

Implementing Speed Cushions on Neighbourhood Collector Streets

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ABSTRACT

Traffic calming in Canada has evolved over the years, however it is still largely based on the 1998 Transportation Association of Canada and Institute of Transportation Engineers *Canadian Guide to Neighbourhood Traffic Calming*. This paper covers key case studies that incorporate the implementation of speed cushions which are not included in the *Canadian Guide to Neighbourhood Traffic Calming*. Speed cushions are a form of speed humps where the hump is segmented across the road. They allow for emergency vehicles with wider axle widths (fire trucks and ambulances) to pass through the speed cushion without being vertically deflected while passenger vehicles (shorter axle widths) are still deflected.

The case studies in the District of West Kelowna include two neighbourhood traffic calming plans that implemented speed cushions. One implementation greatly reduced operating speeds (85th percentile of 70km/h) on a neighbourhood collector road back to posted speed limits. Another study involved the use of speed cushions to reduce shortcutting of passenger and heavy vehicles through a neighbourhood minor collector road. Recommendations and considerations for the design of speed cushions are summarized.

INTRODUCTION

Traffic calming in Canada has evolved over the years, however it is still largely based on the 1998 Transportation Association of Canada and Institute of Transportation Engineers *Canadian Guide to Neighbourhood Traffic Calming*. More recently, traffic calming policies have been developed for municipalities to help guide staff and practitioners. The intent of these policies is to provide guidance to staff, Council, and practitioners on the application of traffic calming on

residential streets in a manner that is consistent with community goals. They also provide a backbone for the public engagement process. This paper discusses evolutions and challenges of traffic calming particularly on neighbourhood collector streets. These challenges include the use of vertical deflections, road grades (particularly for hilly communities), rural cross-sections, and developing measures that fit within the context of a community.

The key case studies in the paper incorporate the implementation of speed cushions which are not included in the Canadian Guide to Neighbourhood Traffic Calming. Speed cushions are a form of speed humps where the hump is segmented across the road. This allows for emergency vehicles with wider axle widths (fire trucks and ambulances) to pass through the speed cushion without being vertically deflected while passenger vehicles (shorter axle widths) are still deflected.

With an update planned for the Canadian Guide to Neighbourhood Traffic Calming, this paper provides conclusions and lessons learned pertinent to the national knowledgebase on traffic calming. Findings of the case studies are concluded to establish recommendations for the use and design of speed cushions on a national perspective.

BACKGROUND

Traffic calming is defined by the Institute of Transportation Engineers (ITE) as *the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behaviour and improve conditions for non-motorized street users*. Traffic calming is a series of features coordinated to address a known or anticipated neighbourhood issue of speed, short-cutting, or safety. Traffic calming features generally fall into five (5) categories:

- **Obstructions:** Features that obstruct vehicle movements. They discourage short-cutting (depending on the type / number of features), reduce conflicts, and enhance the neighbourhood environment.
- **Vertical deflections:** Features that require a motorist to reduce speed due to surface variation. The primary benefit is reduced vehicle speeds, and secondary effects are decreased traffic volumes and conflicts, and enhanced walking corridors.

- **Horizontal deflections:** Features that require a motorist to alter their direction or choose a different route. They can be used to reduce short-cutting, vehicle speeds, and/or conflicts.
- **Signage:** Signage features include those that regulate traffic movements within a neighbourhood, provide supplemental warning signage for traffic calming devices, and information signage.
- **Technology:** Technologies are used to communicate a message to motorists about the intent of the street. These may include radar message signs.

The use of any traffic calming devices is dependent upon the local context. Generally, all of the traffic calming features are applicable to local roads, obstructions and some vertical deflections are not suitable for collector roads, and arterials are mainly limited to signage and technologies. The most effective measures are physical devices that force vehicles to slow down or restrict their movements such as with vertical deflections (e.g. speed humps, raised crosswalks) and obstructions. Most physical traffic calming features are also more effective on urban cross-sections (curb and gutter) than on rural road cross-sections. Curb and gutter provides physical restrictions to navigating around physical features in the roadway such as with speed humps and raised median islands.

VERTICAL DEFLECTIONS

Traffic calming devices that provide vertical deflection require a driver to reduce speed due to a varied surface level. Vertical deflections have the primary benefit of reduced vehicle speeds, and can result in decreased volumes, reduced conflicts, and enhanced pedestrian conditions. Devices include, but are not limited to: speed humps, raised crosswalks, raised intersections, sidewalk extensions, and textured crosswalks. Speed humps are the most effective at reducing speeds, but are limited in use on steep grades (recommended for 5% or below, no more than 8%). This is a challenge for many hillside communities where other traffic calming measures are not effective enough to reduce speeds. This issue is not covered in the TAC guide.

Vertical deflections are typically not desirable on emergency vehicle (fire truck and ambulance) routes as they can reduce response times and create discomfort for ambulance passengers. They are also not desirable for transit routes. BC Transit's design guidelines discourage the use

of vertical deflections along transit routes and state that speed humps should not be located immediately before or after a bus stop for passenger safety. The Canadian Guide to Neighbourhood Traffic Calming recommends locating speed humps at least 25m in advance of bus stops to minimize potential stability problems for passengers alighting from the bus to the bus stop. The difficulty in designing for this is that bus routes commonly change. Collector roads tend to be important roads to support neighbourhood emergency service and transit routes; however in the public process for traffic calming, collector roads garner the most attention from residents.

THE CASE FOR THE SPEED CUSHION

While speed humps are the most effective device at reducing speeds of passenger vehicles, they will also reduce speeds of emergency vehicles. Collector roads need to service emergency vehicles efficiently and safely. In some cases, speed humps may be strongly desired by residents. Speed cushions are a viable alternative to provide deflection to passenger vehicles and passage for emergency vehicles. Disbenefits to speed cushions are the same as speed humps such as increased noise (especially for heavier vehicles), delays to transit, and diverting traffic to other neighbourhood streets. The latter can be planned for with neighbourhood-wide traffic calming studies. Speed cushions are also less effective at calming two wheel vehicles such as motorcycles with the separation of the cushions; however, this can be a benefit to cycling.

There are two typical layouts for speed cushions (**Figure 1**); one where the emergency vehicle straddles the cushion in the vehicle lane, the other where they straddle the cushion in the centre lane. The design to straddle the centreline is recommended since emergency vehicles require other vehicles to pull-over when the sirens are in use. This gives them unrestricted operations to mount the centre island. However, use of a double solid yellow centreline is recommended so trucks with similar axle widths are not permitted to cross the centreline and must be vertically deflected. The double solid centreline ensures that crossing over the centreline can be enforced. Delineation of the roadway is important to force heavy trucks to mount speed cushions. Considering this, speed cushions should be used on residential roads where heavy truck traffic is not desired.



Image Source: http://www.trafficcalming.net/speed_humps.htm

Photo Credit: Nadine King, Boulevard Transportation

Figure 1 – Speed Cushion Layouts: Emergency Vehicle Straddles Lane (Left) or Centreline (Right)

CASE STUDIES

West Kelowna, BC

The District of West Kelowna adopted a Traffic Calming Policy to guide staff, Council, and practitioners on the application of traffic calming in the municipality. The Policy summarizes methods of engaging the public for neighbourhood traffic calming studies that is more or less consistent with the Canadian Guide to Neighbourhood Traffic Calming. The Policy also establishes the types of traffic calming measures that can be applied on a variety of roadway types and the thresholds that warrant them. **Figure 2** provides an excerpt from the District of West Kelowna's Traffic Calming Policy for road classifications and threshold limits for applying traffic calming. It also indicates applicable traffic calming measures for collector roads, which are horizontal deflection and technology.

Road Classifications and Threshold Limits for Application of Traffic Calming Initiatives	
Traffic Calming should be considered where any of the following thresholds are exceeded on a specific roadway.	
<u>Road Classification</u>	<u>Threshold Limits</u>
<p>Local</p> <p>*including school and playground zones</p> <p>**short-cutting trips are those trips which do not have a purpose or destination within the specified area and instead are using local roads to travel through the area</p>	<ul style="list-style-type: none"> ● Traffic Volume: >1,000 vehicles per day ● Operating Speed: >10km over the posted speed limit* ● Short Cutting**: >25% of vehicles are not making trips to/from the specified area
	<p>Applicable Traffic Calming Measures:</p> <p><input type="checkbox"/> Technological <input type="checkbox"/> Horizontal Deflection</p> <p><input type="checkbox"/> Vertical Deflection <input type="checkbox"/> Obstruction</p> <p><input type="checkbox"/> Signage</p>
<p>Collector (Minor or Major)</p>	<ul style="list-style-type: none"> ● Traffic Volume: >5,000 vehicles per day ● Operating Speed: >10km over the posted speed limit
	<p>Applicable Traffic Calming Measures:</p> <p><input type="checkbox"/> Technological <input type="checkbox"/> Horizontal Deflection</p>
<p>Arterial or Expressway</p>	<p>Traffic calming initiatives typically assessed at a community planning (OCP) level, in consultation with the local road authority</p>
	<p>Applicable Traffic Calming Measures:</p> <p><input type="checkbox"/> Technological</p>

Figure 2 – Evaluation Criteria for Traffic Calming (Excerpt from West Kelowna Traffic Calming Policy)

Auburn Road Speed Cushions

The first application of the District’s Traffic Calming Policy was for the Shannon Lake neighbourhood. Auburn Road, a residential collector road with a posted speed of 50 km/h, had a measured operational (85th percentile) speed of 70 km/h. During the public engagement

process, residents adjacent to Auburn Road indicated a strong desire for speed humps along the road. A series of three speed cushions, spaced 100-120 metres apart, were proposed in response as an alternative.

The Neighbourhood Traffic Calming Guide provided the design guidance for spacing of speed cushions and design of their profile. The design of the outside edges must maintain drainage to the gutter pan adjacent to the speed cushion to prevent ponding and ice formation. The separation of the cushions is designed to fit the axle width of emergency vehicles so that they drive between the separated cushions without being deflected vertically while passenger cars attempting this will be deflected. Chang and Nolan (2006) identified axle track widths for various passenger, emergency vehicles, and heavy trucks to establish a design for separation of the cushions. A sample of these are summarized below:

- Passenger vehicles
 - Ford F-Series: Width: 67.0" (1.70m)
 - Chevrolet Silverado: Width: 65.0" – 66.0" (1.65m – 1.68m)
 - Toyota Camry: Width: 60.4"-60.8" (1.53m – 1.54m)
 - Dodge Ram: Width: 67.9" – 68.6" (1.72m – 1.74m)
 - Honda Civic: Width: 59.0" – 60.2" (1.50m – 1.53m)
- Ambulance manufacturers
 - Lifeline: Width: 72.0"-75.2" (1.83m – 1.91m)
 - Demers: Width: 74.5"-78.8" (1.89m-2.00m)
- Fire truck manufacturers:
 - H&W: Width: 73.8"-82.8" (1.87m – 2.10m)
- Heavy Trucks
 - Mack Straight Truck: width 72.5"-85.3" (1.84m-2.17m)

Figure 3 shows the District of West Kelowna's design for a speed cushion. Painted "sharks teeth" enhance visibility of the device when snow is not present. This is important for artificial lighting conditions and general contrast. A length of 4.0 metres is used for the hump instead of alternatives for 7.0 metre humps to keep a shorter segment for emergency vehicle tires to traverse between cushions. Speed humps signs are placed on either side of the street to indicate the appropriate warning and also to identify the devices location when pavement markings are no longer visible (due to snow, debris, or wear). In cases where there is no barrier

curb, the signs should be mounted close to the street to prevent vehicles from passing around the speed cushion. The width of the outside cushions should also extend to the edge of gutter to limit vehicles by-passing the deflection, ensure they are wider than the centre cushion, and maintain drainage.

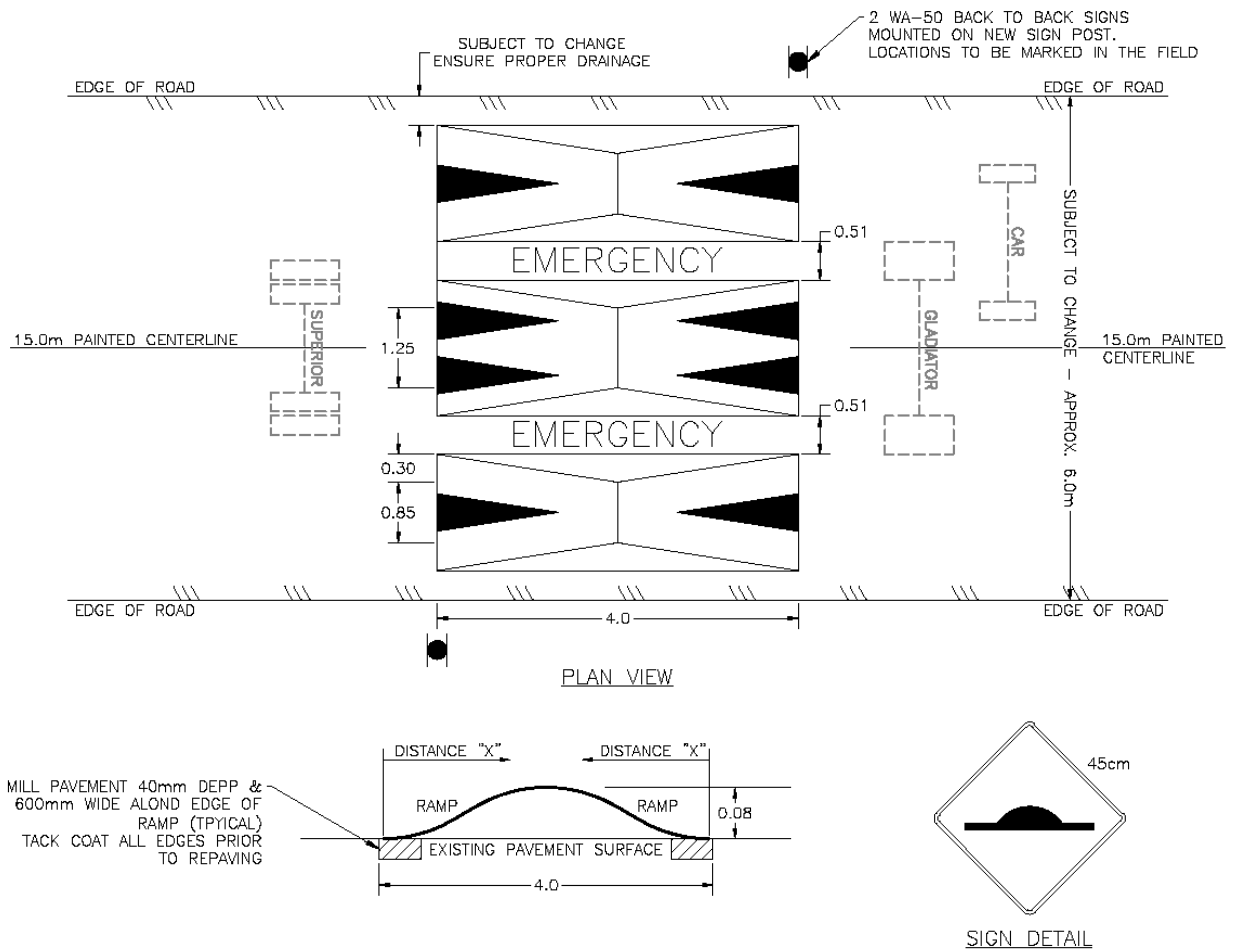


Figure 3 – District of West Kelowna Speed Cushion Design, Modified from District of Saanich

Note: It is recommended that double solid centreline is used to allow for enforcement of non-emergency vehicles over the centre cushion.

The speed cushions were implemented to reduce traffic speeds along Auburn Road (see **Figure 4**). Three cushions were installed and follow-up data collection on speeds yielded an operating 85th percentile speed of 49 km/h.



Figure 4 – Speed Cushion on Auburn Road

Wild Horse Drive / Ironridge Drive Speed Cushions

A second traffic calming study was conducted for West Kelowna for the Smith Creek neighbourhood. Residents were concerned about heavy vehicles short cutting through the neighbourhood along Wild Horse Drive and Ironridge Road. The two roads are classified as minor collectors and provide an east-west connection through the neighbourhood. With limited road network connectivity and no truck route policy, heavy trucks were hauling materials through the residential neighbourhood. Speed cushions were implemented to dissuade heavy truck traffic by increasing their travel time while maintaining emergency vehicle travel. These speed cushions were strategically placed at the entrances into the neighbourhood so as not to route heavy trucks to parallel residential routes within the neighbourhood. **Figure 5** shows the proposed traffic calming alternatives for the neighbourhood and recommended placement of speed cushions. **Figure 6** shows a speed cushion placed on Wild Horse Drive at the entrance to the neighbourhood. The speed cushion was installed in the fall of 2014 and the District is waiting for the summer construction season to evaluate the effectiveness of the measure.



Figure 5 – Proposed Traffic Calming Options Including Placement of Speed Cushions



Figure 6 – Wild Horse Drive Speed Cushion

Note: Double solid centreline is not yet installed.

Cost Implications

The construction of speed cushions cost \$7,700 to \$10,500 for the District of West Kelowna. Variations in cost are related to tailoring the design to fit into the roadway context.

CONCLUSIONS

Speed cushions allow for the use of traffic calming devices with vertical deflection on residential roads. They have the added benefit to speed humps of allowing emergency vehicles (fire trucks and ambulances) to manoeuvre over the centre cushion and not be deflected vertically to reduce losses to response times. They are highly effective at reducing speeds of passenger vehicles. While heavy trucks may be within the same axle width range of the emergency vehicles, they are not permitted to cross the double solid centreline and mount the centre cushion. This makes speed cushions a practical application of dissuading undesirable heavy truck traffic through residential communities.

The update to the Canadian Guide to Neighbourhood Traffic Calming should consider the application of speed cushions as a traffic calming device. Many jurisdictions throughout North America have implemented these devices and an understanding of various experiences is needed.

LESSONS LEARNED

The following lessons learned were results of the neighbourhood traffic calming plans conducted for the District of West Kelowna. This information should be considered with the update to the Canadian Guide to Neighbourhood Traffic Calming.

On speed cushions:

- In West Kelowna, there has been very little debris collecting between the cushions as vehicles often mount one-side of the car on a cushion and allow the other to pass through the separation. This is a benefit for cyclists who may pass through as well.
- The signs and markings contained in the current guide are appropriate as is the design guidance provided. This information should be retained, however further guidance is needed for communities that have road grades greater than 5%.

On the traffic calming toolbox:

- Limited tools in existing traffic calming guide to handle vast contextual challenges of different communities and neighbourhood contexts. Engaging early and often with the

community is critical. Since neighbourhood responses to various traffic calming devices differ drastically throughout the community, their input is invaluable.

- All traffic calming features need to be evaluated for effectiveness to determine whether they have met their goals and to identify other observations to operations that may be relevant.
- The communities have wide perceptions of traffic calming, operations, and safety on their residential roads. Education is an important part of the engagement process to speak with residents through open houses on the benefits and drawbacks of certain devices so they may make an informed decision when asked for support on various traffic calming devices.
- Landscaping is a key component of many traffic calming treatments, primarily horizontal deflections. It offers aesthetic that further enhance the neighbourhood environment and can provide visual cues to motorists for gateways and transitions.

On the public process:

- Public process is the most important piece of neighbourhood traffic calming. In West Kelowna, Council supported all the recommendations on three studies and commented positively on the thorough public process and open house attendance.
- Caution should be exercised when engaging neighbourhood associations or other special interest groups exclusively as the rest of the community may feel that they do not speak for them. Significant efforts should be made to advertise and involve the entire neighbourhood outside of interest groups exclusively.
- Establish thresholds of support, the District used a minimum of 75% support or neutral from residents to make a recommendation.
- An initial petition process should occur to ensure that the entire neighbourhood is behind the process. This should be done to ensure there is enough support going into the process and that it is not being led by a vocal minority only.

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