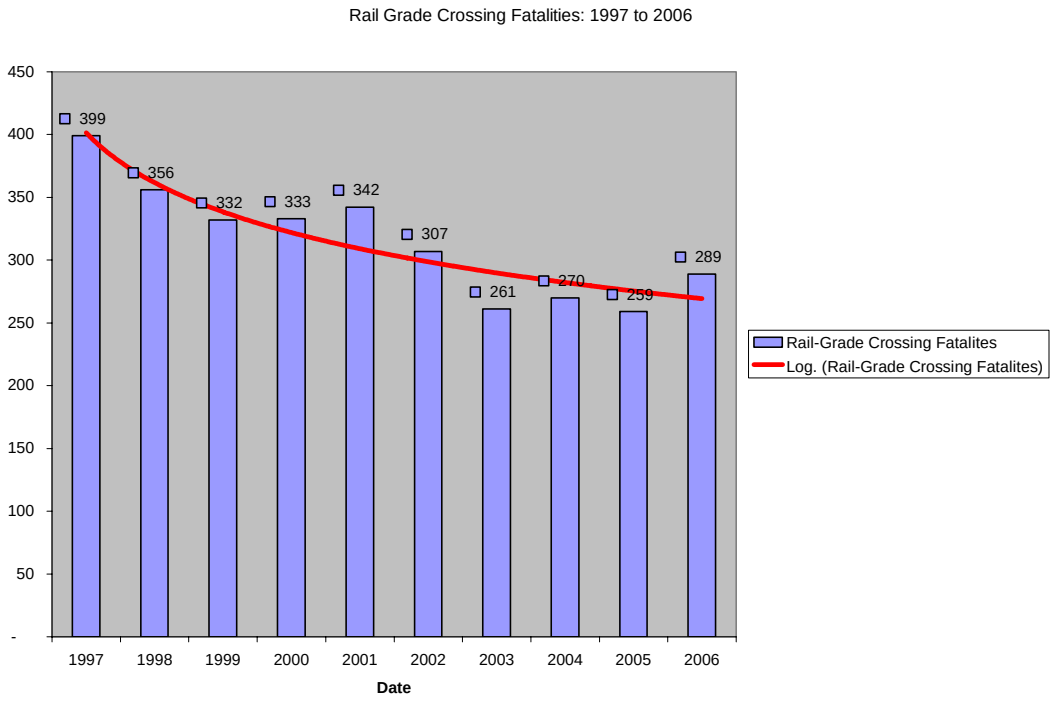

Figure 13: Rail-Grade Crossing Fatalities 1997 to 2006

SUMMARY RECOMMENDATIONS

1. For the purposes of the NHTSA annual *Traffic Safety Facts* Reports:

    - The Intersection and Intersection-Related subunits have been combined to form one category, Intersection. These intersection fatalities meet the pure definition of the GES/NASS and other organizations discussed in this paper. However, access fatalities are proximal to intersections and should be reported together with the pure intersection fatality counts.

    - An "Access Fatality" subunit of Intersection-Influence Area Fatalities should be developed. The following junction fatalities have been subsumed under this major category:

        - Driveways (DW)
        - Other Non-Interchange, Driveway-Related (DR-REL)
        - Entrance/Exit Ramps (ENT/EX)
        - Crossover (XO)

- There are a small number of Intersection Unknown fatalities. It is recommended that Intersection Unknown fatalities become a subunit of Intersection fatalities.

- The above three categories, Intersections (in the purist sense of the word), Access Fatalities and Unknown Intersection Fatalities would compromise what this author suggests as reporting as Total Intersection Influence Area Fatalities. Access Fatalities can and do have a significant influence in the fatalities that occur in the vicinity of intersection in the United States and should be accounted for in the context of the intersection environment.

- Under "Other Junction" fatalities, Interchange and Rail-Grade Crossing fatalities should be reported separately.

2. The data contained in **Table 7** (or some variation thereof) is recommended for inclusion in *NHTSA's Traffic Safety Facts* publication. The table provides a simple summary of the data necessary for technical professionals as well as decision-makers to understand the complex junction components within the GES and NASS.

3. The next steps to make access components become part of the Fatal Crashes or Fatalities/Relation to Junction statistics involve the following steps:
    a. Convene a Working Group between FHWA, NHTSA, and others to discuss the straw concept provided in this paper;
    b. Try to achieve consensus on definitions and reporting
    c. Implement changes through MMUCC and GES data elements

Table 7 : 2006 US Junction Fatalities	Number	% Total Intersections	% Total Junctions	% Total US Fatalities
Intersection Fatalities	8,797	86.8%	76.4%	20.6%
Access Fatalities	1,317	13.0%	11.4%	3.1%
Intersection Unknown Fatalities	23	0.2%	0.2%	0.1%
Total Intersection Influence Area Fatalities	10,137	**100.0%**	88.1%	23.8%
Interchange Fatalities	1,083		9.4%	2.5%
Rail-Grade Crossing Fatalities	289		2.5%	0.7%
Total Other Junction Fatalities	1,372		11.9%	3.2%
Total Junction Fatalities	11,509		**100.0%**	27.0%
Total US Traffic Fatalities	42,642			