PIARC 2014 Andorra

Winter Road Management in Japan

The flexibility to adapt to the changing climate

MLIT

Contents

Winter lifestyles and attractions

From olden times, not only have the Japanese people overcome issues of snow. They have also made the most of the blessings of snow and have developed lifestyles and culture rooted in snowy regions. Here, you can see festivals with a few hundred years of history, relatively recent winter festivals, lifestyles in regions of extreme snowfall, and winter sports and other activities.

The Festival of 108 Lights (Uonuma, Niigata Pref.)

Annual Naked Visit to Kyogase Hachiman Shrine (Agano, Niigata)

International Snowball Fight (Uonuma, Niigata Pref.)

Winter Circus (Taisetsu-Furano Scenic Byway Hokkaido, Hokkaido Pref.)

White Illumination (Sapporo, Hokkaido Pref.)

Area-wide roof snow unloading day (Joetsu, Niigata Pref.)

Rooftop snow (Joetsu, Niigata Pref.)

School children (Yokote, Akita Pref.)

Sapporo Snow Festival (Sapporo, Hokkaido Pref.)

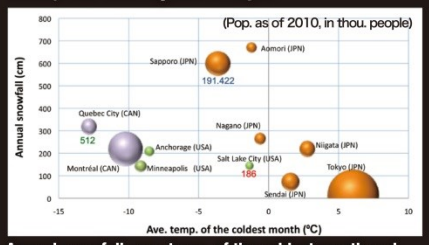
Streetcar track snow sweeper (Sapporo, Hokkaido Pref.)

Snowy and cold regions and their winter climate

2 Snowy and cold regions and their winter climate
Les régions froides et enneigées et leur climat en hiver
Les regions fredes amb neu i el seu clima hivernal

A national highway running through a mountainous area (Route 49, Fukushima Pref.)

Snowy and cold regions in Japan



Annual snowfall, avg. temp. of the coldest month and population of cities around the world

Seventy percent of Japan is steep mountains. Seasonal winds pick up moisture when they pass over the Sea of Japan, and they bring great amounts of snow to the Sea of Japan side of the country. Aiming to promote industry and security for those in the cold, snowy regions of Japan, the 1956 Act on Special Measures concerning Maintenance of Road Traffic in Specified Snow Coverage and Cold Districts calls for measures to secure winter road traffic that include snow removal and protection from the adverse effects of snow and frost heave. The blue

regions on the map of Japan, designated cold and/or snowy regions, account for more than 60% of the nation's land area. The densely populated flatlands in these cold, snowy regions receive extreme snowfall every year.

For further information…

National Highway and Risk Management Division, Road Bureau
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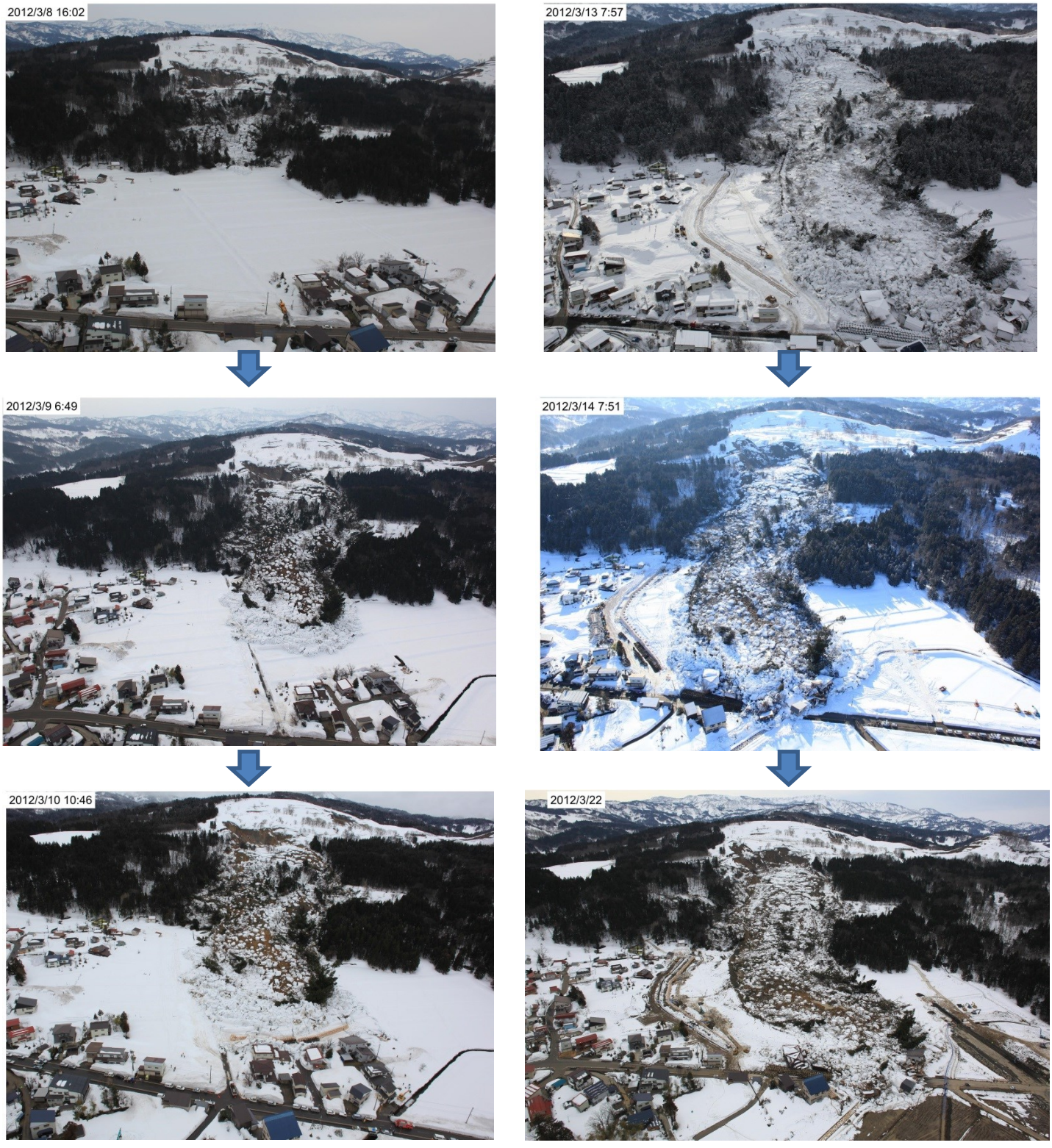
Snowmelt disasters from climate change

(Photo: Niigata Prefectural government)

In recent years in Japan, landslides have occurred in the snow-melting season. Sharp rises in air temperature generate large volumes of snowmelt, which is considered a major cause of such landslides.

On March 7, 2012, a large-scale landslide occurred in Joetsu, Niigata Prefecture. A mud slide containing large amounts of snow-melt water moved 250 m down a gentle snow-covered slope at 15 m/h, pushing accumulated snow downward. The snow and mud damaged a prefectural highway and houses.

Landslide



(Photo: Niigata Prefectural government)

Landslide outline

Location: Chinai, Kokugawa Itakura-ku, Joetsu, Niigata Prefecture

Date: March 7, 2012

Event scale: 150 m width, 500 m long, 20 m deep.
Estimated volume of sliding soil: 750,000 m^3
Landslide scale: 120 m width, 250 m long, 7 m deep
Estimated volume of sliding soil: 210,000 m^3

Geology: Tertiary deposit

Soil type: Fine-grained clay

Damages: Complete destruction of four houses and seven buildings,
Closure of 1.5 km of prefectural highway due to mud flow,
Filling of several agricultural watercourses with mud

For further information:

Hokuriku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan

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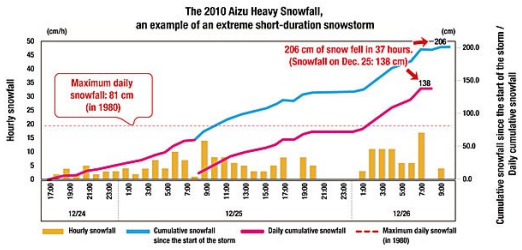
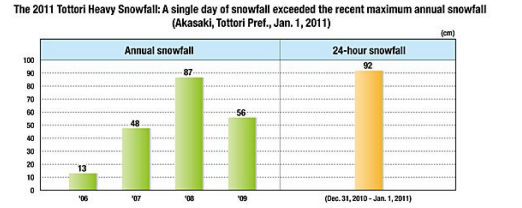
The recent winter climate

4 The recent winter climate
Changements climatiques récents
Canvis climàtics recents

Increases in extreme short-duration snowfall events






The 2011 Tottori Heavy Snowfall
(Route 9 in Daisen, Tottori Pref., Jan. 1, 2011)


The 2011 Tottori Heavy Snowfall
(Route 9 in Kotoura, Tottori Pref., Jan. 1, 2011)


The 2010 Aizu Heavy Snowfall
(Route 49 in Nishiaizu, Fukushima Pref., Dec. 26, 2010)

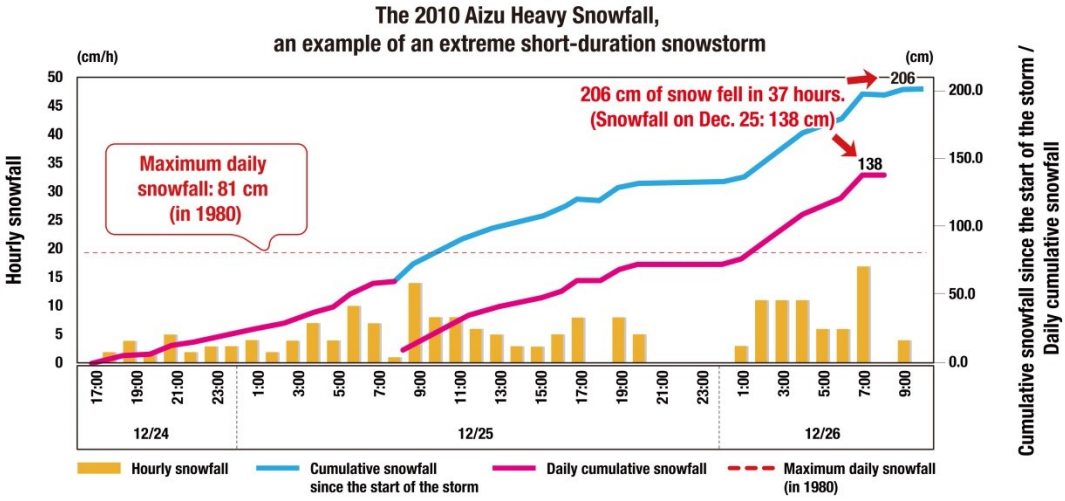

Vehicles backed up by the 2010 Aizu Heavy Snowfall
(Route 49 in Nishiaizu, Fukushima Pref., Dec. 26, 2010)

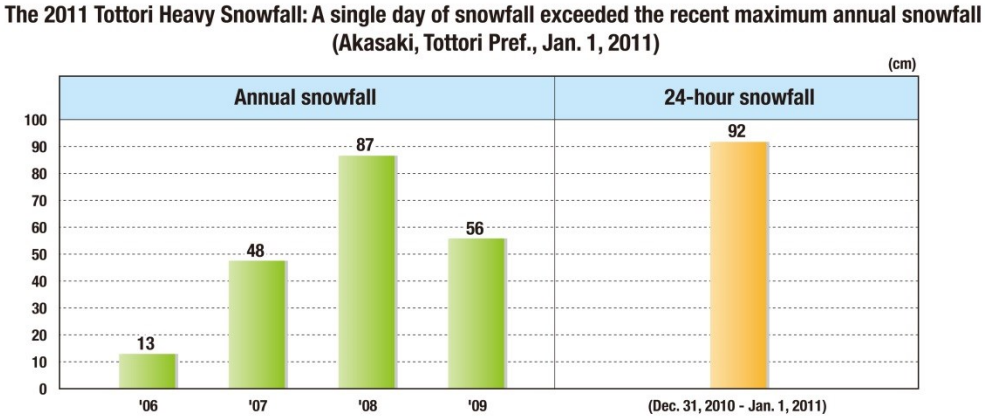

The 2008 Central Hokkaido Blizzard
(Naganuma, Hokkaido Pref., Feb. 24, 2008)


Rescuing vehicles buried in snow
(Naganuma, Hokkaido Pref., Feb. 24, 2008)

Extreme, localized, short-duration snowfall events have become significantly more common in winter in Japan.

Increases in extreme short-duration snowfall events





During the 2010 Aizu Heavy Snowfall event, from December 24 to 26, 2010, a daily snowfall of 138 cm was recorded. This far exceeded the previous maximum recorded daily snowfall of 81 cm, a record that had stood since 1980. During the storm, 206 cm of snow fell in 37 hours.

In the 2011 New Year's Eve extreme snowfall event in Tottori, 92 cm of snow fell in 24 hours. This exceeded the recent annual maximum snowfall of 87 cm in 2008.

The 2008 Central Hokkaido Blizzard that struck on February 23, 2008, was brought by a low pressure system that developed over Hokkaido Island. From the evening of February 23 into the 24th, snowfall was accompanied by

extreme winds. The AMeDAS radar observation data for Chitose, Central Hokkaido, show that strong winds of 15 m per second or higher blew continuously for more than 12 hours. The temperature remained below -10 degrees Celsius. The combination of strong winds and low temperatures led to the extreme event. The blizzard stranded 200 vehicles in snowdrifts along the highway.

For further information:

○ *The 2011 Tottori Heavy Snowfall*

National Highway and Risk Management Division, Road Bureau
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○ *The 2008 Central Hokkaido Blizzard*

Road Maintenance Division, Construction Department, Hokkaido Regional Development Bureau
Ministry of Land, Infrastructure, Transport and Tourism, Japan
c/o Incorporated Administrative Agency Public Works Research Institute
Civil Engineering Research Institute for Cold Region
Address: 1-43 Hiragishi 1-jo 3-chome, Toyohira-ku, Sapporo, Hokkaido, Japan 062-8602
Fax: +81-(0)11-590-4048
e-mail: “gijutusoudan“ followed by “@ceri.go.jp”
URL: http://www.ceri.go.jp/

○ *The 2010 Aizu Heavy Snowfall*

Tohoku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan
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Avalanches and blizzards

Here we introduce recent winter road disasters involving avalanches and blizzards.

An avalanche occurred on February 7, 2011, in Hakusan, Ishikawa Prefecture. It blocked the Komatsu-Torigoe-Tsurugi Arterial Prefectural Road.

A blizzard occurred in Eastern Hokkaido, including the Okhotsk region, from March 2 to 3, 2013. It was caused by a rapidly developing low-pressure system. Nine people died in road-traffic-related incidents. Even in daytime, the

visibility was extremely poor: less than a few meters. This situation continued for many hours. The strong winds lasted until March 4. A maximum wind velocity of 31.4 m/s was recorded at Abashiri. This is extremely high for this region in March.

For further information…

○ *An avalanche occurred on Komatsu-Torigoe-Tsurugi Arterial Prefectural Road*

Hokuriku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan
Address: 1-1-1, Misaki-cho, Chuo-ku, Niigata, Niigata Prefecture 950-8801
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Fax: +81-(0)22-280-8917
e-mail: ”chiiki-douro“ followed by "@hrr.mlit.go.jp“
URL: http://www.hrr.mlit.go.jp/

○ *The 2013 Blizzard in the Eastern and Okhotsk Regions of Hokkaido*

Road Maintenance Division, Construction Department, Hokkaido Regional Development Bureau
Ministry of Land, Infrastructure, Transport and Tourism, Japan
c/o Incorporated Administrative Agency Public Works Research Institute
Civil Engineering Research Institute for Cold Region
Address: 1-43 Hiragishi 1-jo 3-chome, Toyohira-ku, Sapporo, Hokkaido, Japan 062-8602
Fax: +81-(0)11-590-4048
e-mail: “gijutusoudan“ followed by “@ceri.go.jp”
URL: http://www.ceri.go.jp/

Responses to complex winter natural disasters

The tsunamis that struck after the Great East Japan Earthquake of March 11, 2011, left huge amounts of debris everywhere, including on highways.

The earthquake occurred in winter, and snow fell immediately afterward. Obstacles started to be removed from highways immediately, so that survivors could be rescued and otherwise assisted to allow emergency vehicles to pass. In this operation—“Operation Comb”—obstacles on the highway network were first removed on routes in a

comb-shaped pattern. The removal of obstacles from the inland north-south arterial, Route 4, and the Tohoku Expressway was completed within 24 hours after the earthquake. Such removal from the 11 east-west routes was completed within 48 hours after the quake, and an additional four routes were cleared within 4 days after the quake. Then, obstacles were removed from 97% of Route 45, the arterial highway on the Pacific Ocean, within 7 days after the quake.

The Northern Nagano Earthquake occurred on March 12, 2011, on the border of Niigata and Nagano prefectures. It had a magnitude of 6.7. Seismic intensities of “upper 6” on the Japanese scale were recorded in Sakae, Nagano Prefecture, in Niigata Prefecture. Those of “lower 6” were recorded in Tsunan and Tokaichi in Niigata Prefecture. Many landslides and snowslides occurred.

For further information…

○ *The Great East Japan Earthquake (M9.0) of March 11, 2011*

Tohoku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan
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URL: http://www.thr.mlit.go.jp/

○ *The Northern Nagano Prefecture Earthquake (M6.7) of March 12, 2011*

Hokuriku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan
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Niigata Misaki Government Building
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e-mail: “chiiki-douro" followed by “@hrr.mlit.go.jp”
URL: http://www.hrr.mlit.go.jp/

Snow and Ice Research Centre, National Research Institute for Earth Science and Disaster Prevention
Address: 187-16, Maeyama, Suyoshi, Nagaoka, Niigata Prefecture, Japan 940-0821
Fax: +81-(0)25-835-0022
URL: http://www.bosai.go.jp/seppyo/index_e.html

Winter road management policies

Programs under the 1956 Act on Special Measures concerning Maintenance of Road Traffic in Specified Snow Coverage and Cold Districts call for measures to secure winter road traffic. These measures include snow removal and protection from the adverse effects of snow and frost heave. The Act aims to promote industry and security in the cold, snowy regions of Japan. Under the Act, systematic programs have been carried out for snow removal and for the installation of snow hazard control facilities on winter roads, as well as for the development of snow removal machinery.

For further information…

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URL: http://www.mlit.go.jp/

History of snow- and ice-control machinery and facilities

8 History of snow- and ice-control machinery and facilities
Histoire des machines et équipements de contrôle de la neige et du verglas
Història de les màquines i els equipaments per controlar la neu i el gel

Heavy snowfall events, snow- and ice-control policies and social background	Year	Technologies developed/introduced
Many roads are closed in winter	Since 1800	Use of open conduits for snow disposal (Hokuriku region)
	Until 1948	Hand-made V-plows attached to U.S.- or Japan-made tractors and earthworks machinery for carriageway snow removal (Hokkaido Pref.)
Establishment of the Ministry of Construction (former MLIT) Implementation of the first carriageway snow removal as a national project (Hokkaido Pref.)	1948	Various types of Japan-made snow removal machinery
Enactment of the 1956 Act on Special Measures concerning Maintenance of Road Traffic in Specified Snow Coverage and Cold Districts Establishment of a national snow removal subsidy system for relevant highways to revitalize winter activities of people and businesses in cold, snowy regions Widespread adoption of mechanical carriageway snow removal	1956	Pump-up snow-flowing gutter (Niigata Pref.)
Introduction of national snow removal projects in the Hokuriku and Tohoku regions	1958	
The 1961 Heavy Snowfall Research on avalanche measures and snowfences under national assistance	1961	Groundwater snow-melting sprinkler (Niigata Pref.) Electric road heating (Iwate Pref.) Snowshed (Niigata Pref.)
The 1963 Heavy Snowfall Shortage of snow removal machinery Full-scale introduction of snow removal machinery Development and improvement of machinery that meet Japan's snow	1962	Traditional collector snowfence (Yamagata Pref.)
	1963	Screw-type salt spreader (Kinki region)
	1964	Sidewalk road heating (Sapporo City)
	1967	Sidewalk mechanical snow removal (Akita, Gifu and Toyama prefectures) Avalanche control facility (Tohoku region)
	1969	Blower snowfence (Hokkaido Pref.)
Introduction of snow melting systems, snowfences and other snow control facilities	1970	Seawater snow-melting sprinkler (Aomori Pref.)
	1973	Fixed-rate salt spreader (Hokuriku region)
	1976	River water snow-melting sprinkler (Ishikawa Pref.)
	1977	Snow cornice removal vehicle (Hokuriku Pref.)
	1978	Slope solid barrier (Hokkaido Pref.)

Heavy snowfall events, snow- and ice-control policies and social background	Year	Technologies developed/introduced
The 1981 Heavy Snowfall, an event exceeding the 1963 Heavy Snowfall Despite great achievements in snow removal machinery, emergence of an new issue of shortages of snow disposal sites Renewed recognition of the effects of snow-flowing gutters	1981	Groundwater heat-source road heating (Tohoku and Hokuriku regions) Physical-type freeze-resistant pavement (Hokkaido Pref.)
	1982	Chemical-type freeze-resistant pavement (Hokkaido Pref.)
The 1984 Heavy Snowfall Long-term snowfall and low temperatures cause many avalanches and low-visibility events under blowing snow	1984	Small snow-melting tanks in residential areas (Niigata Pref.)
	1985	Heat-pump road heating (Tohoku and Hokuriku regions)
	1986	Gas road heating (Ishikawa Pref.)
	1987	Ground heat-source road heating (Aomori Pref.)
	1988	Collector snowfence (Hokkaido Pref.)
	1989	Solar heat-source road heating
Enactment of the 1990 Studded Tires Regulation Act Emergence of extremely slippery winter roads: countermeasures indispensable	1990	
	1993	Large-scale processed sewerage snow-melting tank (Sapporo City)
	1994	Sewer pipe snow-melting system (Aomori Pref.)
	1997	Wind-power road heating (Fukushima Pref.)
PIARC International Winter Road Congress Sapporo, Japan	2002	Lake-water heat-source road heating (Fukushima Pref.) Physicochemical-type freeze-resistant pavement (Hokkaido Pref.)
	2003	Gas co-generation road heating (Niigata Pref.)
	2004	Micro gas-turbine road heating (Niigata Pref.)
	2007	Building exhaust heat road heating (Ishikawa Pref.)
Frequent occurrences of "guerrilla snowstorms" (localized, short-term, heavy snowfall) such as those in Aizu and Tottori in 2010	2010	
The Great East Japan Earthquake	2011	Multi-functional drainage pavement for cold regions (Nagano Pref.)
Increased occurrences of snowmelt landslides due to rapid increases in air temperatures, such as the landslide in Nagaoka, Niigata in 2012	2011	
The 2013 Basic Law on National Resilience Development	2013	

In Japan, extreme snowfall events such as those of 1958 and 1977 raised the need to prepare for such events. Snow removal machinery, snow-melting facilities and other facilities and systems that mitigate the adverse effects of extreme snow and cold have been introduced to address such issues. Here we introduce history of heavy snowfall events, snow- and ice-control policies and development and introduction of related machinery and facilities.

For further information…

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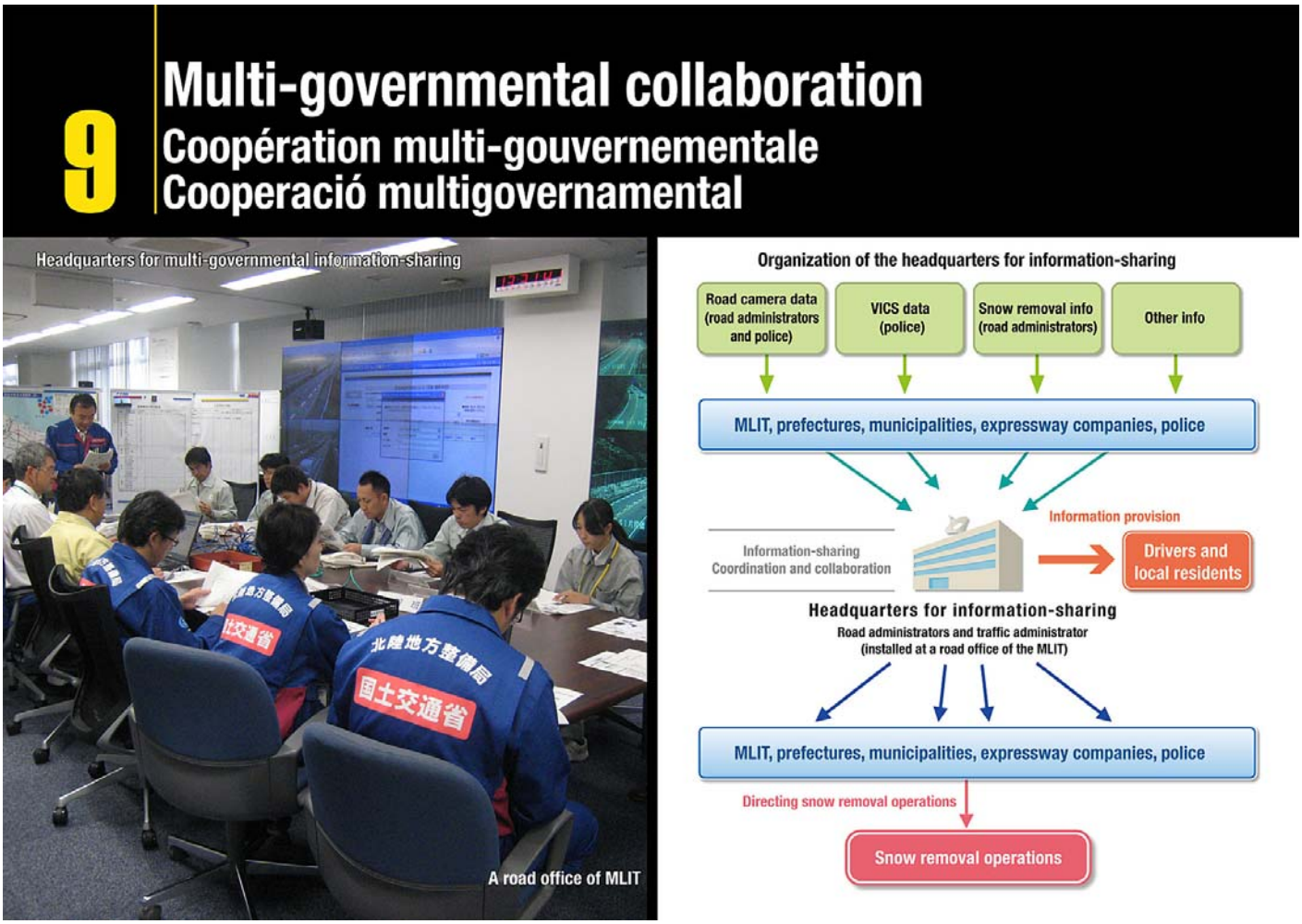
Multi-governmental collaboration



After the 2006 Extreme Snowfall Disaster, the Plans for Special Measures concerning Countermeasures for Heavy Snowfall Areas (Nov., 2006) called for “the establishment of a headquarters for information sharing whose members are multi-level road administrators and police at a road office of MLIT, in order to secure road traffic.”

At times of extreme snowfall, road administrators (the MLIT, expressway companies, prefectures and municipalities) and police organize a headquarters to share information and to coordinate snow removal. Every year before winter, drills are conducted, such as for organizing the meeting, handing over information and towing vehicles that are unable to climb slopes.

For further information…

National Highway and Risk Management Division, Road Bureau

Ministry of Land, Infrastructure, Transport and Tourism, Japan

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Responses to winter and to snow disasters

Echelon plowing on expressway

The Tomei expressway between Tokyo and Nagoya is heavily travelled and is a trunk expressway in Japan. Because it is on the Pacific Ocean side of Japan, where little snow falls, when snow falls, frequent echelon ploughing is conduced to avoid snow accumulation, because a lot of drivers are not accustomed to driving on snowy roads and because expressway closures cause serious socio-economic disruptions.

Responses to an extreme snowfall on expressways

As a result of an extraordinary heavy snowfall on January 30, 2011 in Fukui Prefecture, vehicles were stopped on the Hokuriku Expressway. A 140-cm snowfall was recorded on January 30. The total snowfall for the storm over the

three days until the February 1 was 220 cm. Although the Central Nippon Expressway Company, which operates the expressway, did its best to clear the snow, the expressway was blocked for as long as 29 hours by vehicles that were unable to climb slopes. In both directions, a total of 800 vehicles were stopped and buried by extreme snowfall. The expressway company continued all-out snow removal and provided emergency supplies to the drivers. The snowmobiles were used for delivering relief supplies to the stopped vehicles. The delivered goods included food, drinks, blankets, fuel for vehicles, portable toilets and cell phone chargers.

A small crawler snowblower

Route 49 was closed for 33 hours during the period from December 24 to 26, 2010, as a result of extreme localized snowfall in Fukushima Prefecture. The closure resulted when vehicles that were unable to climb the slope blocked traffic. Learning from this experience, a small crawler snowblower was developed to facilitate the swift restoration of service on national highways blocked by vehicles that were unable to climb slopes, to provide information and relief supplies to traffic that was backed up and to remove snow efficiently from the narrow roadside space to rescue vehicles buried in snow.

The small crawler snowblower's features address the needs at times of extreme snowfall. These needs include high traction, facilitated by triangular crawler treads that lower the ground contact pressure; a loading space with a frame for materials and supplies; and information provision by PA system.

Disaster response base

A *michi-no-eki* is more than just a place to park, rest and use the restrooms. It's also equipped with public facilities, such as restaurants, shops selling local products, terminals giving road and weather information and more. These attract motorists. *Michi-no-ekis* are also used for shelter during extreme snowfall.

The photo is an aerial view of the Michi-no-Eki Asahi roadside rest area in Murakami, Niigata Prefecture. Michi-no-Eki Asahi has hot-spring baths. This one has been equipped to serve as a disaster shelter and a disaster relief response base. It has dedicated storage of blankets and emergency food, an engine-generator, emergency toilets and a freeze-resistant groundwater well.

For further information…

○ *Expressway snow removal and snowfall disaster responses*

International Team, Central Nippon Expressway Co., Ltd.
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e-mail: "k.okamoto.ac" followed by "@ c-nexco.co.jp"
URL: http://global.c-nexco.co.jp/en/

○ *A small crawler snowblower*

Tohoku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan
Address: 9-15, Futsuka-cho, Aoba-ku, Sendai, Miyagi Prefecture 980-8602
Fax: +81-(0)22-225-6988
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URL: http://www.thr.mlit.go.jp/

○ *Michi-no-eki Asahi*

Hokuriku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan
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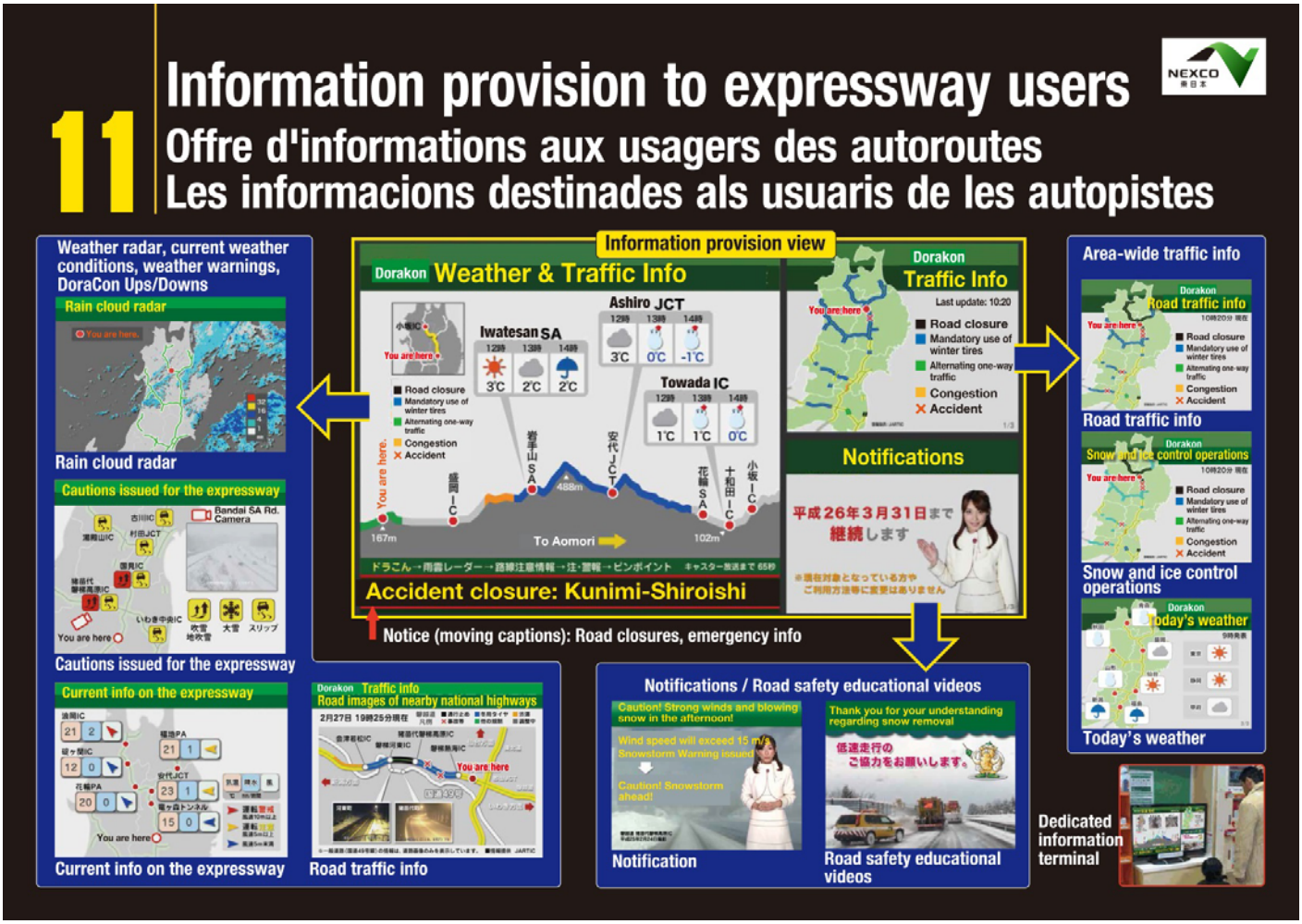
Information provision to expressway users



Driving Weather is a road weather information-provision system for expressway users. Dedicated terminals at rest areas on expressways operated by Nexco East, the East Nippon Expressway Company Limited, provide information that drivers need during their brief stops. The content can be optimized for each rest area by selecting items from transmitted data. Road users can access Driving Weather at the 46 service areas and parking areas on expressways operated by Nexco East.

Driving Weather is divided into three “views.” One shows weather and traffic info at the service area or parking area. The others are the “area-wide weather and traffic information view” and the “notification view,” which includes road safety educational content. In addition to these, a moving caption system displays emergency notifications, such as of expressway closures.

The animations are updated four times a day in winter and twice a day in summer. When snowstorm warnings are issued, dedicated terminals at facilities located at or near the area subject to the warnings issue cautions regarding snowstorms, blowing snow, extreme snowfall, torrential rainfall and so on. The aim is to make expressway users more aware of dangers.

For further information…

International Department, East Nippon Expressway Co., Ltd.

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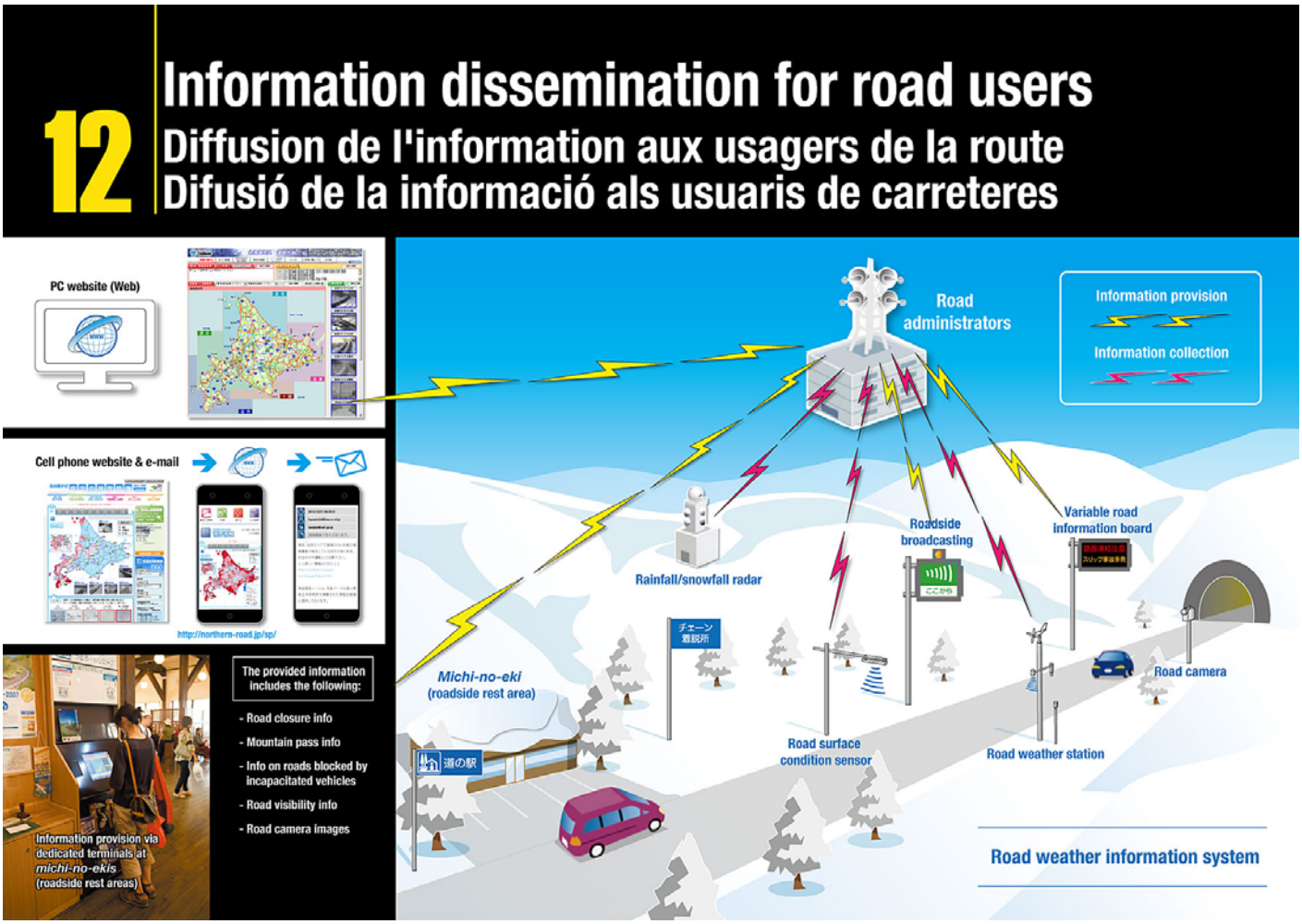
Fax: +81-(0)3-3506-0355 International Department

e-mail: “International” followed by “@e-nexco.co.jp”

URL: http://www.e-nexco.co.jp/company/

Information dissemination for road users



Data of road weather information and road conditions collected by road administrators, and weather information provided by weather stations are processed and provided to road users. Information provision media include variable road information boards, roadside broadcasting systems and dedicated terminals at michi-no-ekis on roads, websites for PCs and cell-phones, and e-mails to cell-phones.

■Winter visibility website

http: //northern-road.jp/navi/touge/sp/fubuki.htm

For further information…

Road Maintenance Division, Construction Department, Hokkaido Regional Development Bureau

Ministry of Land, Infrastructure, Transport and Tourism, Japan

Incorporated Administrative Agency Public Works Research Institute

Civil Engineering Research Institute for Cold Region

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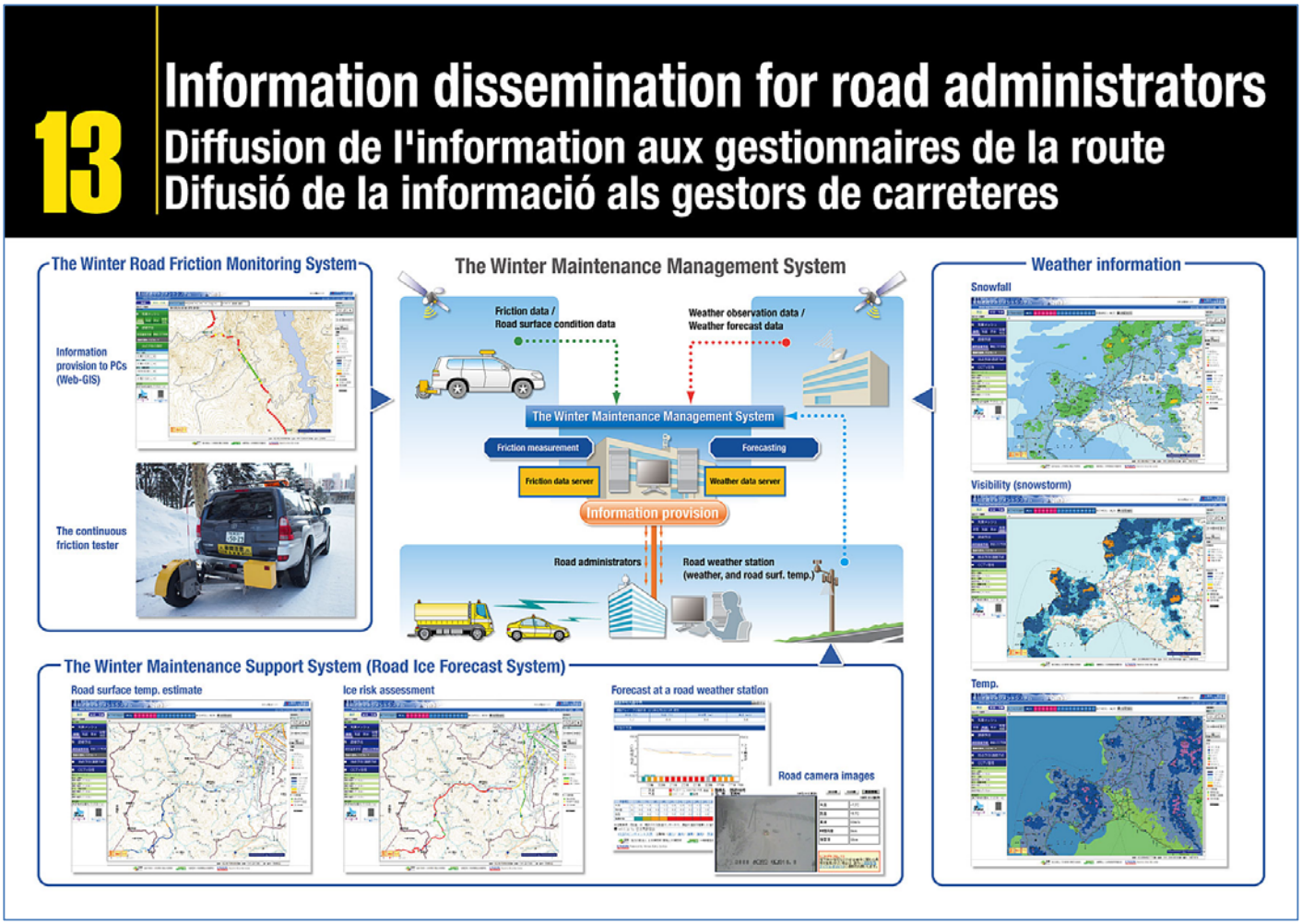
e-mail: “gijutusoudan“ followed by “@ceri.go.jp”

URL: http://www.ceri.go.jp/

Information dessmination for road administrators



The Winter Maintenance Management System supports the timely and proper operational planning of snow and ice control and an understanding of road surface conditions by road administrators. The system consists of two subsystems: the Winter Maintenance Support System, and the Winter Road Friction Monitoring System.

The Winter Maintenance Support System provides current conditions and forecasts of weather, road surface temperature and road icing. The road weather data are air temperature, snowfall and visibility.

The Winter Road Friction Monitoring System provides information on the slipperiness of roads as assessed by continuous friction tester. The friction information is disseminated by Internet to road administrators and contractors.

Using a GIS, the system displays information for any road section. It's even accessible by smart phone.

For further information…

Road Maintenance Division, Construction Department, Hokkaido Regional Development Bureau
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Civil Engineering Research Institute for Cold Region
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Fax: +81-(0)11-590-4048
e-mail: "gijutusoudan" followed by "@ceri.go.jp"
URL: http://www.ceri.go.jp/

Resident-government partnership

■ Small sidewalk snowblowers are lent free of charge

Under the Winter Volunteer Support Program, MLIT, the road administrator and a local residents' group make an agreement to share local road management and maintenance operations, with the assistance of the municipality. One such example is the collaborative sidewalk snow removal in Tsubata-machi, Ishikawa Prefecture. The MLIT offers the free use of small sidewalk snowblowers, and a residents' group uses them to clear the sidewalks. The municipality covers the costs of snowblower fuel.

An easy-to-use sidewalk snowblower has been developed that can be operated even by residents.
Residents can take PET bottles filled with sand from public facilities or boxes at the roadside and spread the sand at road intersections and on sidewalks. Such sanding is an effective way of combatting slippery roads.

■Resident volunteers fill PET bottles with sand.

Senior citizen volunteer groups help to bottle the sand. Under the Local Collaborative Road Management program, the road administrator collaborates with local groups, such as residents and businesses. The program aims to enhance local attractiveness by making the most of local resources and to enhance the capacity and roles of roads through effective and efficient road maintenance and management.

■Local Collaborative Road Management

On Route 334 along the Sea of Okhotsk, locals and the road administrator work together every winter to remove snow piled on the seaward side of the road, so that tourists can view the ice flows.

For further information…

○*Small sidewalk snowblowers are lent free of charge.*

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URL: http://www.hrr.mlit.go.jp/

○*Resident volunteers fill PET bottles with sand.*

Snow Removal Planning Section
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e-mail: “yukikei“ followed by “@kensetsu.city.sapporo.jp “
URL: http://www.city.sapporo.jp/kensetsu/yuki/plan/

○ *Local Collaborative Road Management*

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Awareness-raising

Measures have been taken to raise awareness that poorly equipped vehicles can block highway slopes in extreme snowfall. These measures include the distribution of posters, handouts and e-mailings, and the use of variable road information boards. In such blockages, following vehicles cannot pass, and traffic backs up. Then need for the early mounting of winter tires and tire chains is promoted, and winter driving tips are given, such as warnings about the much longer breaking distance that's needed compared with the snow-free season and about avalanche danger.

■Tips for walking on slippery winter roads for tourists

Tips on safe walking on winter roads are provided to residents. They are also provided to tourists, who may not be used to walking on snowy roads.

■Tire chain inspection

In collaboration with the police, vehicles are inspected at road sections below mountain passes to make sure they' are equipped with tire chains.

■Disseminating information on road weather and on road blockages by stuck vehicles

When, despite these measures, ill-prepared vehicles block the highway, e-mails are sent to registered users informing them that the section is impassable.

For further information…

○ *Tips for walking on slippery winter roads for tourists*

Winter Life Promotion Council, Sapporo, Japan
Address: 2-17, North 11 West 2, Kita-ku, Sapporo, Hokkaido, Japan 001-0011
e-mail: "koroban" followed by "@tsurutsuru.jp "
URL: http://www.winter-life.jp/

○ *Tire chain inspection*

Hokuriku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan
Address: 1-1-1, Misaki-cho, Chuo-ku, Niigata, Niigata Prefecture 950-8801
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○ *Disseminating information on road weather and on road blockages by stuck vehicles*

Hokuriku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan
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Mobile data collection systems

■Visibility observation vehicle.

Weather conditions change with changes in position along the route. Toward developing effective measures against blowing snow, it is necessary to measure these changes at many locations. However, if we try to measure different points on the same route at the same time, we need a great number of measurement devices and personnel. Toward efficient observations, a visibility observation vehicle that can collect road weather data while driving has been developed and used to understand the differences in weather at different points on the route and to assess the danger of snowstorms.

The vehicle is equipped with weather observation equipment, including a visibility meter, an anemometer and a thermometer. It's also equipped with devices to assess the operator's driving behaviour under poor visibility, as indicated by outputs from a steering angle meter, an accelerator pedal sensor and a brake pedal sensor.

■Vehicle for Measuring Effective Road Width

Variations in the effective width of roads in winter greatly affect vehicle travel speeds. To continuously measure the width of roads with roadside snow banks,
a patrol vehicle with onboard devices, such as a laser scanner, a Web camera and GPS, has been under development. Its measurement accuracy has been tested on a test course, and field a measurement test has been made toward verifying the applicability of the system.

For further information…

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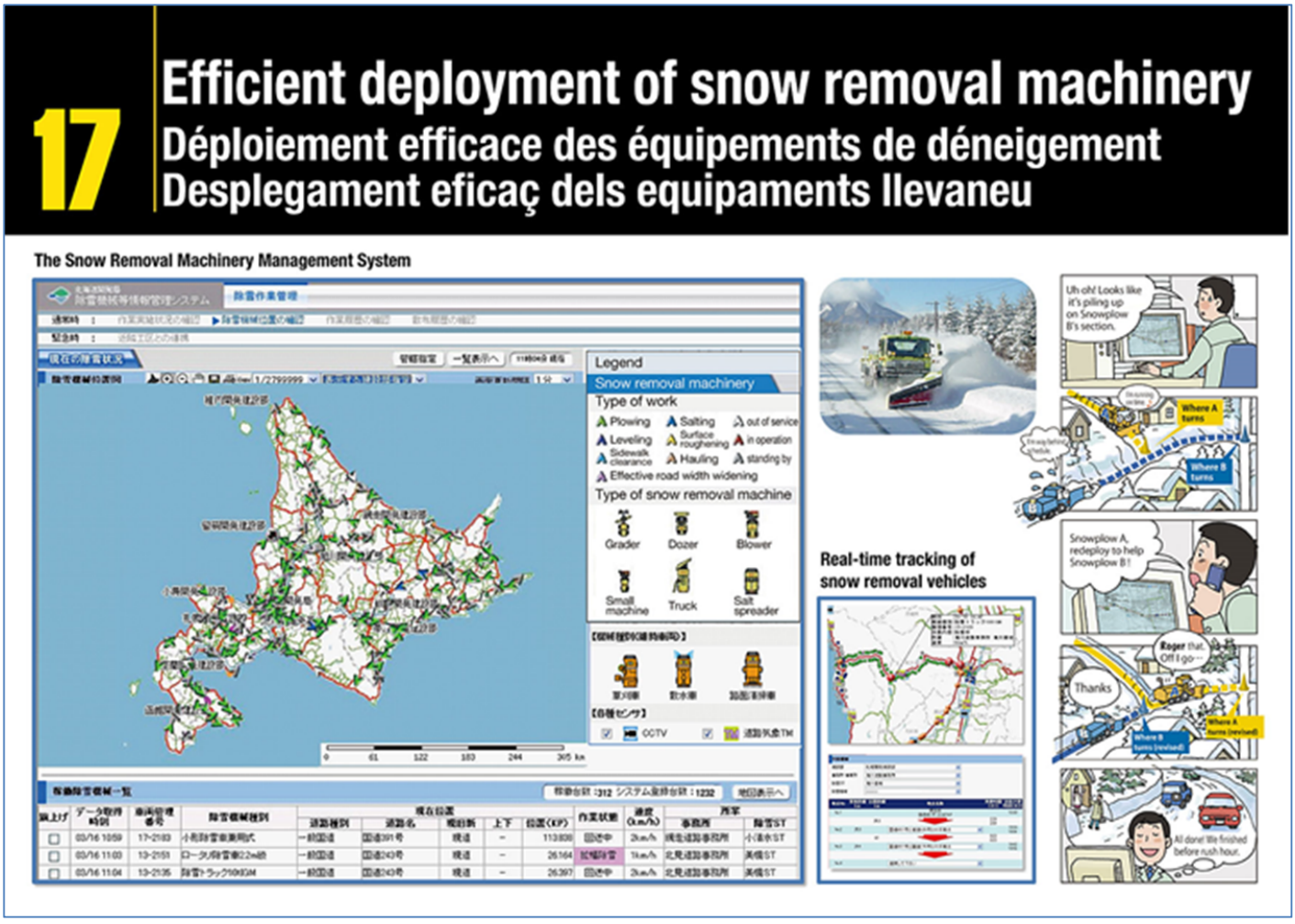
Efficient deployment of snow removal machinery



The Snow Removal Machinery Management System collects and stores real-time data on the location and operation status of snow removal machinery. The system aims to support the flexible deployment of such machinery. The system makes it easy to understand the progress of snow removal operations. During such operations, you can simulate the completion time by setting the route to be worked.

At times of extreme localized snowfall, a road management officer at a depot can simulate the operation completion times for each group of machines. When it's found that operations on one section are seriously lagging, the manager can divert machinery from other sections to assist. This allows snow removal to be completed at about the same time for all the road sections.

A map displays stored data on where salt spreaders have spread salt and how much they've spread. Such data are used to develop efficient salting plans.

For further information…

Road Maintenance Division, Construction Department, Hokkaido Regional Development Bureau
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Snow melting facilities

■Snow-melting sprinklers

Snow-melting sprinklers are widely seen in the warmer snowy regions of Japan. Groundwater is pumped up, sent through pipes and sprinkled from nozzles to melt snow. The pipes and nozzles are embedded in the road.

■Snow-flowing gutters

Snow-flowing gutters are constructed at the roadside. Residents dump snow removed from the street into the openings of a covered box culvert. The snow is then swept away by water running down a natural incline. The water sources are river water and processed sewage effluent.

■Snow-melting tanks

Snow-melting tanks dispose of snow that is removed from roads, carried by dump trucks and dumped directly into heated water. The energy used to melt snow is from sources previously considered as waste, including processed sewage and the heat generated in waste incineration. The tanks are not just used during winter. They are also used in other seasons, as fire-fighting water tanks and balancing reservoirs to retain rainfall and sewage. Snow-melting tanks melt large quantities of snow while occupying relatively small areas of land.

For further information…

○*Snow-melting sprinklers*

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○*Snow-flowing gutters*

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Civil Engineering Research Institute for Cold Region
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○*A snow-melting tank uses the residual heat from a centralized urban heating system.*

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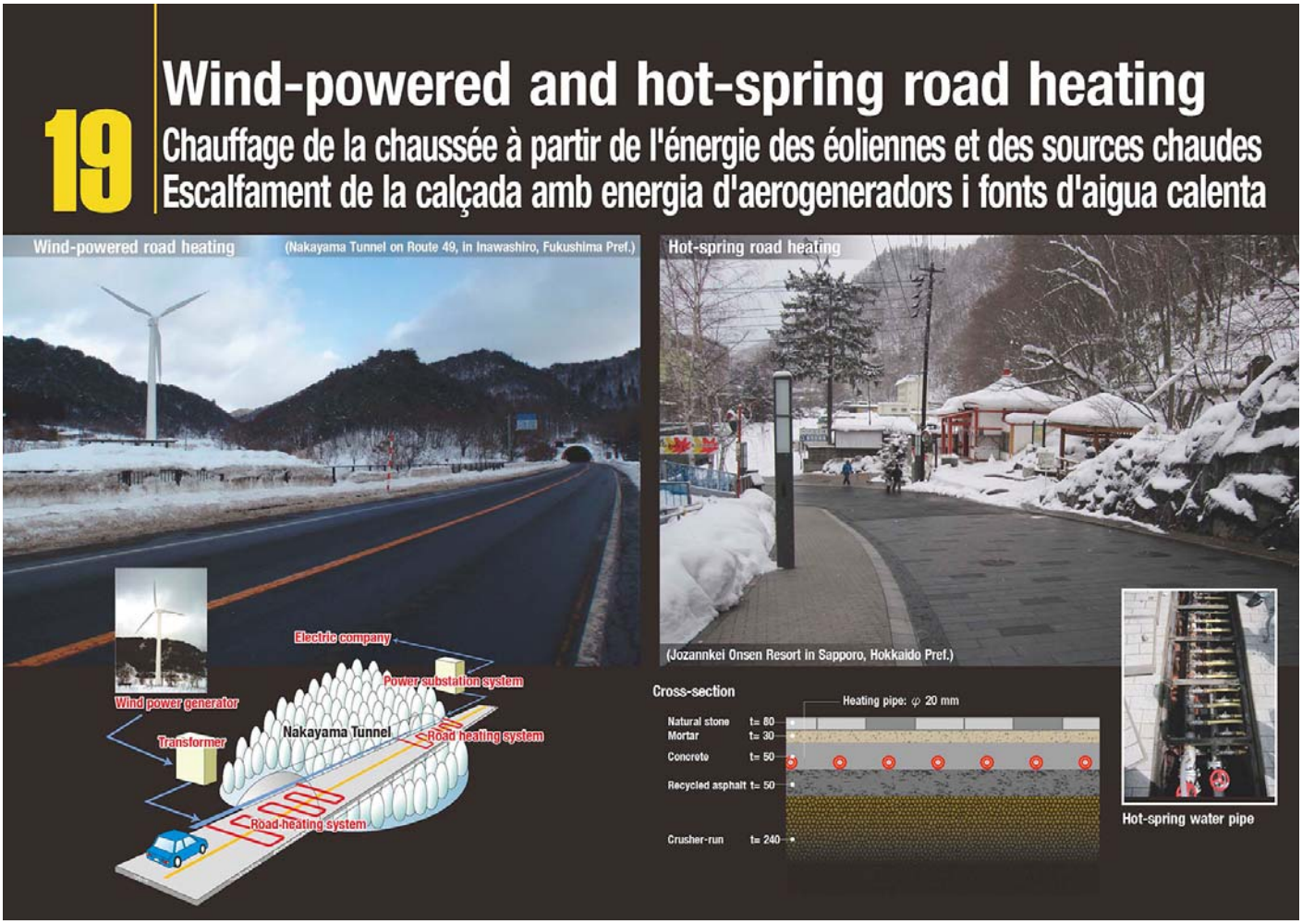
URL: http://www.city.sapporo.jp/kensetsu/yuki/plan/

Wind-powered and hot-spring road heating



■Wind-powered road heating

Most road heating systems need electricity, regardless of how the heat is generated. Wind power has been incorporated into road heating systems at places where the wind blows throughout the year. The electricity that is generated by the wind is used to melt snow by powering heating coils. It is also used to light roads, to ventilate tunnels and to power other parts of the system. Surplus power is sold to the grid or the electric company.

■ Hot-spring road heating system

Japan is volcanically active, and hot springs are found at many places. Since olden times, hot spring water has been used for heat, in addition to being used for bathing. Some hot-spring road heating systems use direct circulation, in which hot-spring pipes installed in the pavement emit heat to melt snow. Others use a heat-pipe system. The system at the Jozankei hot spring resort in Sapporo, Hokkaido Prefecture, uses direct circulation. The pipes circulating the hot spring water are made of polybutene. They have little danger of leaking, because polybutene pipes can be joined by heating and they’ re resistant to corrosion from hot spring water. The pavement materials have high heat conductivity, and thin slabs of natural stone are used. This enhances snow melting.

For further information…

○ *Wind-powered road heating*

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○ *Hot-spring road heating*

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URL: http://www.city.sapporo.jp/kensetsu/yuki/plan/

Ground-source road heating

■Ground-source heat-pipe road heating

The systems of ground-source road heating include heat-pipe systems and heat exchanger systems. Ground-source heat-pipe road heating systems use heat pipes. A heat pipe is made by creating a vacuum in a metal pipe and then enclosing a medium that evaporates when heated. The medium can be freon, water, alcohol or the like. When one end of the metal pipe is heated, evaporated median moves to the other end. Then, the median emits condensation heat when it cools and liquefied. Heat-pipe road heating uses this mechanism to melt snow. Because the system is simple and does not require a driving device such as a motor, heat pipes do not need

electrical power. The heat source can be ground heat, hot spring or hot exhaust air. Ground-source heat-pipe road heating systems have heat pipes installed in boreholes. They extract ground heat for road heating when snow falls or when the temperature drops below freezing.

Installation site: Benten IC on Niigata Bypass on Route 8, Niigata, Niigata Pref.

Design conditions:

Area of road heating	257.1 m^2
Design hourly snowfall	1.5 cm/h
Thermal load	124 W/m^2

Facilities

Borehole	100 mm × 11 m - 20 m deep × 131 holes
Heat pipe	PE-sheathed corrugated heat pipe
Diameter	φ26.5 mm
No. of units	393 units
Installation interval	200 mm

■Solar and ground-source direct road heating

At right is a solar and ground-source direct road heating system. A ground heat exchanger is installed in a vertical borehole. In summer, heat radiated by the sun onto the pavement is conducted to a heat carrier fluid that is driven upward from deep underground. The heat is circulated deep into the ground by means of the heat carrier fluid.

In winter, the heat exchanger extracts the heat from the ground. That heat is released at heat dissipation pipes embedded in the pavement to melt snow.

Installation site: Sidewalk on Route 4, Aomori, Aomori Prefecture

Design conditions:

Design snowfall: 1.9 cm/h	
Ambient air temp.	-3.4 ºC
Snow temp.	-3.4ºC
Snow density	70 kg/m^3
Wind velocity	4.0 m/s
Thermal load	211 W/m^2

Facilities:

Double-pipe coaxial heat exchanger	150 mℓ× 8 units

Heat pump output	22.5 kW × 2 units
Thermal output	130 kW (65 kW × 2 units)
Area of road heating	659 m^2

For further information…

○ *Ground-source heat-pipe road heating*

Hokuriku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan

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URL: http://www.hrr.mlit.go.jp/

○ *Solar and ground-source direct road heating*

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Heat-pump road heating

A heat pump consists of a compressor, an expansion valve, a heat exchanger and connecting pipes. The carrier fluid in the pipes is compressed, thereby raising the temperature of that fluid. Then, the fluid is evaporated by expansion to absorb the heat.

■Air-source heat-pump road heating

Air-source heat-pump road heating, shown at left, uses the ambient heat of the air. Even the heat energy of ambient air below freezing temperatures can be used for road heating.

Installation location: Route 7 in Odate, Akita Prefecture

Design conditions:

Design hourly snowfall:	0.68 cm/h (capable of melting 15 cm of snow in 22 hours daily)
Ambient air temp.:	-7.0 ^{o}C (City Hall and Nagakura sections),
	5.0 ^{o}C (Ariura and Saiwaicho sections)
Snow temp.:	-7.0 ^{o}C
Snow density:	80 kg/m^3
Wind velocity:	2.0 m/s
Thermal load:	140.7 W/m^2 (City Hall and Nagakura sections)

Facilities:

Air-source heat pump:	143 kW (City Hall section)
	200 kW (Nagakura section)
	260 kW (Ariura section)
	142 kW (Saiwaicho section)
Area of road heating:	1,158 m^2 (City Hall section)
	1,872 m^2 (Nagakura section)
	3,032 m^2 (Ariura section)
	1,616 m^2 (Saiwaicho section)

■Ground-source heat-pump road heating

A ground-source heat-pump road-heating system uses a heat exchanger to extract heat from the ground for use as the heat source. The heat pump circulates the heat carrier fluid through heat radiation pipes under the road to melt the snow on the road.

Installation site: Sekiyama Tunnel on Route 48 in Tone, Yamagata Prefecture

Design conditions:

Design snowfall:	2.4 cm/h
Ambient air temp.:	-6.1^{o}C
Snow temp.:	-6.1^{o}C
Snow density:	60 kg/m^3

Wind velocity: 3.8 m/s

Thermal load: 200 W/m^2

Facilities:

Compressor: 42 kW

Plate-type heat exchanger

Circulation pump for heating pavement: 353 ℓ/min X 22 mAq X 5.5 kW X 1 unit

Main pump: 535 ℓ/min X 14 mAq X 3.0 kW X 1 unit

Heat storage tank: 17 m^3

Borehole: φ165 X 100 m deep X 18 units

Area of road heating: 700 m^2

CO_2 reduction: 46% reduction compared with electric coil system

■Lake-water-heat-source road-heating

At right is the lake-water-heat-source road-heating system at Lake Inawashiro. The lake almost never freezes in winter. Water at the depth of about 5 m stays between 3 and 6 ° C in every season. Lake water heat is used as the heat source for the heat-pump road-heating system near the snow shed on the lake.

Installation site: Inawashiro Lakeside on Route 49 in Inawashiro, Fukushima Prefecture

Design conditions:

Design snowfall: 2.05 cm/h

Ambient air temp.: -5.7ºC

Snow temp.: -5.7ºC

Facilities:

Heat collection: heat exchanger loop coils

φ25 mm X 100 m/coil = total 200 coils

Heat source:

Water cooled heat pump: heating capacity of 80 kw X 4 units; 65 kw X 4 units

Circulation pump (heat source): 3.7 kw X 4 units; 2.2 kw X 2 units; 1.5 kw X 2 units

Circulation pump (hot water): 0.75 kw X 8 units

Circulation pump (heat release): 3.7 kw X 4 units; 1.5 kw X 4 units (alternate operation)

Heat storage tank: 3,000 ℓ X 4 units

Area of road heating: 480 m X 2 lanes (area: 3,040 m^2)

Heating method: Circulating hot water (φ15 X 150 mm)

Pavement: asphalt pavement

Control system: Two-element control: moisture sensor + surface temperature

For further information…

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Avalanche and snowstorm countermeasures

■Showshed

A showshed is a structure installed to cover the entire roadway. In the event of an avalanche, the snow passes along the roof, keeping the road safe.

■ Avalanche control fences

Avalanche control fences are installed on the mountain slopes of roads where there is the danger of avalanche.

■Parking shelter

Parking shelters protects against snowstorm. They are installed at snowstorm- and snowdrift-prone locations. Some parking shelters are equipped with public phones, vending machines and toilets, in addition to parking lanes.

■Solid barrier preventing snow from blowing up from the valley side

The first solid barrier preventing snow from blowing up from the valley side was installed at Nakayama Pass on Route 230 in 1978. Such barriers reduce snow that blows up the slope.

For further information…

Road Maintenance Division, Construction Department, Hokkaido Regional Development Bureau
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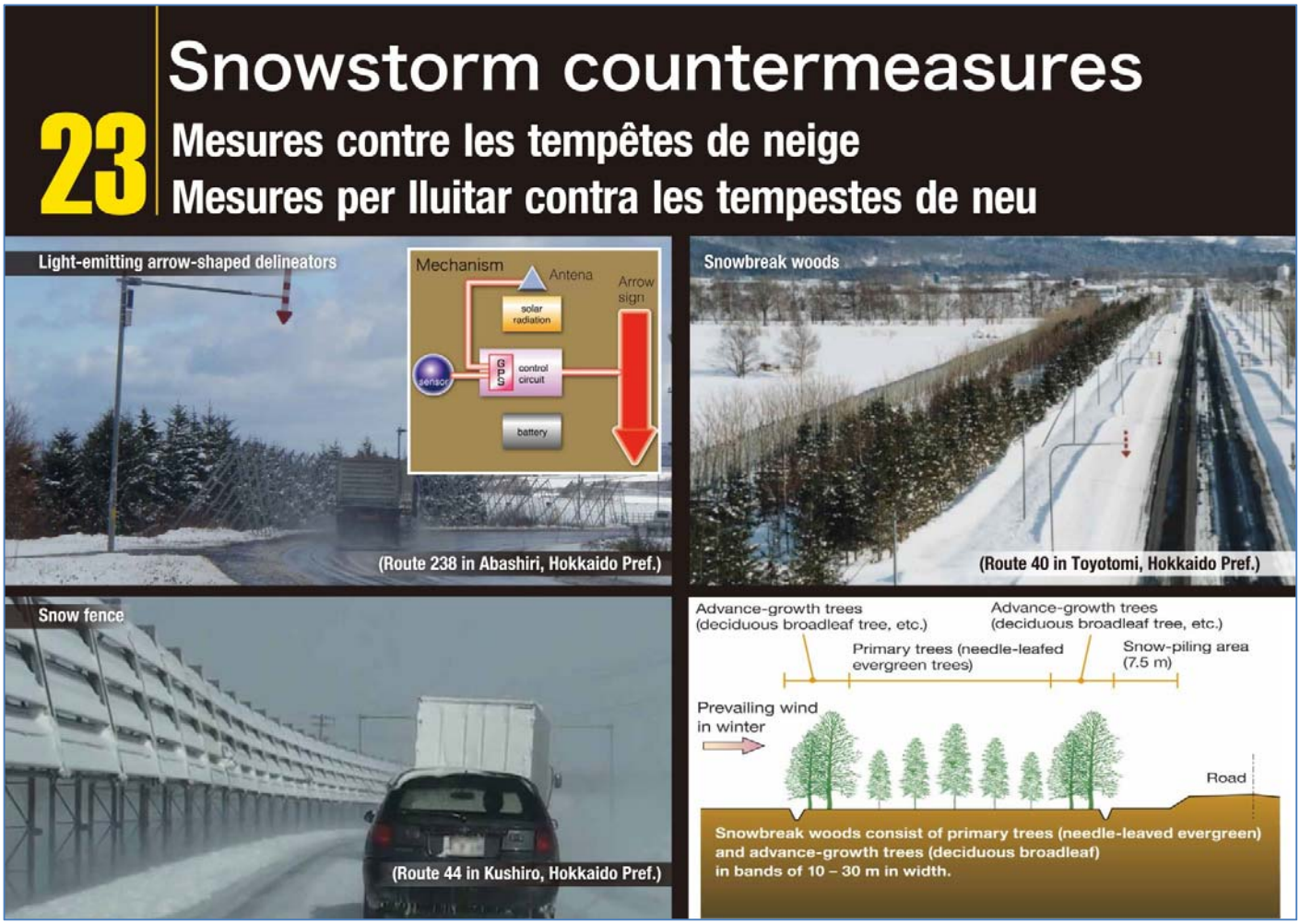
Snowstorm countermeasures



The facilities introduced here mitigate poor visibility and snowdrifts, which are obstacles to smooth winter road traffic.

■Light-emitting arrow-shaped delineators

Light-emitting arrow-shaped delineators indicate the border of the road and improve the efficiency of snow removal operations. They also help drivers by indicating the edges of the road when snowstorms cause poor visibility. LEDs are used for the light emitting parts, and some of them are powered by solar cells.

■Snow fences

Snow fences help to retard blowing snow and the formation of roadside snowbanks. In this way, they mitigate poor visibly caused by blowing snow.

■Snowbreak woods

Snowbreak woods are narrow strips of trees planted along the road to prevent snowdrifts from forming. When needle-leaved evergreen trees are planted at an appropriate density, their leaves and branches reduce the velocity of wind blowing onto the road. This mitigates poor visibility and snowdrift formation by reducing the amount of saltating snow. In addition, snowbreak woods help drivers to recognize the road edges. It takes several years for the trees to achieve these effects. However, in addition to being an excellent snowstorm countermeasure, they have the benefits of taking in carbon dioxide and creating superior roadscapes.

For further information…

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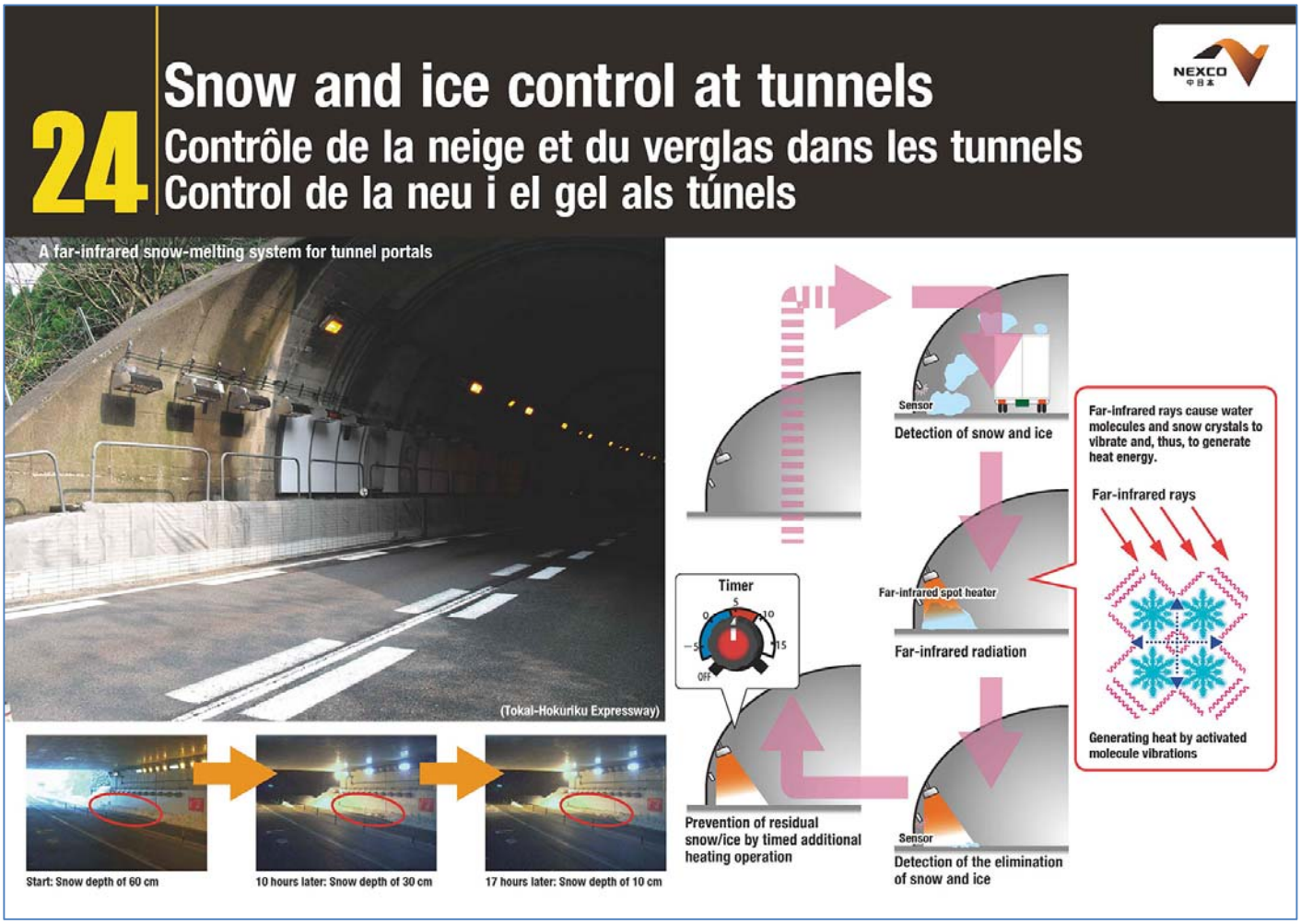
Snow and ice control at tunnels

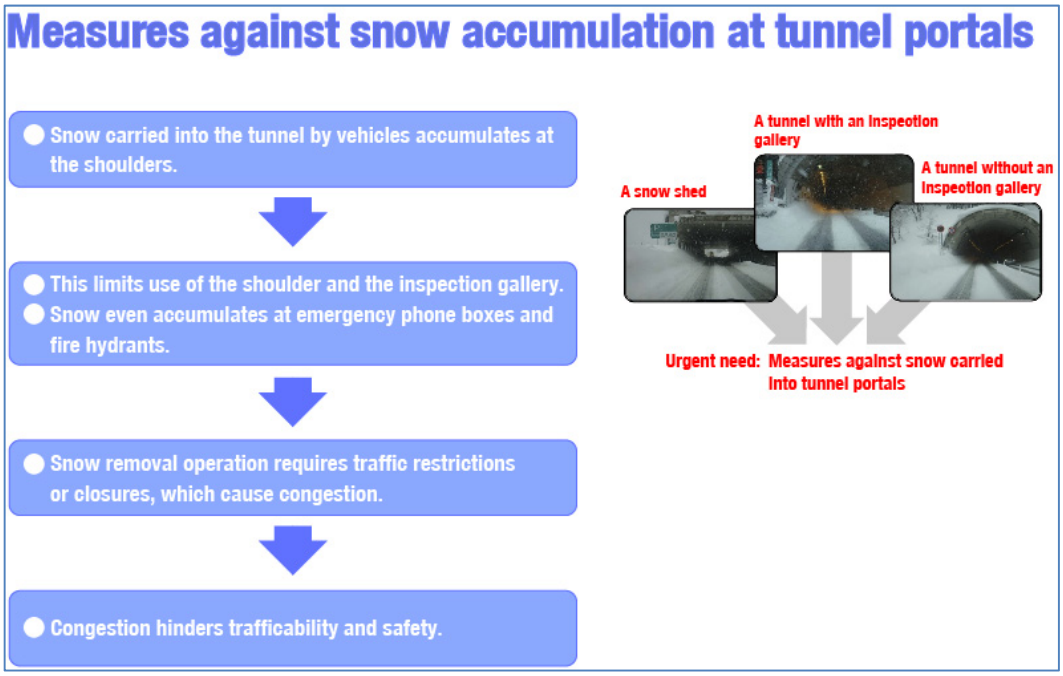


The snow can be a meter deep at tunnels portals on the Hokuriku Expressway and Tokai-Hokuriku Expressway, roads that run through a snowy, cold region. Such snow hiders driving, so swift snow removal is a must for driving safety

The Kanazawa Branch of Nexco Central, the Central Nippon Expressway Co., Ltd., has installed a far-infrared snow-melting system to secure safe, smooth traffic. The system is equipped with a far-infrared heater consisting of a

halogen lamp and a reflector. It radiates far-infrared rays directly at the snow and ice. The mechanism of snow melting is not heating but increase in vibrations of water molecules or snow crystals, and such increases in vibration generate heat that melts snow and ice.

Experiments have demonstrated that 60-cm-deep snow at tunnel portals can be reduced to 30 cm in 10 hours and 10 cm in 17 hours. It's a very effective measure to eliminate snow carried into a tunnel and accumulated near the portal. The system is also used against snow accumulation and accretion on sensors of electronic toll booths at smart interchanges.



For further information…

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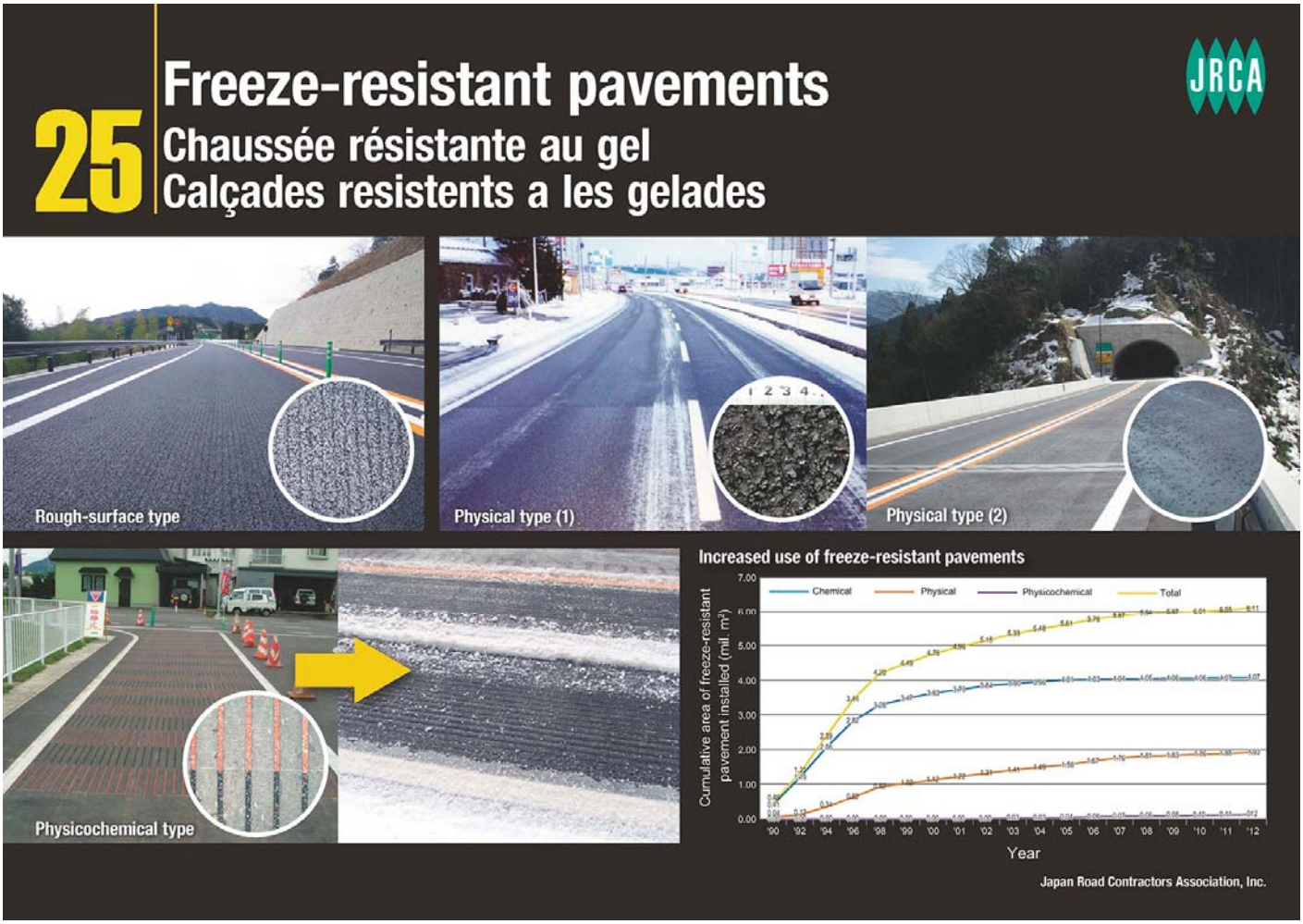
URL: http://global.c-nexco.co.jp/en/

Freeze-resistant pavements



■Freeze-resistant pavement

Freeze-resistant pavements have been developed to secure safe traffic in the cold season. For safe driving, a vehicle's tires must firmly grip the road surface. When snow and ice are on the road, the traction decreases, which results in unstable driving performance. Freeze-resistant pavements prevent ice from forming on the road surface, toward achieving safe driving conditions. Such pavements also increase snow removal efficiency. They are roughly classified into four categories.

The rough-surface types

The rough-surface types have a rough surface texture, as the name suggests. Contact between the vehicle tires and the pavement surface accelerates the abrasion of any ice on the road surface. Improved skid resistance is expected. Because rainwater infiltrates into the pavement body, there is less surface water than on dense-graded asphalt concrete pavement; thus, the formation of black ice is retarded. No special functional materials are added to the asphalt. The rough texture is achieved by the appropriate selection of asphalt mixture and special techniques of application. The ice is abraded when the tire makes contact with the convexities of the aggregate.

The physical types

The physical types contain elastic materials on the surface or in the body of the pavement. Such elastic materials bend with the load of passing vehicles, breaking the ice on the pavement surface and increasing the road surface exposure rate. The elastic materials include new rubber, rubber recycled from tires and urethane resin. Such materials can be added to the asphalt mixture, pressed into the pavement surface, coated on the pavement surface, injected into the voids of porous asphalt pavement, filled into the grooves on the pavement surface or hardened with a resin binder.

The physiochemical types

The physiochemical types have the freeze-resistant features of both the chemical types and the physical types. Physiochemical-type pavements can be applied by adding freezing-resistant materials to the asphalt mixture or filling grooves in the pavement surface with freezing resistant materials and then hardening such materials.

The chemical types

The chemical types exhibit freeze resistance by the addition of materials with freeze-resistance effects, such as sodium chloride and calcium chloride, to the asphalt mixture.

The freeze-resistant materials mixed into the pavement elute from the pavement surface to lower the freezing temperature, thus affording freezing resistance.

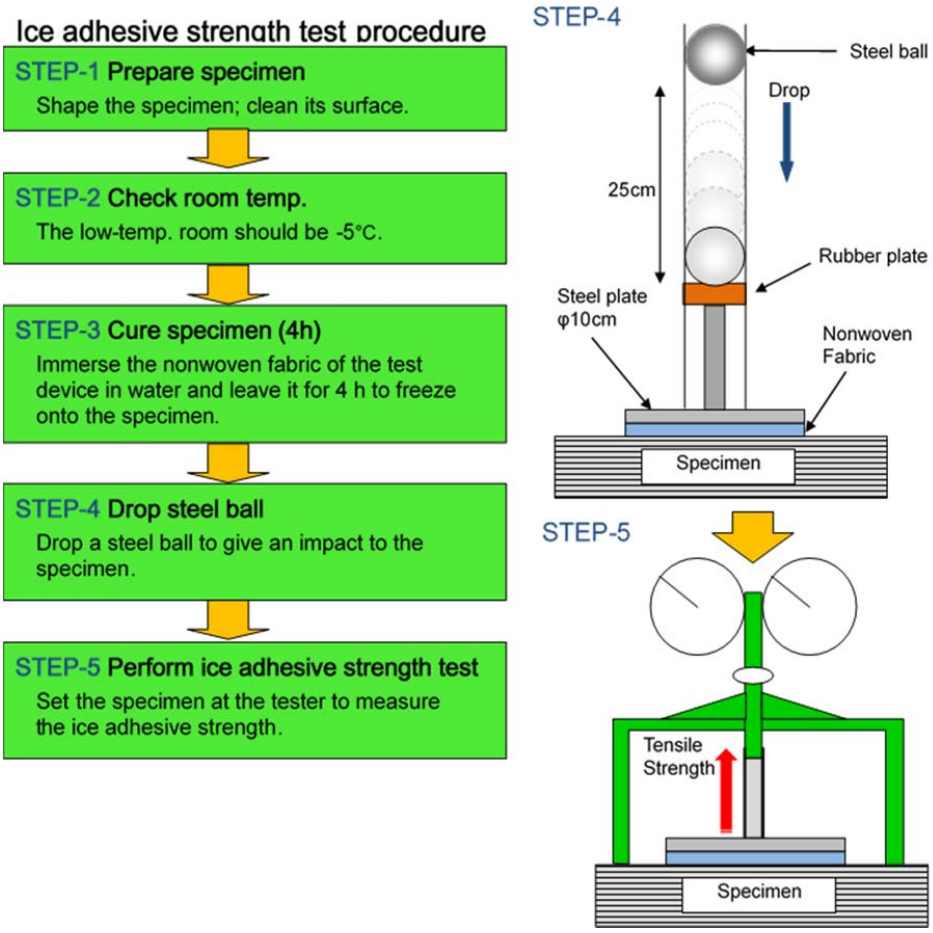
■Method for Evaluating the Freeze-Resistance of Pavements

With increases in the application of freeze-resistant pavements, there were calls for a method to evaluate the effectiveness of such pavements. The Road Pavement Technology Research Association proposed an ice adhesive strength test.

This test evaluates the adhesive strength between the pavement and the ice sheet by dividing the tensile load by the area of a jig.

The lower the adhesive strength between the pavement and the ice sheet, the greater the effectiveness at preventing icing on the road surface and at making snow easy for snowplows to separate from the pavement.

ice adhesive strength (MPa) = tensile load (N) ÷ area of jig (mm^2)



For further information…

○ *Freeze-resistant pavements*

Japan Road Contractors Association, Inc.
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e-mail: "info" followed by "@dohkenkyo.or.jp "
URL: http://www.dohkenkyo.com/english/

○ Method for Evaluating the Freeze-Resistance of Pavements

Road Pavement Technology Research Association

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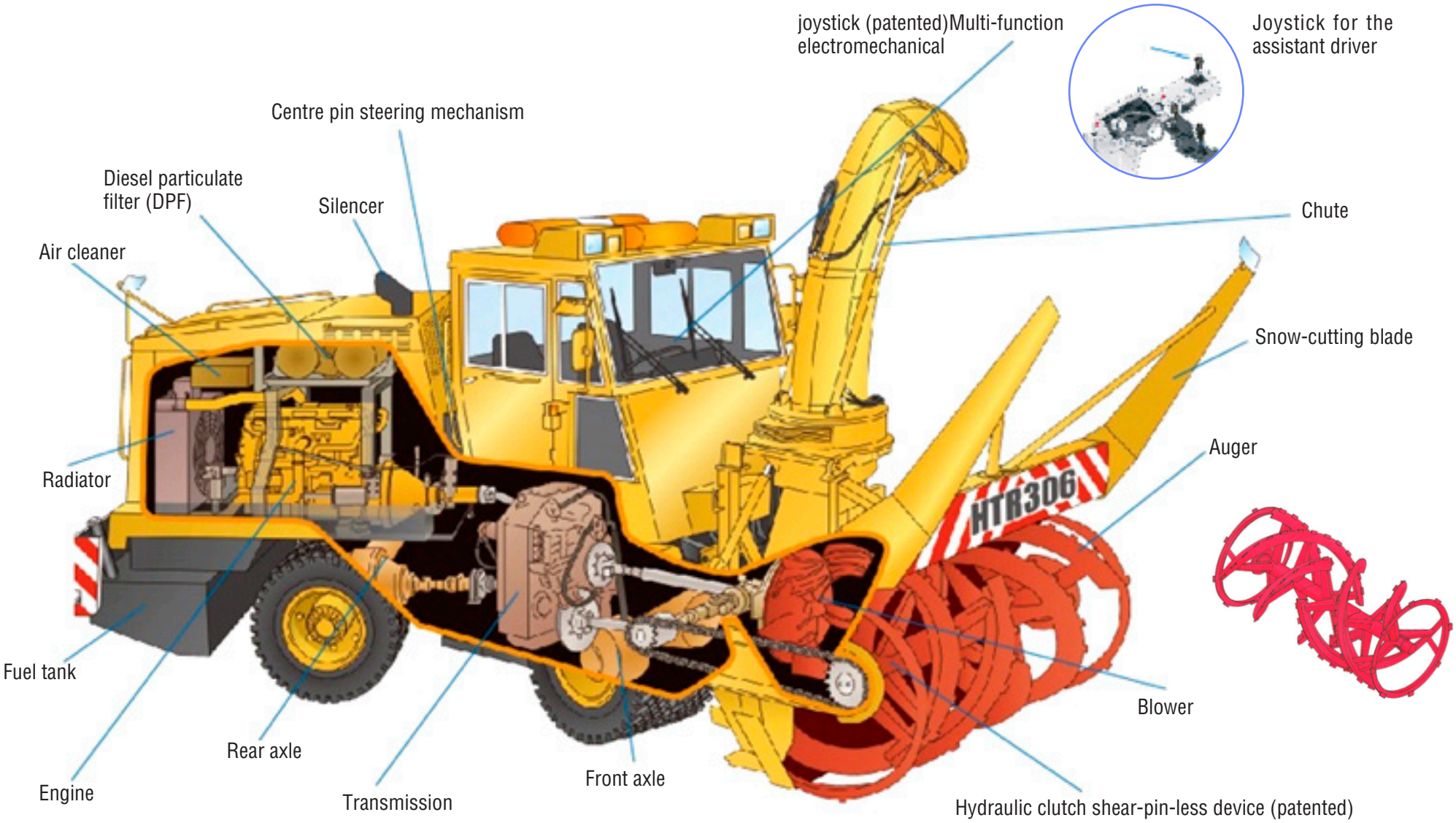
Constantly dealing with snow

Winter. Japan experiences snow cover in 61% of its land area, and that 61% is home to a quarter of the Japanese population. We at Nichijo proudly present rotary snowplows that excel under the most punishing conditions, clearing our roads and safeguarding our precious living spaces.

The power of snowplows is nothing short of a lifeline, and we're the top snowplow specialists in Japan. We started in 1962 in frigid Hokkaido. The high safety standards and outstanding performance of our rotary snowplows have earned them the trust of our many customers. Our roads are increasingly trafficked. To keep them safe, snowplows will become even more necessary in the near future. We continue to develop better and better machines to fight snow.

Nichijo Rotary Snowblower

Certified as meeting Tier 4 exhaust gas regulations



Nichijo rotary snowblower line-up

HTR605 446kw/606PS

High-speed rotary snowblower for airport runways

HTR407 354kw/481PS

For highways and areas of extreme snowfall

HTR306 287kw/390PS

For highways and areas of extreme snowfall

HTR146 115kw/156PS

For urban areas and narrow roads

HTR53 36kw/48PS

For sidewalks

HTR265L 220kw/299PS

For urban areas and single traffic lanes
Snow loader

HTR605 446kw/606PS

High-speed rotary snowblower for airport runways

HTR605		446 kW
High-speed rotary snowblower for airport runways		
Capacity: 2,300 t/h, 30 km/h		
Clearing width		2,600 mm
Clearing height		1,750 mm
Throwing distance		20 m/30 m/45 m
Operating speed		0-49 km/h
Dimensions	Overall length	8,500 mm
	Overall width	2,600 mm
	Overall height	3,790 mm
Total weight		19,060 kg
Passenger capacity		Two persons
Frame	Type	All-wheel drive, articulated frame, one rear engine
	Tires	14.00 R24 star rating ☆ 3 (front & rear)
	Min. turning radius	6.6 m
Engine	Make and model	Caterpillar C18 ACERT™ diesel
	Power rating	446 kW/1,800 rpm (606 PS/1,800 rpm)
Snow removal device	Type	Two-stage
	Auger	Ribbon screw
	Blower	Five blade centrifugal
	Chute	Fixed to blower case; rotation /chuting angle adjustable

The HTR605 is a 440-kW-class high-speed snowblower that's ideal for airport runway snow removal. The auger blower, specially developed for high-speed snow removal, has greatly improved the snow removal operation speed.

HTR407 354kw/481PS

For highways and areas of extreme snowfall

HTR407		354 kW
Rotary snowblower for expressways and for highways in heavy-snowfall regions		
Max. capacity: 3,600 t/h		
Clearing width		2,600 mm
Clearing height		1,750 mm
Throwing distance		20 m/30 m/41 m
Operating speed		0-49 km/h
Dimensions	Overall length	8,450 mm
	Overall width	2,600 mm
	Overall height	3,570 mm
Total weight		17,120 kg
Passenger capacity		Two persons
Frame	Type	All-wheel drive, articulated frame, one rear engine
	Tires	14.00-24-24PR (front & rear)
	Min. turning radius	6.6 m
Engine	Make and model	Caterpillar C15 ACERT™ diesel
	Power rating	354 kW/2,000 rpm (481 PS/2,000 rpm)
Snow removal device	Type	Two-stage
	Auger	Ribbon screw
	Blower	Five blade centrifugal
	Chute	Fixed to support frame; rotation /chuting angle adjustable; extendible folding type

The HTR407is a state-of-the-art, 400PS-class snowblower. With a capacity of 3,600 t/h, it's a quick, powerful snowblower recommended for expressways and highways in heavy-snowfall regions.

HTR306 287kw/390PS

For mountain roads and areas of extreme snowfall

HTR306		287 kW
All-purpose snowblower, usable even in urbanized areas		
Capacity: 2,900 t/h		
Clearing width		2,200 mm
Clearing height		1,700 mm
Throwing distance		20 m/30 m/46 m
Operating speed		0-49 km/h
Dimensions	Overall length	7,480 mm
	Overall width	2,200 mm (2,600 mm)
	Overall height	3,570 mm
Total weight		13,760 kg (13,940 kg)
Passenger capacity		Two persons
Frame	Type	All-wheel drive, articulated frame, one rear engine
	Tires	12R22.5-16PR (front & rear)
	Min. turning radius	6.1 m
Engine	Make and model	Caterpillar C13 ACERT™ diesel
	Rating power	287 kW/2,100 rpm (390 PS/2,100 rpm)
Snow removal device	Type	Two-stage
	Auger	Ribbon screw
	Blower	Five blade centrifugal
	Chute	Fixed to support frame; rotation /chuting angle adjustable; extendible folding type

The HTR306 is a state-of-the-art, 300PS-class snowblower. Because its clearing width is adjustable, it exhibits high performance when used for road width widening snow removal in heavy-snowfall areas.

HTR146 115kw/156PS

For urban areas and narrow roads

HTR146		115 kW
Narrow carriageways and sidewalks		
Capacity: 1,100 t/h		
Clearing width		1,500 mm
Clearing height		1,150 mm
Throwing distance		20 m / 31 m
Operating speed		0-40 km/h
Dimensions	Overall length	5,680 mm
	Overall width	1,500 mm (1,800 mm)
	Overall height	2,620 mm
Total weight		6,690 kg (6,770 kg)
Passenger capacity		Two persons
Frame	Type	All-wheel drive, articulated frame, one rear engine
	Tires	11/70R22.5 (front & rear)
	Min. turning radius	4.4 m
Engine	Make and model	Isuzu AM-4HK1 diesel
	Power rating	115 kW/2,200 rpm (156PS/2,200 rpm)
Snow removal device	Type	Two-stage
	Auger	Ribbon screw
	Blower	Five blade centrifugal
	Chute	Fixed to support frame; rotation /chuting angle adjustable; extendible folding type

The HTR146 is a small snowblower designed for removing snow from urban areas, narrow municipal roads and local roads.

HTR53 36kw/49PS

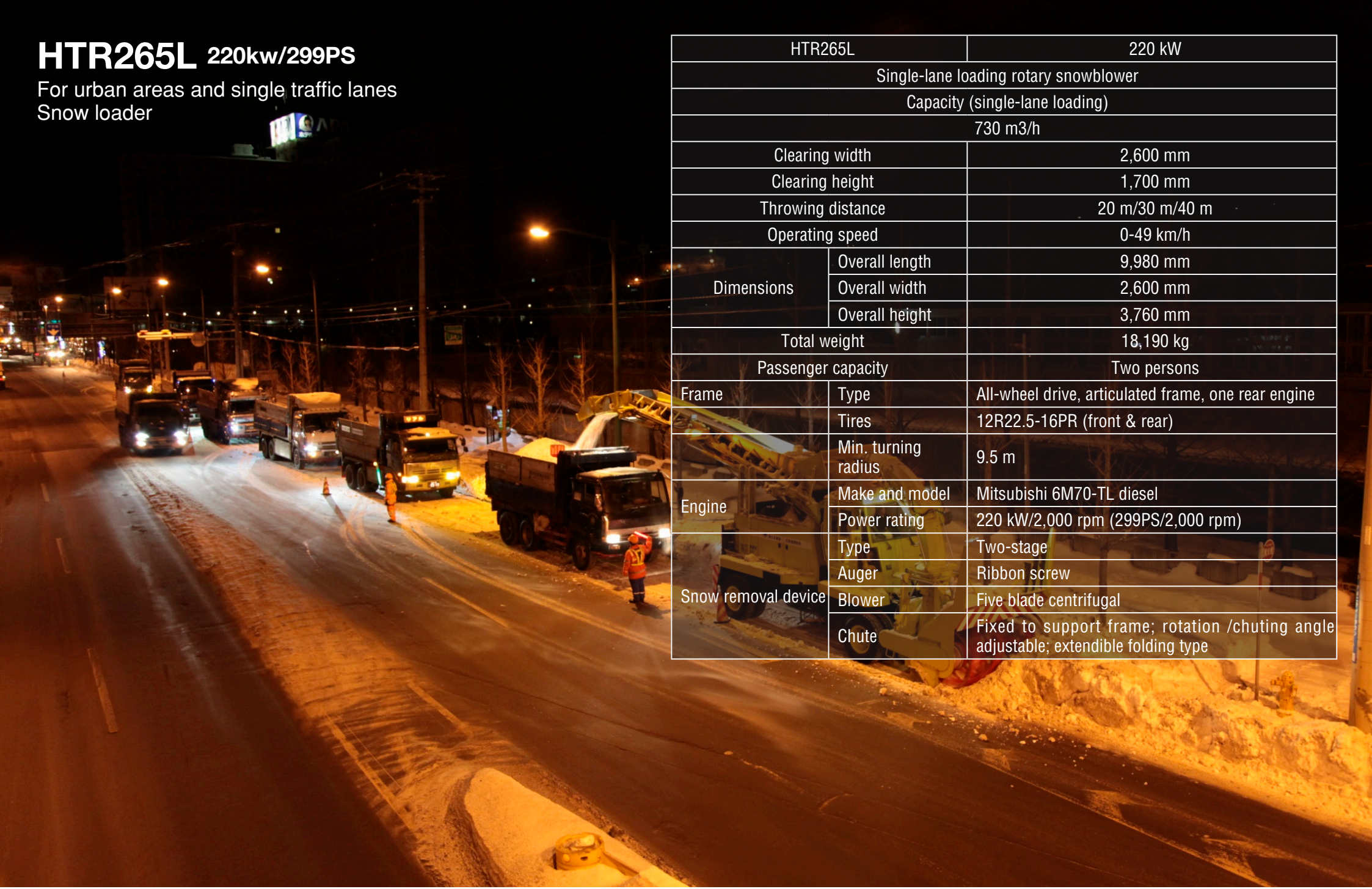
For sidewalk

HTR53		36 kW
Narrow carriageways and sidewalks		
Capacity: 300 t/h		
Clearing width		1,000 mm
Clearing height		870 mm
Throwing distance		15 m
Operating speed		0-15 km/h
Dimensions	Overall length	4,350 mm
	Overall width	1,000 mm
	Overall height	1,995 mm
Total weight		2,280 kg
Passenger capacity		One person
Frame	Type	All-wheel drive, articulated frame, one rear engine
	Tires	165R14-8PR (front & rear)
	Min. turning radius	3.8 m
Engine	Make and model	Nissan Diesel TD27 diesel
	Rating power	36 kW/2,300 rpm (48PS/2,300 rpm)
Snow removal device	Type	Two-stage
	Auger	Ribbon screw
	Blower	Four blade centrifugal
	Chute	Rotation /chuting angle adjustable; articulated

The HTR53 is a small rotary snowblower designed for clearing snow from sidewalks safely and quickly.

HTR265L 220kw/299PS

For urban areas and single traffic lanes
Snow loader



HTR265L		220 kW
Single-lane loading rotary snowblower		
Capacity (single-lane loading)		
730 m3/h		
Clearing width		2,600 mm
Clearing height		1,700 mm
Throwing distance		20 m/30 m/40 m
Operating speed		0-49 km/h
Dimensions	Overall length	9,980 mm
	Overall width	2,600 mm
	Overall height	3,760 mm
Total weight		18,190 kg
Passenger capacity		Two persons
Frame	Type	All-wheel drive, articulated frame, one rear engine
	Tires	12R22.5-16PR (front & rear)
	Min. turning radius	9.5 m
Engine	Make and model	Mitsubishi 6M70-TL diesel
	Power rating	220 kW/2,000 rpm (299PS/2,000 rpm)
Snow removal device	Type	Two-stage
	Auger	Ribbon screw
	Blower	Five blade centrifugal
	Chute	Fixed to support frame; rotation /chuting angle adjustable; extendible folding type

The HTR265L is a single-lane rear loading rotary snowblower for city snow removal. It enables a rotary snowblower and a snow removal truck to load roadside snow using only one lane; thus, it eases traffic congestion in cities during snow loading.

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Measures to address the shortages of skilled operators

Technologies have been developed to address issues regarding the ageing of, and shortages of, skilled snow remover operators. Examples are an automatic salting system that applies salt only where necessary and an easy-to-operate rotary sidewalk snowblower.

■Automatic salting-control system that uses a tire-sensor-based road surface condition judgment system

At left is an automatic salting-control system that uses a tire-sensor-based road surface condition judgment system. The road patrol vehicle uses that system in combination with an onboard GPS to upload data to the server in real time. The salt spreader downloads the data and automatically calculates the necessary amount of salt to be loaded. Then, on the road, the spreader automatically spreads salt only where necessary using the downloaded road surface judgement data and GPS. The system allows salt to be spread only on road sections where it’s needed and to maintain the road conditions while avoiding excess salting even when the operator is unskilled.

■The easy-to-operate "Block Free" rotary sidewalk snowblower

The easy-to-operate "Block Free" rotary sidewalk snowblower has simplified sidewalk snow removal. Conventional sidewalk snowblowers require lots of skill to operate. The operation speed needs to be changed to meet the quality and volume of snow on the road. The auger needs to be raised or lowered to follow the unevenness of the road surface. The device needs to be steered, and the direction of the blown snow needs to be adjusted.

This new machine eliminates these complicated tasks and enables a beginner or even a resident volunteer to remove snow from sidewalks. Two patents have been awarded for its two groundbreaking new technologies: one for the automatic speed control to conform to the snow depth, and the other for the automatic road surface unevenness following device.

● *Patents*

(1) Automatic road surface unevenness following device for snow removal machines
Patent No. 4442730 (January 22, 2010)
(2) Automatic speed control of rotary snowblower to conform to the snow depth
Patent No. 4553154 (July 23, 2010)

● *Specifications*

Type of machine: Small rotary snowblower
Dimension: 4.7 m long x 1.0 m wide x 2.0 m high (when operating)
Weight: 2.5 tons
Passenger capacity: 1 person
Engine: Water-cooled diesel engine
Rating power: 30 kW
Drive system: All-wheel drive
Max. snow removal capacity: 200 ton/h

Chuting distance: 0 - 12 m

Max. snow removal width: 1.0 m

Max. height of snow to be removed: 0.8 m

Max. operating speed: 15 km/h

For further information…

○ *The easy-to-operate 'Block Free' rotary sidewalk snowblower*

Hokuriku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan

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#1 Niigata Misaki Government Building

FAX: +81-(0)25-280-8809

E-mail: "kikai" followed by "@hrr.mlit.go.jp"

URL: http://www.hrr.mlit.go.jp/

○ *Automatic salting-control system using a road surface condition judgment system*

Nexco-Engineering Hokkaido Co., Ltd.

Address: 3-20, Higashi-Sapporo 5-jo 4-chome, Shiroishi-ku, Sapporo, Japan 003-0005

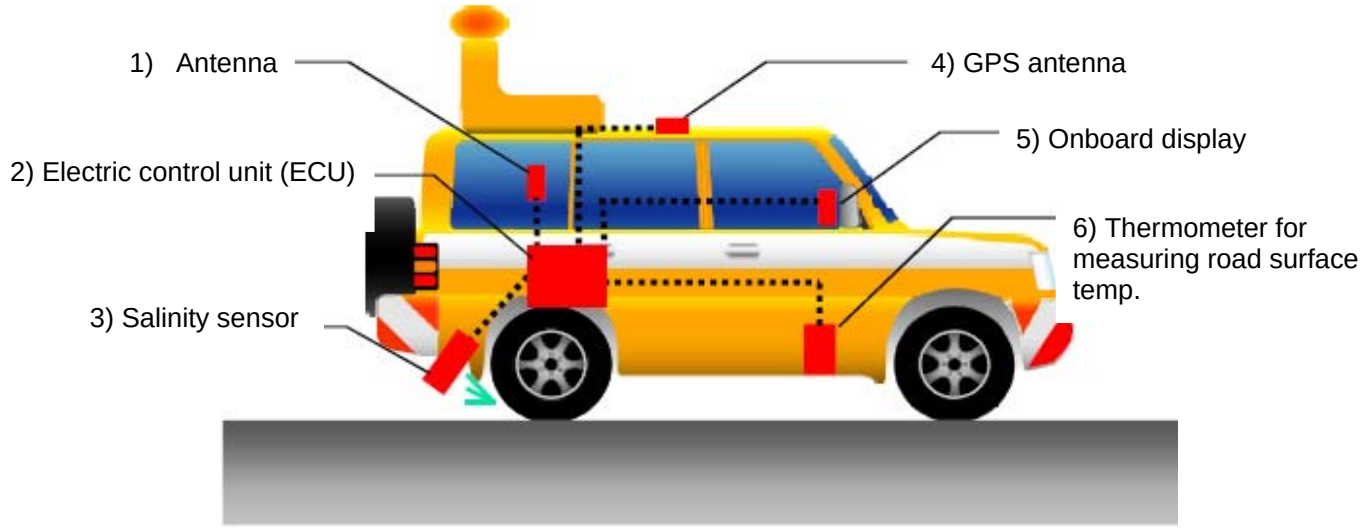
FAX: +81-(0)11-842-3274

E-mail: "eng.ho" followed by "@e-nexco.co.jp"

URL: http://www.e-nexco-engiho.co.jp/

Onboard salinity sensor

In this system, a thermometer continuously measures the road surface temperature and a salinity sensor continuously measures the road surface salinity. The system calculates the salinity needed to prevent ice from forming at one-second intervals to support real-time reduction of salt application.



1) Telecommunication antenna

Transmits measured data to snow removal station for real-time monitoring

2) Electric control unit (ECU)

3) Salinity sensor

Measures salinity contained in the water splashed by the tire.

4) GPS antenna

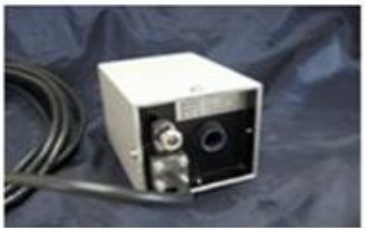
5) Onboard display

Displays measured salinity and temp. of road surface. Attached to a salt spreader, it controls salting rate.

6) Thermometer for measuring road surface temp.

Configuration of the onboard salinity measurement system

Salinity sensor



Thermometer for measuring road surface temp.

Vehicle mounted salinity sensor

Electric control unit (ECU)

Sensors and ECU

System features

1. The system makes two comparisons in order to evaluate residual salinity on road surface:

a: measured salinity vs. theoretical freezing salinity (converted to NaCl) at the measured road surface temp.

b: measured temp. of road surface vs. theoretical freezing point of road surface at the measured salinity

2. The measured salinity is compared to the salinity required to prevent freezing at the measured road surface temperature. This “salinity evaluation” is indicated on the map by the following colors:

Green: sufficient	Yellow: marginal	Red: insufficient

Example of use of onboard salinity sensor

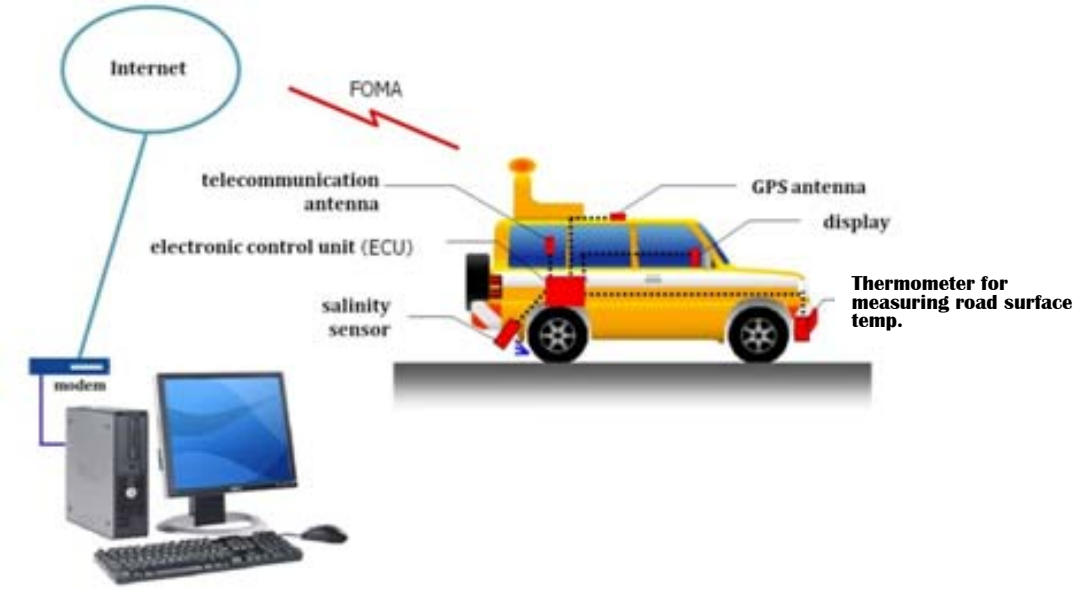
1. Salinity and road surface temperature sensors are installed on a salt spreader to control the salting rate.

Sensor equipped spreader

Salinity sensor

Temperature sensor

2. Remote monitoring of measured data using GPS and a telecommunication device



Salinity sensor specifications

Detection method	Optical reflection index measurement
Subject of measurement	Sodium chloride. Calcium chloride and magnesium chloride also can be measured.
Salinity measurement range	0 – 20% (resolution: 0.25%)
Dimensions and weight	Salinity sensor: 120 mm x 180 mm x 130 mm; 3 kg Road surface thermometer: 74 mm x 120 mm x 84 mm; 1 kg
Salinity measurement accuracy	Error* in the field: < +/- 3% Error indoors: < +/- 1% Notes: 1) *Relative error. When the true value is 10%, the value indicated maybe between 7% and 13%. 2) 0.25% maybe indicated even when salinity is 0%.
Measureable surfaces	Sufficiently wet asphalt, concrete, porous asphalt, and some other wet surfaces. (Measurement not possible on dry road surface, gravel, dirt, compacted snow, ice and dry snow.)
Voltage	DC12V(±10%)/DC24V(±10%)
Power consumption	< 120 W (Sensor: 90 W incl. 60 W of heater; ECU: 30 W)
Data storage	USB memory, SD card
Design conditions	a) Sensor (outside vehicle): Operating temp.: -15 to 30°C; humidity: 40 to 90% Rh; Storing temp.: -35 to 70°C b) ECU (inside vehicle): Operating temp.: 0 to 50°C; humidity: 40 to 90% Rh; Storing temp.: -10 to 70°C
Waterproofing	Sensors: water-jet proof (JIS C0920 Class 5); however, not proofed against the water jets of a high-pressure vehicle washer ECU: no waterproofing
Durable life	ECU and road surface thermometer: 4000 hours (about 5 years; under the assumption of 4 hr /day X 200 day/year). Salinity sensor: ditto. Preseason inspection needed. Optical device needs to be replaced every 30,000 km of driving.
Limitations	Sufficient moisture is needed on the road surface, because the sensor's optical measurement depends on the reflection index of water.

For further information…

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