

Jurisdictional Scan of Sidewalk Management Practices from North American Municipalities

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Abstract

Sidewalks generally receive lower attention than primary infrastructure, such as roadways and bridges. Lawsuits incurred from sidewalk hazards can be costly for jurisdictions and detrimental to public perception of safety and mobility. Many municipalities recognize the importance of maintaining sidewalk assets systematically, from condition evaluation to treatment selection. However, limited resources for sidewalk assets, such as standards, reports, and research papers, are available.

To gain a better understanding of sidewalk management practices, a survey was distributed to select municipalities across North America. The survey comprised 41 questions covering various sidewalk management aspects, including sidewalk network information, data collection methods, distress types, data quality check and calibration, and management system.

Analyses were performed on the collected survey feedback. The results show that, while some respondents have similar sidewalk network sizes to maintain, the available budget varies greatly. Most participating municipalities do not have calibration and/or acceptance criteria for the collected sidewalk condition data. Subsequently, a condition rating system and/or performance index have not been developed for sidewalks. This may lead to unspecified treatment triggers and inconsistent decision-making processes. The data and findings presented in this paper can serve as a reference for any size municipality looking to benchmark its sidewalk management practices.

Introduction

Sidewalks are critical infrastructures serving essential daily trips for pedestrians. However, sidewalks generally receive lower attention than primary infrastructure, such as roadways and bridges, due to the municipalities' limited resources or lack of expertise. It was found that many municipalities in the United States either require the adjacent property owner to pay for the pedestrian improvements or rely on a cost-sharing program to maintain their sidewalks (Boyer et al., 2018). Although many municipalities may place sidewalk maintenance responsibilities on the adjacent property owner, the municipalities may still be liable for pedestrian injuries if the sidewalk is deemed public property (Kim et al., 2016). Lawsuits incurred from sidewalk hazards can be costly for jurisdictions and detrimental to public perception of safety and mobility.

Lack of maintenance leads to a network of unsafe sidewalks. Unsatisfactory sidewalk conditions can further deteriorate by adverse weather conditions, poor maintenance, low-quality materials, inappropriate use of equipment, and other factors.

Defective sidewalks can pose a serious safety concern to pedestrians. Safety accidents, such as slips, trips, and falls, may occur for pedestrians. Moreover, when pedestrians do not feel comfortable walking on distressed or too narrow sidewalks, they are induced to detour and sometimes walk on the roadway, which is even more dangerous (Corazza et al., 2017).

The dependence and increasing demand for a safe and well-maintained network of sidewalks from the public has pressed municipalities for cost-effective sidewalk maintenance practices. These problems can potentially be addressed by implementing an appropriate sidewalk management system. However, limited resources such as research or case studies in sidewalk management are available.

Project Description

Many municipalities recognize the importance of maintaining sidewalk assets systematically, from condition evaluation to treatment selection. However, they lack resources, such as standards, reports, and research papers, as the first step to implementing the sidewalk management system.

Halifax Regional Municipality (HRM) is among a few municipal agencies in Canada that have embarked on a strategic enterprise asset management journey and invested in developing sidewalk management tools and processes. These efforts are part of an initiative to improve the quality of service through sidewalk asset management analysis and capital programming.

Therefore, HRM retained Stantec Consulting Ltd. (Stantec) to conduct a jurisdictional scan of sidewalk asset management practices. The survey, jointly developed by HRM and Stantec, was sent to select municipalities across North America.

This paper thus aims to summarize sidewalk asset management practices from the survey-participating municipalities in North America and identify potential practices that can help improve a municipality's sidewalk network.

Survey Distribution and Response

The survey included 41 questions covering various sidewalk management aspects. In addition, eight voluntary follow-up questions were included, such as contact information and consent to be contacted.

The survey was distributed to 18 municipalities across North America. Unfortunately, many jurisdictions indicated that no established sidewalk management was in place, so their surveys could not be completed. Nonetheless, nine municipalities responded to the survey. The results are presented anonymously in the following sections:

- Sidewalk network information
- Data collection
- Sidewalk distress type
- Data quality check and calibration
- Sidewalk management

Sidewalk Network Information

The answers to the following questions related to network information are subsequently presented:

- **Q1:** What is the size of your sidewalk network?
- **Q2:** What is the approximate annual maintenance and rehabilitation (M&R) budget in dollars for the sidewalk network in your agency?
- **Q3:** What is the % estimate of Portland Cement Concrete (PCC) sidewalks in your network?
- **Q4:** What is the typical thickness of your PCC sidewalk slab cross-section, including PCC slab, granular base layer, or others?
- **Q5:** What is the % estimate of stamped concrete sidewalks in your network?
- **Q6:** What is the % estimate of asphalt sidewalks in your network?
- **Q7:** What is the % estimate of brick sidewalks in your network?
- **Q8:** What is the % estimate of stone sidewalks in your network?
- **Q9:** What is the % estimate of other types of sidewalks in your network?

The participating municipalities provided sidewalk network information. The network size and annual Maintenance & Rehabilitation (M&R) budget are summarized in Figure 1.

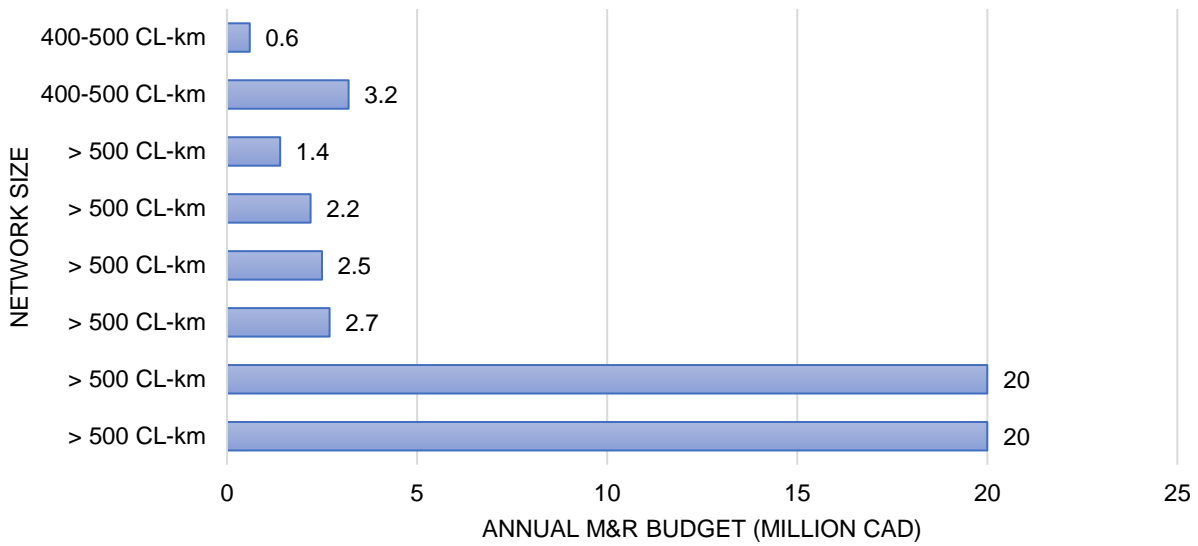


Figure 1: Network Size and Annual Budget (Q1 and 2)

Seven municipalities have a sidewalk network of more than 500 centreline-kilometres (CL-km), and two have a 400 to 500 CL-km network. The approximate annual Maintenance & Rehabilitation (M&R) budgets vary significantly from \$0.6 million (CAD) to \$20 million (CAD). The budgets appear to be uncorrelated with the network size.

The sidewalk material type distribution is shown in Figure 2.

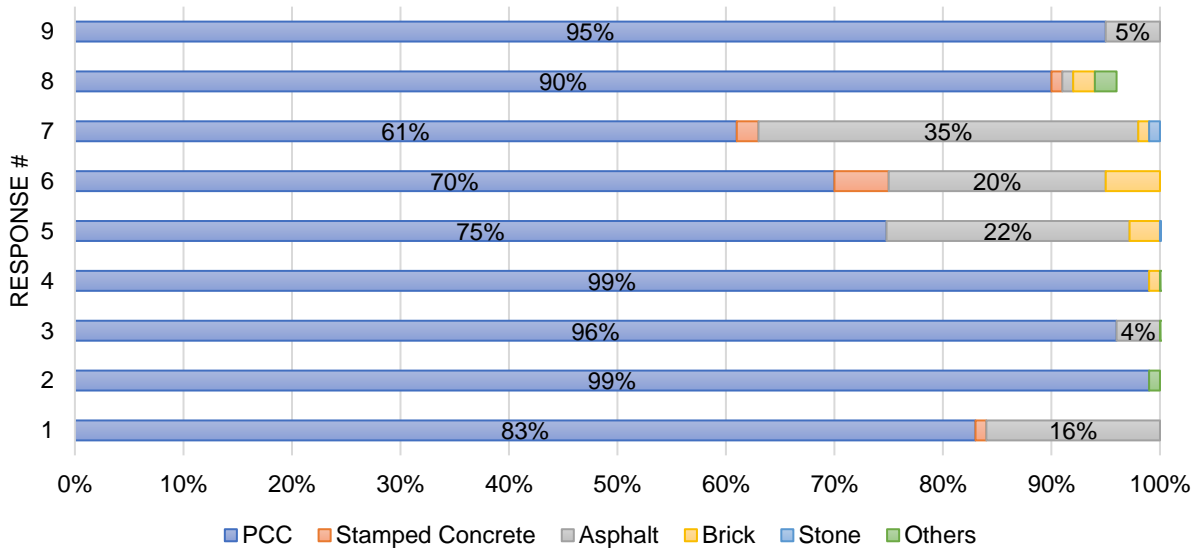


Figure 2: Sidewalk Type (Q3, 5-9)

Portland Cement Concrete (PCC) is the most common sidewalk type, followed by asphalt. Other sidewalk material types include stamped concrete, brick, stone, and other. Some jurisdictions have more than 90% PCC sidewalks.

The typical PCC design thicknesses are summarized in Table 1.

Table 1. Responses to Typical PCC Sidewalk Design Thickness Questions (Q4)

Response #	PCC Sidewalk Typical Thickness (slab, granular base or others included)
1	100 mm
2	100 mm base + 125 mm PCC slab
3	100 mm base + 100mm concrete
4	150 mm
5	150 mm Granular Base Course (GBC) + 120 mm concrete
6	100 to 150mm
7	400 mm
8	150 mm
9	150mm granular + 150mm concrete

The typical thickness for a PCC slab or granular base ranges from 100 to 150 mm. At least one municipality's total thickness for its PCC sidewalk is 400 mm.

Data Collection

The responses to the following questions related to data collection are subsequently presented:

- **Q10:** How often do you collect condition data?
- **Q11:** What method do you use to collect your sidewalk condition?
- **Q12:** What sidewalk attributes are collected during a PCC or asphalt sidewalk condition survey?
- **Q13:** Who collects the sidewalk condition data?
- **Q14:** How many people are in-house staff for data collection?

Responses to Questions 10 and 13 are summarized in Figure 3 and Figure 4, respectively.

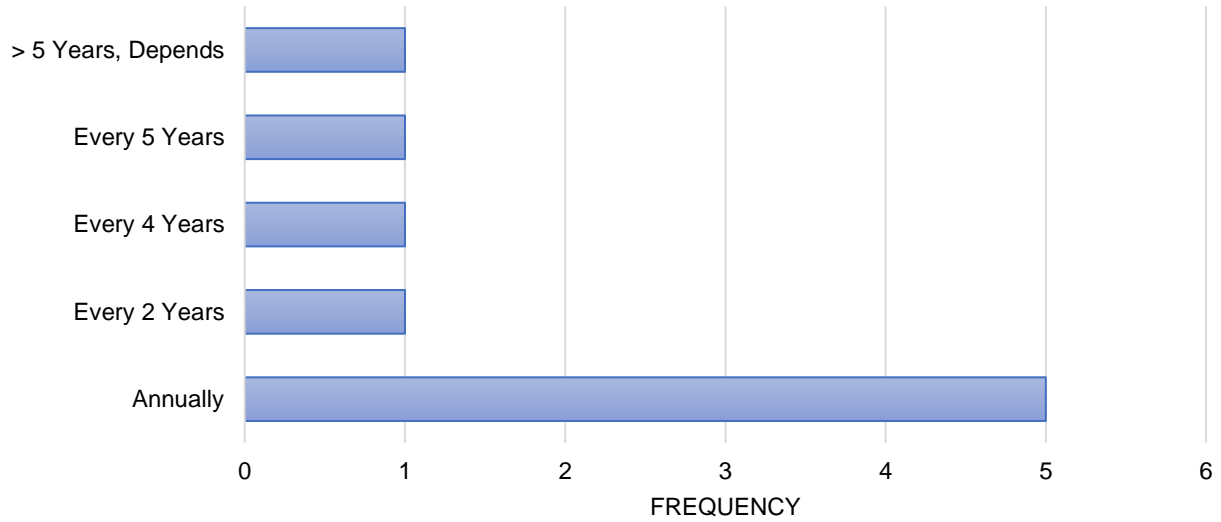


Figure 3: Data Collection Frequency (Q10)

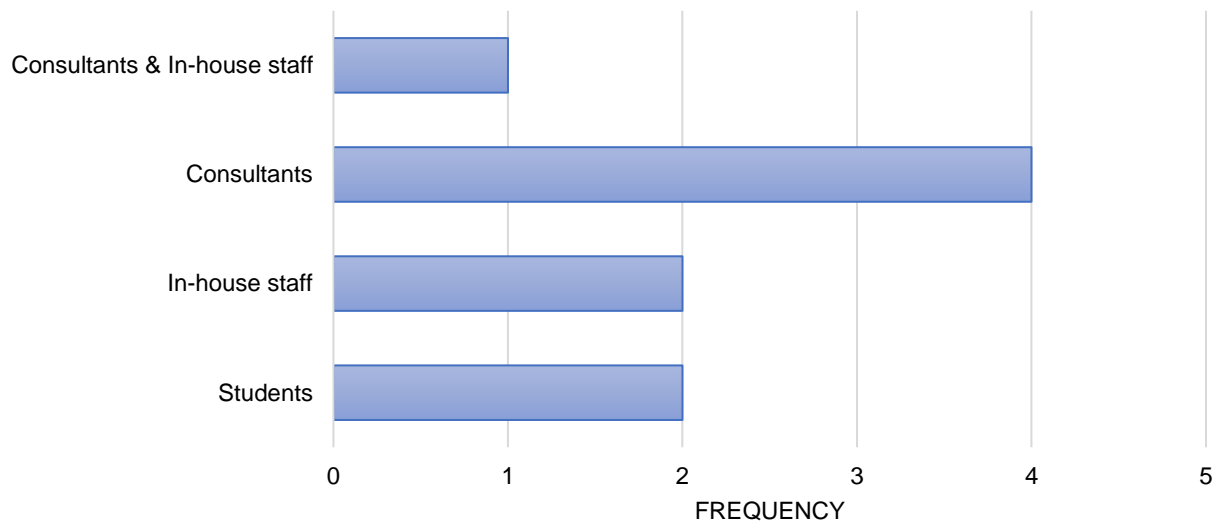


Figure 4: Data Collection Team Selection (Q13)

Data collection is performed annually in five municipalities. By comparison, other municipalities perform data collection every two to five years. One municipality noted that its data collection is conducted every five to ten years, depending on available funding.

Based on the answers to Q11, eight municipalities perform a visual/walking survey with tablet entry, and one municipality performs a visual inspection with tablet entry in a van.

One survey question (Q12) asked about attributes collected for PCC or asphalt sidewalks. The responses are shown in Figure 5.

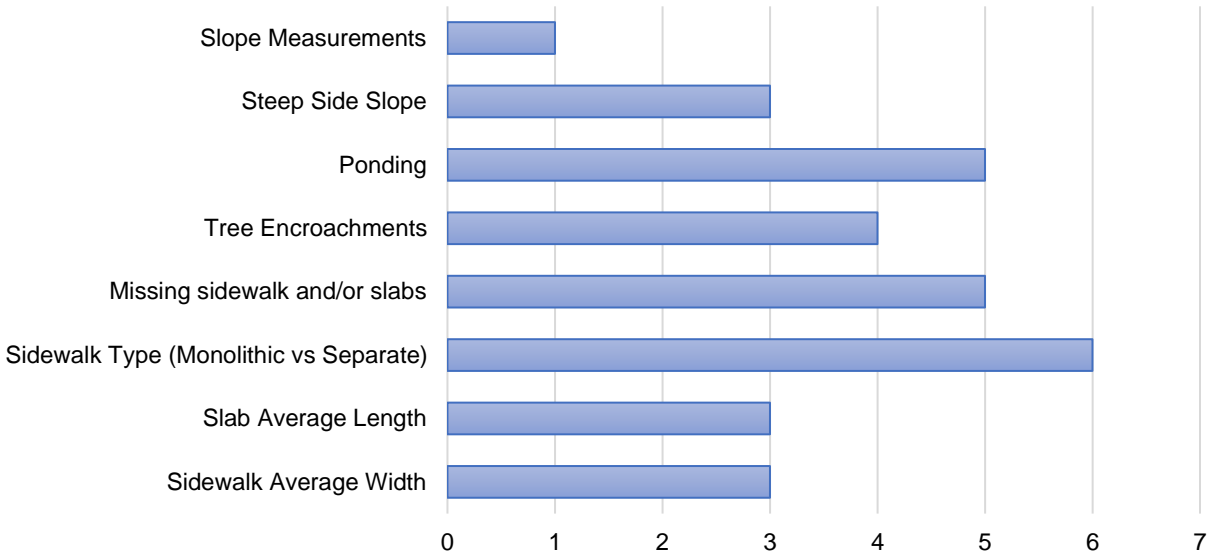


Figure 5: Attributes Collected for PCC or Asphalt Sidewalks (Q12)

Over half of the municipalities collect sidewalk type, missing sidewalk and/or slabs, and ponding. Average length and width, tree encroachments, and steep side slopes are also documented by some municipalities.

Municipalities tend to rely more on consultants or co-op students (Q13), as only two municipalities have in-house staff for the data collection task (Q14). One has 25, and the other has more than 50 in-house staff members.

Sidewalk Distress Type

The responses to the following questions related to distress type are subsequently presented:

- **Q15:** What PCC distresses are collected?
- **Q16:** What asphalt distresses are collected?
- **Q17:** What is your agency’s trigger for defining a “Trip Hazard”?

The distresses collected on PCC and asphalt sidewalks are summarized in Figure 6 and Figure 7, respectively, based on Q15 and Q16.

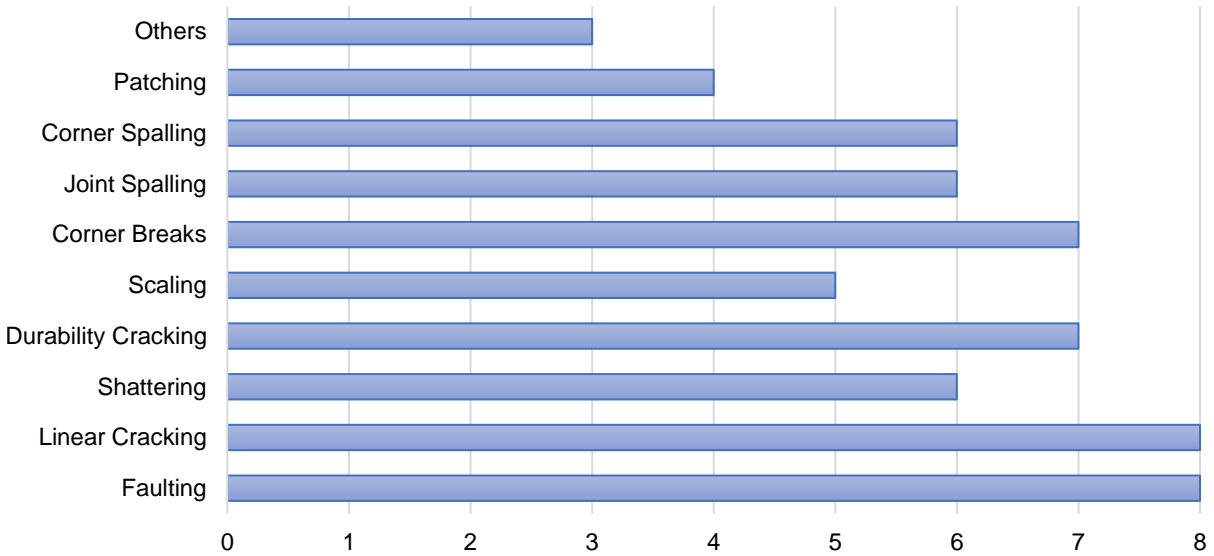


Figure 6: PCC Distresses Collected (Q15)

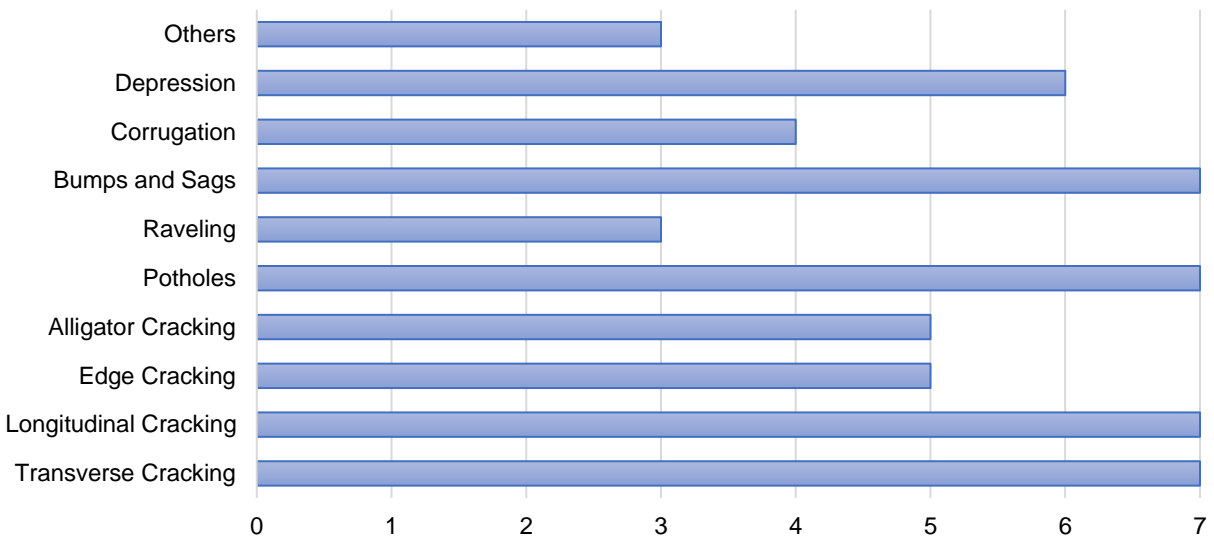


Figure 7: Asphalt Distresses Collected (Q16)

Eight out of nine municipalities collect faulting and linear cracking for PCC sidewalks. More than half of municipalities collect shattering, durability cracking, scaling, corner breaks, joint spalling and corner spalling for PCC sidewalks.

For asphalt sidewalks, the most commonly collected distresses are transverse cracking, longitudinal cracking, potholes, and bumps and sags. More than half of municipalities have also selected edge cracking, alligator cracking and depression.

One question (Q17) was asked about the trip hazard definition. The most common definition of trip hazard used by the responding municipalities is any differential settlement > 12.5 mm. Two municipalities have defined a trip hazard as any differential settlement > 15 mm or 19 mm.

Data Quality Check and Calibration

The responses to the following questions related to data quality check and calibration are subsequently presented:

- **Q18:** Do you have any calibration and/or acceptance criteria of the collected sidewalk condition data?
- **Q19:** Please briefly specify your data calibration and/or acceptance criteria, if you have answered yes to the previous question.
- **Q20:** In case of your agency using multiple staff (internal or external) to visually collect the sidewalk conditions, how do you deal with subjectivity resulting from using different staff as well as the subjectivity resulting from visually collecting the condition data as opposed to using automated surveys?
- **Q21:** Please name your automated survey technology if in use.

Seven municipalities do not use any calibration and/or acceptance criteria of the collected sidewalk condition data. The remaining two municipalities indicated that a data quality check system was in place and performed by consultants.

Seven responding municipalities do not use automated survey technology. The remaining two hire consultants who use automated survey technologies.

Survey participants were asked how they deal with subjectivity from different staff during visual data collection. Seven municipalities chose “if using 2 or more staff, we ensure staff are well trained”, and two municipalities answered, “we hire consultants, and we spot check their ratings”. One municipality commented, “supervisor does a weekly quality check on sample sidewalk sections”.

Sidewalk Management

The responses to the following questions related to sidewalk management system are subsequently presented:

- **Q22:** At what point do you replace the sidewalk on an entire block?
- **Q23:** Do you have a sidewalk management system in place?
- **Q24:** Please name your sidewalk management system, if you have answered yes to the previous question.
- **Q25:** Which of the following PCC sidewalk treatments do you use?
- **Q26:** Please specify the types of your asphalt sealers, filler types and/or patching materials, if you have selected the corresponding options in the previous question.
- **Q27:** Which of the following triggers a sidewalk slab replacement in your agency?
- **Q28:** Please specify the trigger values and units, if you have selected any triggers to the previous question.
- **Q29:** When replacing a slab, does your agency typically replace any of the surrounding slabs if they are in good condition?
- **Q30:** How do you measure and present the sidewalk performance in your agency?
- **Q31:** Please specify the performance index and/or specific standards, if you have selected those options in the previous question.
- **Q32:** While every agency strives to deliver the best sidewalk conditions for the safety and enjoyment of its residents, funding constraints proved to affect which sidewalks get to be

selected for work each year. That being said, does your agency have a minimum acceptable performance target that you try to meet or exceed on an annual basis?

- **Q33:** Please specify, if you have answered yes to the previous question.
- **Q34:** Does your agency employ any performance deterioration curves into predicting future sidewalk performance of PCC and asphalt sidewalk?
- **Q35:** Please specify if you have selected “third-party sidewalk performance deterioration curves” in the previous question.
- **Q36:** Sidewalk collected condition data (distress type, extent, and severity) are typically converted into an overall sidewalk condition index (SCI) for presentation and statistical analysis. Does your agency currently have a certain equation/model to calculate a SCI?
- **Q37:** Please specify if you have selected yes options in the previous question.
- **Q38:** Does your agency have a long-term (10-15 years) investment plan strategy?
- **Q39:** Please specify your long-term investment plan strategy, if you have selected yes to the previous question.
- **Q40:** Does your agency have a separate program for pedestrian ramps management?
- **Q41:** Have you adopted legislative requirements for ramps and sidewalks, e.g., Americans with Disabilities Act (ADA)?

The participating municipalities were asked if they had a sidewalk management system. Their responses are provided in Figure 8.

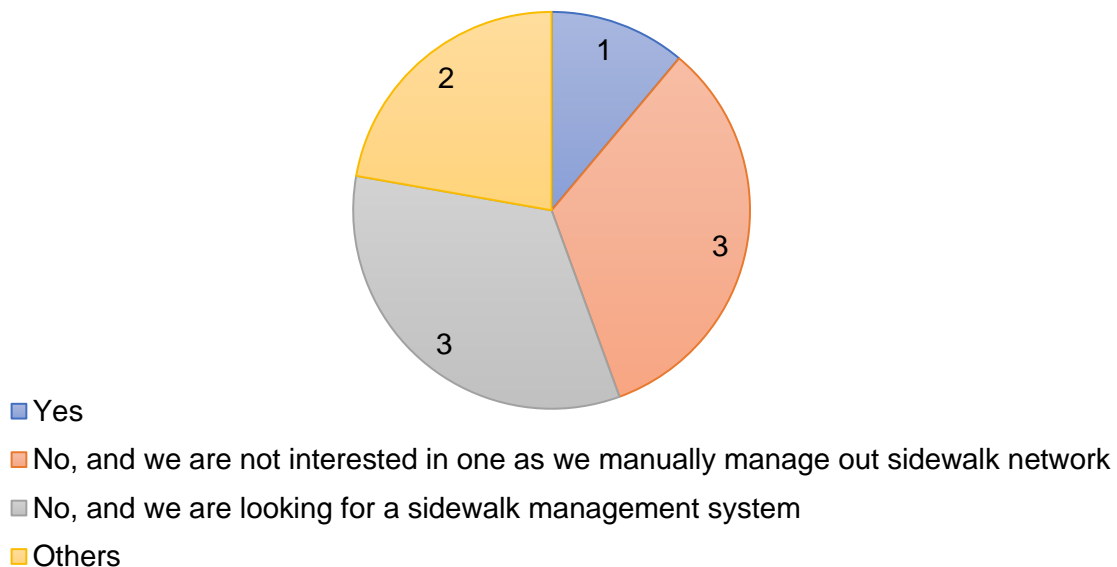


Figure 8. Existing Sidewalk Management System in Place (Q23 and 24)

Six municipalities do not have a sidewalk management system. Half of those (three) manually manage their network and do not plan to find a management system. The remaining three municipalities indicated that they have some GIS-based systems.

The answers to what PCC sidewalk treatments are used are summarized in Figure 9.

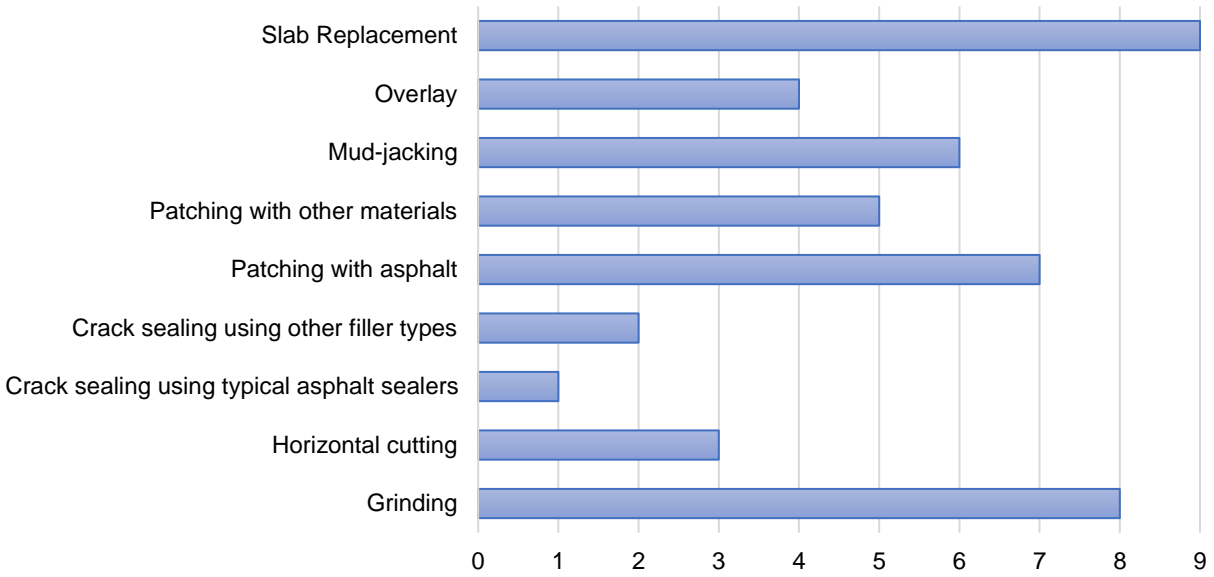


Figure 9. PCC Sidewalk Treatments (Q25)

Every participating municipality used the slab replacement treatment. Eight out of nine municipalities use grinding. More than half of participating municipalities perform treatments such as overlay, mud-jacking, patching with asphalt, and patching with other materials. Only one municipality does cracking sealing using typical asphalt sealer, and two municipalities do cracking sealing using other filler types.

The answers to Q26 reveal that some sealer, filler, and patching materials are used and listed below:

- Polymer-based grout in resurfacing
- Cold mix product in asphalt patching
- Parging and rubberized sealer
- Concrete joint sealer

The responses to questions related to sidewalk slab replacement are provided in Table 2.

Table 2. Sidewalk Slab Replacement

Response #	What trigger a sidewalk slab replacement? (Q27)	Trigger values and units to the selection in Q27 (Q28)	When replacing a slab, replace any surrounding slabs if they are in good condition? (Q29)	At what point do you replace the sidewalk on an entire block? (Q22)
1	Many of the defects may result in a replacement	N/A	No	Condition rating and coordination with other projects
2	Severe cracking	N/A	No	When at least 50 % of sidewalk slabs have failed and needed replacement
3	Many of the defects may result in a replacement	A rating system will trigger the treatment of the defects identified. This is evaluated by the inspectors and scheduled accordingly. However, there is a fiscal balance to deciding on a replacement.	No	The cost-effectiveness is considered when block replacement is evaluated
4	Severe tree root damage and/or vegetation	N/A	No	If vertical displacement exceeds 3/4" or extreme cracking on the slab
5	All the defects may result in a replacement	N/A	No	When at least 50 % of sidewalk slabs have failed and needed replacement
6	Severe cracking	Overall slab condition and wear	Yes	Depends on the available budget, and other work in the area i.e., road work. no set percentage but it would be larger than 50%
7	Settlement lower than the adjacent curb	Tripping hazards	No	When at least 50 % of sidewalk slabs have failed and needed replacement
8	All the defects may result in a replacement	We typically only replace concrete in areas where we are doing roadway resurfacing. We will also handle a case-by-case basis with customer complaints.	No	We only replace what is needed
9	Faulting	Faulting ≥ 20 mm. Other nearby slabs with defects will also be replaced when replacing the sidewalk.	Yes	When at least 50 % of sidewalk slabs have failed and needed replacement

Most municipalities indicated that many factors (e.g., faulting, cracking, tree root, etc.) could trigger a slab replacement. Generally, the participating municipalities only replace the faulted slabs, not the good surrounding ones. Most municipalities decide to replace an entire block on a case-by-case basis considering other factors such as available budget, condition, and coordination with other projects. Four municipalities are likely to replace an entire block if at least 50% of slabs have failed.

Responses to sidewalk performance index questions are provided in Table 3.

Table 3. Responses to Sidewalk Performance Index Questions

Response #	Sidewalk performance is measured and presented by (Q30&31)	Have equations or models to calculate Sidewalk Condition Index (SCI)? (Q36&37)
1	N/A	No, we don't currently have an SCI that we use.
2	Own performance index	Yes, we have an SCI model that we have developed in-house and can share with other agencies upon request
3	Own performance index: Defect Severity X Land Use = Overall Rating Overall rating 1-30 (LOS >15)	No, we don't currently have an SCI that we use. We have defect-based ratings. Working towards a segment-based rating system.
4	Own performance index	No, we don't currently have an SCI that we use.
5	Specific standards: ASTM PCI	Yes, we use a third-party SCI model developed by a consultant
6	Own performance index: A criteria set for a score of 1-5 with information recorded within a GIS system	No, we don't currently have an SCI that we use.
7	Consultant report	Yes, we use a third-party SCI model, by consultant
8	Don't have	No, we don't currently have an SCI that we use.
9	Own performance index: % of sidewalk network with deficiencies	No, we don't currently have an SCI that we use.

Two municipalities do not have a sidewalk performance measure. Two municipalities are relying on indices developed by consultants. The rest of the municipalities have indices developed in-house. Examples include a defect-based rating system and a percentage of the sidewalk network with deficiencies.

Responses related to minimum acceptable performance targets and deterioration curves are presented in Table 4.

Table 4. Responses to Sidewalk Performance Target and Prediction Model Questions

Response #	Have a minimum acceptable performance target annually? (Q32&33)	Any performance deterioration curves into prediction? (Q34&35)
1	No	No, don't think we need to
2	Yes: 80% of the network is in good condition	Yes, have own developed deterioration curves
3	No	No, don't think we need to
4	No. Vertical displacement caused by tree roots triggers most slab replacements. Typically those slabs are replaced when the tree is removed, and an asphalt patch is placed temporarily. The tree is marked for removal based on the severity of its condition of the tree.	No, don't think we need to
5	No	No, don't think we need to
6	No	No, don't think we need to
7	No	Yes, a consultant helps
8	No	Yes, have own developed deterioration curves
9	Yes: to complete all Ontario Minimum Maintenance Standard (MMS) repair requirements, as mandated by MMS.	No, don't think we need to

Seven municipalities responded that no minimum acceptable performance target is set for sidewalks. Although no target is set, one municipality replaces slabs triggered by vertical displacement caused by tree roots. Two municipalities have a minimum performance target: one follows the Ontario Minimum Maintenance Standard (MMS), and another maintains at least 80% of sidewalks in good condition. Most municipalities deemed it unnecessary to develop deterioration curves to predict sidewalk performance. Only three municipalities have deterioration curves developed by themselves or consultants.

Responses to long-term investment strategies and other miscellaneous questions are presented in Table 5.

Table 5. Responses to Miscellaneous Questions

Response #	Does your agency have a long-term (10-15 years) investment plan strategy? (Q38&39)	Have a separate program for pedestrian ramps management? (Q40)	Adopted legislative requirements for Ramps and sidewalks, e.g., ADA? (Q41)
1	No, on an annual basis	No	Yes
2	Yes, Pedestrian Strategy.	No	No
3	Yes, Part of the adopted Asset Management Policy.	Yes	No
4	No, on an annual basis	Yes	Yes
5	No, on an annual basis	No	No
6	No, but we would like to implement one	Yes	No
7	No, on an annual basis	Yes	Yes
8	No, on an annual basis	Yes	Yes
9	No, on an annual basis	No	Yes

As most municipalities lack an established sidewalk management system (treatment triggers, prediction model, and performance target), it is unsurprising that few municipalities have a long-term investment plan strategy. Five municipalities have a separate program for pedestrian ramps management. Five municipalities have adopted legislative requirements for ramps and sidewalks.

Conclusions

A sidewalk management survey, consisting of 41 questions, was distributed to 18 municipalities in North America. This paper summarizes responses for the nine survey respondents.

- The respondents have similar amounts of sidewalks to maintain, but the available budget varies greatly. The municipalities with the larger budget tend to have in-house staff for data collection.
- Most municipalities rely on external sources, such as consultants and co-op students, to visually inspect the sidewalks and record the data using a tablet.
- The survey results show that most participating municipalities do not have any calibration and acceptance criteria for the collected condition data.
- The types of PCC or asphalt sidewalk distress collected by the participating municipalities are comprehensive. The most commonly used treatments for PCC sidewalks include slab replacement, grinding, and patching with asphalt or other materials.
- The trip hazard is generally defined as any differential settlement greater than 12.5 mm.
- Most municipalities do not use the various distress data to develop the condition rating system and performance index, leading to unspecified treatment triggers and inconsistent decision-making processes.

The survey results have shown that municipalities need to maintain their sidewalk network in serviceable condition over time for the least cost. This cannot be done without the support of sufficient data. As more data on the sidewalk is recorded and compiled, municipalities can refine the sidewalk management plan by conducting budget and optimization analysis. Only through this process are the selected treatments in the sidewalk management plan most cost-effective. The sidewalk management system with a comprehensive database, well-developed prediction models, and sound engineering analysis methodologies can provide municipalities with consistent and defensible decision-making procedures and reliable strategic plans.

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