Technical Circular T-01/22
Date: May 18, 2022

To: All HQ Directors: Operations, Planning and Major Projects
All Executive Directors
All Directors, Integrated Transportation & Infrastructure Services Division
All Regional Project Managers
All District Managers

Subject: **Collision Prediction Models and Collision Modification Factors for British Columbia**

Purpose:

This Technical Circular supersedes the Technical Circular (T-04/09) effective immediately. This Technical Circular provides the updated collision prediction models (CPMs) and collision modification factors (CMFs) to be used for the Ministry. These CPMs and CMFs were developed for British Columbia (BC) highways to improve the overall safety performance estimate for road safety analysis.

Background:

CPMs and CMFs are essential for road safety evaluation and analysis. The Ministry has been using two documents, namely, (1) ***Collision Prediction Models for British Columbia, December 2008*** and (2) ***Collision Modification Factors for British Columbia, December 2008*** by Dr. Tarek Sayed and Dr. Paul de Leur since 2009.

The first document (***Collision Prediction Models for British Columbia, December 2008***) describes and presents a set of CPMs developed using the BC provincial highway collision data and can be used to estimate the safety performance of various types of provincial highway segments and intersections. However, the CPMs found in this document are outdated. The models represent a collision data period no longer indicative of the current safety performance and trends. In addition, the developed CPMs involve collisions of all severity levels, including fatal, injury, and property-damage-only (PDO) collisions. In recent years, the police reporting of PDO collisions has substantially changed, making these collisions under-reported and unreliable, therefore inadequate input for developing CPMs. As such, the CPMs are updated using the most recent data (2016-2020) of police-attended serious (fatal and injury) collisions and listed in this Technical Circular. Specifically, these models replace the CPMs found in **Section 2**, **Section 3**, and **Appendix C** of the document "***Collision Prediction Models for British Columbia, December 2008***".

The second document (***Collision Modification Factors for British Columbia, December 2008***) provides the relationships between road design elements and the resulting impact on safety performance. This document remains unchanged and serves as a reference for assessing highway safety improvements on BC highways.

The two documents referenced above are available at the following URL:
https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/traffic-engineering-safety

Scope and Application:

CPMs and the CMFs listed in this circular are to be used for safety analysis when required in planning, design, and operational studies.

1. Collision Prediction Models

CPMs are developed for several types of highway segments and intersections using the most recent data (2016-2020) of police-attended serious collisions (fatal and injury). The functional model forms are:

Segment Model Form: $E(\Lambda) = a_0 V^{a_1} L^{a_2}$

Intersection Model Form: $E(\Lambda) = a_0 {V_1}^{a_1} {V_2}^{a_2}$

Where,
- $E(\Lambda)$ = collision frequency (number of collisions per 5 years)
- L = segment length in kms
- V = annual average daily traffic (AADT) of the segment
- V_1 = AADT entering the intersection from the major roadway
- V_2 = AADT entering the intersection from the minor roadway
- a_0, a_1, a_2 = model parameters

1.1. Highway segment models

A total of ten CPMs are developed for highway segments, representing the following highway classifications:

- Rural Arterial Divided Four-Lane Highways (RAD4)
- Rural Arterial Un-Divided Two-Lane Highways (RAU2)
- Rural Arterial Un-Divided Four-Lane Highways (RAU4)
- Rural Expressway Divided Four-Lane Highways (RED4)
- Rural Freeway Divided Highways (RFD4)
- Urban Arterial Divided Four-Lane Highways (UAD4)
- Urban Arterial Un-Divided Two-Lane Highways (UAU2)
- Urban Arterial Un-Divided Four-Lane Highways (UAU4)
- Urban Expressway Divided Four-Lane Highways (UED4)
- Urban Freeway Divided Highways (UFD4)

The table below provides the updated parameters for the highway segment models.

CPMs for Highway Segments							
Model#	**Highway Class**	**Collision Severity**	a_0	a_1 **AADT**	a_2 **Length**	K **Dispersion Parameter**	**AADT Max***
1	RAD4	Severe	0.009354	0.5507	0.9010	2.424	45,000
2	RAU2	Severe	0.001033	0.8042	1.0348	1.557	30,000
3	RAU4	Severe	0.117530	0.2426	1.0276	1.768	35,000
4	RED4	Severe	0.000130	0.9887	0.7359	1.649	45,000
5	RFD4	Severe	0.001045	0.8261	0.9816	2.479	65,000
6	UAD4	Severe	0.000222	0.9053	0.7232	1.165	55,000
7	UAU2	Severe	0.005992	0.5671	0.8658	0.783	30,000
8	UAU4	Severe	0.000125	1.0000	0.8690	0.540	60,000
9	UED4/ UFD4	Severe	0.000156	0.9956	1.0636	1.687	120,000

** This is the maximum AADT value in the data used to develop the CPMs. Using AADT values significantly higher than this value may lead to inaccurate collision prediction results.*

1.2. Highway intersection models

CPMs of signalized intersections have been updated. A total of five models are developed, representing the following types of signalized intersections:

- All signalized intersections (3-leg and 4-leg combined)
- 4-leg signalized intersections (urban and rural combined)
- 3-leg signalized intersections (urban and rural combined)
- 4-leg rural signalized intersections
- 4-leg urban signalized intersections

The table below provides the updated parameters for the signalized intersection models.

CPMs for Signalized Intersections						
Model#	**Type of Signalized Intersections**	**Collision Severity**	a_0	a_1 **Major AADT**	a_2 **Minor AADT**	K **Dispersion Parameter**
10	All	Severe	0.000755	0.8314	0.1009	3.699
11	4-Leg	Severe	0.000583	0.8390	0.1300	4.381
12	3-Leg	Severe	0.000677	0.8229	0.0863	4.118
13	4-Leg Rural	Severe	0.000737	0.8192	0.1362	4.445
14	4-Leg Urban	Severe	0.000077	0.8804	0.3014	3.367

CPMs for un-signalized intersections will be updated as data becomes available. CPMs provided in the previous Technical Circular (T-04/09) are outdated and should not be used.

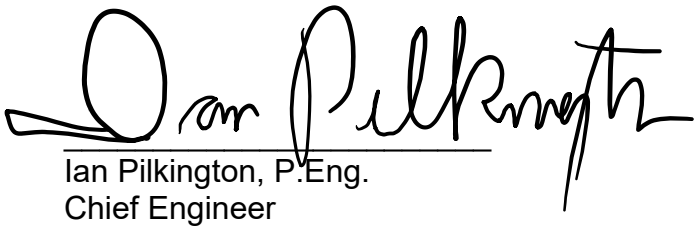
2. Collision Modification Factors

A CMF is simply a multiplicative factor used to reflect the expected change in safety performance associated with the corresponding change in highway design and/or the traffic control feature. There are various CMFs for different types of improvements to roads for both cross-sectional design elements and longitudinal design elements. Examples of cross-sectional design elements are lane width, shoulder width, shoulder rumble strips; and examples of longitudinal design elements include horizontal alignment, vertical alignment, passing lane, etc.).

The document (***Collision Modification Factors for British Columbia, December 2008***) identifies the specific CMFs, and their values, which are to be used when evaluating the predicted safety effect of proposed changes to highway infrastructure. Other CMFs may be considered if specific CMFs developed for British Columbia are not available or do not seem appropriate for the required analysis. Other CMFs must be approved by the Ministry Principal Highway Safety Engineer before they are applied.

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