LEARNING FROM ABROAD — WINTER MAINTENANCE PROGRAM

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INTRODUCTION

The cost of winter maintenance in North America consumes a staggering amount of money, about $2 billion annually (1). These expenditures do not include the costs associated with corrosion, water quality degradation and other environmental impacts. Even a modest improvement in present snow and ice control procedures can produce substantial savings. Each State's economy and quality of life rely heavily on a reliable and safe highway transportation system, so any improvement in winter maintenance practices can help to enhance and fulfill those economic and mobility needs.

In recognition of the major annual investment made by state and local governments in snow and ice control, the need to advance the use of state-of-the-art technologies in this critical endeavor, and the fact that snow and ice control operations in the United States differ from those used in other countries, a Winter Maintenance Panel was organized and visited Japan and Europe to study the differences. The Panel was sponsored by the U.S. Department of Transportation's Federal Highway Administration's Office of International Outreach Programs, the American Association of State Highway and Transportation Officials, 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 from federal, state, county and municipal authorities. General topics of interest to the Panel members included winter maintenance equipment, anti-icing and de-icing operations, road weather information systems, weather forecasting services, public information systems, policy, roadway level of service criteria and environmental issues. The Panel visited Japanese and European officials at national and local governments, and toured field operations and research facilities.

Each area visited in Japan and Europe had very complex winter maintenance problems. Each country developed unique solutions to those problems that may have application here in the U.S. A Winter Maintenance Program involving federal, state and local governments has now been established in the United States where technologies imported from other industrialized nations and/or developed in the U.S. will soon be demonstrated, vigorously evaluated and acceptance tested in an operational setting against the state-of-the-art.

PARTNERING TO IMPROVE WINTER MAINTENANCE TECHNOLOGY

Partnering is an important part of creating and implementing new and innovative winter maintenance technology in Japan. An example of that partnering was demonstrated in the way the Japanese Government solved the following serious air pollution problem. Hokkaido, the northern island of Japan, receives more than 500 centimeters of snow each winter. This heavy snowfall combined with high traffic volumes team up to create difficult snow and ice control problems. Studded tires were introduced in Japan in 1962 to improve 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 rapidly eroded the road surface, creating a heavy concentration of dust and contributing to an air pollution problem. To address this problem, the Japanese Ministry of Trade and Industry introduced a studless tire in 1982. The government partnered with private industry and heavily promoted studless tires by offering rebates on new studless tire purchases. The government also partnered with education by providing winter driving training courses to teach motorists how to use the new studless tires effectively. This partnering changed motorists driving and buying habits and resulted in very few studded tires being used today. The bottom line partnering benefits are that air quality today is greatly improved and Japanese motorists have good winter mobility.

The Hokkaido Development Bureau conducts quasi public/private ventures in the development of new construction and winter maintenance machinery. A next generation snowplow truck is currently under development. Manually performed operator tasks are being automated. These tasks include the setting of down pressure and blade angle for underbody plows and the height adjustments of a wing plow to clear roadside guardrail. The operator because of automated steering assistance does not feel lateral snowplow forces. On-board video cameras and in-cab displays provide the operator

with multiple angle observations of plowing operations in progress.

WINTER EQUIPMENT TECHNOLOGY

The Panel visited road maintenance facilities in Japan and Europe. Equipment, roads, bridges and facilities were of high quality and well maintained. Fuel taxes greater than two dollars per U.S. gallon and approximately 25 cents per kilometer tolls plus often a $1.50 terminal fee provide an excellent funding base for roadway construction and maintenance.

The Panel visited the equipment display at the Permanent International Association of Road Congresses (now World Road Association—PIARC) meeting in Seefeld, Austria. This was the largest display and demonstration of winter maintenance equipment in Europe. Snow blowers, plows, trucks, loaders and spreaders demonstrated advanced technology and increased capacity to that found in the U.S.

Since the price of salt in Japan and Europe averages about $250 per short ton, chemicals are used very sparingly. They always prewet salt or abrasives at the spinner with brine or liquid calcium chloride to reduce material loss and speed up the melting process. Hopper spreaders are designed with plastic storage tanks for liquids that tuck under the spreader's sloping sides. Most units have ground speed orientation or fifth wheel sensing for better spread rate accuracy.

Snow plows are usually heavier than U.S. plows, some have independent one meter sections that conform better to the pavement cross section or varying crown with blades made of metal, plastic or rubber. Some plows have foldout sections to increase plowing width. To reduce snow over spray and increase operator visibility, a canvas snowplow shield is mounted about 25 cm above the snowplow. This shield traps most of the over spray and forces it under the truck.

WINTER TRAFFIC MANAGEMENT SYSTEMS

Roadway weather information systems in Europe and Japan provide impressive amounts of information to both road maintenance operators and the motoring public. Typical climate sensors include ambient air and pavement temperature, wind speed and direction, humidity and road brine concentration. There are video cameras mounted along the roadside that provide a visual observation of road and weather conditions. The Hokkaido Development Bureau designed a prototype winter maintenance information vehicle that has a suite of sensors and visibility imagers on-board that provides a moving assessment of roadway and weather conditions. This vehicle also gathers information on pavement temperature and rolling wheel friction.

This information is brought to a central traffic management station via land line or radio datalink. Experienced traffic engineers and meteorologists are on the staff of these management centers. These centers can change the speed limit and information signs on a section of roadway remotely and selectively close or limit access to sections of the roadway. They can automatically call for emergency services. Information developed in these traffic management centers is distributed to the motoring public through extensive audio and video displays at rest areas and information sites.

IVHS FOR MOTORISTS

Japan utilizes advanced global positioning satellite (GPS) systems for tracking vehicles and reporting information to their management systems. Nearly all the government vehicles used to transport the Panel in Hokkaido had GPS and a television monitor that reported the vehicle's current position and direction of travel on a moving street grid background. Technology using Intermittent/Minimum Zone Mode Communication coupled with digital route maps allow motorists to be informed on-line and en-route of potential delays or hazards and offer alternative route planning.

PANEL RESEARCH AND TECHNOLOGY TRANSFER RECOMMENDATIONS

The Panel prepared a brief summary report with technology program and transfer recommendations at the end of the trip. The document served as the basis for the National Cooperative Highway Research Program (NCHRP) Research Results Digest Number 204 published in January 1995 (2). The NCHRP Digest summarizes findings and recommendations of the international tour and delineates the guidance found in the AASHTO Administrative Resolution that calls for the establishment of a Winter Maintenance Program (WMP). AASHTO's concept for the WMP is:

> *AASHTO subscribes to the concept that Member Departments, and appropriate agencies in the nation's counties and cities, should consider developing and adopting for their respective jurisdictions a system concept for snow and ice control on their highways, roads and streets, addressing the vehicle, the driver, and*

the equipment and practices for managing roadway and bridge snow and ice, and designed to assure that the best technologies in the world are properly and effectively used in the United States.

The goals for such a system concept should be to:

-sustain or improve levels of winter maintenance service with significant cost/benefit improvements;

-provide an enhanced level of environmental protection; and

-increase the safety of driving under winter conditions.(2)

The AASHTO Administrative Resolution recommended the use of funding under NCHRP Project 20-7 and the establishment of the AASHTO Winter Maintenance Policy Coordinating Committee to monitor and advise on a full program of winter maintenance activities delineated in the following tasks:

Task 1--Develop a comprehensive guide for establishing a systems approach to snow and ice control. This will probably be a guide manual or handbook designed to provide state and local agencies comprehensive guidelines for snow and ice control programs under applicable geographic and environmental conditions.

Task 2--Establish an AASHTO Snow and Ice Pooled Fund Cooperative Program (SICOP). The purpose of this fund would be to use pooled funds to underwrite the costs of testing snow and ice control technologies not now in use in the United States.(2)

ACCOMPLISHMENTS

Accomplishments at the writing of this paper, April 1996, are: the NCHRP fund has been established; a Winter Maintenance Policy Coordinating Committee consisting of members from AASHTO, the National Association of County Engineers (NACE) and the American Public Works Association (APWA), has been appointed and has met several times; and a national workshop (to address tasks one and two above) was held. Workshop participants developed a working outline and an action plan for preparing and publishing the comprehensive winter maintenance guide manual and developed recommendations for the administrative and operating concepts and procedures to be used in the establishment and operation of the SICOP program.

OTHER ACCOMPLISHMENTS BY THE PANEL

Panel members have published articles in trade magazines, written and presented technical papers at conferences and national workshops, and actively tested international snow and ice control products in their agencies since returning from the tour. This has resulted in some lower cost and less complicated products being implemented in snow and ice control operations. Examples of these lower cost products include: Iowa uses more than 200 snow plow shields (European idea) to increase operator visibility and increase radiator and windshield life (3); Kansas City, Missouri uses an endgate to cover the snow plow moldboard (Japanese idea) to retain snow spoil when plowing across intersections; Minnesota has tested and published the results of many snow and ice control innovations, foreign and domestic, as part of its operational research program (4); and many states are now using prewetting and liquid applications of ice control materials and making their own brine to support these operations (European, Japanese and United States research ideas).

These lower cost and less complicated ideas can be built and tested by individual states, but the more complicated and expensive products such as the rearward (one-lane) snow-conveying rotary snow plows or the improved winter maintenance management systems the Panel saw demonstrated in Japan and Europe will need the attention of the Winter Maintenance Program to fund and insure tests are carried out in a fair and credible manner.

REFERENCES

1. *NCHRP Synthesis of Highway Practice 207,* "Managing Roadway Snow and Ice Control Operations," Transportation Research Board, National Research Council, Washington, D.C., 1994.

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4. "Statewide Maintenance Operations Research Report," Minnesota Department of Transportation, St. Paul, December 1995.