

Issues of and Measures for Ensuring Winter Road Traffic in Japan

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ABSTRACT

About 60% of Japan's national land belongs to snowy regions, where about 20% of the total population lives, and occupies an important position in social economy in Japan. In snowy regions, constant snowfall had inhibited traffic every winter and had had a great impact on regional development. In order to secure road traffic in those regions, the Snow Cold District Act (Act on Special Measures concerning Maintenance of Road Traffic in Specified Snow Coverage and Cold Districts) was enacted in 1956. Consequently, full-scale projects including mechanized snow removal for snowy and cold regions have been initiated to secure safe and smooth road traffic in winter.

However, due to the changes in social conditions such as the development of road traffic systems and popularization of vehicles, the needs for securement of winter road traffic have been increasing more than ever before. With the changes in situation surrounding regional areas, there are various issues on securement of winter road traffic, including advancement of population aging, diversified residents' needs, frequent occurrence of unusual weather, and difficulty in securing human resources for snow removal projects due to depopulation. In addition, projects for snow and cold regions including road snow removal require strict cost management under the present circumstances where budgets for public works projects have been slashed due to severe fiscal conditions.

This paper aims to introduce the recent situation of snowfall and issues on snow removal in Japan and to summarize efforts for those issues and measures for securing efficient road traffic.

KEY WORDS

WINTER ROAD MAINTENANCE

1. Winter weather conditions and issues in Japan

1.1 Climatic and geographic conditions in Japan

One characteristic of snowy regions in Japan is an extremely large amount of snow accumulation despite of being located at low latitudes, and the regions are world famous heavy snowfall areas. Because of wet heavy snow, snow removal work in those regions requires a larger amount of labor.

Besides, Japan has some densely-populated large cities with heavy snowfall. In the case of Sapporo City, where the 11th PIARC International Winter Road Congress was held in 2002, its population reached about 1.8 million and it has an annual accumulated snowfall depth of 5 m.

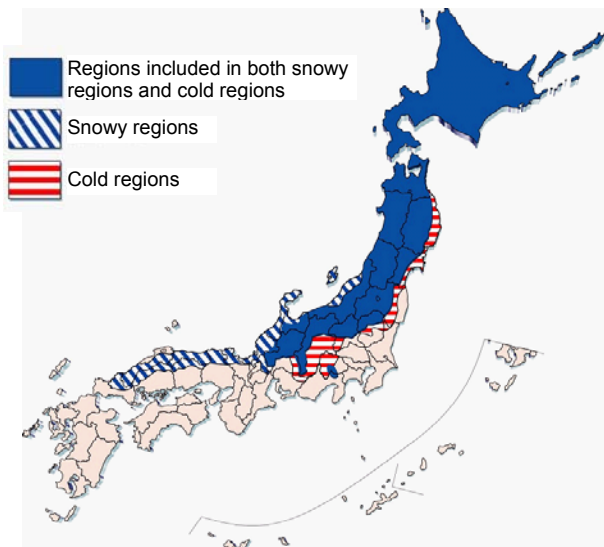
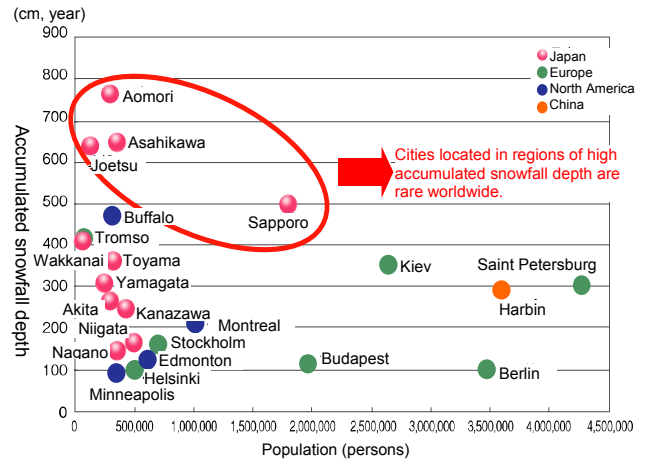


Chart: Snowy and cold regions in Japan



Relation between population and accumulated snowfall depth in cities in the world

Data: Snowfall of overseas cities from the "Winter Stage Now" (Sapporo City)
 Snowfall of Japanese cities from the "Climatic Table of Japan—Normal Values of 1971-2000" (Meteorological Agency)
 Population from the "Demographic Yearbook 1995" (United Nations)

Chart: Relation between population and snowfall by city

1.2 Recent conditions of snowfall

In winter from December in 2005 to February in 2006, the first snowfall occurred earlier than in an average year and broad areas along the Sea of Japan were frequently hit by heavy snow combined with storm wind. Of 339 sites in the country where the Meteorological Agency makes observations of snowfall, 106 sites broke the record for the deepest snow accumulation in December, and 23 sites broke the record for the annual deepest snow accumulation. Those snow disasters caused many victims, depriving 152 people of their precious lives nationwide, two thirds of which were the elderly aged 65 or older. The Road Bureau of the Ministry of Land, Infrastructure and Transport took measures against snow damage in cooperation with related departments and agencies, as well as other necessary measures including urgent allocation of subsidies for snow removal on prefecturally managed roads and municipal roads. However, those disasters highlighted various issues such as the occurrence of regional isolation due to snowslides etc. and blocked traffic on highways due to traffic jam.

On the contrary, the next winter had far less snow, and the accumulated snowfall depth was less than 60% of the average over the past ten years. Snow removal contractors' earned value was significantly affected by the decrease of the workload, and issues on risks in snow removal services became obvious.

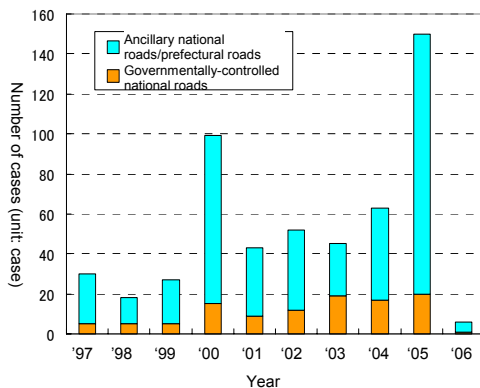


Chart : Number of cases of the occurrence of snowslide disasters on roads



Blocked traffic on highways due to traffic jam



Difficulty in going by each other



Pedestrians walking on the roadway

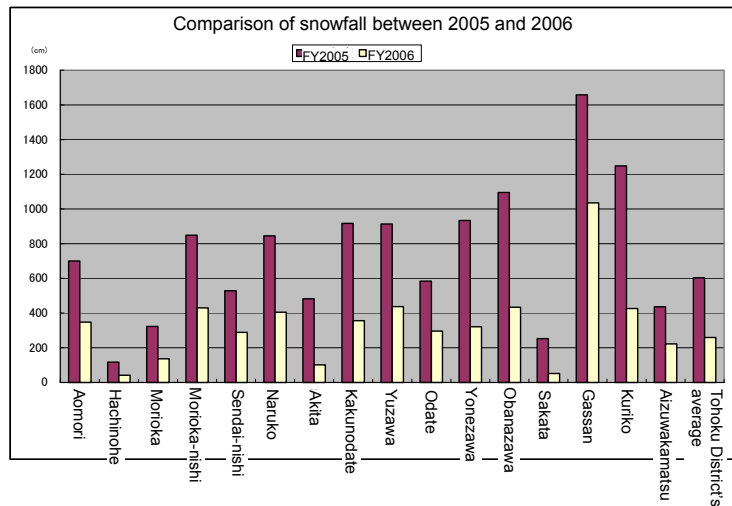


Chart: Comparison of snowfall between 2005 and 2006

2. Efficient winter road traffic

2.1 Allocation of budget for snow removal work

(1) Composition of snow removal costs

Road snow removal costs generally consist of;

- Costs for snow removal on roadways,
- Costs for snow removal on sidewalks,
- Costs for spray of antifreezing agents etc., and
- Costs for snow hauling.

In snow removal projects, which are conducted under the above cost composition and work details, the amount of workload varies according to various factors such as snowfall and temperature. For example, costs for spray of antifreezing agents will be higher when the temperature is lower, and costs for snow hauling will be higher when there is heavier snowfall. Workload and cost composition vary according to the situation in each year.

In Japan, the budget is compiled for each fiscal year from April to March, and the end of the budget period coincides with the timing of implementation of snow removal. As a result, changes in snow removal costs constitute a significant risk of budget preparation.

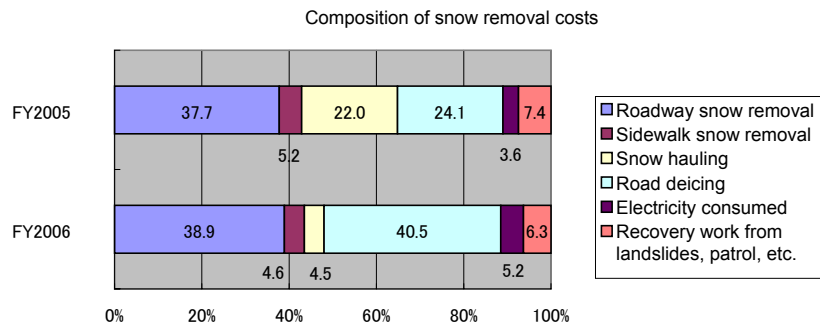


Chart : Composition of snow removal costs for each year

(2) Budget allocation for snow removal projects

The national government subsidizes two-thirds of the budget for snow removal projects implemented by prefectural governments. However, as annual snow removal costs vary significantly according to snowfall conditions in each prefecture as stated above, the budget is supposed to be allocated to each prefecture according to its snowfall conditions in late February, when approximate snowfall for the fiscal year can be estimated.

(3) Comparison of costs based on the snow removal unit price curve

As snow removal work is influenced by various factors under natural conditions, it is difficult to compare costs. However, it is necessary to facilitate cost reduction for the purpose of establishing an efficient snow removal system under severe fiscal circumstances.

Therefore, on the assumption that there is a certain correlation between snowfall and snow removal costs spent among similar regions though snow removal costs are influenced by various factors, we have examined cost management methods using the snow removal unit price curve. A brief overview is given as follows.

In this curve graph, the vertical axis represents snow removal unit price (yen/km/cm) calculated by dividing costs required for snow removal by the total length of roads and the snowfall depth, and the horizontal axis represents the accumulated snowfall depth. The example is shown below.

Snow removal unit prices on the vertical axis, which represent costs required to remove snow 1 cm deep on a 1 km long road, are supposed to rise when there is less snowfall because snowfall is not the only factor that influences snow removal costs. By using this curve, it is possible, to some extent, to compare costs by fiscal year and by region regardless of differences in snowfall.

Previously, it has been difficult to compare costs for snow removal projects. However, it is expected that this method will make it possible to conduct cost management by region or administrator, thereby promoting further efforts for cost reduction. The allocation method of the snow removal budget taking into account the idea of the snow removal unit price curve has been partly introduced since FY2006.

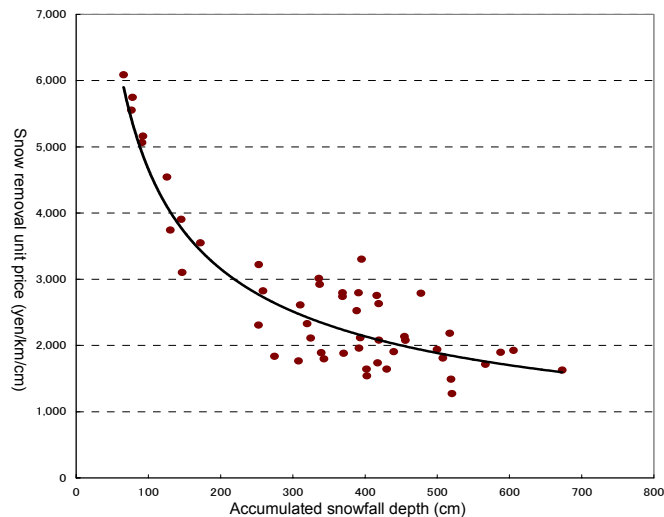


Chart: Example of the snow removal unit price curve

2.2 Implementation of an efficient snow removal system through collaboration among road administrators

Road management in Japan is conducted by different administration bodies according to road types; expressways are managed by expressway companies, some of national roads are managed by the national government, the rest of national roads and prefectural roads are managed by prefectural governments, and municipal roads are managed by municipal governments. Consequently, in order to prevent traffic accidents and massive traffic jam due to heavy snow, it is necessary to conduct snow removal operations in collaboration with different road administrators.

In Kanazawa City in the Hokuriku District, the “Information and Liaison Headquarters”, consisting of the national, prefectural and municipal governments, expressway companies, and police departments, is established in case of heavy snowfall. The headquarters conduct efficient snow removal operations by unifying and sharing information, conducting liaison/coordination and having consultations, as well as provide information to drivers.



Training at the Information and Liaison Headquarters



Provision of information to drivers through the Internet

2.3 Optimized risk management in snow removal based on climate changes

When there is less snow, costs for snow removal projects will decrease and snow removal contractors will be significantly affected from a business standpoint. In particular, many of snow removal contractors in Japan are small-sized businesses and face various problems, including recent reduction in number and size of public works and aging snow removal operators. A decrease in the contract amount due to less snow is a matter of life and death for them. In order to address those problems, in view of the actual situation of snow removal contractors in each region, some improvements in cost estimation for national snow removal projects have been made with regard to waiting time of snow removal operators and maintenance and retention of snow removal machinery.

- (1) In snowy regions, including mountain areas, snow removal operators become obliged to wait at night a certain period of time (end of December to end of February) and labor costs should be included in the estimation.
- (2) In cases where there are some consecutive nonoperational days without using snow removal machinery, snow removal operators are obliged to do the start-up running for 30 minutes in two weeks, and necessary costs should be included in the estimation.

2.4 Upgrading of snow protection and frost/snow damage prevention facilities

In addition to snow removal, the upgrading of snow protection facilities such as snow sheds and snow shelters has been promoted to prevent snowslides in mountain areas and snow drifting in plain areas as one of projects for snowy and cold regions. Especially in the section that needs to conduct intensive snow disposal, snow-melting facilities that do not need snow removal operations, such as snow-melting pipes and road heating systems, have been developed.



Snow shed



Snow fence



Snowslide protection fence



Snow-melting pipe

3. Ensuring safety on winter roads in urban areas

3.1 Promotion of winter-time barrier-free measures in urban areas etc.

Urban areas face barriers specific to winter, including narrowed pedestrian space due to accumulated snow or increased risks of falling. Therefore, in areas with heavy pedestrian traffic, such as train station vicinities and city centers, some intensive measures against snow, including snow control measures for pedestrian crossings and their surroundings, antifreezing measures for slopes, securement of snow-piling space, and snow control measures for bus stops and their surroundings, have been taken.



Pedestrians in winter

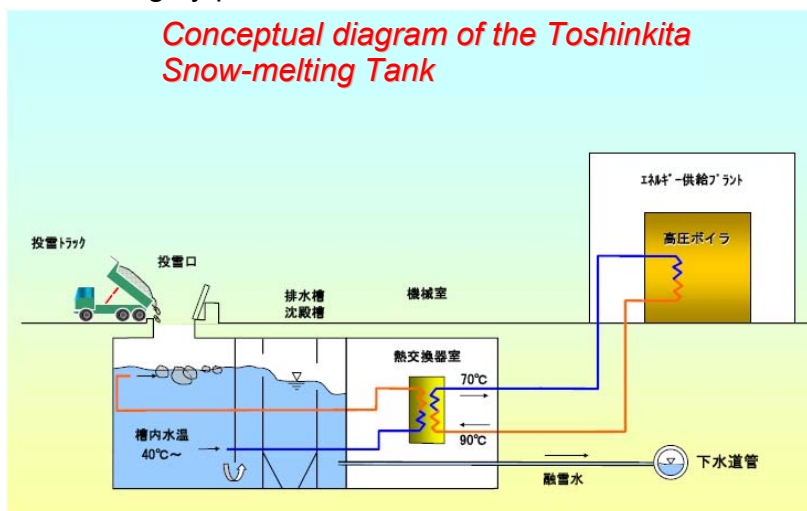


Road heating system

3.2 Development of snow-melting tanks

A snow-melting tank is a device to melt snow using a certain kind of heat energy. It is installed when there is no snow-piling space on roadsides, when it is far from snow dumping sites, or when dumping space is too small for transportation fees. Those tanks are mostly installed in urban areas which have little vacant space, and are often attached to sewerage facilities or waste disposal facilities to use their residual heat as energy source.

The Toshinkita Snow-melting Tank in the north exit area of JR Sapporo Station in Sapporo City, which was constructed together with an underground car park and public underground concourses, adopts a system to melt snow using heat from a cooling and heating plant. Being established in the center of Sapporo City, this facility contributes to shortening of the distance of snow transport by dump trucks for snow disposal and enhancing the efficiency in snow transport operations, as well as securing winter road traffic in urban areas, where city functions are concentrated and are highly public in nature.



Snow thrown into a snow-melting tank

Chart: Toshinkita Snow-melting Tank in Sapporo City

4. Securement of winter road traffic through the use of information technology

4.1 Provision of images captured by road surveillance cameras through the Internet

It is very important for road users to grasp in advance the road surface conditions along their intended route when they plan to travel to their destination. The Road Bureau has installed about 7,000 units of surveillance cameras at mountain passes etc. along national roads to monitor the conditions of road surface and road structures. Efforts to provide image information by those surveillance cameras to road users through the Internet have been promoted. Some cameras allow them to obtain images through a cell-phone.



Chart: Provision of images through the Internet

4.2 Efficient operations of snow removal vehicles using GPS technology

In snowy urban areas, it is necessary to conduct efficient snow removal operations from late at night to early morning so as not to paralyze the socioeconomic systems. However, it is extremely difficult to control hundreds of snow removal and disposal vehicles promptly and properly according to residents' needs for snow removal and snowfall conditions.

Under such circumstances, upgraded snow removal and disposal operations have been carried out using GPS technology in Akita Prefecture and Iwate Prefecture. GPS, a system in which we can identify our location through satellites, is now widely used for car navigation, air crafts, land surveys, cell-phones, etc., and exhibits remarkable improvement in accuracy. Snow removal and disposal vehicles equipped with GPS allow us to confirm the present location of those vehicles and the progress of operations and to obtain more timely information on snow removal and disposal than ever. Such information is also provided to the public through the Internet or cell-phone so that it can be used by residents along roads who intend to remove snow on their own premises or road users to plan a travel.



Chart: Present location of a snow removal vehicle

5. Conclusion

Due to the advancement of the aging society, diversification of resident needs, progress of motorization, etc., the situation surrounding snowy regions has been changing. Record-breaking heavy snow in 2005-2006 reveals that measures against snow damage only by developing facilities have their limits, and people's understanding of snow damage and their cooperation are essential. It seems necessary to promote collaboration with local authorities so as to achieve appropriate contracts and estimation in view of the actual situation of regions when there is less snow.

The Ministry of Land, Infrastructure and Transport strives to promote the development of facilities by making effective use of limited budgets, and to implement various measures in both hardware and software sides, including reinforcement of the cooperative structure with local authorities etc. and collaboration in various efforts, with the aim of ensuring safe and secure winter road traffic.