

JAPANESE AND EUROPEAN WINTER EQUIPMENT TECHNOLOGY

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INTRODUCTION

It has been recognized that snow and ice control operations in the United States differ from those in other countries. A Winter Maintenance Panel was organized and visited Japan and Europe to study these differences. The Panel was sponsored by the U.S. DOT's Federal Highway Administration's Office of International Outreach Programs and the National Cooperative Highway Research Program of the Transportation Research Board. The Panel consisted of six U.S. managers responsible for snow and ice control operations. They came from U.S. federal, state, county and municipal authorities.

General topics of interest to the Winter Maintenance Panel included equipment, anti-icing operations, road weather information systems, weather forecasting services, public information systems, policy, roadway level-of-service criteria, visibility and environmental issues. The Panel visited Japan March 12-19 and Europe (Germany and Austria) March 20-27, 1994. While in Austria the Panel was based in Seefeld and attended the 9th Permanent International Association of Road Congress (PIARC) International Winter Road Congress and the International Road Weather Conference.

JAPANESE WINTER ROAD TECHNOLOGY

Japan deals with very complex winter maintenance problems. Japan's population is half that of the United States, but when those people occupy an area 1/30 the size of the U.S. and 2/3 of that land is covered by mountains, high urban population density results. Hokkaido, the northern island of Japan, receives more than 500 centimeters (200 inches) of snow each winter. Heavy snowfall and high traffic volumes team up to create difficult snow and ice control problems.

Studded tires were introduced in Japan in 1962 to provide winter mobility. Before 1962 mobility was achieved by putting chains over summer tires. By the late 1970s nearly all drivers were using studded tires. These studs were much larger than those used the United States and rapidly eroded the road surface, creating a heavy concentration of dust and causing an air

pollution problem. To solve the problem, the Japanese Ministry of Trade and Industry introduced a studless tire in 1982. The government heavily promoted these studless tires by offering rebates on new studless tire purchases and providing winter driving training courses. Very few vehicles have studded tires today.

Snow removal standards had to be established to insure mobility without chains and studded tires. Main trunk roads are kept clear of snow pack while lesser traveled roads are allowed to develop snow pack several centimeters deep. Trucks and plows similar to those found in the U.S. are used on the main roads while motor graders with serrated blades, sacrifiers or milling heads smooth snow packed and rutted local streets. Sand (because of air pollution problems) and salt (because it costs \$200 per short ton and caused ground water problems) are used very sparingly.

Japan has developed some unique high performance snow control equipment to mechanically achieve their level of service standards with the 500 centimeters (200 inches) of snowfall they receive each winter. The Hokkaido Development Bureau uses a partnering relationship with private companies, universities and research institutes to produce heavy duty snow removal trucks, plows, blowers and blower/loaders. Their use of *mechatronics* (joy sticks and video cameras) make it possible for one person to operate a three-plow (forward, underbody and rear plows) heavy-duty truck. An open-vane snow blower/auger allows for cutting through hard packed snow. Packed and plowed snow is hauled to snow melting facilities or stored in huge piles outside the city and melted during the following summer.

Japan utilizes advanced global positioning satellite (GPS) system for tracking vehicles and reporting information to their management systems. Nearly all the government vehicles that transported the Panel in northern Japan had GPS and a television monitor reporting our current position and direction of travel on a moving street grid background.

EUROPEAN WINTER ROAD TECHNOLOGY

The Panel visited road maintenance facilities in Germany and Austria. The Panel found roads, bridges,

equipment and facilities in both Japan and Europe were of high quality and well maintained. Fuel taxes in excess of two dollars per U.S. gallon and approximately 25 cents per kilometer tolls plus a \$1.50 terminal fee provide an excellent funding base for roadway construction and maintenance.

The equipment display at the PIARC Meeting in Seefeld was the largest display and demonstration in Europe. Snow blowers, plows, trucks, loaders and spreaders demonstrated advanced technology and increased capacity to that found in the United States.

The price of salt in Europe is about the same as Japan (\$200 per short ton). Both countries use chemicals very sparingly and prewet salt at the spinner with brine or liquid calcium chloride to reduce loss and speed up the melting process. Hopper spreaders with plastic liquid storage tanks designed to tuck into the spreader's sloping undersides are the most common design. Many have fifth wheel sensing for spread rate accuracy.

Snow plows are usually heavier than U.S. plows, often use independent one meter sections that conform to the pavement cross section or varying crown with cutting edge trip actions. They use metal, plastic or rubber blades and have foldout wings for extending the plow width. To reduce snow over spray and increase operator visibility, a canvas snow shield rides about $\frac{1}{3}$ to $\frac{1}{2}$ meter above the snow plow. This shield traps the snow spray and forces it under the truck. Both Japan and Europe use advanced road/weather information technology to assist in managing snow and ice control operations and to keep the motoring public advised on road/weather conditions.

TECHNOLOGY TRANSFER

The Panel at the end of the trip prepared a brief interim summary with technology transfer recommendations. The document was prepared to provide those agencies who organized and supported the trip with highlight information on Panel international findings about the state-of-the-practice. A more comprehensive report will be published later. [*NCHRP Research Results Digest No. 204, "Winter Maintenance Technology and Practices - Learning from Abroad,"* Transportation Research Board, Washington, D.C., January 1995.]

One of the major proposals will be for the establishment of Winter Maintenance Program (WMP) where technologies imported from other industrialized nations and/or developed in the U.S. can be demonstrated, vigorously evaluated and acceptance tested in an operational setting against the present state-of-the-art. The following items discovered by the Panel will be recommended for WMP evaluation:

- European snow plows;
- European spreaders with prewetting equipment and aerodynamic tailoring;
- Japanese rearward (one-lane) snow conveying rotary plows;
- Improved anti-icing and deicing materials, and application management;
- Improved roadway weather information system technologies; and
- Road user information systems.

It is envisioned the WMP will actively develop research problem statements and provide direction for further winter maintenance research.