

Transportation Association of Canada

TAC 2009

2008 Road Safety Engineering Award

Annual Conference - Vancouver (British Columbia)

Ministère des Transports du Québec Submission for the
Winter Road Safety Engineering Award

March 6, 2009

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The ministère des Transports du Québec (MTQ) is presenting this submission for the Transportation Association of Canada (TAC) 2008 Road Safety Engineering Award.

This submission brief includes the following:

- An outline of the MTQ's approach to road safety;
- A brief summary of activities undertaken by the MTQ as part of its overall commitment to road safety, with a special focus on the development and implementation of a mobile weather and road conditions monitoring station;
- A demonstration of the innovative aspects of this MTQ initiative;
- A discussion on the potential applications of this new tool in the transportation field.

Road safety: the MTQ's primary concern

There has been a dramatic improvement in Quebec's road safety record in recent decades, despite a significant increase in the number of vehicles on the roads and highways.

Table 1 – Number of vehicles in circulation on Quebec roadways and number of road-related fatalities, in 1973 and 2003

Year	Number of vehicles on the roadways	Number of fatalities
1973	2 265 471	2 209
2003	5 063 449	621
Change – 1973-2003	123,5 %	- 71,9 %

Quebec ranks among the top industrialized countries as to the lowest number of roadway fatalities per billion kilometers traveled. Despite these excellent results, the MTQ and its partners remain fully aware of the continued effort required to maintain and improve upon Quebec's road safety record.

MTQ activities follow the Quebec Government general policy framework, which specifies the transportation sector's role in achieving the Government's target results. Thus, in recent years, the MTQ has focused on consolidating the existing road and highway network as a means to address issues in the key areas of driver safety and the long-term viability of transportation infrastructures.

In order to meet this challenge, the MTQ Strategic Plan includes a commitment to provide a safe, functional and sound transportation infrastructure to all users. Among the key areas of intervention targeted to achieve this objective is the prevention and reduction of accidents involving the loss of control causing the vehicle to run off the roadway. It has been shown that the MTQ's interventions targeting road conditions have the most direct impact on road safety. Roadside accidents account for over one-third of all accidents involving fatalities or serious injuries occurring on roadways under MTQ jurisdiction, and all of these accidents involve a vehicle running off the roadway. This becomes particularly evident under winter driving conditions. Quebec is a vast territory featuring innumerable water bodies and watercourses, and a harsh climate. In addition, the number of vehicles on Quebec roads and the number of kilometers traveled increases yearly. This is the challenge the MTQ must face in designing, managing and above all maintaining Quebec's road network, especially under winter conditions.

In order to meet its commitments in regards to winter road safety, the MTQ has in recent years invested a great deal of resources on two fronts: first, drivers have been made aware of their responsibilities in driving safely; secondly, tools and methods have been developed to increase the safety and effectiveness of winter maintenance activities across the MTQ network.

Winter driving: awareness, information and preparation

For several years, the MTQ has conducted information and advertising campaigns on safe winter driving. Using an information-based approach, these campaigns point out the hazards of winter driving as a means to encourage everyone to change their driving habits and to drive in a more prudent manner.

As a complement to these communication activities, the MTQ offers drivers and the public detailed information on road conditions in winter. This is accomplished by making road conditions information available through the Quebec 511 Web, which provides all the information required for safe winter road trip planning. In support of this public information tool, the MTQ has developed a specific terminology base to ensure clear comprehension of winter driving conditions among all users.

On the legislative front, in fall 2008 the MTQ played a lead role in implementing a new law requiring the use of winter tires on all vehicles bearing Quebec license

plates. This new law paved the way for a safer winter driving season for all drivers.

Guiding and improving winter maintenance decision-making

As part of the pioneering work involved in the development of the Quebec road conditions information system, the MTQ innovated on several fronts by developing and implementing new technologies to assist maintenance operations personnel in making the decisions required to ensure optimal driver safety under winter conditions.



Figure 1: Light-duty truck fitted with a mobile monitoring station

Following a pilot project conducted in 2001, a number of decision-support tools were developed in response to the needs of roadway maintenance operations personnel. Among these new tools is a mobile weather and road conditions monitoring station, which measures a series of weather and road condition-related parameters in real time as the vehicle patrols the road network.

This unique and innovative tool was developed following a detailed analysis of the needs expressed by maintenance personnel and snow removal specialists. This approach led to the identification of the most relevant meteorological and

road surface conditions parameters required to assist decision-making by maintenance operations personnel. In addition, the involvement of operations personnel at the earliest developmental stages ensured full cooperation and buy-in at the implementation stage.

Principles and operation of the mobile weather and road conditions monitoring station

A total of six meteorological and road surface conditions parameters are available in real-time to assist maintenance operations decision-makers in predicting and quantifying weather and road conditions factors that determine the timing and extent of roadway network maintenance activities.

Table 2 – Weather and roadway surface conditions measured by the mobile monitoring station

Types of measurements	Symbol
Roadway surface temperature	T _s
Dew point	T _d
Air temperature	T _a
Relative humidity	U
Barometric pressure	Kpa
Elevation	m

Sensors on the vehicle measure these parameters and readings are displayed on a digital screen inside the vehicle.

In the fall of 2002, after three months in development, the MTQ delivered 60 first-generation vehicle-mounted mobile weather and road conditions monitoring stations, to be operated by snow removal patrol personnel. These vehicles are usually driven by MTQ personnel overseeing snow removal operations.

Given the interest generated by the first-generation of mobile monitoring stations, the MTQ has developed a second-generation monitoring station within the framework of Transport Canada’s ITS Program. Key physical changes include improvements to apparatus ergonomics and driver protection against mobile radio emissions, while system changes include improved data capture, on-board display and database storage performance.

The data management system was designed top to bottom by the MTQ. It optimizes data capture using existing, readily available sensor technology. As all sensors provide remote access to stored data, the user may view the data on the dash-mounted display screen, retrieve stored data from the computer database or even access all data remotely using a wireless connection. The data

management system, which does not require any computer programming knowledge, allows the user to easily configure the parameters to suit their needs.

A new data acquisition system equipped with a dash-mounted backlit display screen (Figure 2) has been installed in each mobile monitoring vehicle, along with four sensors (Figure 3) providing real-time measurements of the chosen parameters. An infrared thermometer, located on the underside of the vehicle, measures the roadway surface temperature (T_s), a digitally interfaced thermometer and hygrometer mounted on the cab roof measure air temperature (T_a) and relative humidity (U). A barometric pressure sensor located in the cab measures barometric pressure (P). The system calculates the dew point (T_d) based on T_a , U and P measurements. A GPS unit identifies the specific location where the measurements are collected.



Figure 2: Backlit display

**Température de la surface
de la chaussée**

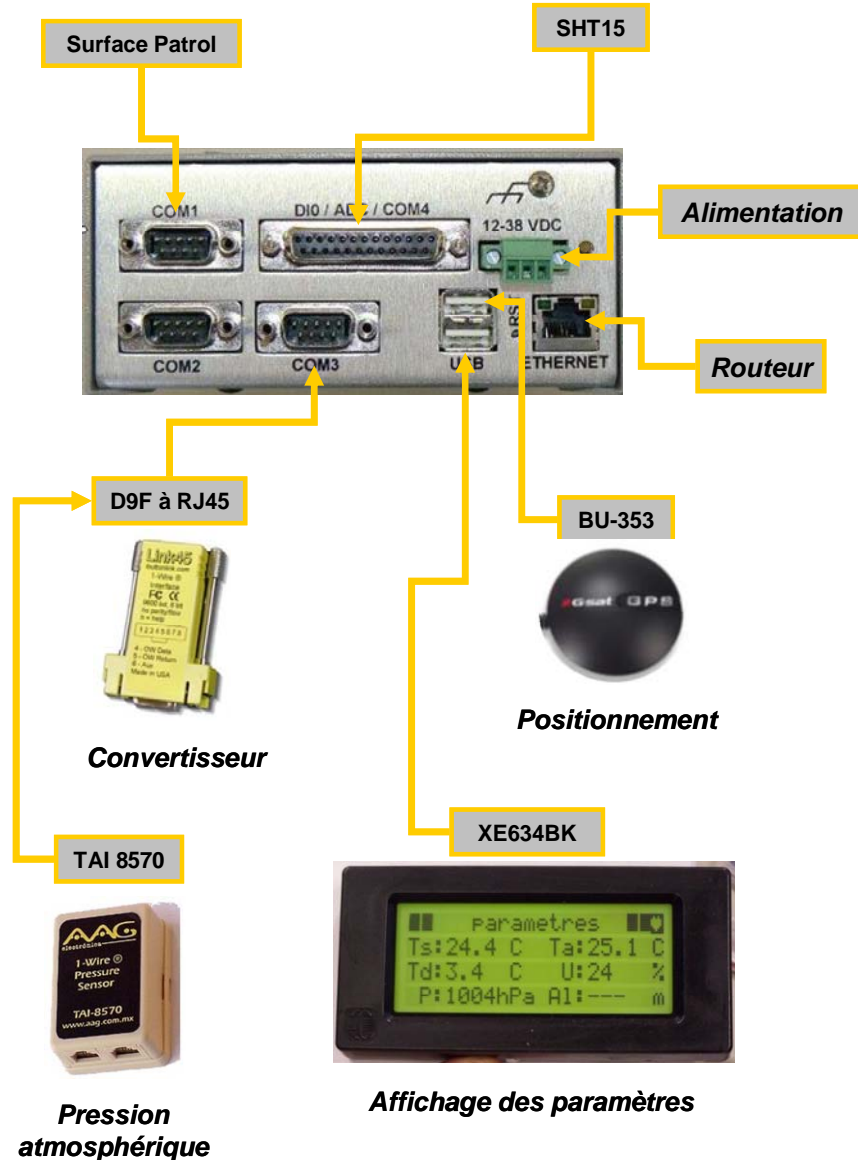


Surface Patrol

**Température de l'air
et hygrométrie**



SHT15



Alimentation

Routeur

Convertisseur

Positionnement

Pression
atmosphérique

Affichage des paramètres

Fig. 3: Second génération data acquisition system
(Roadway surface temperature – Air temperature and level of humidity – Feed – Router – Converter – Positioning – Barometric pressure – Parameter display)

Tool deployment and use

Over 130 MTQ vehicles monitoring winter roads are now equipped with these second generation mobile weather and road conditions monitoring stations. MTQ winter road maintenance professionals have fully embraced the new technology as an effective means to identify and analyze weather and road surface conditions with a potential impact on road safety, such as icy roads.

The development and use of this user-friendly technology provide effective, real-time support to winter road maintenance decision-making by helping operations personnel plan the deployment of the right type of intervention, using the right materials, at the right time. Indeed, the complementary nature of the parameters has proven highly useful in modeling the predicted impact of weather events on road conditions, therefore enabling decision-makers to deploy the maintenance activities required to ensure the safety of the road network.

Simply put, comparing the T_s and T_a values has proven to be a valid means to predict the risk of condensation on the roadway surface. Once it has been determined that the T_s value is lower than the T_a value ($T_s < T_a$), signifying that condensation is likely, the T_s value is then compared to the dew point value T_d . In situations where $T_s < T_d$, further analysis determines if it will be a liquid (formation of water when $T_s > 0C$) or a solid condensation event (formation of white ice when $T_s < 0C$).

MTQ operations personnel now consider this new tool essential in carrying out their daily responsibilities on the Quebec's road system. In their opinion, the tool has improved the operation of the entire roadway system because it has enhanced the quality of road maintenance by helping decision-makers give priority to maintenance activities that have the highest impact on highway safety..

In the face of Quebec's harsh winter conditions, innovative solutions are constantly being developed to protect all roadway users by improving winter maintenance operations.

The mobile weather and road conditions monitoring stations play a key role in this continuing effort. They provide an innovative and effective means to collect the environmental, weather and road surface data needed to make sound winter maintenance decisions; they contribute directly to the significant improvement of highway safety, and they greatly assist in the optimal use of road de-icing and sanding materials, which helps protect the environment.