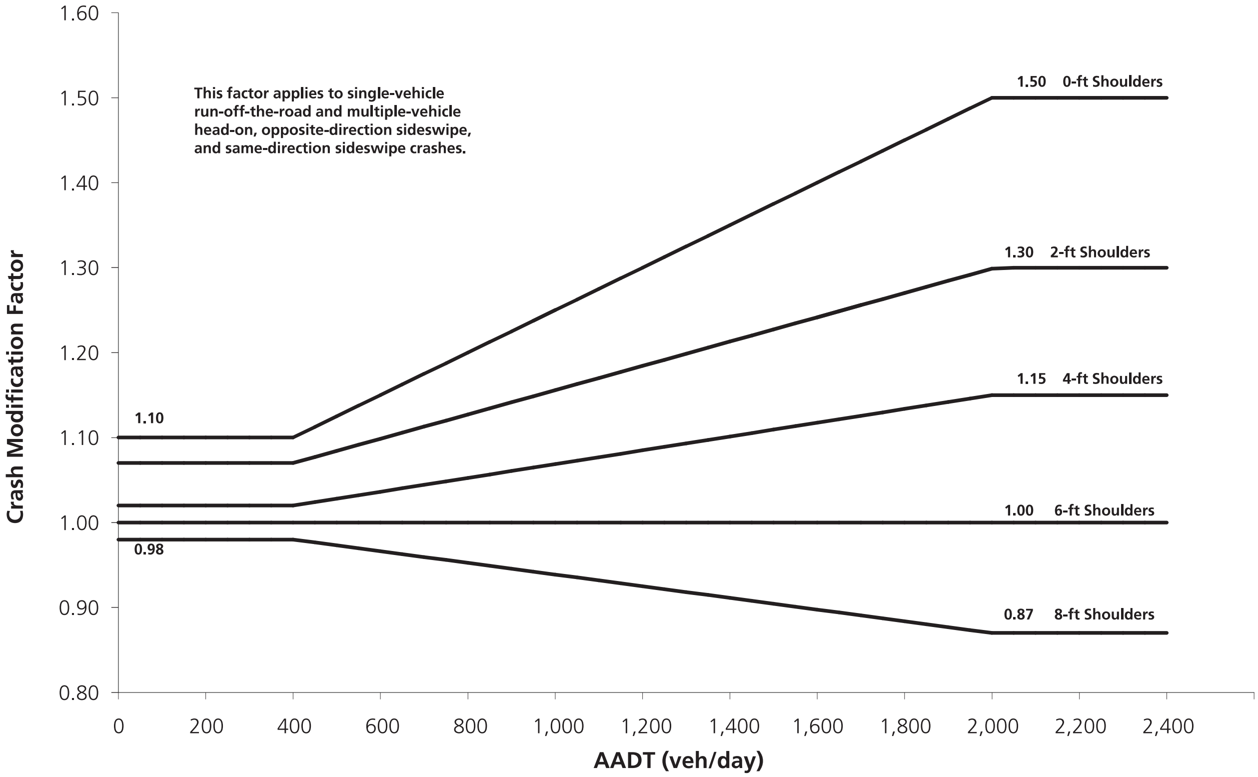

Figure 10-8. Crash Modification Factor for Shoulder Width on Roadway Segments

The base condition for shoulder type is paved. Table 10-10 presents values for CMF_{tra} which adjusts for the safety effects of gravel, turf, and composite shoulders as a function of shoulder width.

Table 10-10. Crash Modification Factors for Shoulder Types and Shoulder Widths on Roadway Segments (CMF_{tra})

	Shoulder Width (ft)						
Shoulder Type	**0**	**1**	**2**	**3**	**4**	**6**	**8**
Paved	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Gravel	1.00	1.00	1.01	1.01	1.01	1.02	1.02
Composite	1.00	1.01	1.02	1.02	1.03	1.04	1.06
Turf	1.00	1.01	1.03	1.04	1.05	1.08	1.11

Note: The values for composite shoulders in this table represent a shoulder for which 50 percent of the shoulder width is paved and 50 percent of the shoulder width is turf.

If the shoulder types and/or widths for the two directions of a roadway segment differ, the CMF are determined separately for the shoulder type and width in each direction of travel and the resulting CMFs are then be averaged.

The CMFs for shoulder width and type shown in Tables 10-9 and 10-10, and Figure 10-8 apply only to the collision types that are most likely to be affected by shoulder width and type: single-vehicle run-off the-road and multiple-vehicle head-on, opposite-direction sideswipe, and same-direction sideswipe crashes. The CMFs expressed on this basis are, therefore, adjusted to total crashes using Equation 10-12.

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$$CMF_{2r} = (CMF_{wra} \times CMF_{tra} - 1.0) \times p_{ra} + 1.0 \quad (10\text{-}12)$$

Where:

CMF_{2r} = crash modification factor for the effect of shoulder width and type on total crashes;

CMF_{wra} = crash modification factor for related crashes (i.e., single-vehicle run-off-the-road and multiple-vehicle head-on, opposite-direction sideswipe, and same-direction sideswipe crashes), based on shoulder width (from Table 10-9);

CMF_{tra} = crash modification factor for related crashes based on shoulder type (from Table 10-10); and

p_{ra} = proportion of total crashes constituted by related crashes.

The proportion of related crashes, p_{ra}, (i.e., single-vehicle run-off-the-road, and multiple-vehicle head-on, opposite-direction sideswipe, and same-direction sideswipes crashes) is estimated as 0.574 (i.e., 57.4 percent) based on the default distribution of crash types presented in Table 10-4. This default crash type distribution, and therefore the value of p_{ra}, may be updated from local data by a highway agency as part of the calibration process.

CMF_{3r}—Horizontal Curves: Length, Radius, and Presence or Absence of Spiral Transitions

The base condition for horizontal alignment is a tangent roadway segment. A CMF has been developed to represent the manner in which crash experience on curved alignments differs from that of tangents. This CMF applies to total roadway segment crashes.

The CMF for horizontal curves has been determined from the regression model developed by Zegeer et al. (18).

The CMF for horizontal curvature is in the form of an equation and yields a factor similar to the other CMFs in this chapter. The CMF for length, radius, and presence or absence of spiral transitions on horizontal curves is determined using Equation 10-13.

$$CMF_{3r} = \frac{(1.55 \times L_c) + \left(\frac{80.2}{R}\right) - (0.012 \times S)}{(1.55 \times L_c)} \quad (10\text{-}13)$$

Where:

CMF_{3r} = crash modification factor for the effect of horizontal alignment on total crashes;

L_c = length of horizontal curve (miles) which includes spiral transitions, if present;

R = radius of curvature (feet); and

S = 1 if spiral transition curve is present; 0 if spiral transition curve is not present; 0.5 if a spiral transition curve is present at one but not both ends of the horizontal curve.

Some roadway segments being analyzed may include only a portion of a horizontal curve. In this case, L_c represents the length of the entire horizontal curve, including portions of the horizontal curve that may lie outside the roadway segment of interest.

In applying Equation 10-13, if the radius of curvature (R) is less than 100-ft, R is set to equal to 100 ft. If the length of the horizontal curve (L_c) is less than 100 feet, L_c is set to equal 100 ft.

CMF values are computed separately for each horizontal curve in a horizontal curve set (a curve set consists of a series of consecutive curve elements). For each individual curve, the value of L_c used in Equation 10-13 is the total length of the compound curve set and the value of R is the radius of the individual curve.

If the value of CMF_{3r} is less than 1.00, the value of CMF_{3r} is set equal to 1.00.

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CMF_{4r}—Horizontal Curves: Superelevation

The base condition for the CMF for the superelevation of a horizontal curve is the amount of superelevation identified in *A Policy on Geometric Design of Highways and Streets*—also called the AASHTO Green Book (1). The superelevation in the AASHTO Green Book is determined by taking into account the value of maximum superelevation rate, e_{max}, established by highway agency policies. Policies concerning maximum superelevation rates for horizontal curves vary between highway agencies based on climate and other considerations.

The CMF for superelevation is based on the superelevation variance of a horizontal curve (i.e., the difference between the actual superelevation and the superelevation identified by AASHTO policy). When the actual superelevation meets or exceeds that in the AASHTO policy, the value of the superelevation CMF is 1.00. There is no effect of superelevation variance on crash frequency until the superelevation variance exceeds 0.01. The general functional form of a CMF for superelevation variance is based on the work of Zegeer et al. (18, 19).

The following relationships present the CMF for superelevation variance:

$$CMF_{4r} = 1.00 \text{ for } SV < 0.01 \tag{10-14}$$

$$CMF_{4r} = 1.00 + 6 \times (SV - 0.01) \text{ for } 0.01 \leq SV < 0.02 \tag{10-15}$$

$$CMF_{4r} = 1.06 + 3 \times (SV - 0.02) \text{ for } SV \geq 0.02 \tag{10-16}$$

Where:

CMF_{4r} = crash modification factor for the effect of superelevation variance on total crashes; and

SV = superelevation variance (ft/ft), which represents the superelevation rate contained in the AASHTO Green Book minus the actual superelevation of the curve.

CMF_{4r} applies to total roadway segment crashes for roadway segments located on horizontal curves.

CMF_{5r}—Grades

The base condition for grade is a generally level roadway. Table 10-11 presents the CMF for grades based on an analysis of rural two-lane, two-way highway grades in Utah conducted by Miaou (8). The CMFs in Table 10-11 are applied to each individual grade segment on the roadway being evaluated without respect to the sign of the grade. The sign of the grade is irrelevant because each grade on a rural two-lane, two-way highway is an upgrade for one direction of travel and a downgrade for the other. The grade factors are applied to the entire grade from one point of vertical intersection (PVI) to the next (i.e., there is no special account taken of vertical curves). The CMFs in Table 10-11 apply to total roadway segment crashes.

Table 10-11. Crash Modification Factors (CMF_{5r}) for Grade of Roadway Segments

Approximate Grade (%)		
Level Grade (≤ 3%)	Moderate Terrain (3%< grade ≤ 6%)	Steep Terrain (> 6%)
1.00	1.10	1.16

CMF_{6r}—Driveway Density

The base condition for driveway density is five driveways per mile. As with the other CMFs, the model for the base condition was established for roadways with this driveway density. The CMF for driveway density is determined using Equation 10-17, derived from the work of Muskaug (9).

$$CMF_{6r} = \frac{0.322 + DD \times [0.05 - 0.005 \times \ln(AADT)]}{0.322 + 5 \times [0.05 - 0.005 \times \ln(AADT)]} \tag{10-17}$$

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Where:

CMF_{6r} = crash modification factor for the effect of driveway density on total crashes;

$AADT$ = average annual daily traffic volume of the roadway being evaluated (vehicles per day); and

DD = driveway density considering driveways on both sides of the highway (driveways/mile).

If driveway density is less than 5 driveways per mile, CMF_{6r} is 1.00. Equation 10-17 can be applied to total roadway crashes of all severity levels.

Driveways serving all types of land use are considered in determining the driveway density. All driveways that are used by traffic on at least a daily basis for entering or leaving the highway are considered. Driveways that receive only occasional use (less than daily), such as field entrances are not considered.

CMF_{7r}—Centerline Rumble Strips

Centerline rumble strips are installed on undivided highways along the centerline of the roadway which divides opposing directions of traffic flow. Centerline rumble strips are incorporated in the roadway surface to alert drivers who unintentionally cross, or begin to cross, the roadway centerline. The base condition for centerline rumble strips is the absence of rumble strips.

The value of CMF_{7r} for the effect of centerline rumble strips for total crashes on rural two-lane, two-way highways is derived as 0.94 from the CMF value presented in Chapter 13 and crash type percentages found in Chapter 10. Details of this derivation are not provided.

The CMF for centerline rumble strips applies only to two-lane undivided highways with no separation other than a centerline marking between the lanes in opposite directions of travel. Otherwise the value of this CMF is 1.00.

CMF_{8r}—Passing Lanes

The base condition for passing lanes is the absence of a lane (i.e., the normal two-lane cross section). The CMF for a conventional passing or climbing lane added in one direction of travel on a rural two-lane, two-way highway is 0.75 for total crashes in both directions of travel over the length of the passing lane from the upstream end of the lane addition taper to the downstream end of the lane drop taper. This value assumes that the passing lane is operationally warranted and that the length of the passing lane is appropriate for the operational conditions on the roadway. There may also be some safety benefit on the roadway downstream of a passing lane, but this effect has not been quantified.

The CMF for short four-lane sections (i.e., side-by-side passing lanes provided in opposite directions on the same section of roadway) is 0.65 for total crashes over the length of the short four-lane section. This CMF applies to any portion of roadway where the cross section has four lanes and where both added lanes have been provided over a limited distance to increase passing opportunities. This CMF does not apply to extended four-lane highway sections.

The CMF for passing lanes is based primarily on the work of Harwood and St.John (6), with consideration also given to the results of Rinde (11) and Nettelblad (10). The CMF for short four-lane sections is based on the work of Harwood and St. John (6).

CMF_{9r}—Two-Way Left-Turn Lanes

The installation of a center two-way left-turn lane (TWLTL) on a rural two-lane, two-way highway to create a three-lane cross-section can reduce crashes related to turning maneuvers at driveways. The base condition for two-way left-turn lanes is the absence of a TWLTL. The CMF for installation of a TWLTL is:

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$$CMF_{9r} = 1.0 - (0.7 \times p_{dwy} \times p_{LT/D}) \tag{10-18}$$

Where:

CMF_{9r} = crash modification factor for the effect of two-way left-turn lanes on total crashes;

p_{dwy} = driveway-related crashes as a proportion of total crashes; and

$p_{LT/D}$ = left-turn crashes susceptible to correction by a TWLTL as a proportion of driveway-related crashes.

The value of p_{dwy} can be estimated using Equation 10-19 (6).

$$p_{dwy} = \frac{(0.0047 \times DD) + \left(0.0024 \times DD^{(2)}\right)}{1.199 + (0.0047 \times DD) + \left(0.0024 \times DD^{(2)}\right)} \tag{10-19}$$

Where:

P_{dwy} = driveway-related crashes as a proportion of total crashes; and

DD = driveway density considering driveways on both sides of the highway (driveways/mile).

The value of $p_{LT/D}$ is estimated as 0.5 (6).

Equation 10-18 provides the best estimate of the CMF for TWLTL installation that can be made without data on the left-turn volumes within the TWLTL. Realistically, such volumes are seldom available for use in such analyses though Part C, Appendix A.1 describes how to appropriately calibrate this value. This CMF applies to total roadway segment crashes.

The CMF for TWLTL installation is not applied unless the driveway density is greater than or equal to five driveways per mile. If the driveway density is less than five driveways per mile, the CMF for TWLTL installation is 1.00.

CMF_{10r}—Roadside Design

For purposes of the HSM predictive method, the level of roadside design is represented by the roadside hazard rating (1–7 scale) developed by Zegeer et al. (16). The CMF for roadside design was developed in research by Harwood et al. (5). The base value of roadside hazard rating for roadway segments is 3. The CMF is:

$$CMF_{10r} = \frac{e^{(-0.6869 + 0.0668 \times RHR)}}{e^{(-0.4865)}} \tag{10-20}$$

Where:

CMF_{10r} = crash modification factor for the effect of roadside design; and

RHR = roadside hazard rating.

This CMF applies to total roadway segment crashes. Photographic examples and quantitative definitions for each roadside hazard rating (1–7) as a function of roadside design features such as sideslope and clear zone width are presented in Appendix 13A.

CMF_{11r}—Lighting

The base condition for lighting is the absence of roadway segment lighting. The CMF for lighted roadway segments is determined, based on the work of Elvik and Vaa (2), as:

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$$CMF_{11r} = 1.0 - [(1.0 - 0.72 \times p_{inr} - 0.83 \times p_{pnr}) \times p_{nr}] \quad (10\text{-}21)$$

Where:

CMF_{11r} = crash modification factor for the effect of lighting on total crashes;

p_{inr} = proportion of total nighttime crashes for unlighted roadway segments that involve a fatality or injury;

p_{pnr} = proportion of total nighttime crashes for unlighted roadway segments that involve property damage only; and

p_{nr} = proportion of total crashes for unlighted roadway segments that occur at night.

This CMF applies to total roadway segment crashes. Table 10-12 presents default values for the nighttime crash proportions p_{inr}, p_{pnr}, and p_{nr}. HSM users are encouraged to replace the estimates in Table 10-12 with locally derived values. If lighting installation increases the density of roadside fixed objects, the value of CMF_{10r} is adjusted accordingly.

Table 10-12. Nighttime Crash Proportions for Unlighted Roadway Segments

	Proportion of Total Nighttime Crashes by Severity Level		Proportion of Crashes that Occur at Night
Roadway Type	**Fatal and Injury p_{inr}**	**PDO p_{pnr}**	**p_{nr}**
2U	0.382	0.618	0.370

Note: Based on HSIS data for Washington (2002–2006)

CMF_{12r}—Automated Speed Enforcement

Automated speed enforcement systems use video or photographic identification in conjunction with radar or lasers to detect speeding drivers. These systems automatically record vehicle identification information without the need for police officers at the scene. The base condition for automated speed enforcement is that it is absent.

The value of CMF_{12r} for the effect of automated speed enforcement for total crashes on rural two-lane, two-way highways is derived as 0.93 from the CMF value presented in Chapter 17 and crash type percentages found in Chapter 10. Details of this derivation are not provided.

10.7.2. Crash Modification Factors for Intersections

The effects of individual geometric design and traffic control features of intersections are represented in the predictive models by CMFs. The CMFs for intersection skew angle, left-turn lanes, right-turn lanes, and lighting are presented below. Each of the CMFs applies to total crashes.

CMF_{1i}—Intersection Skew Angle

The base condition for intersection skew angle is zero degrees of skew (i.e., an intersection angle of 90 degrees). The skew angle for an intersection was defined as the absolute value of the deviation from an intersection angle of 90 degrees. The absolute value is used in the definition of skew angle because positive and negative skew angles are considered to have similar detrimental effect (4). This is illustrated in Section 14.6.2.

Three-Leg Intersections with Stop-Control on the Minor Approach

The CMF for intersection angle at three-leg intersections with stop-control on the minor approach is:

$$CMF_{1i} = e^{(0.004 \times skew)} \quad (10\text{-}22)$$

Where:

CMF_{1i} = crash modification factor for the effect of intersection skew on total crashes; and

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skew = intersection skew angle (in degrees); the absolute value of the difference between 90 degrees and the actual intersection angle.

This CMF applies to total intersection crashes.

Four-Leg Intersections with Stop-Control on the Minor Approaches

The CMF for intersection angle at four-leg intersection with stop-control on the minor approaches is:

$$CMF_{1i} = e^{(0.0054 \times skew)} \tag{10-23}$$

Where:

CMF_{1i} = crash modification factor for the effect of intersection skew on total crashes; and

skew = intersection skew angle (in degrees); the absolute value of the difference between 90 degrees and the actual intersection angle.

This CMF applies to total intersection crashes.

If the skew angle differs for the two minor road legs at a four-leg stop-controlled intersection, values of CMF_{1i} is computed separately for each minor road leg and then averaged.

Four-Leg Signalized Intersections

Since the traffic signal separates most movements from conflicting approaches, the risk of collisions related to the skew angle between the intersecting approaches is limited at a signalized intersection. Therefore, the CMF for skew angle at four-leg signalized intersections is 1.00 for all cases.

CMF_{2i}—Intersection Left-Turn Lanes

The base condition for intersection left-turn lanes is the absence of left-turn lanes on the intersection approaches. The CMFs for the presence of left-turn lanes are presented in Table 10-13. These CMFs apply to installation of left-turn lanes on any approach to a signalized intersection, but only on uncontrolled major road approaches to a stop-controlled intersection. The CMFs for installation of left-turn lanes on multiple approaches to an intersection are equal to the corresponding CMF for the installation of a left-turn lane on one approach raised to a power equal to the number of approaches with left-turn lanes. There is no indication of any safety effect of providing a left-turn lane on an approach controlled by a stop sign, so the presence of a left-turn lane on a stop-controlled approach is not considered in applying Table 10-13. The CMFs for installation of left-turn lanes are based on research by Harwood et al. (5) and are consistent with the CMFs presented in Chapter 14. A CMF of 1.00 is always be used when no left-turn lanes are present.

Table 10-13. Crash Modification Factors (CMF_{2i}) for Installation of Left-Turn Lanes on Intersection Approaches

		Number of Approaches with Left-Turn Lanes[a]			
Intersection Type	**Intersection Traffic Control**	**One Approach**	**Two Approaches**	**Three Approaches**	**Four Approaches**
Three-leg Intersection	Minor road stop control[b]	0.56	0.31	—	—
Four-leg Intersection	Minor road stop control[b]	0.72	0.52	—	—
	Traffic signal	0.82	0.67	0.55	0.45

[a] Stop-controlled approaches are not considered in determining the number of approaches with left-turn lanes
[b] Stop signs present on minor road approaches only.

CMF_{3i}—Intersection Right-Turn Lanes

The base condition for intersection right-turn lanes is the absence of right-turn lanes on the intersection approaches. The CMF for the presence of right-turn lanes is based on research by Harwood et al. (5) and is consistent with the CMFs in Chapter 14. These CMFs apply to installation of right-turn lanes on any approach to a signalized intersec-

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tion, but only on uncontrolled major road approaches to stop-controlled intersections. The CMFs for installation of right-turn lanes on multiple approaches to an intersection are equal to the corresponding CMF for installation of a right-turn lane on one approach raised to a power equal to the number of approaches with right-turn lanes. There is no indication of any safety effect for providing a right-turn lane on an approach controlled by a stop sign, so the presence of a right-turn lane on a stop-controlled approach is not considered in applying Table 10-14. The CMFs in the table apply to total intersection crashes. A CMF value of 1.00 is always be used when no right-turn lanes are present. This CMF applies only to right-turn lanes that are identified by marking or signing. The CMF is not applicable to long tapers, flares, or paved shoulders that may be used informally by right-turn traffic.

Table 10-14. Crash Modification Factors (CMF_{3i}) for Right-Turn Lanes on Approaches to an Intersection on Rural Two-Lane, Two-Way Highways

		Number of Approaches with Right-Turn Lanes[a]			
Intersection Type	**Intersection Traffic Control**	**One Approach**	**Two Approaches**	**Three Approaches**	**Four Approaches**
Three-Leg Intersection	Minor road stop control[b]	0.86	0.74	—	—
Four-Leg Intersection	Minor road stop control[b]	0.86	0.74	—	—
	Traffic signal	0.96	0.92	0.88	0.85

[a] Stop-controlled approaches are not considered in determining the number of approaches with right-turn lanes.
[b] Stop signs present on minor road approaches only.

CMF_{4i}—Lighting

The base condition for lighting is the absence of intersection lighting. The CMF for lighted intersections is adapted from the work of Elvik and Vaa (2), as:

$$CMF_{4i} = 1 - 0.38 \times p_{ni} \tag{10-24}$$

Where:

CMF_{4i} = crash modification factor for the effect of lighting on total crashes; and

p_{ni} = proportion of total crashes for unlighted intersections that occur at night.

This CMF applies to total intersection crashes. Table 10-15 presents default values for the nighttime crash proportion p_{ni}. HSM users are encouraged to replace the estimates in Table 10-15 with locally derived values.

Table 10-15. Nighttime Crash Proportions for Unlighted Intersections

	Proportion of Crashes that Occur at Night
Intersection Type	p_{ni}
3ST	0.260
4ST	0.244
4SG	0.286

Note: Based on HSIS data for California (2002–2006)

10.8. CALIBRATION OF THE SPFS TO LOCAL CONDITIONS

In Step 10 of the predictive method, presented in Section 10.4, the predictive model is calibrated to local state or geographic conditions. Crash frequencies, even for nominally similar roadway segments or intersections, can vary widely from one jurisdiction to another. Geographic regions differ markedly in climate, animal population, driver populations, crash reporting threshold, and crash reporting practices. These variations may result in some jurisdictions

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experiencing a different number of reported traffic crashes on rural two-lane, two-way roads than others. Calibration factors are included in the methodology to allow highway agencies to adjust the SPFs to match actual local conditions.

The calibration factors for roadway segments and intersections (defined as C_r and C_i, respectively) will have values greater than 1.0 for roadways that, on average, experience more crashes than the roadways used in the development of the SPFs. The calibration factors for roadways that experience fewer crashes on average than the roadways used in the development of the SPFs will have values less than 1.0. The calibration procedures are presented in Part C, Appendix A.

Calibration factors provide one method of incorporating local data to improve estimated crash frequencies for individual agencies or locations. Several other default values used in the predictive method, such as collision type distribution, can also be replaced with locally derived values. The derivation of values for these parameters is addressed in the calibration procedure in Part C, Appendix A.

10.9. LIMITATIONS OF PREDICTIVE METHOD IN CHAPTER 10

This section discusses limitations of the specific predictive models and the application of the predictive method in Chapter 10.

Where rural two-lane, two-way roads intersect access-controlled facilities (i.e., freeways), the grade-separated interchange facility, including the two-lane road within the interchange area, cannot be addressed with the predictive method for rural two-lane, two-way roads.

The SPFs developed for Chapter 10 do not include signalized three-leg intersection models. Such intersections are occasionally found on rural two-lane, two-way roads.

10.10. APPLICATION OF CHAPTER 10 PREDICTIVE METHOD

The predictive method presented in Chapter 10 applies to rural two-lane, two-way roads. The predictive method is applied to a rural two-lane, two-way facility by following the 18 steps presented in Section 10.4. Appendix 10A provides a series of worksheets for applying the predictive method and the predictive models detailed in this chapter. All computations within these worksheets are conducted with values expressed to three decimal places. This level of precision is needed for consistency in computations. In the last stage of computations, rounding the final estimate of expected average crash frequency to one decimal place is appropriate.

10.11. SUMMARY

The predictive method can be used to estimate the expected average crash frequency for a series of contiguous sites (entire rural two-lane, two-way facility), or a single individual site. A rural two-lane, two-way facility is defined in Section 10.3, and consists of a two-lane, two-way undivided road which does not have access control and is outside of cities or towns with a population greater than 5,000 persons. Two-lane, two-way undivided roads that have occasional added lanes to provide additional passing opportunities can also be addressed with the Chapter 10 predictive method.

The predictive method for rural two-lane, two-way roads is applied by following the 18 steps of the predictive method presented in Section 10.4. Predictive models, developed for rural two-lane, two-way facilities, are applied in Steps 9, 10, and 11 of the method. These predictive models have been developed to estimate the predicted average crash frequency of an individual site which is an intersection or homogenous roadway segment. The facility is divided into these individual sites in Step 5 of the predictive method.

Each predictive model in Chapter 10 consists of a safety performance function (SPF), crash modification factors (CMFs), and a calibration factor. The SPF is selected in Step 9 and is used to estimate the predicted average crash frequency for a site with base conditions. The estimate can be for either total crashes or organized by crash-severity or collision-type distribution. In order to account for differences between the base conditions and the specific conditions of the site, CMFs are applied in Step 10, which adjust the prediction to account for the

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geometric design and traffic control features of the site. Calibration factors are also used to adjust the prediction to local conditions in the jurisdiction where the site is located. The process for determining calibration factors for the predictive models is described in Part C, Appendix A.1.

Section 10.12 presents six sample problems which detail the application of the predictive method. Appendix 10A contains worksheets which can be used in the calculations for the predictive method steps.

10.12. SAMPLE PROBLEMS

In this section, six sample problems are presented using the predictive method for rural two-lane, two-way roads. Sample Problems 1 and 2 illustrate how to calculate the predicted average crash frequency for rural two-lane roadway segments. Sample Problem 3 illustrates how to calculate the predicted average crash frequency for a stop-controlled intersection. Sample Problem 4 illustrates a similar calculation for a signalized intersection. Sample Problem 5 illustrates how to combine the results from Sample Problems 1 through 3 in a case where site-specific observed crash data are available (i.e., using the site-specific EB Method). Sample Problem 6 illustrates how to combine the results from Sample Problems 1 through 3 in a case where site-specific observed crash data are not available but project-level observed crash data are available (i.e., using the project-level EB Method).

Table 10-16. List of Sample Problems in Chapter 10

Problem No.	Page No.	Description
1	10–35	Predicted average crash frequency for a tangent roadway segment
2	10–42	Predicted average crash frequency for a curved roadway segment
3	10–49	Predicted average crash frequency for a three-leg stop-controlled intersection
4	10–55	Predicted average crash frequency for a four-leg signalized intersection
5	10–60	Expected average crash frequency for a facility when site-specific observed crash data are available
6	10–62	Expected average crash frequency for a facility when site-specific observed crash data are not available

10.12.1. Sample Problem 1

The Site/Facility

A rural two-lane tangent roadway segment.

The Question

What is the predicted average crash frequency of the roadway segment for a particular year?

The Facts

- 1.5-mi length
- Tangent roadway segment
- 10,000 veh/day
- 2% grade
- 6 driveways per mi
- 10-ft lane width
- 4-ft gravel shoulder
- Roadside hazard rating = 4

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