

# Winter weather and municipal winter road maintenance

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## Background

Municipalities as local governments are usually responsible for winter road maintenance in built-up areas contrary to state road authorities that are mainly responsible for winter road maintenance in rural areas. For many reasons, municipal winter road maintenance is a complex task to accomplish and no two municipalities are alike regarding that type of service. In Sweden, the number of built-up areas in a municipality range from very few to more than 20, but not every municipality is responsible for the winter road maintenance in all of its built-up areas. Furthermore, every built-up area has different types of traffic areas for different types of road users. Traffic areas are often used by more than one type of road user. Other factors contributing to make every municipality unique are geographical location, political majority, number of inhabitants, land area, organisation, traditions, priorities, methods of working, equipment, etc.

Weather conditions is one of the factors that governs the actions taken for snow and ice control of streets and roads, foot and cycles paths, and other traffic areas in a municipality. In its report on the need of weather services for municipal winter road maintenance, the Swedish Association of Local Authorities (SALA) (1993) established that good weather information increases the chances to optimise actions of snow and ice control. In this respect, good weather information should involve that weather forecasts are reliable and give early warnings of difficult road conditions.

In an inquiry dealing with the organisation and handling of municipal winter road maintenance during the winter season 1997/98 in Sweden, Johansson (2000) found that the municipalities used various types of winter weather information. The most common types of information used by the 288 municipalities were forecasts bought from the Swedish Meteorological and Hydrological Institute (SMHI), forecasts presented on TV or radio, and visual observations made by their personnel. However, the use of forecasts from the SMHI varied greatly. Most small municipalities did not afford to buy the forecasts, while all the 11 largest municipalities bought the forecasts. In 1997/98, the Swedish National Road Administration (SNRA) had since long established its road weather information system (RWIS) with nearly 700 stations all over the country. Most of these stations are located along rural roads and not within built-up areas. Only 49 municipalities had a station within or just outside the largest built-up area., This information system was therefore used by less than 20 percent of the municipalities that mostly had to pay for that service.

The maintenance action taken depends on the level of service decided on. For example, it can be described by a snow depth that determines when to start ploughing or whether to use preventive ice control methods or not. Sometimes the payment for executed actions is regulated by the amount of precipitation (snow in water equivalent) and by the number of temperature fluctuations around zero degrees that has resulted in slippery road conditions. These circumstances call for detailed weather information and measuring of weather conditions.

Berntman (1999) conclude that a few days with very slippery road conditions generate many injuries, especially among pedestrians but also to some degree among cyclists. Her advice to municipal road authorities and their contractors is to learn more about the special weather conditions that occur at such occasions to be able to provide preventive and early actions. In his "good advise for municipal winter road maintenance", Johansson (2000) states that it is important for all personnel involved in winter road maintenance to have a good knowledge of how different types of winter weather develop and of the specific road conditions that may occur from severe winter weather. It is also important to understand how to interpret weather forecasts and other weather information correctly to be able to take the right actions at the right time, thereby exposing road users as short time as possible to accident hazards because of snowy and icy traffic areas. The understanding is most important for supervisors that have the responsibility to decide when to call out personnel and units to start actions.

Because of the need for providing municipalities with road weather information, the Section for Infrastructure and Property Management at SALA made a deal with the SNRA in 2000 that the municipalities can use information from the RWIS for free. The municipalities only have to ask for usernames and passwords for those who need the information in their work with winter road maintenance.

In the light of this background, it seemed to be a good idea to present a course in winter weather and winter road maintenance to the Swedish municipalities. Therefore, such a course was discussed with the City of Göteborg, the second largest municipality in Sweden. The reaction from the city was clear enough: "Give us that course as soon as possible!" The first course was given in the autumn of 2002.

## **Course contents**

### **Winter weather**

Winter road maintenance personnel constantly need to estimate the risk for slippery road conditions. The next step is to make a suitable decision about when and where to perform winter road maintenance. The decisions require an understanding for why and how different road conditions develop. The course participants have seldom been given the opportunity to any education in weather-related subjects before. However, the maintenance personnel develop a large experience and "feeling" for road conditions through the years. The main purpose with this course has been to give a general background and increased understanding for winter weather. The consequences could be an increase in the number of "correct" maintenance actions.

The course gives knowledge in basic meteorology and climatology, with focus on situations and processes that may lead to difficult winter road conditions. An understanding for surface

warming and cooling is important as well as typical weather associated with warm and cold fronts. The general background can then be used to explain local climate variations, especially in urban areas. Urban climate is a wide research subject and the urban heat island is well known as well as the importance of sky view factors for temperature distributions in urban areas (e.g. Oke, 1990). Road climate studies have traditionally focused on variations in rural areas. Gustavsson et al. (2001) points out the important factors for air- and road surface temperatures within an urban area. Especially the urban heat island was shown to be important for temperature variations.

As discussed earlier, one of the most important subjects to discuss with the municipal maintenance personnel is weather information and the tools available today. General weather maps and forecasts are widely available on TV, radio, daily papers and on the internet. The larger municipalities also buy local forecasts from SMHI. Even if this information is clear and easy to interpret, a person with some meteorological background can also understand the implications for road conditions. Satellite images are information that can be useful when following fronts etc. One exercise during the course is to compare satellite images and weather maps (figure 1). The exercise increases the understanding for how weather conditions are associated with different weather elements.



*Figure 1. The photo shows how weather maps can be compared with satellite images.*

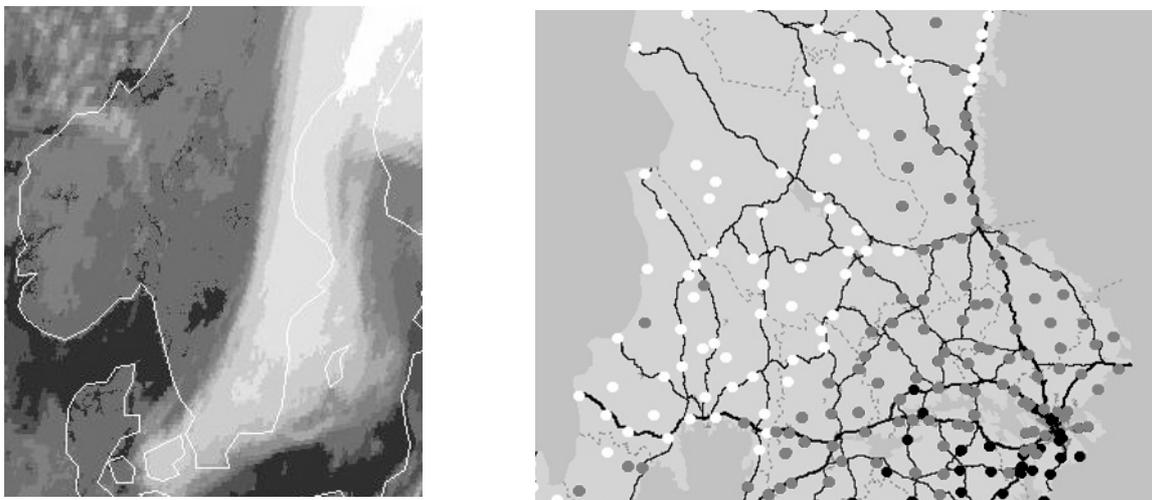
Road weather information systems provide another important piece of information. There is a great need for education in how to use and interpret this information. Since few stations are placed in built-up areas, even more knowledge is needed to use and interpret the RWIS information correctly. Awareness of local climate variation is necessary, since the stations are placed in different local environments. It is also possible to use the RWIS presentation to follow regional climate variation (e.g. Eriksson, 2001). For example, weather changes can be monitored through studying how road surface temperature is affected. Figure 2a and 2b shows how the road surface temperatures react when a front passes southern Sweden.

### **Municipal winter road maintenance**

Usually, in a course there are participants from several municipalities. Therefore the participants as a part of the course are encouraged to discuss municipal winter road

maintenance from a more comprehensive view and compare their experiences etc. Such a discussion usually covers different topics on municipal winter road maintenance, such as:

- Juridical aspects including delimitation towards property owners.
- Different forms of client-contractor relationships including questions on contracts, "push-the-button", inspection and monitoring.
- The use of internal and/or external units including equipment
- Priorities regarding different types of traffic areas and snow and ice control including starting criteria and completion times.
- Different types of ice control methods and material.
- Environmental impacts.
- Information to and from the public.



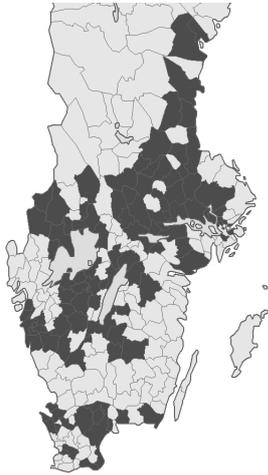
*Figure 2. 2a shows a satellite image of southern Sweden and 2b shows the responding road surface temperatures where different shades of grey represent different temperature intervals (black = warm and white = cold).*

## **Concluding remarks**

In Sweden, the need for a course like this has turned out extremely high. Until the end of 2003, about 500 supervisors and contractors from about 100 Swedish municipalities (figure 3) have participated in almost 20 courses. However, so far very few of the small municipalities (with less than 10 000 inhabitants) have participated. There are mainly two reasons given not to participate in the course. Either, a municipality recently participated or will participate in a course on winter weather given by the SMHI, or the municipality does not have the money for letting people take the course.

Even if information from the SNRA's RWIS has been free to use for municipalities since 2000, not many of the municipalities did use the information before they participated in the course. The main reason was that they did not consider the information to be valuable and/or they found it difficult to get and understand the information. According to SALA, after participating in the course most of the municipalities have asked for usernames and passwords to be able to use the RWIS. Actually, SALA has continuously been able to notice in what area of Sweden a course has been given.

So far, no course has been given in the northern part of Sweden. The reason for this can be illustrated by the message from the municipality of Umeå: "The winter here in the north is predictable. It will snow and we will plough". It seems to be a more complex task to handle winter road maintenance in the southern part of Sweden than in the northern part of the country. The municipalities in the south often have to deal with weather conditions around 0°C, thus facing more occasions with slippery conditions during a winter season.



*Figure 3. The map shows which municipalities in southern Sweden that has participated in the course as of December 2003 (dark grey).*

## References

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