CITY OF OTTAWA

Pedestrian Safety Field Guide and Workbook

Crosswalks at Intersections

January 2010

Overview

A set of pedestrian safety review field assessment procedures to be used in carrying out road safety reviews at pedestrian intersection crosswalks.

McCormick Rankin Corporation

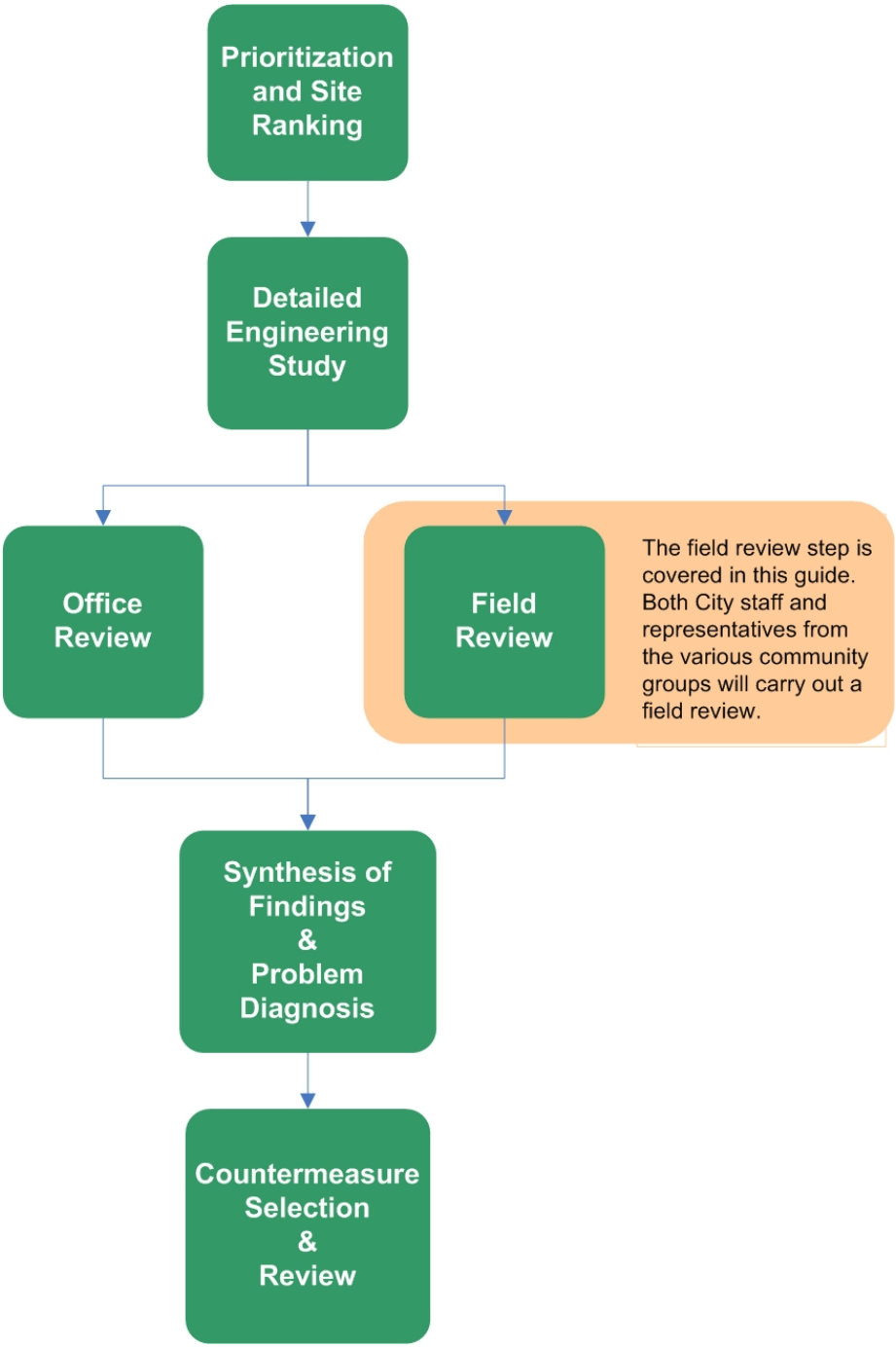
Inside:

Ottawa

delphi MRC

Introduction

This field guide represents a compilation of safety review procedures based on material gleaned from the McCormick Rankin Corporation, Human Factors North, and the Institute of Transportation Engineer's (ITE). The purpose of this document is to assist practitioners and community representatives during the field review component of a detailed engineering study (DES) – one element of an overall safety evaluation program. We have illustrated the City of Ottawa's pedestrian intersection safety program in the Figure to the right in order to provide the reader with an understanding of when and by whom a field review should be conducted. As illustrated in the Figure, both an office and field review will be carried out. This document does not address the need and/or procedures for reviewing plans, specifications, and other documentary evidence that can provide valuable clues to the road safety review team with respect to the road's characteristics and safety-related performance. Such office review processes are generally well understood and need little elaboration since they are primarily oriented to providing "foundation information" about the road being reviewed.



Human Factors

This section is a representative summary of material prepared by Human Factors North. The complete materials can be found in the Technical Foundations Report submitted to the City of Ottawa.

Road users, whether pedestrians, drivers or cyclists, make frequent mistakes because of human physical, perceptual and cognitive limitations. These mistakes seldom result in crashes because we compensate for them on time or because the circumstances are forgiving. Near misses, or conflicts are vastly more frequent than crashes. As a result, intersection design and traffic controls can have major impacts on road safety. There is potential to reduce the probability of errors by improving an intersection design that accounts for varied visual, information processing and motor skills of both pedestrians and drivers.

What is needed?

In the process of negotiating any intersection, road users are required to:

- Detect the intersection;
- Identify if there are traffic signals and an appropriate path;
- Search for oncoming vehicles, pedestrians or bicycles;
- Assess whether there is time to cross or traverse the intersection to avoid an oncoming vehicle/pedestrian/bicycle;
- Cross successfully.

Thus intersections place high demands in terms of visual search, gap estimation and decision–making requirements. We must keep this in mind when conducting a field review of intersection crosswalks. Our advice: view the situation from not only the pedestrian's viewpoint, but the driver's as well.

Human limitations: the driver perspective

Human attention and the ability to process information is limited. These limitations can create difficulties for drivers because driving requires the division of attention between:

- Controlling the vehicle (maintaining speed and lane position);
- Guiding the vehicle (interacting with other vehicles);
- Navigating the vehicle (reading signs and using landmarks)

In addition to these tasks, drivers at intersections must be aware of others such as pedestrians and bicyclists. Reducing the effort required by drivers is one way to improve safety for intersection users. This can be achieved through improved design considerations that include:

- Presenting information in a consistent manner;
- Presenting information sequentially, rather than all at once;
- Ensuring that drivers are not overloaded with information at a given time

In addition to information processing limitations, research has identified that drivers' attention is not fully under their conscious control. For drivers with some degree of experience, driving is a highly automated task. That is, driving can be performed while a driver is engaged in thinking about other matters. The less demanding the driving task, the more likely it is that a driver's attention may wander. This presents a significant safety risk for pedestrians at intersections.

Other human limitations that need to be considered include:

- Vision – this includes acuity, contrast sensitivity, peripheral vision, movement depth

perception and visual search abilities.

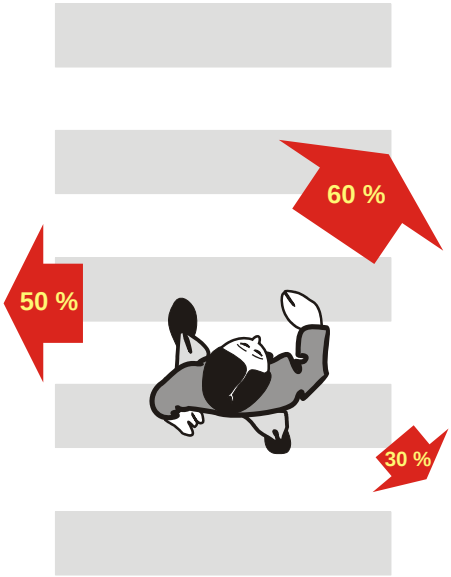
- Perception and reaction time – this includes the driver's ability to detect an obstacle or pedestrian, process the information, and initiate the appropriate response.
- Speed – a large component of road safety risk centres around a vehicle's speed. When a collision occurs, the higher the speed the more likely a fatality or serious injury will result. Research tells us that speed limit signs are not the only factor in a driver's speed choice. Speed choice is very much a function of the roadway or intersection environment and how "comfortable" it is to drive.

Human limitations: the pedestrian perspective

One of the most frequently identified causes of pedestrian crashes is improper crossing of the roadway or intersection. Pedestrians who dart out in mid-block, who cross against traffic signals, or who attempt to cross freeways, are engaged in behaviours that do not comply with traffic laws.

Pedestrians may cross improperly due to an inadequate "search." One study found that 8 to 25 percent of pedestrians did not look for threats. Search varied with respect to the three types of threats: vehicles coming from behind, vehicles coming from the side, and vehicles coming from ahead.

The diagram below shows how limited our search is in each of these directions.



A 1997 study showed that we often do a poor job of assessing the risks as we cross the street. Most people look ahead, but less than one in three look behind them as they cross. Only one in two look from side to side.

In right-turning crashes, pedestrians and drivers have been found to be equally guilty of failure to search. In left-turning crashes, drivers are more frequently found at fault, likely because the left-turn is more visually demanding than the right-turn.

Pedestrians may cross improperly due to insufficient gaps in traffic. One researcher analyzed pedestrian behaviour at pedestrian crossings, examining a broad range of road user and roadway factors, and discovered that the amount of time that a pedestrian must wait to cross the first half of a divided street is linked to the risk that they will cross the second half when it is potentially unsafe (i.e., the longer they wait, the more likely they will take risks).

Another study found that the crossing gap varied with crossing distance and walking speed. For a walking speed of 1.1 metres per second (m/s), the lowest gap acceptance (defined as the 85th percentile gap) varied from 8.5 seconds for a crossing distance of 9 metres to 14.5 seconds for a crossing distance of 15 metres. For a four lane road, the 85th percentile gap accepted would be equivalent to 10 seconds. These gaps are shorter than that required based on reaction time, walking speed and safety margin, and likely reflect pedestrian expectations that vehicle operators will slow if necessary to allow them to complete their crossing.

Pedestrians who make improper crossings can easily surprise

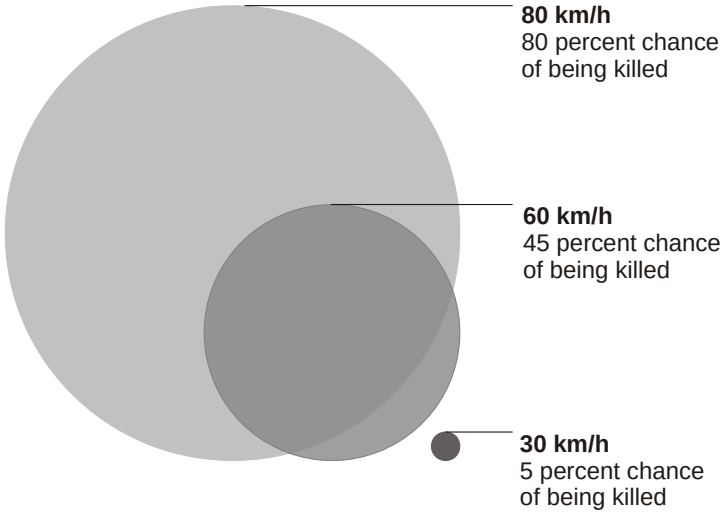
drivers, putting them in the position of being unable to respond in time. When a clearly visible pedestrian suddenly steps into the lane from the curb, drivers will need about 1.0 to 1.6 seconds to initiate a braking response. When visibility is poor, this may take considerably longer.

A pedestrian who dashes across the roadway moves at 3 to 4 m/s, and so can move across one and a half lanes in the time it takes a driver to take evasive action. At 50 km/h the total distance required for perception, reaction and braking is a minimum of 25 metres. A pedestrian who steps out when a vehicle is closer than this distance is highly likely to be hit and, in triggering an emergency stop, could also cause a rear-end crash. Stopping distances are substantial, especially from high speeds, and pedestrians may over-estimate a driver's ability to stop.

Even when pedestrians have the right of way at a marked crosswalk, they can put drivers in an impossible situation. Drivers are legally required to stop when a pedestrian signal at a crosswalk is activated or the pedestrian makes clear his or her intention to cross. While some drivers do not stop even if they can, others may simply not be able to. The demands on a driver at a marked crosswalk are much more difficult than at a traffic signal. A traffic signal provides a yellow (or amber) warning signal of several seconds duration to warn drivers before turning red. This allows drivers who are too close to the intersection at the light change to continue through the intersection, while drivers further away have sufficient time to decelerate comfortably, and without risking a rear-end crash. There is no warning interval at a crosswalk. A pedestrian who steps out when the vehicle is too close can precipitate a crash.

Pedestrians are at risk because of the time required for drivers to respond and because of the energy involved in collisions, even at low speeds. Relatively small changes in speed can have a large impact on the severity of a pedestrian crash, as shown in the diagram below.

Pedestrians (and cyclists) are often not conspicuous, especially at night. This greatly increases the risk of being hit. Clothing is often dark, providing little contrast against dark backgrounds. Although street lighting helps, it can create uneven patches of light and dark, and pedestrians can be difficult to see at any distance from the light.



A study in 1982 concluded that relatively small changes in speed can have a big impact on the severity of a pedestrian crash.

A word about the Guide and Workbook

In general, the safety review procedures that form the basis of these guidelines address the primary design elements of the crosswalk being reviewed. These are summarized in the table below. For each of the design elements listed in the table, we identify specific details to be examined. These take the form of both "assessment details" and "locational events". The assessment details are simply more detailed components of each design element. The "locational events" are specific locations of certain aspects of the road design and are usually only noted when a GPS/GIS-based road safety review is being undertaken.

The pages that follow provide individual guides to each design element in the Table below and are to be used during a field evaluation of an existing intersection crosswalk.

It is important that these NOT be regarded as "checklists", but rather are guides to help the reviewer ensure consistency. In no way are these guides to be considered a substitute for transportation and road safety knowledge and expertise. They are intended to serve only as guidelines.

The workbook component of this booklet concludes with a place to make notes regarding each element as you review a particular crossing location. A final sheet at the end allows you to consolidate your notes for reporting purposes.

Design Element	*Description (examples)*
Location and environment	*Land use, street class, appurtenances*
The pedestrian crossing	*Distance, markings, median refuge*
Intersection lighting	*Visibility of crosswalk, pedestrians*
Traffic & driver behaviour	*Speed, congestion*
Sightlines and visibility	*Driver and pedestrian visibility*
Signals and push buttons	*Condition, location, timing*
Signs	*Condition, location, clarity, appropriateness*
Curb ramps and corner radii	*Condition and adequacy*
Transit and bicycles	*Presence of stops, bike lanes*

Location and Environment

4

Some questions to consider:

- Are there pedestrians with specials needs?
- Is there a school nearby?
- Is there a crossing guard at this intersection/crosswalk?
- How wide is the intersection?
- Is there a predominant pedestrian user group (i.e. children, teens, etc.)
- Might sun glare pose a visibility issue?

Assessment details	Locational Events
• Intersecting street names and class • Surrounding land use type • Pedestrian comfort level (subjective) • Pedestrian and vehicle volumes (subjective) • Primary pedestrian users (children, elderly)	• Crosswalk direction/orientation • Sidewalk hazard location • Sun glare issues

NOTES

2. Photos—Location and Environment

The surrounding land uses can influence the type of pedestrian users at an intersection. A predominantly residential area with schools or parks may see an increase in small children and adults with strollers using the intersection crosswalks. (McCormick Rankin Corporation)

An example of a special needs user crossing at a signalized intersection. At particularly long crossings or crossings with high traffic volumes and high speeds, special needs users may need assistance from others. (McCormick Rankin Corporation)

Pedestrian Crossing

5

Some questions to consider:

- What is the crosswalk marking configuration (ladder, zig zag, etc.)
- How many lanes are crossed and what type (through or turning lanes)?
- What is the condition of the crosswalk markings?
- Are the crosswalk markings visible to drivers during both day and night?
- Is the crosswalk wide enough for the number of users?
- Are steep grades an issue for pedestrians or mobility impaired?
- Is the crossing direct and intuitive?
- Is there a way to minimize the crossing distance?

Assessment details	Locational Events
• Crossing distance and width • Crosswalk markings/type • Number of vehicle lanes to cross • Grade of street or crosswalk	• Measure crosswalk distance & width • Identify marking configuration • Number of through and turning lanes • Document steep slopes

NOTES

3. Photos—Pedestrian Crossing

An example of a Bronson Avenue intersection crosswalk with enhanced crosswalk markings. This makes the crosswalk more visible to drivers. (McCormick Rankin Corporation)

This photo illustrates a poorly marked, narrow crosswalk on a steep slope. In addition, there doesn't appear to be an adequate pedestrian refuge at the end of the crosswalk. (www.pedbikeimages.org / Dan Burden)

Intersection Lighting

6

Some questions to consider:

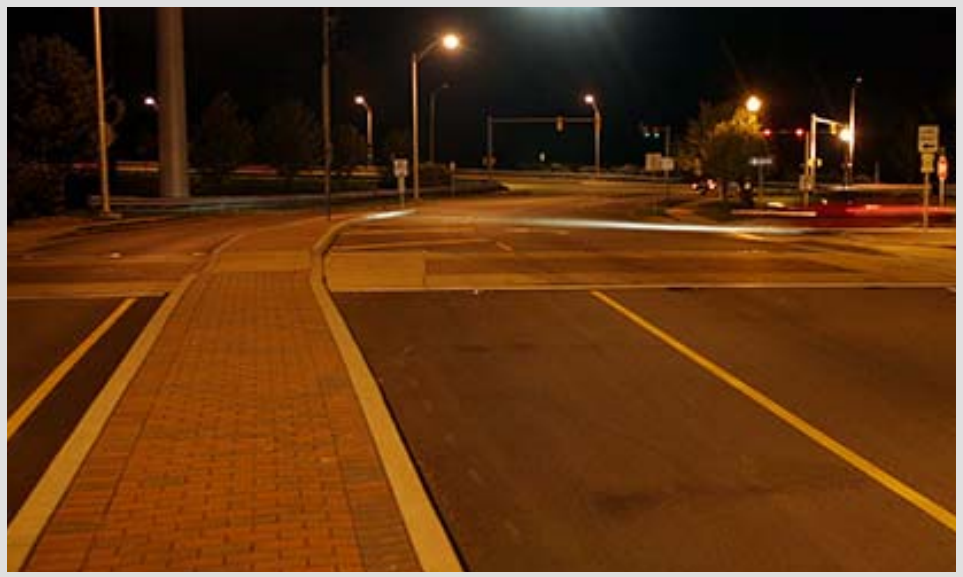
- Are the sidewalks and crosswalks visible at night (from a driver's perspective)?
- Is there adequate lighting at the intersection?
- Is the lighting operational?
- Are the crosswalk signs and traffic control devices visible at night?
- Is there an adjacent light source or backlighting that obscures nighttime visibility?

Assessment details	Locational Events
• Intersection lighting • Crosswalk lighting • Pedestrian visibility at night	• Location of light source at intersection • Location of light source at crosswalk • Visibility review (both drivers & pedestrians)

NOTES

4. Photos—Intersection Lighting

This particular crosswalk has downward lighting from the overhead crosswalk treatment. This helps to highlight the crosswalk location at night but may create "dark" areas at the ends the crosswalk.
(www.flickr.com / photo femme)



Although not at an intersection, this is an example of a well-lit crosswalk with signs that are highly visible.
(www.pedbikeimages.org / Dan Burden)

Traffic and Driver Behaviour

7

Some questions to consider:

- What is the posted speed limit?
- Are vehicle speeds higher than the posted limit?
- Are there traffic calming devices in place to control speeds?
- Is there evidence of erratic driver behaviour such as red light running, illegal passing or driving under the influence?
- Does traffic congestion cause vehicles to block crosswalks?
- Are there driver/pedestrian conflicts for right-turn-on-red movements?
- Are there driver/pedestrian conflicts for right-turn-on-green movements?

Assessment details	Locational Events
• Vehicle speed (subjective) • Erratic driver behaviour • Traffic congestion • Drivers yielding to pedestrians	• Vehicle speeds approaching crosswalk • Posted speed limit: location • Driver/pedestrian conflict review • Vehicles blocking crosswalks • Driver/pedestrian compliance issues

NOTES

5. Photos—Traffic and Driver Behaviour

This is an example of a stop-controlled intersection where drivers are required to pull ahead into the crosswalk to see oncoming traffic. Note the standing water that creates a hazard for pedestrians. (www.pedbikeimages.org / Dan Burden)

This photo illustrates how drivers at Holland Avenue encroach into the crosswalk area when pedestrians are present. At intersections with high volume turning movements (such as right turns) can create potential conflicts between vehicles and pedestrians. (McCormick Rankin Corporation)

Sightlines and Visibility

8

Some questions to consider:

- Are there objects at the side of the street that obscure the visibility of pedestrians (i.e. trees, utility poles, street furniture, transit shelters, snow banks, etc.)?
- Are children visible?
- Is there a horizontal or vertical curve in the roadway that limits sightlines to a crosswalk?
- Can pedestrians see approaching cars?
- Is there on-street parking adjacent to the crosswalk?
- Is the stopping sight distance adequate for the vehicle operating speeds?
- On roadways with multiple lanes in the same direction (i.e. a 4-lane roadway), do vehicles in adjacent lanes block the visibility of crossing pedestrians?

Assessment details	Locational Events
• Roadway alignment • Presence of transit stops • Pedestrian visibility • Driver visibility	• Location of obstacles and hazards • Start/end of on-street parking • Stopping and/or decision sight distances for drivers

NOTES

6. Photos—Sightlines and Visibility

The vegetation planters installed at this Ottawa intersection can easily obscure the driver's view of a pedestrian waiting to cross the street. Can you see the pedestrian on the sidewalk on the right side of the photo? (McCormick Rankin Corporation)

Street appurtenances such as signal poles and signs can obscure the view of pedestrians and drivers. Can you see the pedestrian waiting to cross the street? (McCormick Rankin Corporation)

Signals and Push Buttons

9

Some questions to consider:

- Are there traffic signals at the intersection?
- Are the signals visible to all users?
- Are there pedestrian signals at the intersection/crosswalk?
- Is there adequate crossing time for pedestrians?
- If there is no pedestrian signal, can a pedestrian see the traffic signal lights?
- Are the pedestrian signals audible for special needs users?
- Is there signs/information explaining the flashing "Don't Walk" symbol and/or the pedestrian push button?
- How long is the "Walk" phase and the flashing "Don't Walk" phase for each crosswalk?
- Are there pedestrian push buttons?
- Can you tell which crosswalk the push button is for?
- If there is a centre median, are there push buttons located in the median?
- Is there enough area and refuge at the push button to accommodate a pedestrian in a wheel chair or a pedestrian pushing a stroller?

Assessment details	Locational Events
• Operating condition of signals • Visibility of signals/push buttons • Signal timing	• Location of signal heads • Location of push buttons • Signal timing and phasing sequence

NOTES

7. Photos—Signals and Push Buttons

Supplementary information signs and accessible push buttons (for special needs users) can assist pedestrians. This is an example of a deteriorated push button sign that is poorly located. It would be very difficult for a mobility challenged pedestrian to use this push button—particularly during the winter months. (McCormick Rankin Corporation)

Although not an example in the City of Ottawa, above is a photo of a pedestrian signal head that is not operating. To the left is a photo (at the same intersection) of pedestrian signal heads that are not directed at the pedestrians in the crosswalk and thus are not visible. (McCormick Rankin Corporation)

Signs

10

Some questions to consider:

- Are the sign mounting locations correct?
- Are the signs visible to all users?
- Is the meaning of the signs clear and concise?
- Are there too many signs or redundant signs?
- Do the signs conform to the road agency's standard of practice (i.e. Ministry of Transportation guidelines)?
- Are the signs worn or in poor condition?
- Are there missing signs?
- Are the signs retro-reflective and visible at night?

Assessment details	Locational Events
• Mounting location	• Sign visibility • Retro-reflectivity

NOTES

8. Photos—Signs

Intersection crosswalks that are used by school children may require enhanced or additional signage. The Manual of Uniform Traffic Control Devices for Canada (MUTCDC) requires that all school area signs have a fluorescent yellow-green background. (McCormick Rankin Corporation)

In some locations, such as this location on Jeanne D'Arc Boulevard, additional signage may be required to help make drivers more aware of an upcoming crosswalk. (McCormick Rankin Corporation)

Curb Ramps and Corner Radii

11

Some questions to consider:

- Is the waiting area/refuge large enough to accommodate pedestrians, wheelchairs and strollers?
- Are the corner radii at the pedestrian crosswalks large or small?
- Is there evidence of long vehicles (such as large trucks) mounting the curb and tracking across the sidewalk/refuge area?
- Are vehicle operating speeds high at large radius corners?
- Is there a channelized right turn island at the large radius corners?
- Are there curb ramps provided to transition from the sidewalk to the roadway?
- Is the curb ramp aligned within the crosswalk width or are pedestrians required to move outside the crosswalk markings?
- Is the transition from sidewalk to roadway smooth?
- Does each curb ramp have a level area at the top to accommodate a wheelchair or stroller?
- Do the curb ramps have a texturized surface to assist special needs users in identifying the location of the crosswalk and curb ramp?

Assessment details	*Locational Events*
• Intersection road class (i.e. arterial, collector, etc.) • Roadway width • Turning traffic volume	• Corner radius measurement • Number of lanes to cross • Number of curb ramps • Vehicle turning speeds

NOTES

9. Photos—Curb Ramps and Corner Radii

This Holland Avenue curb extension has a curb ramp to transition from the sidewalk to the pavement. Curb ramps must be designed to accommodate wheelchairs, walkers, strollers and so forth. (McCormick Rankin Corporation)

This curb radius is very small and likely causes drivers to mount the sidewalk—a hazard for pedestrians. In this location there is no curb ramp, making it very difficult to traverse for wheelchairs, walkers, strollers and so forth. (McCormick Rankin Corporation)

Transit and Bicycles

12

Some questions to consider:

- Is the bus stop before or after the intersection?
- Are there crosswalks to access the bus stop?
- Are there sidewalks or pathways to easily access the bus stop?
- Do pedestrians take risks while traveling to/from the bus stop?
- Is there a sufficient landing/refuge at the bus stop?
- Do buses stop in traffic or is there a lay-by to pull over?
- Is there on-street parking in the vicinity of the bus stop?
- Are marked bicycle lanes provided in the roadway?
- Do you observe bicyclists in the roadway? On the sidewalk?
- Are there separate bicycle signal heads at the intersection?
- Are there separate transit priority signal heads at the intersection?

Assessment details	*Locational Events*
• Bus route • Bus stop traffic operations • Bicycle route	• Bus frequency/headway • Bus stop refuge area • Bus lay-by length/width • Bike lane & roadway width

NOTES

CITY OF OTTAWA

Field Notes Summary Sheet

Having completed your evaluation, use this sheet to make a concise consolidation of your findings. Be as clear and precise as you can. Then, take this information and enter it into the City of Ottawa's collaborative web site (http:/www.ottawa .ca) and follow the instructions therein. This will initiate the official review process at this intersection.

Design Element	*Comments*
Location and environment	*Land use, street class, street furniture and utility poles*
The pedestrian crossing	*Distance, markings, median refuge*
Intersection lighting	*Visibility of crosswalk, pedestrians*
Traffic & driver behaviour	*Speed, congestion*
Sightlines and visibility	*Driver and pedestrian visibility*
Signals and push buttons	*Condition, location, timing*
Signs	*Condition, location, clarity, appropriateness*
Curb ramps and corner radii	*Condition and adequacy*
Transit and bicycles	*Presence of stops, bike lanes*

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