RRFB Pedestrian Crossing on Murray Street in the City of Port Moody

Michael Ge, Mark Halpin

Abstract

Pedestrian safety at the crosswalk to Rocky Point Park on Murray Street has been a concern in the City of Port Moody due to high traffic volumes, on-street parking, long pedestrian crossing distance, and multiple business accesses. To respond to public concerns of pedestrian safety, the Mayor has requested a pedestrian safety review study to improve pedestrian safety along this corridor.

Upon detailed review of traffic conditions and pedestrian crossing characteristics, Rectangular Rapid Flashing Beacon (RRFB) was recommended as an innovative, lower-cost pedestrian crossing control device alternative. To further enhance pedestrian visibility and improve driver compliance behavior, two existing pedestrian crosswalks were removed, the eastbound bus stop was relocated, on-street parking was rearranged, and an eastbound left-turn bay was installed. In addition, a raised median was constructed to restrict lane width, reduce vehicle speed, and act as a pedestrian refuge area. RRFBs were also installed on the median to improve drivers’ awareness.

The study found that RRFB improves pedestrian safety at the study corridor by increasing driver yielding compliance, and has received very positive feedback from local residents and businesses. Completed just under $37,000, this project showcases RRFB as a cost-effective alternative to other special pedestrian crosswalks.

Project Background

Prior to the installation of RRFB, two pedestrian crosswalks were provided at the west and east ends of Rocky Point Park (approximately 130 metres apart). However, due to high traffic volumes, long pedestrian crossing distance, vehicle ingress/egress from/to local businesses, and pedestrian crossing disbursed between two crosswalks, pedestrian visibility and reports of driver compliance were low. The study area and two study crosswalks were shown in Figure 1.

As the City received complaints from local businesses and residents regarding pedestrian safety at the crosswalks, in 2010 the City conducted a safety review of pedestrian crossing Murray Street by Rocky Point Park. The study included a pedestrian crossing control warrant analysis based on Pedestrian Crossing Control Manual for British Columbia, Second Edition. It was found that a signed and marked crosswalk was warranted. Through the field review, the study also identified the visibility
of pedestrian and driveway egress as safety issues. The installation of curb extension, use of different street lighting, development of access management plan, and crosswalk relocation were recommended. Following the study, temporary medians consisting of traffic barriers with supplementary crosswalk signage were installed at the west Murray Street crosswalk as a trial crosswalk improvement measure.

As the pedestrian safety concern persists, in 2014 the Mayor requested another pedestrian safety review study. In 2015, ISL Engineering and Land Services (ISL) was retained to update the study findings of the previous safety study, propose pedestrian safety improvement options, and provide detailed design for the study crosswalks.

The objectives of this paper are to conduct pedestrian safety review, propose innovative RRFB design, evaluate RRFB effectiveness, and consolidate public feedback.

**Pedestrian Safety Field Review**

Some vehicular and pedestrian traffic operation and safety issues are listed below (the two crosswalks were shown in Figure 2):

- Closely-spaced driveway accesses on the south side of Murray Street;
- Traffic conflicts between on-street parking, traffic to parking lots of local businesses and Rocky Point Park, crossing pedestrians, and through traffic;
- Cluster of traffic control signs adjacent to the crosswalk;

![Figure 1: Study Area – Murray Street Crosswalks at Rocky Point Park](image-url)
• Transition of westbound single lane to two lanes near the west crosswalk;
• On-street parking on the south side of Murray Street;
• Not a fully-accessible pedestrian facility due to the lack of curb let-down;

Figure 2: Crosswalks Prior to RRFB Installations

Warrant Analysis

The Transportation Association of Canada (TAC) Pedestrian Crossing Control Guide was used to determine the type of pedestrian crossing facility warranted at the study location. The warrant analysis uses a decision support tool that consists of preliminary assessment (to identify necessity) and treatment selection (to determine appropriateness) of the pedestrian crossing control types. Preliminary assessment is used to identify whether there is a need for any pedestrian crossing controls at a study location, which takes account of requirements such as equivalent adult units (EAUs) and annual daily traffic (ADT) volumes, and system connectivity and pedestrian desired lines. Treatment selection is used to indicate the type of pedestrian crossing control system at study location based on factors such as number of lanes (including pedestrian refuge) and speed limit, additional to the ADT.

Pedestrian and vehicular traffic volume was obtained from the 2010 Pedestrian Safety Report and projected to 2015 traffic volume based on an estimated annual growth rate of 2% (linear). The volumes for vehicular and pedestrian traffic (Equivalent Adult Unit – EAU) during peak hours were summarized in Table 1. A Special Crosswalk is warranted for the study location.

Table 1: Vehicular and Pedestrian Traffic Volume at the Study Area

<table>
<thead>
<tr>
<th>Volume Peak Hour</th>
<th>Vehicle Two-Way</th>
<th>Pedestrian Children</th>
<th>Pedestrian Seniors</th>
<th>Pedestrian Physically Challenged</th>
<th>Adults</th>
<th>Total EAUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>1,725</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>22</td>
<td>27.5</td>
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<tr>
<td>PM</td>
<td>2,116</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>20</td>
<td>26.0</td>
</tr>
</tbody>
</table>
Rectangular Rapid Flashing Beacon (RRFB) Design

The option of installing Rectangular Rapid-Flash Beacon (RRFB) was considered. According to the ITE Journal (Rapid-Flash Beacons for Pedestrian Treatments by Kay Fitzpatrick, Ph.D., P.E., Ann Do, P.E., and Bruce Friedman, P.E.) published in December 2014, the pedestrian-activated RRFB consists of two rapidly flashing rectangular yellow indications with light-emitting diode (LED) array-based pulsing light sources (Figure 3).


Figure 3: RRFB with Solar Power Panel

The major changes associated with the new crosswalk are listed as below:

- Remove the existing two marked crosswalks and install a new marked crosswalk at the Rocky Point Park main entrance (east side) to prevent vehicles from stopping twice in a short travel distance (Figures 4.a and 4.b);
- Provide a left-turn bay of 12 metres long for eastbound traffic to enter Rocky Point Park to minimize traffic operation and road safety issues (Figure 4.c);
- Install a raised median at the proposed crosswalk to provide a safe refuge to crossing pedestrians and act as a traffic calming device (Figure 4.d);
- Install RRFB on both ends of the proposed crosswalk and the median, facing both directions of travel to raise drivers’ awareness of crossing pedestrians (Figure 4.e);
- Extend the existing on-street parking on the north side of Murray Street up to 6 metres away from the Rocky Point Park west exit to increase parking supply (Figure 4.a);

(a) Removal of West Crosswalk  
(b) Removal of East Crosswalk  
(c) Installation of Eastbound Left-Turn  
(d) Installation of Raised Median  
(e) Pedestrian Let-Downs  
(f) Push Button with Instructions

Figure 4: RRFB Crosswalk Design Post-Construction
This particular push-button design shown in Figure 4.f was chosen as it illustrates the need to activate the crosswalk flashing beacon by pushing the button. During the pedestrian safety review, ISL conducted a site visit in the City of Surrey at locations where two RRFBs were installed and observed that although RRFB worked well, some pedestrians did not use the pushbutton. With RRFB being a new crosswalk device, it was recognized of the need to educate pedestrians on using RRFBs.

**RRFB Effectiveness Evaluation**

Once the recommendation of RRFB installation was approved by the Transportation Committee in the City of Port Moody, the RRFB crosswalk was installed and open to the public on August 26, 2015.

Typically the effectiveness of RRFBs would be evaluated based on a before-and-after yielding compliance study. Since this RRFB crosswalk is new with the removal of previous two crosswalks, the comparison of driver yielding compliance was conducted with another crosswalk (Figure 5) by Inlet Park at Electronic Avenue on Murray Street (about 500 metres east to the RRFB crosswalk). This location was chosen as it is on the same Murray Street corridor with very similar traffic patterns and driver behaviors. Different from a standard signed crosswalk, this location was equipped with two larger-size crosswalk signs due to the frequent use of Inlet Park soccer field by children during soccer league season.

![Figure 5: Crosswalk for Driver Compliance Study at Electronic Avenue on Murray Street](image)

The yielding compliance evaluation methodology was established in reference to Effects of Yellow Rectangular Rapid-Flashin g Beacons on Yielding at Multilane Uncontrolled Crosswalks (Shurbutt & Van Houten, 2010). Data was collected for each crossing when vehicles were present, on a weekday afternoon between 4PM and 5PM to capture
drivers’ yielding behavior to pedestrians during PM peak hour. Staged crossing was used where the staged pedestrian attempted to use the crosswalk and recorded driver yielding behavior. For each crossing, the pedestrian approached the crosswalk and placed one foot in the crosswalk or activated the flashing beacon when the vehicle was beyond the pre-defined distance. If the driver made no attempt to stop, the pedestrian did not cross.

Regarding driver compliance, it was defined as yielding if vehicle stopped or slowed down to allow pedestrian crossing; it was defined as not yielding if vehicle did not stop when it would have been able to safely from the pre-defined distance (calculated using the Institute of Transportation Engineers amber signal formula). For each crossing, all non-complied vehicles were recorded as not yielding and the first yielding vehicle was recorded as yielding.

For each crossing, the following information was recorded:
- Driver yielding compliance;
- Unsafe behavior of pedestrian and/or driver;

At each site the data collection was conducted in one direction of travel (pedestrian travelling north). The compliance study was conducted at the Inlet Park location on February 11, 2016 during the PM peak hour, and 54 crossings were recorded with 75 compliance samples (72% compliance rate); the compliance study was conducted at the RRFB location on February 23, 2016 during the PM peak hour, and 50 crossings were recorded with 50 compliance samples (100% compliance).

Study results indicated that RRFB crosswalk on Murray Street had higher driver yielding compliance rate compared to the standard signed and marked crosswalk by Inlet Park. However, it should be noted that this driver yielding compliance survey was conducted only for a day. It is recommended that the effectiveness of RRFB continue to be monitored to obtain more compliance samples.

By Inlet Park, the following unsafe behaviors were observed at the crosswalk:
- 1 vehicle hard braking behind a yielding vehicle;
- 5 non-compliances of westbound vehicle to pedestrians in the crosswalk;

At RRFB location, the following unsafe behavior were observed at the crosswalk:
- 1 non-compliance of westbound vehicle with pedestrian in the raised median;
- 1 pedestrian did not use the push button;

RRFB Cost

RRFB is a lower cost alternative to a traffic signal and hybrid signal that are shown to improving driver yielding behavior at crosswalks significantly, such as an overhead pedestrian-actuated signal. RRFB is treated as a popular alternative for pedestrian crosswalks considering its effectiveness and that the majority of municipalities in Canada and United States are facing limited budget.
According to U.S. Department of Transportation Federal Highway Administration, RRFB generally costs approximately $10,000 to $15,000 for the purchase and installation of two RRFB units. For the RRFB crosswalk at Murray Street, the total cost is just under $37,000. It should be noted that the total cost includes the analysis and design of RRFB crosswalk with different options as well as the material and construction cost of the raise median.

The cost breakdown of the RRFB crosswalk at Murray Street is as follows:
- Material cost of about $9,000, including $8,000 for purchase of two RRFB units;
- Engineering cost of about $5,000, including pedestrian safety review, design, construction support, etc.;
- Construction cost of about $23,000, including material supply, labor cost, line marking, traffic management, etc.;

**Online Public Survey and Feedback**

To confirm RRFB effectiveness from the perspective of drivers and pedestrians, and understand residents’ acceptance of RRFB as a new and innovative crosswalk device, the City of Port Moody social media team started a simple two-question online survey on the City’s website which was available from March 3rd to 7th.

The questions were set up as follows:
1. We recently installed a new crosswalk with flashing lights on Murray Street near Rocky Point and want to know your thoughts!
   - I don’t like it
   - It’s okay
   - It’s great!
2. Do you have additional comments about the new crosswalk?

![Figure 6: RRFB Online Survey Results for Question 1](image)
In total 88 submissions (Question 1) with 68 comments (Question 2) were received. Over 90% of responses (80 respondents) chose C (It’s great!) and only one respondent chose A (I don’t like it). Although Question 2 was designed as an open-ended question, a common theme was found that over 36% of respondents (25 respondents) indicate that they would like to see more RRFB crosswalks within the City.

Lessons Learned

The lessons learned from the RRFB crosswalk design are summarized below:

1. RRFBs have received very positive feedback from the residents (both pedestrians and drivers). Pedestrians feel much safer to cross the roadway and drivers find crossing pedestrians more visible especially during rainy and dark conditions (common safety issue in the Lower Mainland region), and find pedestrians less likely to jaywalk in this high vehicle and pedestrian conflict area;

2. In an urban city area where on-street parking is present, the installation of RRFBs on a raised median can improve drivers’ visibility of pedestrian crossing, act as a pedestrian refuge area, and serve as a traffic calming device. The installation of RRFB on a raised median for multi-lane crosswalk could also be beneficial and should be considered where possible;

3. RRFBs powered by solar power panel have worked well in the Lower Mainland region of British Columbia where harsh winter conditions are rarely present;

4. The success of this RRFB pilot project in an area with pedestrian safety complaints has led to a strong desire for additional RRFB installations in the City of Port Moody from local residents;

5. RRFB can be more cost-effective compared to other special crosswalks, such as traffic signals and hybrid signals. It does not stop major through traffic with a red signal and cause major traffic delay;

6. Follow-up survey and field review is important for a RRFB pilot project to prove its effectiveness and gain support from residents and the City Council.

What’s Next?

TAC has recently approved the addition of RRFB as a pedestrian crossing control device in its Manual of Uniform Traffic Control Devices for Canada (MUTCDC) and TAC is currently developing a RRFB warrant procedure for use in the Canadian context.

The City of Port Moody will further conduct driver compliance studies and continue monitoring at the RRFB crosswalk to confirm RRFB effectiveness. Considering the effectiveness of the recently installed RRFB on Murray Street, the City is planning to expand its usage of RRFB as it is seen as a cost-effective pedestrian crossing control
device (high driver yielding compliance rate and lower cost compared to the traditional overhead flashing lights used in the Lower Mainland region). The City Transportation Department is expecting to establish a RRFB implementation plan applicable to the City and initiate more pilot projects at different locations throughout the City.

References

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2. David Lee, Murray Street at Rocky Point Park Parking Safety Review
3. Transportation Association of Canada Pedestrian Crossing Control Guide
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8. Institute of Transportation Engineers Determining Vehicle Signal Change and Clearance Intervals
9. U.S. Department of Transportation Federal Highway Administration Rectangular Rapid Flashing Beacon (RRFB)

Author Information

Michael Ge, M.Sc., EIT
Transportation Engineer
ISL Engineering and Land Services Ltd
#201, 8506 200 Street, Langley, BC V2Y 0M1
Phone 604-371-0091
Fax 604-371-0098
Email: mge@islengineering.com

Mark Halpin
Transportation Planner
City of Port Moody
100 Newport Drive, Port Moody, BC V3H 5C3
Phone 604-469-4567
Fax 604-469-4533
Email: mhalpin@portmoody.ca