

TxDOT's Combined CMF Calculator Tool

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Introductions



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Overview

- What are TxDOT Work Codes?
- What's TxDOT's Work Code Combo Calculator?
- How is it used?
- Combined Crash Modification Factor (CMF) Methodology
- Example – Spreadsheet Walkthrough (version 1.0)
- Next Steps



TxDOT Work Codes

- Before calculating the SII, the proposed corrective action or safety countermeasure must be translated into the appropriate “work code”.
- The HSIP Work Codes Table (Appendix B in 2026 TxDOT HSIP Guidelines) provides each countermeasure’s work code, definitions, **crash reduction factors**, service life, maintenance cost, and preventable crash types.

Appendix B - HSIP Work Codes Table

The work codes are grouped into five categories, as shown in the following table.

Code	Item
100	Signing and Signals
200	Roadside Obstacles and Barriers
300	Resurfacing and Roadway Lighting
400	Pavement Markings
500	Roadway Work

Work codes are listed by number within each group. Preventable Crash Decoding is in Appendix C of this document.

100 - Signing and Signals

101 Install Warning/Guide Signs			
Definition:	Provide advance signing for unusual or unexpected roadway features where no signing existed previously.		
Reduction Factor (%):	20%	Maintenance Cost:	0
Service Life (Years):	15	G-Match:	Y
Preventable Crash:	(Vehicle Movements/Manner of Collision = 20-22 or 30) OR (Roadway Related = 2, 3 or 4)		
Required Documents:			
107 Install Traffic Signal			
Definition:	Provide a traffic signal where none existed previously. This does not include the installation of flashing beacons. SPICE and CAP-X analyses are required for all intersection related HSIP project submittals. See TxDOT Chief Engineer June 24, 2024 memo.		
Reduction Factor (%):	20%	Maintenance Cost:	\$3,400 (Isolated) \$3,900 (Interconnected) \$5,400 (Diamond Interchange)
Service Life (Years):	10	G-Match:	Y
Preventable Crash:	[(Intersection Related = 1 or 2) AND (Vehicle Movements/Manner of Collision = 10-39)] OR (First Harmful Event = 1 or 5)		
Required Documents:	Overhead Intersection Layout, Traffic Signal Warrants, SPICE and CAP-X analyses.		

Definition of Terms

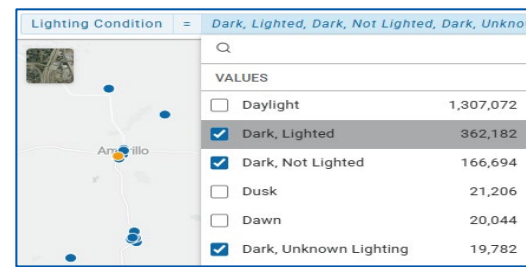
- **Crash Modification Factor (CMF):** ratio of preventable crashes after installation of safety countermeasure(s) / preventable crashes before installation of safety countermeasure(s)
 - Example: 100 crashes over a 3-year period before construction (denominator), 68 crashes over a 3-year period after construction (numerator) → $CMF = 0.68$
- [CMF Clearinghouse](#) website is a primary source for research on the effectiveness of roadway safety countermeasures, that can be used for predictive analysis
- **Crash Reduction Factor (CRF) = $1 - CMF$**
- Example for Safety Lighting:
 $CMF = 0.68 \rightarrow CRF = 1 - 0.68 = 0.32$, or a predicted 32% reduction in preventable crashes

▼ Countermeasure: Install lighting

<input type="checkbox"/>	CMF	CRF(%)	Quality	Crash Type	Crash Severity	Area Type	Reference
<input type="checkbox"/>	0.68	32	★★★★☆	All	All	All	ABDEL-ATY ET AL., 2014

Definition of Terms

- **Preventable Crashes:** A crash with specific circumstances that could have theoretically been prevented by an applicable safety countermeasure
- **Example:** Installing Safety Lighting should theoretically prevent crashes at nighttime
 - Preventable Crash Assessment: Analyze only those crashes which occurred after dark
 - CR-4 Crash Report Form, “Light Condition” field = “Dark, Not Lighted”, “Dark, Lighted”, or “Dark, Unknown Lighting”
 - MicroStrategy and AASHTOWare Safety support this level of crash filtering



The screenshot shows a software interface with a map on the left and a filter table on the right. The map displays a road network with several blue dots representing data points. The filter table is titled 'Lighting Condition' and lists various categories with their corresponding counts. The categories are: Daylight (1,307,072), Dark, Lighted (362,182), Dark, Not Lighted (166,694), Dusk (21,206), Dawn (20,044), and Dark, Unknown Lighting (19,782). The 'Dark, Lighted' and 'Dark, Not Lighted' categories are selected with checkmarks.

Lighting Condition	Count
Daylight	1,307,072
<input checked="" type="checkbox"/> Dark, Lighted	362,182
<input checked="" type="checkbox"/> Dark, Not Lighted	166,694
Dusk	21,206
Dawn	20,044
<input checked="" type="checkbox"/> Dark, Unknown Lighting	19,782

What's TxDOT's Work Code Combo Calculator?

- Intuitive spreadsheet tool developed to calculate the crash reduction of multiple countermeasures.
- End User
 - TxDOT Safety Division & District Staff
- Primary Use
 - Used in Benefit-Cost Analysis to justify HSIP Project Funding

Work Code Combo Calculator



2026 Program Call HSIP Project Submission Form

(UTP 2027 - TRF 2027 Sub-Program)

Typical Bid Item Specs

- 500 MOBILIZATION
- 502 BARRICADES, SIGNS, AND TRAFFIC HANDLING
- 506 TEMPORARY EROSION, SEDIMENTATION, AND ENVIRONMENTAL CONTROLS
- 618 CONDUIT
- 620 ELECTRICAL CONDUCTORS
- 624 GROUND BOXES
- 636 SIGNS
- 644 SMALL ROADSIDE SIGN ASSEMBLIES
- 654 SIGN WALKWAYS
- 656 FOUNDATIONS FOR TRAFFIC CONTROL DEVICES
- 666 RETROREFLECTORIZED PAVEMENT MARKINGS
- 678 PAVEMENT SURFACE PREPARATION FOR MARKINGS
- 680 HIGHWAY TRAFFIC SIGNALS
- 681 TEMPORARY TRAFFIC SIGNALS
- 682 VEHICLE AND PEDESTRIAN SIGNAL HEADS
- 684 TRAFFIC SIGNAL CABLES
- 685 ROADSIDE FLASHING BEACON ASSEMBLIES
- 686 TRAFFIC SIGNAL POLE ASSEMBLIES
- 687 PEDESTAL POLE ASSEMBLIES
- 688 PEDESTRIAN AND VEHICLE DETECTORS

SAVE FORM 2026_AUS_

MANUAL

Proposal Information

District County

Comments

Project Work Codes* *Can include up to 8 work codes as scope of project

133 Improve School Zone	
108 Improve Traffic Signals (Hardware)	
115 Install Pedestrian Countdown Timer	
410 Install Dedicated Bicycle Lanes	

Supervised By

Roadway Information

Primary Roadway Limits From
Limits To

C-S-J(s)
Beg DFO
End DFO

On or Off System

Length (miles)

Selection Method

Work Code Combo* *See WC Combo RF Calculator tab to determine Top 3 Work Codes & Combo Reduction Factor

133 Improve School Zone	RF	50%
108 Improve Traffic Signals (Hardware)	K	
115 Install Pedestrian Countdown Time	A	
	B	
	SII	

Preferred Letting Letting Fiscal Year

Step 1: Select up to 8 work codes

Combos with 4 or more Work Codes

Work Code Combo
133 108 115 410

RF = 50%

Step 2: Check whether all work codes from Step 1 populated here

Table 1A -- Enter Project-Specific Information	
Total Corridor Length (miles)	Total Number of Intersections
1	2

Step 3: Fill in green input cells and use engineering judgment to designate the Top 3 in the last column when rankings are tied

Table 1B -- Ranking Criteria to Select Most Effective Safety Treatments (ONLY NEEDED FOR COMBOS WITH 4 OR MORE WORK CODES)													
ID	Work Code (WC)	Description	Definition	Reduction Factor (RF)	CMF	Type of Work	Total Length of Improvements (in Miles)	Total Number of Intersections with Improvements	Override % Amount of Work	Calculated Amount of Work done	F*L	Rank (F*L)	TIE BREAKER (USER CHOICE DROP-DOWN)
A	133	Improve School Zone	Improve an existing school zone by upgrading signing, pavement markings or signals.	10%	0.90	Other			100%	100%	0.1	3	Top 3
B	108	Improve Traffic Signals (Hardware)	Improve existing intersection signals to current design standards. Can include replacement of signal heads with retroreflective backplates, as well as upgrading wire signals with mast arms. May also include adding and realigning curb ramps, as well as enhancements to	10%	0.90	Intersection		2		100%	0.1	3	
C	115	Install Pedestrian Countdown Timer	Add pedestrian countdown timer to existing pedestrian signals.	50%	0.50	Intersection		1		50%	0.25	2	Top 3
D	410	Install Dedicated Bicycle Lanes	Restripe existing pavement to provide dedicated space for bike lanes. If widening is needed use in combination with WC's 502-504	27%	0.73	Corridor	1			100%	0.27	1	Top 3

Recommended Reduction Factor

Table 2A -- Top 3 (most effective) Safety Treatments

ID	WC	Description	Definition	RF	CMF
A	133	Improve School Zone	Improve an existing school zone by upgrading signing, pavement markings or signals.	10%	0.90
C	115	Install Pedestrian Countdown Timer	Add pedestrian countdown timer to existing pedestrian signals.	50%	0.50
D	410	Install Dedicated Bicycle Lanes	Restripe existing pavement to provide dedicated space for bike lanes. If widening is needed use in combination with WC's 502-504	27%	0.73

Step 4: Check whether Top 3 work codes populated here

Step 5: Use the recommended CMF/RF based on the most appropriate methodology and engineering judgement

Table 2B -- Summary Results for Combined Effect of Multiple Safety Treatments

Method	Combined CMF	Crash Reduction	Recommended Method based on Magnitude	Recommended Method based on Overlap	Combined CMF	Reduction Factor
Additive Method	0.13	87%			0.50	50%
Dominant Effect	0.50	50%				
Dominant Common Residual TSAP	0.57	43%				
Dominant Common Residual FHWA	0.69	31%				
<small>Note: The "X" mark indicates which method to rely on based on FHWA guidance (Magnitude & Overlap); however, if all methods include "X" mark select the value with lowest reduction. The user may use Engineering Judgement to select the final combined CMF value.</small>						

Backend Calculation to find overlapping percentage per crash contributing factor

Table 2C-- Overlap Percentage for Preventable Crash Codes

Work Code (WC)	Manner of Collision	Roadway Related	First Harmful Event	Intersection Related	Light Condition	Object Struck	Surface Condition	Contributing Factor	Part of Roadway No. 1 Involved	Vehicle Body Style	Roadway Part
A	0	0	0	0	0	0	0	0	0	0	0
B	0	0	1	0	0	0	0	0	0	0	0
C	0	0	5	0	0	0	0	0	0	0	0
Overlap %			0%								
Overall Overlap %	0%										

Combined CMF Methodology

		Magnitude	Overlap
Multiplicative Method	$CMF_{Combined} = CMF_1 \times CMF_2$	One or more CMFs > 1.0	N/A
Additive Method	$CMF_{Combined} = 1 - [(1 - CMF_1) + (1 - CMF_2)]$	Both < 1.0	Zero Overlap
Dominant Effect Method	$CMF_{Combined} = CMF_1$	Both < 1.0	Complete Overlap
Dominant Common Residuals Method	$CMF_{Combined} = (CMF_1 \times CMF_2)^{CMF_1}$	Both < 1.0	Some Overlap

Notes: CMF_1 = lowest CMF Value

A CMF is considered independent of another CMF if there is no overlap in their **target crash type and/or crash severity.**

Example - Spreadsheet Walk-through (version 1.0)

Next Steps (version 2.0)

- Integrating the “proportion” of total crashes that are preventable for each WC
- Revision planned for the next TxDOT HSIP update (Sept 2026)
- Example: WC Combo with 107 Traffic Signal (20% RF) and 407 Sidewalk (50% RF)
 - Version 1.0 produces a combined reduction factor of 50% based on Dominant Effect
 - Version 2.0 produces a combined reduction factor of 25%, interpolating between Additive Method (for mutually exclusive crash types) and Dominant Effect (for complete overlap of preventable crash types between 2-3 countermeasures)
- Installing a Traffic Signal is intended to prevent Intersection crashes (35% of all crashes), and Installing a Sidewalk is intended to prevent Ped/Bike crashes (1.6% of all crashes)
- $35 / 1.6 = \text{about } 22$ intersection crashes occur for every 1 ped/bike crash

Next Steps (version 2.0)

- $35 / 1.6 =$ about 22 intersection crashes occur for every 1 ped/bike crash
- The total subset of preventable crashes in this combo (Intersection + Ped/Bike) should be weighted more towards Intersection crashes and the 20% crash reduction resulting from installing a traffic signal
- Proportionality equation from [Utah DOT](#)
 - $CMF_{total} = (CMF_{specific} - 1) \times P + 1$
 - Traffic Signal (Intersection crashes) $CMF_{total} = (0.80 - 1) \times 0.35 + 1 = 0.93$ (7% RFp)
 - Sidewalks (Ped/Bike crashes) $CMF_{total} = (0.50 - 1) \times 0.0164 + 1 = 0.9918$ (0.82% RFp)
- The RFp's can be used to rank combos with more than 3 work codes (version 1.0 has bias towards the highest RF's regardless of crash proportionality)

Next Steps (version 2.0)

- Additive Method: $RF_{\text{combo}} = RF_1 + RF_2 \dots\dots$ but now adjust for proportionality
- $$\frac{RF_1 \times P_1}{P_1 + P_2} + \frac{RF_2 \times P_2}{P_1 + P_2} = \frac{0.20 \times 0.35}{0.35 + 0.0164} + \frac{0.50 \times 0.0164}{0.35 + 0.0164} = 21\%$$
- 21% crash reduction with the Additive Method (assumed mutually exclusive or 0% overlap in preventable crash types)
- Is this true? Let's simulate with a crash set of:
3500 intersection crashes and 164 ped/bike crashes (3664 pre-construction)
 $3500 \times 0.80 + 164 \times 0.50 = 2882$ crashes post-construction
 $2882 / 3664 = 21\%$

Next Steps (version 2.0)

- The spreadsheet calculates a 6% overlap in the crash types between Intersection crashes (some of which will involve ped/bike) and the Ped/Bike crash set which is exclusive to the Sidewalk countermeasure
- The spreadsheet maintains the Dominant Effect of 50%, which creates a range of interpolation between 21% and 50%.
- The result is a final WC Combo Reduction Factor of 23%

Table 2A -- Top 3 (most effective) Safety Treatments

ID	WC	Description	Definition	RF	CMF	RFp	CMFp	RFb	CMFb	F _{3p}
A	107	Install Traffic Signal	Provide a traffic signal where none existed previously. This does not include the installation of flashing beacons. SPICE and CAP-X analyses are required for all intersection related HSIP project submittals. See TxDOT Chief Engineer June 24, 2024 memo.	20%	0.80	6.99%	0.9301	6.99%	0.9301	25.0%
B	407	Install Sidewalks	Install new sidewalks where none currently exist including the extension of existing sidewalks. Widening existing sidewalks is not eligible.	50%	0.50	0.82%	0.9918	0.82%	0.9918	16%
C		#N/A	#N/A	0%	1.00					#N/A

Table 2B -- Summary Results for Combined Effect of Multiple Safety Treatments

Method	Combined CMF	Crash Reduction	Recommended Method based on Magnitude	Recommended Method based on Overlap%	Recommended Combined CMF	Recommended Reduction Factor
Additive Method	0.79	21%			0.77	23%
Dominant Effect	0.50	50%	X	X		
Dominant Common Residual TSAP	0.63	37%		X		
Dominant Common Residual FHWA	0.63	37%		X		
Note: The "X" mark indicates which method to rely on based on FHWA guidance (Magnitude & Overlap); however, if all methods include "X" mark select the value with lowest reduction . The user may use Engineering Judgement to select the final combined CMF value.						

Table 2C -- Overlap Percentage for Preventable Crash Codes

Work Code (WC)	Manner of Collision (30)	Roadway Related (4)	First Harmful Event (5)	Intersection Related (4)	Light Condition	Object Struck	Surface Condition	Contributing Factor	Part of Roadway No. 1 Involved	Vehicle Body Style	Roadway Part
A - 107 Install Traffic Signal	10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38	0	1,5	1,2	0	0	0	0	0	0	0
B - 407 Install Sidewalks	0	0	1,5	0	0	0	0	0	0	0	0
Overlap %	0%		100%	0%							
Overall Overlap %											6%

Next Steps (version 2.0)

- Further considerations: More detailed weighting for each possible preventable crash value.
- Example: Determine how common each Manner of Collision is relative to First Harmful Event = 1 (Pedestrian) or 5 (Pedalcyclist), etc

Work Code (WC)	Manner of Collision (30)	Roadway Related (4)	First Harmful Event (5)	Intersection Related (4)
A - 107 Install Traffic Signal	10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39	0	1,5	1,2
B - 407 Install Sidewalks	0	0	1,5	0

- Balance accuracy with practicality (added complexity may not significantly improve the accuracy of any given combo reduction factor)
- Back-test and re-calculate HSIP projects that have already been approved but have not let yet

Thank You!

Questions?

