

# Michigan Distribution Values for the Highway Safety Manual



1<sup>st</sup> Edition  
Spring 2012

## What are Highway Safety Manual (HSM) Distribution Values?

### *Background:*

- Distribution values that appear in chapters 10, 11 and 12 of the HSM, were developed from many different data sets from across the United States. The data used was from 2002-2006 typically but can vary by a few years. To be more applicable to Michigan, distribution values were developed to enhance the usefulness of the HSM in explaining predicted crashes. In this first edition for Michigan 2005-2010 data was used to develop these distribution values.

### *Reason:*

- Distribution values reflect typical characteristics of each general site type for both rural and urban locations. After computing the predicted number of crashes using SPFs, CMFs and calibration, the distribution will provide a typical cross-section of crash types and injury types for a particular site-type.

### *Understanding of Numbers:*

- Tables are all shown as proportions / percent of the respective site type. Michigan values in some cases are substantially different than the HSM due to certain ecological differences which account for a substantial proportion of the crashes.

### *What is Available:*

- Currently chapters 10 & 11 are complete and chapter 12 is expected later this year. The following tables are available:
- Chapter 10
  - 10.3 - Michigan Distribution for Crash Severity Level on Rural Two-Lane, Two-Way Roadway Segments
  - 10.4 - Michigan Distribution by Collision Type for Specific Crash Severity Levels on Rural Two-Lane Two-Way Road Segments
  - 10.5 - Michigan Distribution for Crash Severity Level at Rural Two-Lane, Two-Way Intersections
  - 10.6 - Michigan Distribution for Collision Type and Manner of Collision at Rural Two-Way Intersections
  - 10.12 - Michigan Nighttime Crash Proportions for Unlighted Roadway Segments
  - 10.15 - Michigan Nighttime Crash Proportions for Unlighted Intersections

*Continued on next page:*

- Chapter 11
  - 11.4 - Michigan Distribution of Crashes by Collision Type and Crash Severity Level for Undivided Roadway Segments
  - 11.6 - Michigan Distribution of Crashes by Collision Type and Crash Severity Level for Divided Roadway Segments
  - 11.9 - Michigan Distribution of Crashes by Collision Type and Crash Severity Level for Divided Roadway Segments
  - 11.15 - Michigan Nighttime Crash Proportions for Unlighted Roadway Segments 4-Lane Undivided
  - 11.19 - Michigan Nighttime Crash Proportions for Unlighted Roadway Segments 4-Lane Divided
  - 11.24 - Michigan Nighttime Crash Proportions for Unlighted Intersections

## CHAPTER 10: RURAL TWO-LANE

**TABLE 10.3** Michigan Distribution for Crash Severity Level on Rural Two-Lane, Two-Way Roadway Segments

Crash Severity Level	Percentage of Total Roadway Segment Crashes <i>2005-2009</i>
Fatal	0.5
Incapacitating Injury	1.8
Nonincapacitating Injury	3.3
Possible Injury	5.3
Total fatal plus injury	10.9
Property damage only	89.1
Total	100.0

**TABLE 10.4** Michigan Distribution by Collision Type for Specific Crash Severity Levels on Rural Two-Lane Two-Way Road Segments

Collision Type	Percentage of Total Roadway Segment Crashes by Crash Severity Level		
	Total Fatal and Injury	Property Damage Only	Total
<b>SINGLE-VEHICLE CRASHES</b>			
Collision with Animal	11.5	74.8	67.7
Collision with Bicycle	0.7	0.0	0.0
Collision with Pedestrian	1.3	0.0	0.2
Overtaken	15.5	2.5	4.0
Ran off Road	26.7	11.2	12.9
Other Single Vehicle Crash	2.9	1.3	1.5
Total Single Vehicle Crashes	58.7	89.9	86.5
<b>MULTIPLE-VEHICLE CRASHES</b>			
Angle Collision	6.1	1.2	1.7
Head-On Collision	9.0	0.3	1.3
Read-End Collision	16.4	4.2	5.5
Sideswipe Collision	5.7	2.4	2.8
Other Multiple-Vehicle Collision	4.2	2.0	2.3
Total Multiple-Vehicle Crashes	41.3	10.1	13.6
<b>TOTAL CRASHES</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Michigan Department of Transportation  
CALIBRATED Highway Safety Manual Tables - Chapter 10

**Table 10.5** Michigan Distribution for Crash Severity Level at Rural Two-Lane, Two-Way Intersections

Crash Severity Level	Percentage of Total Crashes		
	Three-Leg	Four-Leg	Four-Leg
	Stop Controlled Intersections	Stop Controlled Intersections	Signalized Intersections
Fatal	0.5	0.7	0.2
Incapacitating Injury	2.8	4.0	2.5
Nonincapacitating Injury	5.5	6.8	5.7
Possible Injury	9.8	12.0	15.1
Total fatal plus injury	18.6	23.5	23.5
Property damage only	81.4	76.5	76.5
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

**Table 10.6** Michigan Distribution for Collision Type and Manner of Collision at Rural Two-Way Intersections

Collision Type	Percentage of Total Crashes by Collision Type								
	Three-Leg Stop-Controlled Intersections			Four-Leg Stop-Controlled Intersections			Four-Leg Signalized Intersections		
	Fatal & Injury	PDO	Total	Fatal & Injury	PDO	Total	Fatal & Injury	PDO	Total
<b>SINGLE-VEHICLE CRASHES</b>									
Collision with Animal	3.9	39.4	32.8	1.5	28.8	22.3	0.2	4.4	3.4
Collision with Bicycle	1	0.1	0.3	1.2	0.1	0.4	1.9	0.3	0.6
Collision with Pedestrian	1.5	0	0.3	1.5	0	0.4	4.7	0.1	1.2
Overtaken	9.6	2.6	3.9	3.1	1.4	1.8	0.3	0.3	0.3
Ran off Road	18.8	17.7	17.9	8.5	11.8	11	3.7	5	4.7
Other Single Vehicle Crash	2.9	2.5	2.6	1.5	1.7	1.6	1.1	0.6	0.7
<b>Total Single Vehicle Crashes</b>	<b>37.7</b>	<b>62.3</b>	<b>57.8</b>	<b>17.3</b>	<b>43.8</b>	<b>37.5</b>	<b>11.9</b>	<b>10.7</b>	<b>10.9</b>
<b>MULTIPLE-VEHICLE CRASHES</b>									
Angle Collision	16.7	7.7	9.4	41.6	18.1	23.8	33.0	21.2	24.0
Head-On Collision	8.9	1.5	2.9	9.0	2.6	4.1	14.6	6.1	8.1
Read-End Collision	26.6	15.7	17.7	20.7	17.4	18.1	31.9	37.5	36.3
Sideswipe Collision	4.5	6.9	6.4	4.7	8.3	7.4	2.7	11.5	9.4
Other Multiple-Vehicle Collision	5.6	5.9	5.8	6.7	9.8	9.1	5.9	13.0	11.3
<b>Total Multiple-Vehicle Crashes</b>	<b>62.3</b>	<b>37.7</b>	<b>42.2</b>	<b>82.7</b>	<b>56.2</b>	<b>62.5</b>	<b>88.1</b>	<b>89.3</b>	<b>89.1</b>
<b>TOTAL CRASHES</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

**Table 10.12** Michigan Nighttime Crash Proportions for Unlighted Roadway Segments

Roadway Type	Proportion of Total Nighttime Crashes by Severity Level		Proportion of Crashes that Occur at Night
	Fatal and Injury $p_{inr}$	PDO $p_{pnr}$	$p_{nr}$
2U	0.270	0.650	0.463

2U = 2-Lane Undivided Roadway

**Table 10.15** Michigan Nighttime Crash Proportions for Unlighted Intersections

Intersection Type	Proportion of Crashes that Occur at Night
	$p_{ni}$
3ST	0.248
4ST	0.208
4SG	0.188

3ST = 3-Leg Stop Controlled Intersection

4ST = 4-Leg Stop Controlled Intersection

4SG = 4-Leg Signalized Intersection

## CHAPTER 11: RURAL MULTILANE

**Table 11.4** Michigan Distribution of Crashes by Collision Type and Crash Severity Level for Undivided Roadway Segments

*data 2004-2009*

Collision Type	Proportion of Crashes by Collision Type and Crash Severity Level			
	Severity Level			
	Total	Fatal and Injury	Fatal and Injury*	PDO
Head-On	0.045	0.108	0.138	0.022
Sideswipe	0.155	0.062	0.061	0.189
Rear-end	0.205	0.266	0.188	0.184
Angle	0.149	0.180	0.184	0.138
Single	0.321	0.242	0.299	0.349
Other	0.125	0.143	0.130	0.118

\*Using the KABCO scale, these include only KAB crashes.

**Table 11.6** Michigan Distribution of Crashes by Collision Type and Crash Severity Level for Divided Roadway Segments

*data 2004-2009*

Collision Type	Proportion of Crashes by Collision Type and Crash Severity Level			
	Severity Level			
	Total	Fatal and Injury	Fatal and Injury*	PDO
Head-On	0.009	0.018	0.033	0.006
Sideswipe	0.120	0.059	0.055	0.139
Rear-end	0.136	0.195	0.143	0.118
Angle	0.046	0.086	0.143	0.034
Single	0.626	0.605	0.604	0.633
Other	0.063	0.036	0.022	0.072

\*Using the KABCO scale, these include only KAB crashes.

Michigan Department of Transportation  
CALIBRATED Highway Safety Manual Tables - Chapter 11

**Table 11.9** Michigan Distribution of Crashes by Collision Type and Crash Severity Level for Divided Roadway Segments

Collision Type	Proportion of Crashes by Severity Level							
	3-Leg Intersections with Minor Stop				4-Leg Intersections with Minor Stop			
	Total	Fatal & Injury	Fatal & Injury*	PDO	Total	Fatal & Injury	Fatal & Injury*	PDO
Head-On	0.050	0.103	0.146	0.028	0.056	0.094	0.120	0.038
Sideswipe	0.096	0.049	0.051	0.115	0.099	0.049	0.034	0.124
Rear-end	0.293	0.299	0.198	0.291	0.238	0.216	0.149	0.248
Angle	0.161	0.194	0.206	0.147	0.320	0.426	0.466	0.268
Single	0.307	0.266	0.300	0.324	0.180	0.124	0.128	0.207
Other	0.093	0.089	0.099	0.095	0.107	0.091	0.103	0.115

  

Collision Type	3-Leg Signalized Intersections				4-Leg Signalized Intersections			
	Total	Fatal & Injury	Fatal & Injury*	PDO	Total	Fatal & Injury	Fatal & Injury*	PDO
	Head-On	---	---	---	---	0.087	0.146	0.204
Sideswipe	---	---	---	---	0.101	0.029	0.018	0.125
Rear-end	---	---	---	---	0.380	0.318	0.159	0.403
Angle	---	---	---	---	0.250	0.333	0.404	0.222
Single	---	---	---	---	0.058	0.049	0.065	0.060
Other	---	---	---	---	0.124	0.125	0.150	0.123

**Table 11.15** Michigan Nighttime Crash Proportions for Unlighted Roadway Segments

Roadway Type	Proportion of Total Nighttime Crashes by Severity Level		Proportion of Crashes that Occur at Night
	Fatal and Injury $p_{inr}$	PDO $p_{pnr}$	$p_{nr}$
4U	0.190	0.534	0.290

4U = 4-Lane Undivided Segment

**Table 11.19** Michigan Nighttime Crash Proportions for Unlighted Roadway Segments

Roadway Type	Proportion of Total Nighttime Crashes by Severity Level		Proportion of Crashes that Occur at Night
	Fatal and Injury $p_{inr}$	PDO $p_{pnr}$	$p_{nr}$
4D	0.232	0.718	0.533

4D = 4-Lane Divided Segment



**Table 11.24** Michigan Nighttime Crash Proportions for Unlighted Intersections

<b>Intersection Type</b>	<b>Proportion of Crashes that Occur at Night, <math>p_{ni}</math></b>
3ST	0.148
4ST	0.106

3ST = 3-Leg Stop Controlled Intersection

4ST = 4-Leg Stop Controlled Intersection