

To: All HQ Directors: Operations, Planning and Major Projects
All Regional Directors
All Regional Managers, Engineering
All District Managers, Transportation
All Regional Traffic Engineers

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

Purpose:

The purpose of this Technical Circular is to define the collision prediction models (CPMs) and the collision modification factors (CMFs) to be used for the Ministry. These CPM's and CMF's have been developed for British Columbia highways to improve the overall safety performance estimate for road safety analysis.

Background:

Historically, collision rates have been used as the basis for safety analysis. Research has shown that there are limitations with this approach due to the non-linear relationship between collision frequency and exposure and other related limitations. Collision prediction modeling will be the recommended technique for estimating road safety in the FHWA's Highway Safety Manual, anticipated to be released in 2009.

Two documents have been prepared, namely, *Collision Prediction Models for British Columbia* and *Collision Modification Factors for British Columbia*, December 2008, by Dr. Tarek Sayed, University of British Columbia, and Dr. Paul de Leur, de Leur Consulting Limited.

The *Collision Prediction Models for British Columbia* report describes and presents a set of CPMs that were developed using the BC highway collision data, which can be used to estimate the safety performance of major types of provincial highway segments and intersections in British Columbia.

The *Collision Modification Factors for British Columbia* report provides the relationships between road design elements and the resulting impact on safety performance. This document serves as a reference document for assessing highway safety improvements on British Columbia highways.

Scope and Application:

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

The *Collision Modification Factors for British Columbia Report* identifies the specific CMF's, 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. These CMFs must be approved by the Ministry and the CMF Review Committee before they are applied. Contact the Senior Highway Safety Engineer.

CPMs should be considered for location specific prediction, identification of collision-prone locations, ranking the identified collision-prone locations, and before and after safety evaluation. Additional information on the application including worked out examples are provided in the report entitled *Collision Prediction Models for British Columbia*.

1. Collision Prediction Models

Models are developed for nine different types of highway segments and six different types of intersections as listed below. Within each category, two models are developed, including a property damage only model (PDO) and a severe collision model (i.e., fatal + injury). Stop controlled intersections have a total model (i.e., PDO + Injury + fatal). The functional model forms are:

Segment Model Form:
$$E(\Lambda) = a_0 V_1^{a_1} L_1^{a_2}$$

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

where, $E(\Lambda)$ = collision frequency (collisions/5yrs in this case)
 L = section length
 V = section annual average daily traffic (AADT)
 a_0, a_1, a_2 = model parameters (shown in the Collision Prediction Models for BC document on a per model basis)

1.1 Highway Segment Models

1. Rural Arterial Un-Divided Two-Lane Highways (RAU2)
 - a. PDO Collision Model
 - b. Severe Collision Model

2. Rural Arterial Un-Divided Four-Lane Highways (RAU4)

- a. PDO Collision Model
- b. Severe Collision Model

3. Rural Arterial Divided Four-Lane Highways (RAD4)

- a. PDO Collision Model
- b. Severe Collision Model

4. Rural Freeway Divided Highways (RFD4)

- a. PDO Collision Model
- b. Severe Collision Model

5. Urban Arterial Un-Divided Two-Lane Highways (UAU2)

- a. PDO Collision Model
- b. Severe Collision Model

6. Urban Arterial Un-Divided Four-Lane Highways (UAU4)

- a. PDO Collision Model
- b. Severe Collision Model

7. Urban Arterial Divided Four-Lane Highways (UAD4)

- a. PDO Collision Model
- b. Severe Collision Model

8. Urban Expressway Divided Four-Lane Highways (UED4)

- a. PDO Collision Model
- b. Severe Collision Model

9. Urban Freeway Divided Highways (UFD4)

- a. PDO Collision Model
- b. Severe Collision Model

1.2 Highway Intersection Models

1. ALL Signalized Intersections

- a. PDO Collision Model
- b. Severe Collision Model

2. Four-Leg Signalized Intersections

- a. PDO Collision Model
- b. Severe Collision Model

3. Three-Leg Signalized Intersections

- a. PDO Collision Model
- b. Severe Collision Model

4. ALL Stop-Controlled Intersections

- a. TOTAL Collision Model

5. Four-Leg Stop-Controlled Intersections

- a. TOTAL Collision Model

6. Three-Leg Stop-Controlled Intersections

- a. TOTAL Collision Model

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 selection of CMFs included in the Collision Modification Factors for British Columbia document are relevant to British Columbia in each of the road facility:

1. Two-Lane Highways
2. Multi-Lane Highways
3. Urban Streets
4. Rural Intersections
5. Urban Intersections
6. Pedestrian Facilities

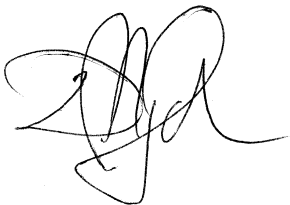
Refer to the *Collision Modification Factors for British Columbia* document for selection of CMFs.

The CPM and CMF reports referenced above are available at the following URL:

http://www.th.gov.bc.ca/publications/eng_publications/eng_pubs.htm#safety

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