

# TRAFFIC CALMING MEASURES IN WINTER CONDITIONS

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## SUMMARY

Speed management is an essential tool in ensuring the improved safety of users of urban roads, particularly vulnerable users. It relies on several measures: awareness campaigns, speed control, as well as the development and operation of the road infrastructure.

More and more, cities are resorting to the development of traffic calming measures, both seasonal and permanent, as well as to designs more conducive to reduced speeds. In Québec, however, cities are faced with an important issue: given the harsh winter conditions, what traffic calming measures are possible? Will they be effective and sustainable?

Based on what is currently known about Québec practices, it would seem that many traffic calming measures remain an effective solution to speed issues, even in winter conditions; they do not hinder snow removal operations and do not cause any insecurity during the winter period. However, some concerns remain. Adjustments are necessary at various levels.

## KEYWORDS

ROAD SAFETY / SPEED / TRAFFIC CALMING / ROAD MAINTENANCE / WINTER

## 1. INTRODUCTION

### 1.1. Speed in urban areas

Road safety in urban areas is a very important issue in Québec: more than half of all injury accidents occur in urban areas, i.e., where the speed limit is 60 km/h or less. Speed is one of the key factors: on the municipal road system in urban areas, speed is involved in 22% of fatal accidents and 8% of injury accidents. Numerous studies show that the higher the driving speed, the greater the risk of accidents and their severity.

Speed management is therefore an essential element of the improvement of road safety, particularly in urban areas. In Québec, for now, the Highway Safety Code prescribes a speed limit of 50 km/h in urban areas, with the option for municipalities to set a different limit on their road network. The great majority of residential streets, commercial streets and urban boulevards operate with such a speed limit. However, more and more cities set reduced speed limits (30 km/h or 40 km/h) on their residential local streets and in school zones with a view to minimizing the risks incurred by vulnerable users in the event of a collision.

However, these relatively low limits are difficult to enforce. Currently, in Québec, more than one driver out of two drives at speeds greater than the limit of 50 km/h in urban areas. Neighbourhoods built in the '50s and '60s with very low density and very wide streets

amply accommodating the use of cars foster such behaviours. In fact, speeding still is not the subject of very strong social disapproval the way impaired driving has now become.

Faced with this situation, speed management strategies rely on several measures. Awareness campaigns to counter speeding are disseminated every year across Québec or at the regional or local level. Speed control relies on police departments and, starting just recently as part of a pilot project, on photographic speed detection devices. When it comes to local residential streets, however, very low traffic volumes on a rather extensive network represent a constraint to speed control planning.

On these streets, cities accordingly turn to management measures, including traffic calming measures.

## 1.2. Traffic calming measures

The purpose of implementing traffic calming measures on a street is to modify drivers' behaviour by introducing constraints or forcing manoeuvres that feel awkward at speeds that are too high. The goal is to foster the safety of road users, particularly vulnerable users, and make residential neighbourhoods more user-friendly.

According to a survey conducted with over 250 of Québec's biggest municipalities (out of a total of around 1,100), 20% have already implemented traffic calming measures.

The first attempts have led to mixed results, as some treatments have trouble standing up to the constraints of traffic and winter maintenance. Several municipalities, particularly smaller ones, do not have sufficient financial resources to implement a good number of treatments. However, the publication in 1998 of a Canadian technical guide in French provided good technical expertise [1], and attempts have since multiplied. Many treatments have now been in place long enough to establish a record, particularly in relation to winter conditions.

## 2. WINTER CONDITIONS IN QUÉBEC

### 2.1. Severe winters

Winter is a daily social reality for Québec's inhabitants. The winter period lasts four to six months. Snowfalls vary greatly from one place to the next within the province. In the south, which corresponds to the urbanized area, average annual precipitations vary between 225 cm in the city of Montréal and over 300 cm in the capital, Québec.

Cities also see low winter temperatures: average temperatures between December and February vary between  $-7^{\circ}\text{C}$  in Montréal and  $-11^{\circ}\text{C}$  in Québec. In January, average temperatures fall between  $-5^{\circ}\text{C}$  and  $-17^{\circ}\text{C}$ . However, the temperature can drop to  $-30^{\circ}\text{C}$  or more. The ground is accordingly frozen five months a year to a depth of 1.2 m to 3 m, depending on the region.

Climate change has also an impact on the province of Québec. It is estimated that intense cold waves will become less frequent but that we will see an increasing number of mild spells in winter. Freezing rain episodes are likely to increase and winter storms, although less frequent, should intensify.

## 2.2. Winter maintenance

Such severe winter conditions represent a sizeable challenge in terms of road design, construction, maintenance and operation.

Road users must be able to rely on an effective and safe road system. Winter maintenance is thus an essential service. Winter maintenance operations include the application of abrasives and ice melters, then snow clearing, and finally snow removal.

In cities, the snow is, whenever possible, blown onto street-side properties, which has proved to be the most economical, the quickest and the most environmentally friendly solution. In older neighbourhoods where the streets are not as wide, snow needs to be loaded on trucks and brought to disposal sites as soon as the accumulation becomes too great.

Local residential roads are generally cleared after priority areas, which include major arteries, commercial and institutional streets and those that border schools, health centres and other institutions.

## 2.3. Winter driving

Despite effective snow removal operations, winter driving presents particular risks and drivers must adjust the way they drive. The speed issue thus presents itself under a different light depending on the season.

The ministère des Transports conducts awareness campaigns at the beginning of every winter and invites drivers to be twice as careful on roads. Campaigns focus on increasing braking distances on icy roads, which can lose up to 90% of their grip, and even more on an icy surface covered in powder snow. Drivers are urged to adjust their speed and keep a sufficient gap between their vehicle and the one in front.

Furthermore, since 2008, winter tires are mandatory from December 15 to March 15. These tires are designed to ensure maximum grip on snowy and icy surfaces.

Although no comprehensive analysis of observed speeds confirms it, we generally presume that drivers are more careful and driving speeds decrease in the winter. In fact, complaints regarding excessive speeding in residential streets are less numerous, which can also be explained by the fact that there are fewer residents, pedestrians and cyclists on the roads and that the traffic noise is lessened.

## 3. TRAFFIC CALMING MEASURES IN QUÉBEC

The extent of constraints associated with winter conditions influences the actions taken by municipalities in terms of traffic calming measures. Cities resort to either seasonal or permanent treatments. More recently, the trend has been to review design standards for new streets, making them correspond from the very start to traffic calming and user safety objectives.

In fall 2009, a survey was conducted in approximately fifty municipalities which implemented traffic calming measures. The questionnaire focused on the type of treatments found on the road network, according to the category of roads, their main geometric elements, the impact on actual speeds, the effect of winter conditions and the

degree of satisfaction of residents and road users. Thirty-four municipalities responded to the questionnaire.

### 3.1. Types of traffic calming measures

The main types of traffic calming treatments used in Québec, alone or in combination with others, are the following.

- Speed humps (68% of respondents)
- The reduction of the width of a street (50% of respondents)
- Center islands (41% of respondents)
- Neckdowns (curb extensions at intersections) (35% of respondents)
- Raised and/or textured crosswalks (24% of respondents)
- Roundabouts (24% of respondents)
- Landscaping (24% of respondents)
- Chicanes (12% of respondents)
- Raised and/or textured intersections (9% of respondents)

The treatments may be permanent or seasonal. To encourage drivers to slow down, some municipalities install temporary equipment that can be removed in the winter, thus avoiding eventual problems associated with snow removal. Many of these facilities correspond to a similarly seasonal use of urban spaces (bicycle path, urban furniture).

### 3.2. Issues regarding winter conditions

The survey particularly sought to evaluate whether traffic calming measures still had an effect during winter, and to what extent winter maintenance operations caused problems. There were three questions for each type of treatment; forty-eight responses were given. Generally, the results spoke for themselves:

- Is the treatment effective in slowing down traffic in winter as well as in summer? Yes in 92% of cases.
- Along the years, does the treatment deteriorate due to winter conditions or snow removal operations? No in 79% of cases.
- Does the removal of snow from the treatment pose problems? No in 71% of cases.

In most cases, winter conditions do not restrict the installation of traffic calming measures. However, some precisions must be made according to the type of treatment.

### 3.3. Characteristics of each treatment

#### *Speed hump*

A speed hump is a circular or sinusoidal raised portion of road, the height and length of which vary depending on the desired speed. It is one of the most widely used traffic calming treatments in Québec. It has gradually replaced the speed bump, which was too aggressive and caused numerous problems for drivers and maintenance crews.

Several municipalities install rubber speed humps which they remove in winter. However, permanent speed humps do not cause snow removal problems. The gradual slope of the speed hump, particularly if it features a sinusoidal profile, allows snow removal operators to cross it fairly easily; they sometimes need to slightly raise the blade of their equipment so as not to damage the treatment (only one municipality mentioned the deterioration of its speed humps). A sign must mark the presence of a speed hump, thus ensuring its visibility in the wintertime.

### *Reduction of the width of a street*

The width of a street can be reduced by decreasing the number of traffic lanes (one-third of the municipalities have used this means of traffic calming), by creating a bicycle lane with dividers that are often removed in winter (a third of the municipalities), and/or by installing plant tubs or concrete blocks that may be removed during winter (a third of the municipalities).

When the equipments used for reducing the width of the street have off-winter functions (bicycling, vegetation), removing them is generally not a problem, but allows to more space for snow accumulation. Snow removal difficulties were reported in cases where the number of traffic lanes was reduced, most likely due to the narrowness of the road.

### *Center Island*

This is a raised island built over the centre line of a two-way street to reduce the overall width of the adjacent lanes. Signage allows the island to remain visible in the event of snow accumulation.

### *Neckdowns*

Neckdowns selectively reduce the width of the road, at an intersection or between intersections. In addition to fostering speed reductions, curb extensions also have the positive effect of reducing the distance pedestrians need to travel to cross the road and significantly increasing the reciprocal visibility of drivers and pedestrians.

Easier turning radiuses facilitate snow removal. The street facing the neckdown must furthermore remain wide enough to accommodate snow removal equipment and take into account future snow accumulations. Although the number of responses is very low, the survey reveals more snow removal difficulties due to curb extensions between intersections than due to curb extensions at intersections, which also led to deterioration of the materials.

### *Raised crosswalk*

A raised crosswalk constitutes an extension of the sidewalk, at the same level, on the road crossed. As with the speed hump, the slope of the ramp is the key parameter determining the degree of slowdown desired in drivers. Observations regarding snow removal are the same as with the speed hump.

In winter, a raised crosswalk is more appreciated by pedestrians than a lowered sidewalk; indeed, in the event of bad drainage, there is often an accumulation of melting snow or ice at the bottom of the sidewalk that presents an obstacle or a fall hazard.

### *Textured crosswalk*

The use of distinctive materials, such as concrete paving blocks, coloured cement concrete and any other typical material, can help enhance the visibility of the crosswalk.

These materials do not create any problems for snow removal; however, they must be installed with care to ensure durability in the winter periods. For example, at some intersections, concrete paving blocks installed on an inadequate foundation quickly degrade under the effects of the freeze-thaw cycle and the passage of buses and heavy vehicles.

### *Roundabout*

Roundabouts are intersections composed of three or more branches, where traffic flows merge and diverge on a one-way road surrounding a central island. Traffic on this roadway runs counter-clockwise and has the right-of-way over vehicles entering the roundabout. The deflection at the entry points causes drivers to slow down.

Small roundabouts, most often used to reduce speeds on local roads, present a particular problem with regard to winter sustainability. The use of smaller and more manoeuvrable snow removal vehicles may be necessary. In addition, the slow speeds practised inside the circle increase the time needed for de-icing salts to take effect. Due to the slow speeds of snow removal trucks, the snow can accumulate around the circle; these snow banks must be removed regularly so as not to reduce the width of the road too much and hinder visibility.

### *Landscaping*

Landscaping contributes significantly to structuring the road environment and plays an important part in influencing driver behaviours, in particular their speed. The choice of species must of course be adapted to the plant hardiness zones of the project. Other elements require particular attention; the lateral clearance between traffic lanes and the trees planted must be sufficient to mitigate the impacts caused by winter maintenance operations and salt sprays. Plantings must also be prepared for every winter, constituting additional maintenance costs.

### *Chicane*

A chicane is a treatment composed of a succession of obstacles that force drivers to manoeuvre and, consequently, slow down. A chicane can be created with a series of neckdowns or cars parked in staggered rows along the street, or even a median. The presence of chicanes can slightly increase snow removal times. Only two municipalities responded to questions about winter issues; they created a chicane configuration using a series of curb extensions. Both municipalities reported problems associated with snow removal and the deterioration of the chicanes.

### *Raised intersection*

A raised intersection is a treatment where the entire intersection is raised to sidewalk level. Problems associated with winter are similar to those encountered with raised crosswalks.

## 3.4. Road design

The design of new roads evolves to reconcile various objectives: ensure the proper safety of all users, particularly by controlling speeds, and minimize winter maintenance costs.

Attention is accordingly given to a number of the road's components:

- The width of the road: a narrow road will incite drivers to adopt moderate speeds; however, the road must be wide enough to allow equipment to push snow to the sides.
- The width of the sidewalk: a minimum width, free of plantings and furniture, is required to ensure optimal conditions for snow removal by municipal equipment.
- The space between the road and the sidewalk: on roads where parking is prohibited, the implementation of street furniture and planters or curbs makes it possible to

distance or separate pedestrians from the road, and accordingly protect them from water or melting snow splashed up by passing vehicles.

- Corner radiuses: decreasing the turning radius at intersections forces drivers to slow down for the turn while reducing the distance crossed by pedestrians. However, easier turning radiuses facilitate snow removal operations.

## 4. CONCLUSION

In order to increase the safety of users on urban roads, particularly vulnerable users, the municipalities of Québec are resorting more and more to the implementation of seasonal and permanent traffic calming measures as well as designs more conducive to slower speeds. Among the constraints facing them, winter sustainability is one of the most important.

Indeed, these treatments represent constraints for cars and other vehicles, but also for snow removal equipment. Each type of traffic calming treatment has particular issues; a number of general observations can, however, be made.

Based on what is currently known about Québec practices, it would seem that most traffic calming measures remain an effective solution to speed issues, even in winter conditions; they do not prevent snow removal operations and are not a cause of insecurity during the winter period. However, some concerns remain. Horizontal shifts between intersections (curb extensions, center islands) seem to pose greater difficulties than treatments at intersections (curb extensions) or vertical deflections (speed humps).

Adjustments are also necessary at various levels.

### 4.1. Snow removal operations

Snow removal operations most often require adjustments (smaller or modified equipment, procedure). They may take longer and thus increase maintenance costs.

Markers or vertical signage is useful for operators and may be installed at the beginning of winter to signal treatments that constitute obstacles on their routes, such as widened sidewalks. The design of traffic calming measures can also take maintenance operations into account (for example, easier turn radiuses).

Finally, the work organization can be reviewed to assign workers to the same snow removal routes so that they become familiar with the traffic calming measures and accordingly adapt the way they do things so as to appropriately clear them of snow without damaging them.

### 4.2. Coordination

For a traffic calming measure project to be successful, working in concert with the various stakeholders involved from the very start of the design is key: municipal services, police forces, public transit corporations, emergency services, residents, users... As regards winter sustainability, maintenance services must be involved. Their support of the project and that of snow removal operators is necessary to ensure the continued effectiveness—and the sustainability—of the features.

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