TranScan

Number 2, Summer 1998

NCHRP Project 20-36 • Highway Research and Technology—International Information Sharing

Winter Maintenance II Scanning Tour

Technology Gap Not Quite So Big Anymore

Four years ago, the participants in the first winter maintenance scanning tour came home from Europe and Japan convinced that the United States had quite a bit of catching up to do—that the winter maintenance technologies and practices used in Japan and Europe were superior to those commonly used in the United States.

This past January, 12 representatives from state, federal, and local highway agencies set out on a follow-up tour. After meeting with their peers in Switzerland, France, Norway, and Sweden, they concluded that the gap between the state of the practice in the United States and in Europe has narrowed appreciably in the past 4 years.

"We attribute this to the heightened emphasis that the American Association of State Highway and Transportation Officials, the American Public Works Association, and FHWA [Federal Highway Administration] have put on improving winter maintenance strategies," says FHWA's Don Steinke.

The narrowed gap surprised some participants. "Based on what I had heard from the first scanning tour, which emphasized how far ahead the European community and the Japanese were in technical advancements, I expected to see a lot more new technologies," said John Blacker, a tour participant from the Montana Department of Transportation (DOT) maintenance division. "What I found was that not only had we closed the gap, but in some cases, we're even out ahead because the technology had continued to evolve. The first tour apparently lit a fire under many state officials."

U.S. highway agencies have stepped up efforts to identify and evaluate innovative winter maintenance technologies and strategies. Here, a road crew clears snow drifts off Route 136 in Atchison County (Missouri) in March 1998.

The 1998 tour did, however, give the participants a "whole new shopping list of ideas" for further improvements in the United States.

"For example, Europe is doing more to provide the public with real-time information on roadway conditions and to let them know exactly what they can expect," says Steinke. "We can certainly do a better job of that in this country. In Sweden, for example, travelers can easily look up real-time pavement conditions for all major and semi-major roads, using the Internet. Although there are iso-

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lated instances of counties or states providing such information in the U.S., in Sweden that type of information is available for the whole country."

A composite snowplow blade in Norway also piqued their interest. Made of tungsten steel embedded in a hard rubber casing, the more-forgiving blade is less damaging to pavements. And because it generates 20 percent less noise than a conventional steel blade, it is well suited for use in urban areas, says Steinke.

The advantages of such a blade weren't lost to Blacker, who says that he came home convinced that Montana should experiment with the plow. "We're in the process of buying one, even though we had to go abroad to find a vendor," says Blacker.

In France, a hard plastic snowplow blade got the group's interest. The plastic blade does a great job moving wet or slushy snow, but it's not so great on packed snow or ice. To get around this problem, the French highway agency devised a mechanism that allows the truck to be outfitted with both the plastic blade and a conventional steel blade; at the push of a button, the operator can easily switch from one blade to the other.

Dave Gravenkamp, director of public works for Siskiyou County (California), says that the tour was "time well spent" and that he gained a new appreciation for anti-icing strategies.

"We typically plow and sand," says Gravenkamp. "We don't use salt, and we've never tried anti-icing. But as a result of the tour, I see the merit in anti-icing techniques, and we will be getting into anti-icing."

Training is one area where the European countries are still way out in front. "All levels of staff—not just managers—are provided ample, continuing training," says Blacker. "And it shows. In the U.S., in contrast, winter maintenance training is rarely a high priority."

The participants were eager to see how privatization of winter maintenance operations has fared in Europe. They were somewhat surprised, says Blacker, to find that "nobody was reporting a good experience with privatization." It's not that the process doesn't work, but that it comes at a high cost.

A summary report of the tour and its findings is expected to be available by late summer. In addition, tour member Mike Dooley, director of the Department of Highways and Traffic for St. Louis County, made a presentation on the tour at the AASHTO Subcommittee on Maintenance meeting in Nashville in July.

The participants in the 1994 tour had strongly recommended that a coordinated process be established to test and evaluate new winter maintenance strategies and technologies in the United States. That recommendation led to the establishment of the AASHTO Snow and Ice Cooperative Pooled Fund Program (SICOP), as well as to a National Cooperative Highway Research Program study (Project 20-7, Task 83), which developed a comprehensive guide for snow and ice control.

Those efforts, together with FHWA's extensive winter maintenance test and evaluation program and AASHTO's Lead States team for anti-icing/road weather information systems, have spurred many highway agencies to implement advanced technologies and innovative strategies for clearing pavements, advising motorists, improving travel safety, and saving money in winter maintenance operations in the United States.

"We no longer just plow and salt the road," said Steinke. "We're smarter now. We're using new technologies, such as road weather information systems and anti-icing strategies. This results in greater wintertime mobility for the motorist and greater productivity for our nation."

Participants—Winter Maintenance II Tour

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Transportation Operations and Management Tour

Lessons from Abroad on Privatization

Save money. Cut staff. Outsource. Privatize.

These edicts ring familiar to highway agencies across the United States who must balance tight budgets against the growing need for repairs and maintenance on the nation's highways. U.S. highway agencies are not alone in facing this dilemma: most U.S. government agencies are facing similar demands, as are many other countries. Some countries are already a few steps ahead in the journey toward privatization, driven by the goal of smaller, more business-like government.

With that in mind, FHWA and AASHTO put together a scanning tour to study how such countries are dealing with organization and management issues. The tour took place over a 10-day period in August and September of 1997. The tour participants—13 representatives of public agencies and private industry (see sidebar, page 4)—studied the roles of government and the private sector in delivering and maintaining transportation facilities in Australia, New Zealand, Sweden, and the United Kingdom. The transportation departments in those countries have all undergone considerable changes during the past 10 years as they moved toward a more business-like environment.

Abbreviation Key:

AASHTO	American Association of State Highway and Transportation Officials
FHWA	Federal Highway Administration
NCHRP	National Cooperative Highway Research Program
TRB	Transportation Research Board

Calling it "more an evolution than a revolution," Michael Walton, tour participant and recorder, said that reform in all four countries began with reevaluating and clarifying the transportation agencies' core functions and responsibilities and identifying those functions that could be transferred to the private sector. "One of the most important and successful changes in structure in all four countries was the explicit separation of the buying and selling roles within the agency," says Walton. "And one thing on which all four countries agreed is that you must understand your costs *before* doing anything."

Walton says the team identified four steps that highway agencies in the four countries have taken to increase private-sector involvement:

1. Define the agency's responsibilities and separate policy and management from delivery of programs. In a privatized system, the government sets policy, but it is up to the private sector to figure out how to deliver services that will meet the policy's objectives.
2. Increase the amount of work that is outsourced.
3. Make across-the-board reductions in public-sector employment.
4. Encourage traditional public agencies to become more competitive.

General Observations

Although the final report from the scanning tour will not be published until later this summer, here's a rundown of some general observations from the tour:

- With the exception of Australia, there was little recognition of the link between transportation infrastructure and economic growth. "The apparent disconnect between transportation and economic development was very surprising," says Larry Goode of the North Carolina Department of Transportation (DOT).
- Highway agencies in the four countries take a business-like approach to management, stressing the importance of competition. Public firms are allowed to compete against private-sector firms, with good results. The Swedish National Road Agency, for example, converted its construction and maintenance, consulting, and ferry operations departments into independent profit centers. A 15 percent profit is added to each of the center's bids, and the centers compete against the private sector.

  In addition, all four countries are increasingly using benefit-cost analyses to prioritize projects and allocate resources. The costs included in the analysis vary, however; in some cases, costs related to noise, environmental degradation, aesthetics, and user delays are included, in others they are not. Costs related to safety are usually included.
- Funding techniques were similar in all four countries, but there did not seem to be any direct link between user fees/revenues and budgets/expenditures.
- Agencies in all countries placed a high priority on retaining their core competencies, realizing that expertise is required for writing contracts and monitoring performance.
- The countries lacked a dedicated, predictable funding mechanism. "There is some concern regarding the ability to do long-range planning without a dedicated funding source," says Walton. "In most countries, the user fees go into a general fund, and highway agencies have to compete for those funds. We came back home saying we are very fortunate to have a dedicated

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source of revenue to sustain our transportation program." There was scant support for the concept of assessing tolls on road users in those countries.

- Highway agencies were generally satisfied with contracting out maintenance and construction operations, but less so for design services. New Zealand, however, has outsourced all its design, construction, and maintenance work; as a result, the Department of Public Works' staff has been dramatically downsized.
- Performance-based contracts, rather than specifications-based contracts, are now the norm. The highway agencies define the quality characteristics that must be evident at the end of the contract period, and the private sector determines how to achieve them.

"The governments of the four countries are moving toward a system of performance measures that would allow them to oversee important areas of the road system while using the fewest number of employees," says Walton.

Making the change to privatized operations is not simple, and it requires strong direction from management. "It is important to note that in all four countries, the changes began with either a national crisis or a mandate from the government, but it was spurred on by strong central leadership," says Walton. "We were impressed with the extent of change and by the leadership evidenced by the managing directors, who were committed to making it work."

Although privatization has led to more efficient operations, research programs have taken a hit in all four countries. "There's very little research being done," says Walton. "And because research is essentially long-term training, there is concern that the training of future transportation professionals may suffer."

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In the Pipeline

Six AASHTO representatives were among the U.S. delegates to the **Fourth International Conference on Managing Pavements,** held in Durban, South Africa, in May. The AASHTO representatives, who received travel assistance from NCHRP Project 20-36, included Dave Winstead, AASHTO president and secretary of the Maryland Department of Transportation (DOT); chief engineers Ray Zink (North Dakota DOT) and Jim Byrnes (Connecticut DOT); and pavement specialists Linda Pierce (Washington State DOT) and Wouter Gulden (Georgia DOT).

Conference sponsors included the Transportation Research Board and the Federal Highway Administration.

At its May 1998 meeting, NCHRP Project Panel SP20-36 voted to cosponsor three **scanning tours in fiscal year 1999:**

- Bridge Scour Countermeasures (fall 1998).
- Methods and Procedures to Reduce Motorist Delay in Construction Zones (spring/summer 1999).
- Techniques for Pavement System Preservation (spring 1999).

We encourage your comments on the technologies discussed in this issue of *TranScan.* Please send them to:

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Scanning Tour of Asian Bridge Structures

Team Identifies Technologies with Potential for U.S. Application

Keeping the nation's half-million bridges in safe, serviceable shape and replacing them when necessary is a big job for state and local highway departments. In fall 1997, 11 representatives from U.S. highway agencies set out on a tour of Japan, South Korea, and Taiwan, with the goal of identifying technological developments in bridge design, construction, and maintenance that have potential for application in the United States. The 2-week tour included visits to major bridges in all three countries.

The technology review focused on seven key areas:

- Design standards, codes, and specifications
- Design and construction practices
- Materials, fabrication, and joining techniques
- Bridge protection strategies
- Inspection and rehabilitation practices
- Programming and management practices
- Innovations

Here is a summary of some of the key findings from the draft report on that tour.

Design Standards, Codes, and Specifications

Design standards, codes, and specifications in Japan, South Korea, and Taiwan are very similar to those in the United States. The three countries are moving toward a load and resistance factor design method.

In Japan, seismic design is being emphasized at two levels: In Level 1, the structure is designed to survive an earthquake with no damage; in Level 2, some damage is allowed. The Honshu-Shikoku Bridge Authority, which is responsible for the bridges between the islands of Honshu and Shikoku, has developed its own design standards for superstructure design, wind-resistant design, seismic design, and substructure design.

South Korea's design specifications are similar to the *AASHTO Standard Specifications for Highway Bridges*, but are based on 33 percent larger truck loads. Seismic design standards are in the process of being rewritten.

Taiwan's bridges are designed using specifications published by the Ministry of Transportation and Communications; the specifications reference the *AASHTO Standard Specifications for Highway Bridges* and the *CalTrans Bridge Design Specifications Manual.*

Design and Construction Practices

Highway agencies in Japan have been directed to cut costs by 10 percent and to begin using life-cycle costing on projects. The Japanese have only limited experience with value engineering and design-build contracts.

To reduce weight and seismic forces, many of the superstructures of Japanese bridges are built of steel. However, for spans between 60 and 100 m (200 and 330 ft), there is a growing use of precast concrete superstructures. To reduce the bridge's footprint, substructures are also made of steel. As much work as possible is done in the steel prefabrication plant, to minimize labor costs.

One of Japan's innovative bridge designs is called the "extradosed concrete bridge." Although the bridge looks like a small cable-stayed bridge with a lower tower, it is more appropriately considered a modification of a conventional precast concrete cantilever bridge. This type of bridge is another evolution beyond current U.S. practice, which uses internal and external tendons located within the cross section. The advantages of the "extradosed" bridge include ease and standardization of casting operations, reduced tower height, less stress range in the cables, and no need to adjust cable forces.

In designing collision-avoidance systems for bridge piers, Japan strives to protect not only the piers, but also the ship. To minimize damage to the ship and protect the pier, cellular steel buffer systems and 1-m-long (3-ft) breakaway plastic rods are affixed to the piers.

The Japanese attribute premature failure of their concrete bridge decks to repeated heavy loads, which the decks were not designed to carry. Eventually, a punching shear type of failure occurs, resulting in holes in the deck.

The tour participants took note of the high degree of precision reported in Japanese construction practices. For example, the tops of the towers of the Akashi-Kaikyo Bridge are reportedly within 20 mm (0.75 in) of their planned location. The bridge's deck drainage system is also innovative. A perforated steel curb barrier is placed along the edge of the roadway surface; the perforations allow water to drain into pipes in the curb, which carry the drainage to the abutments. The tour report calls this concept "a simple one to use in USA practice with either steel or precast concrete barriers."

Although 95 percent of the bridges in South Korea are built with concrete, steel bridges are becoming more competitive as the price of steel drops and the price of labor increases. Until recently, steel bridges were designed for a service life of 100 years and concrete bridges for a service life of 50 years; as a result of heavier traffic weights and growing truck volumes, the design lives have been reduced to 50 years and 25 years, respectively.

The Korea Institute of Technology reports that some concrete decks have failed as a result of cracks generated by drying shrinkage; the cracks get larger as a result

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of traffic loads and eventually penetrate through the deck, causing leaching of the concrete and corrosion of the reinforcing steel, leading to punching shear failure.

Almost all bridges (95 percent) in Taiwan are also concrete. The Taiwanese attribute most bridge deck cracking to overloaded trucks. An innovative foundation practice used to speed construction of the Kao-Ping River Bridge involved the use of 1.3-m-thick (4.25-ft) conventionally reinforced concrete slurry walls constructed in a rectangle around the plan view of the tower. The soil was excavated to a depth of 7 m (23 ft) within the confines of these walls. Reinforcing steel was tied into the walls to create a 4-m-deep (13-ft) "tabletop" to transfer tower foundation loads to the slurry walls. The remainder of the area was backfilled. The result: a high-capacity foundation for the bridge tower, in a relatively short period of time.

Materials, Fabrication, and Joining Techniques

The Japanese specifications for steel do not seem to be more stringent than the U.S. specifications. The Japanese do, however, use the vacuum degassing process in fabricating steel. The process reduces the amount of hydrogen and other gases trapped in solution in molten steel, which can lead to weldability and toughness problems.

There is no clear definition of what constitutes "high-performance steel" in Japan; thus, steel labeled as such may not necessarily correspond to what is referred to as high-performance steel in the United States.

The Japanese are developing a new product that may improve the performance of weathering steel. The product, a primer coating that encourages the development of a stable rust patina on the steel, could pave the way for increased use of weathering steel in the United States. South Korea is increasingly using weathering steel and is conducting research to develop weathering steels that have yield strengths higher than 483 MPa.

During a visit to the Yokogawa Bridge Corporation in Japan, tour members noticed a greater emphasis on quality control than typically found in U.S. shops. In some of the corporation's plants, there is a direct interface between the computer-aided design and drafting (CADD) system and the systems used to program the automatic cutting and drilling equipment on the shop floor; the tour report notes that "further development and implementation of this technology should be strongly encouraged in the USA to improve the fabrication efficiency of steel bridges."

Japan's Akashi-Kaikyo Bridge is a 3,910-m-long (12,838 ft) suspension bridge that carries six lanes of traffic on the upper deck and an access road, inspection galleries, and utilities on the lower deck.

In Taiwan, most steel bridges are built with materials conforming to American Society for Testing and Materials (ASTM) designations A36 and A572; a few have been built with steel conforming to ASTM A588, but they have been painted.

Bridge Protection Strategies

Many of the overpass bridges in Japan were made of hot-dip galvanized steel, made possible by hot-dip tanks much larger than those available in the United States.

The Japan Public Works Research Institute is testing and evaluating a new corrosion protection technology for steel bridges—a spray-on product marketed by Sumitomo Metal Industries, Ltd., as the "Weather-Act Method." This product is intended to substantially increase the proportion of chromium steel on the treated surfaces. To date, the results have been positive, and the product has the potential to enhance protection for steel bridges in the United States.

In response to environmental concerns, South Korea is converting to organic coatings on its steel bridges. The Korean Highway Corporation does not have any weathering steel bridges in its system. More than 90 percent of the bridges in South Korea have a concrete deck, and approximately 60 percent of those decks are reinforced concrete slabs. Bridge deck protection strategies include attention to drainage systems, design, and maintenance and use of preformed sheet membranes, coating membranes, and penetrating sealers.

Corrosion of the reinforcement steel in bridge decks does not appear to be a concern in Taiwan, primarily because deicing salts are not used. Instead, concern focuses on deterioration caused by cracking and carbonation.

Recommendations

In their draft report, the team members identified 30 topics for further action and evaluation and possibly application. The panel has winnowed that list down to the following 6 high-priority recommendations and 7 medium-priority recommendations:

High-Priority Recommendations

- Information about Japan's dimple pipe for the exterior of stay cables should be made available to the U.S. bridge engineering community.

- FHWA, in cooperation with state departments of transportation, should sponsor high-performance concrete demonstration projects to show the advantages of using nonsegregating flowable concrete.
- U.S. highway agencies and industry groups should investigate the use of one-sided welds using nonmetallic back-up bars, as is being done in Japan.
- Computer assembly test systems (CATS) for steel components should be evaluated for use in the United States.
- Samples of the special paint primer used for weathering steel bridges in Japan should be obtained and tested.
- The dry air injection system should be investigated to determine its suitability for use on existing and new bridges.

Medium-Priority Recommendations

- Taiwan's technique of constructing balanced cantilever cast-in-place concrete bridges with alternate segments offset by a half-segment length should be considered by bridge owners, designers, and contractors.
- Bridge owners, designers, and contractors should consider using full-cantilever erection for end spans of balanced cantilevered bridges.
- The use of interlocking wrapping wire should be pursued in the design of the next suspension bridge to be built in the United States.
- FHWA, in cooperation with state departments of transportation, should sponsor high-performance concrete demonstration projects to show the advantages of using nonseparating concrete for underwater construction.
- A research project should be initiated to develop design information for the use of 19-wire strand for transverse post-tensioning of bridge

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Travel Assistance Helps Create "Champions"

A key purpose of NCHRP Project 20-36 is to fund travel costs for state highway agency representatives who want to participate in international meetings on highway technologies, but who are unable to do so because of funding constraints. To be eligible for travel assistance, you must be a professional staff member involved in transportation management, design, construction operations, planning, or research at an AASHTO member department (state department of transportation). You must also be a participant in the meeting (presenter, discussion leader, panelist, or moderator), not merely a member of the audience.

Not all meetings qualify for travel assistance. The meeting must be held outside the United States, and it must be sponsored by a recognized public, private, or professional organization whose mission includes highway transportation. An international conference, congress, or seminar would typically qualify, but a committee meeting would not.

"We're creating champions when we send people to participate in international meetings," says Merritt Linzie of the Minnesota Department of Transportation and a member of NCHRP Project Panel SP20-36. "They come back full of new ideas and raring to share them."

Application Procedure

To apply, send the following information on your agency's letterhead:

- A brief description of the meeting and your role or responsibilities in it.
- Information on how you, your agency, and the transportation industry will benefit from your participation in the meeting.
- A complete travel itinerary, highlighting the dates you are scheduled to participate in the meeting.
- An itemized list of expected eligible expenses. (Eligible expenses include coach-class air fares, in accordance with applicable federal travel regulations; lodging, meals, and incidentals up to the current maximum per diem allowed by the Department of State, but only for the time necessary to travel to, attend, and return from the meeting; registration fees; and any necessary ground transportation.)
- A brief resume of your educational background, work experience, and current professional duties.

Awards are made on a calendar year basis, subject to availability of funds. Applications are still being accepted for calendar year 1998; applications for calendar year 1999 may be submitted as early as October 1, 1998.

Send the letter at least 90 days before your scheduled date of departure to:

Robert Reilly
Director, Cooperative Research Programs
Transportation Research Board
2101 Constitution Ave., N.W.
Washington, DC 20418

Within 30 days of submitting your application, you'll be notified as to whether you've been awarded travel assistance. The amount of travel assistance varies, depending on funds available, estimated expenses, and eligible expenses.

If selected, you'll be required to submit an expense report and receipts, as well as a trip report, within 30 days of the completion of your travel. You'll then be reimbursed for the authorized expenditures.

The trip report consists of a description of your involvement in the meeting, a summary of what you learned or accomplished at the meeting, a list of benefits that may be transferable to highway transportation practice in the United States, and suggestions on how this information could be disseminated or implemented within AASHTO and its member departments.

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decks and prestressing high-strength concrete beams.

- Tests of the improved thermal spray system and the 50:50 zinc-aluminum spray should be incorporated into existing research projects on controlling corrosion.
- Relevant sections of the Honshu-Shikoku Bridge Authority specifications should be translated into English and made available to the engineering community.

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TranScan

TranScan (ISSN 1095-5593), published periodically by the Transportation Research Board, reports news and information resulting from National Cooperative Highway Research Program Project 20-36, Highway Research and Technology—International Information Sharing. This publication is also available through the Internet (www2.nas.edu/trbcrp).

The Transportation Research Board is a unit of the National Research Council, a private, nonprofit institution that is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering. Under a congressional charter granted to the National Academy of Sciences, the National Research Council provides scientific and technical advice to the government, the public, and the scientific and engineering communities.

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