Development of Crash Modification Factors for Use on Provincial Highways in Ontario

Research for the Ministry of Transportation, Ontario Highway Infrastructure Innovation Funding Program (HIIFP)
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Crash modification factor (CMF)

A CMF is used to compute the expected number of crashes after implementing a countermeasure on a road or intersection.

For example:
CMF = 0.8 20% expected reduction in crashes.

There are many CMFs in the Highway Safety Manual and on the CMF Clearinghouse
Most are single valued – is that reality?

Also, can we generalize any CMFs to different jurisdictions?

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Background for new HIIFP project

MTO has been applying the AASHTO *SafetyAnalyst* software for all aspects of safety management including the evaluation of implemented treatments.

However, there is a need to
a) Obtain CMFs that are not currently configured in the software
b) Calibrate some key CMFs for application to Ontario highways

A recently completed Ryerson HIIFP project addressed CMFs pertaining to the following six treatments:
1) flattening horizontal curves; 2) flattening vertical curves;
3) extending speed change lanes; 4) extending passing lanes;
5) extending truck climbing lanes; and 6) installing rumble strips.

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2018 HIIPF Graduate Student Research Components

1. Develop additional crash modification functions (Alireza Jafari (me))

2. CMFs for combination treatments (me and Mark Eskandar)

3. Safety effects of rumble strips (Mark Eskandar)

4. Safety effects of providing adequate length left turn lanes at signalized intersections (Nima Farid)

5. Safety effects of improving pavement surface (Iliya Nemtsov)

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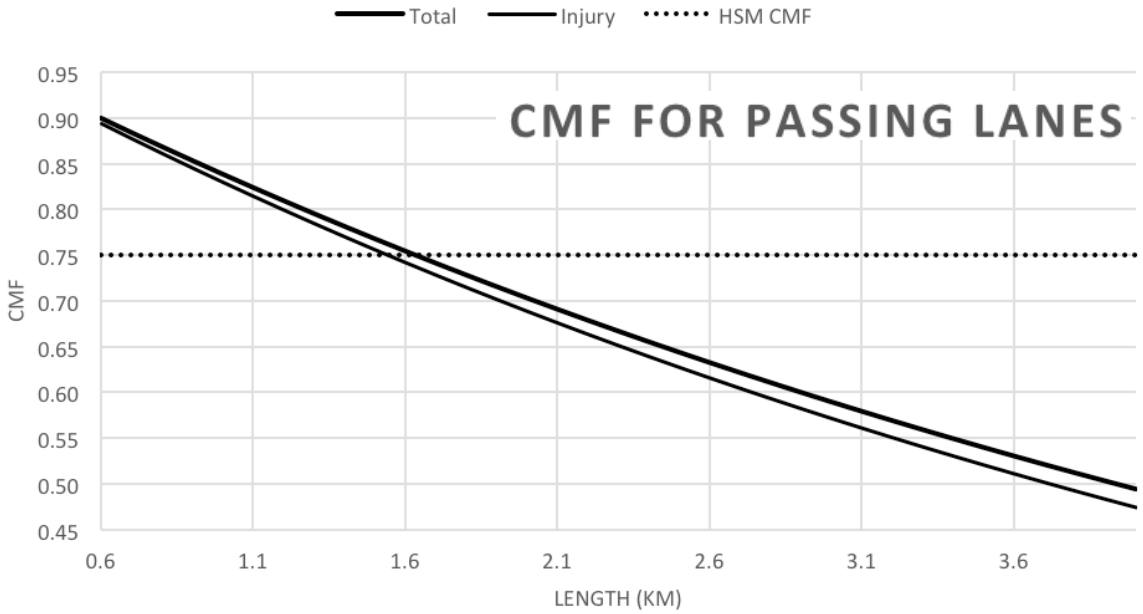
Component 1: Crash Modification Functions

For example, it was found that the CMF for installing a passing lane is not constant but decreases with increasing length.



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Preliminary Candidates for Developing other Crash Modification Functions

SEGMENT TREATMENTS

- Changing median width
- Changing lane width
- Changing shoulder width
- Changing shoulder type
- Freeway on-ramp density
- Changing number of lanes
- Installation of cable median barrier

INTERSECTION TREATMENTS

- Converting unsignalized intersections to signalized
- Converting 4 leg intersections into 3 leg intersections
- Installing left or right turn lanes at intersections

Component 2: CMF for combination treatments

- The Issue:
  - With current guidance, e.g., in the Highway Safety Manual, the CMF for two combined treatments with individual CMFs of 0.8 and 0.7 = 0.8 x 0.7 = 0.56;
    - Adding two more treatments with similar effects gives a CMF of 0.31
  - Most engineers believe this multiplicative process overestimates the benefit of the combined treatment – does not make sense that applying enough treatments will almost eliminate crashes!
- How to resolve:
  - Apply and test heuristic procedures recently developed in NCHRP Project 17-63 for combinations of interest to MTO, e.g.,
    - Combination of centre-line and shoulder rumble strips (Component 3)
    - Left turn lanes and protected left turn phase at signalized intersections
    - Other -- TBD

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Component 3: Developing Rumble Strip CMFs for Ontario

Crash Data

Data found for 2-lane highways with edgeline and centreline rumble strips

Using a GLM to find an SPF

SPFs determined for total, fatal, and injury collisions as well as approach and sideswipe crash types.

Use EB Method to find CMFs

EB Method used to find CMFs for the specified crash severities and types based upon AADT and length of treatment.

- CMFs will be developed for centre line and shoulder rumble strips and separately for curves and tangents
- CMFs will be used in Component 2 research to develop CMF for dual installation

Component 4: Safety effects of providing adequate length of left turn lanes at signalized intersections

- Inadequate left turn lane length creates a safety concern when left turn vehicles spill over into through lanes
- Approach 1:
    - Cross-sectional models relating collisions to length and adequacy of left turn lane used to infer CMFs
- Approach 2:
    - Traffic conflicts related to left turn lanes are being estimated from microsimulation and related statistically to collisions at actual intersections.
    - Traffic conflicts will be generated from hypothetical intersections with various lengths of left turn lanes (adequate and inadequate)
    - The crash-conflict model will be used to estimate CMFs

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Component 5: Safety Effects of IRI on Flexible Highway Pavement

Identifying the effect International Roughness Index (IRI) has on collision frequency could be used as a compliment to the safety treatments or as a treatment in itself.

Created a database merging:
Road Characteristics and 14 years of MVAB collision and MTO pavement management data (2000 to 2013)

Generated preliminary Safety Performance Functions (SPF's) in SAS relating collisions to incorporating Section Length and IRI)

SPFs will be used for inferring effects of IRI from cross-sectional regression and from an empirical Bayes before-after study

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