Plow blade innovations show potential

PLOWING REMAINS the most environmentally sound method of snow and ice control, a staple of winter maintenance operations across Wisconsin and the upper Midwest for generations. New tools and applications that are on the market now can help local street and highway departments improve their use of mechanical removal and their level of service.

Innovations that can increase the efficiency of a plowing operation include advances in blade technology and the introduction of new multi-edge plow configurations.

Useful data on these innovations comes from a national Clear Roads research project that field-tested the performance of prototype multi-edge plows under different conditions and surveyed public road agencies on the performance of the newest cutting edges.

Clear Roads is a pooled-fund research project with 26 participating state DOTs that conducts rigorous testing of winter maintenance materials, equipment and methods for use by highway maintenance crews. Results of the study provide public agencies and equipment manufacturers with information to apply new technologies effectively. Details on the multi-edge plow study are at http://clearroads.org/multi-edge-blade-plow-prototypes.html.

Flexible technology

Two road agencies in neighboring states are among the first county and municipal departments with multi-edge plows in their fleets. Mark DeVries, Maintenance Superintendent for the McHenry County Division of Transportation in Illinois, and John Klostermann, City of Dubuque, Iowa, Street and Sewer Maintenance Supervisor, talk here about their experience using multiple blades and the newest cutting edges in their operations.

The full configuration for a multi-edge plow begins at the front with the main snow blade followed by a squeegee blade at the back to remove slush. Some configurations position a scarifying blade between the front and back blades that breaks up hard-packed snow. Operators can raise or lower each blade separately to select the combination of blades that will clear the road best based on pavement temperature and precipitation type. Production multi-edge plow units typically use air pressure to lower and raise the edges. This cushions the blades against excess vibration and damage to the cutting edge.

The field tests and road-agency surveys generally showed that the combination clears the road of more snow and ice in a single pass than a conventional plow and reduces the amount of salt needed to achieve bare pavement.

Use of multi-edge plows on both county roads and city streets demonstrates the flexibility of the technology. The three blades each have a distinct job to do in snow and ice control, and are deployed according to conditions and a department’s winter maintenance policies.

McHenry County plow operators use this two-blade plow configuration to remove snow and slush on their northern Illinois roads. The county is one of the first in the U.S. to experiment with multi-edge plows.

Innovations that can increase the efficiency of a plowing operation include advances in blade technology and the introduction of new multi-edge plow configurations.

Drawing above shows a multi-edge, 3-blade plow configuration with 1) a squeegee blade at the back to clear slush, 2) a scarifying blade in the middle to break up snow pack and 3) the main snow blade in front.

Continues on page 4

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Continues on page 4
Use authority to post lower weight limits

**LOCAL GOVERNMENTS** have an important defense against damage caused by heavy loads to the roads they manage: setting and posting lower local weight limits.

Besides the seasonal limits common on many roads in Wisconsin during the spring thaw, local road officials can authorize year-round restrictions based the ability of specific road, bridges or culverts to handle the statutory 80,000 pound limit.

Increasing pressure on local transportation infrastructure from more truck trips and heavier equipment is a strong incentive for Wisconsin counties and towns to study the possibility of posting their roads below the maximum weights. When they do, local governments need to minimize disruptions to routine traffic and business.

**Set limits and negotiate**

Towns and villages have fewer resources than ever for replacing roads damaged by heavy loads, says Wisconsin Towns Association Executive Director Rick Stadelman, especially with the proliferation of industries like frac sand mines and large agricultural operations.

“Towns are looking for ways to protect those roads longer, so it’s important to use the power they have.”

Stadelman notes that towns often follow a county’s lead on setting special limits and counties follow state guidelines. He adds that Wisconsin tends to have special weight limits by region. What is true in every case is the need to communicate with businesses affected by the lower limits. This includes discussing how a carrier’s equipment can cause pavement damage and what impact proposed restrictions will have on their hauling operations.

Dan Fedderly of the Wisconsin County Highway Association (WCHA) says counties regularly evaluate roadway conditions in relation to seasonal postings and weight limits that are product and location specific. He cites the timber industry that relies on a 90,000 pound weight limit on six axles to move their goods.

“There are no conflicts except where roads aren’t built to handle even the 80,000 pound limit,” Fedderly says. “Local governments need to look at their road system and any risk of pavement damage to determine which routes and bridges can handle loads without major consequence.”

Industry is aware of the limits and the exceptions. But the more dialogue local government officials have with logging companies, mine owners and large farm operations, the more likely both sides are to find a solution that protects local roads and supports commerce.

**Pay for improvements**

Some special weight restrictions include temporary postings for a section of road in poor condition or a substandard culvert. A town might authorize lower limits on those road miles until there are resources to make repairs.

Local governments also have authority to designate a road as Class B. This limits trucks to 60 percent of allowable weight while allowing normal weight pickup and delivery to driveways that access the Class B highway.

Discussions with industry can lead to alternatives like agreements that establish one-way routes, time-of-day hauling or permits for overweight loads. Local governments can make it a condition of the permit that a carrier reimburse the town, village or county for any damage to local roads. Or they can negotiate payment for road improvements.

If demand is beyond normal historic use of a roadway, Fedderly suggests requiring the industry or operator to pay for upgrades to the road. The local government determines what improvements to do and estimates costs. An agreement can specify a lump sum up front or a multi-year payback.

Fedderly and Stadelman both give the example of an agreement Chippewa County made with several mining companies. The companies paid a total of $8 million for improvements on roads affected by their operations. The result is an all-weather road for the county in exchange for allowing industry to move frequent multiple truck loads along the route.

**Bank financial resources**

Even with restrictions in place or good carrier compliance with the terms of an overweight permit, the weight and frequency of heavy loads can cause unexpected road and shoulder damage. Stadelman advises using other measures to protect against financial loss in that event, like a performance bond or escrow account.

With a performance bond, the carrier guarantees compensation to the local government for the cost of repairing any damage. An escrow account established by the carrier sets money aside that the local road agency could draw against to pay for road repairs.
Document condition

When using these protections or granting exemptions, it is important to document a road’s condition before hauling begins in case of later disputes. Be specific about which section of a hauling route is most at risk for damage. On a two-mile stretch, for example, it might cover only 20 feet.

A sophisticated traffic impact analysis or simple pavement analysis help local governments determine whether roads on a requested route are deficient or can handle heavy truck traffic. With these results, they can calculate reasonable coverage for damages, which Stadelman says gains towns the respect of industry. Carriers are more willing to cooperate if they believe cost figures for improvements or repairs are credible.

Fedderly describes how the Chippewa County Town of Cooks Valley used this strategy to establish an agreement when a sand mining company proposed moving significant tonnage of sand on town roads. Cooks Valley road officials required an engineering analysis of the existing roadway to determine what loads the pavement could carry based on the thickness of asphalt and base layers. The study also documented width and sight distances.

What they learned became the basis of an agreement that allowed the company to work within the town’s right-of-way to make improvements. It also made the operator responsible for all “exceptional maintenance costs” accrued by the town due to the “exceptional maintenance costs” improvements. It also made the town’s right of way to make the company to work within the basis of an agreement that allowed layers. The study also documented management could carry based on the to determine what loads the pavement or prevent premature damage to a new road.

Enforcing special limits

Adequate enforcement is an issue that concerns local governments when they authorize lower weight limits on local roads or issue permits. The Wisconsin State Patrol and County Sheriffs have enforcement authority but limited resources to do more than respond to specific complaints.

Lieutenant Michael Klingenberg of the Wisconsin State Patrol Motor Carrier Enforcement section looks for ways to maximize resources on both sides. He does outreach and training to inform local law enforcement and local public officials about rights and responsibilities related to statutory weight limits and the authorizing of lower limits. Lt. Klingenberg or regional sergeants from Motor Carrier Enforcement attend meetings and public hearings where load limits are on the agenda. They answer questions from public officials, the carriers and affected local residents about the issue and discuss how to work effectively with enforcement options.

Lt. Klingenberg urges local governments to make sure they have a legitimate reason for posting local roads below the statutory limits, one that is consistent and easy to explain to the public and haulers. “Officers can help enforce weight limits but only where there are authorized postings and every road user is treated the same,” Lt. Klingenberg explains. “No unfair exemptions.”

The ideal is to find solutions before strict enforcement is necessary. Lt. Klingenberg and regionally based members of his enforcement group sometimes serve as an intermediary, talking with companies about specific local load limit issues and encouraging them to work things out with townships. The State Patrol cannot patrol for problems every day, so Lt. Klingenberg and his group act to intercept problems before they happen.

Communicate reasons

Compliance with special weight restrictions affects all road users so local governments need to communicate with them through adequate postings, and public announcements or meetings. Fedderly adds that because of the jurisdictional overlap, counties must communicate with towns and villages about weight-limit issues or hauling agreements. Likewise, towns should inform county officials of any plan to authorize and post lower limits.

“Industry, especially out-of-state companies, won’t fully understand the distinctions between town roads and county roads,” he says. Each unit of government retains its authority but by acting cooperatively and with consistency, they avoid confusion.

Written authorizations that detail hauling agreements communicate the intention of county or town officials to grant exemptions for certain carriers. It helps verify if a vehicle has legitimate permission to exceed weight limits.

Power to protect

State law gives local governments the practical power to protect the roads they manage by putting certain of them off limits to over-weight loads. Authorizing lower road weight limits can extend the life of a marginal stretch of pavement or prevent premature damage to a new road.

As more industries locate major facilities along transportation routes that intersect with these roads, signaling their plan to move heavy loads along those routes, it obliges local public officials to research the options and post affected roads clearly and consistently. Making industry aware of local government’s role in managing their roads this way also sends an important message that cooperation on both sides saves tax dollars and supports commerce.

“ Officers can help enforce weight limits but only where there are authorized postings and every road user is treated the same.”

State Patrol-certified portable scales like this give local law enforcement a tool for enforcing lower limits on local roads.

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Resource

www.dot.wisconsin.gov/statepatrol/enforcement/motor-carrier.htm

Links to Wisconsin truck weight enforcement programs and more.
Plow blade innovations show potential
from page 1

Drivers had a feel for when to use the blades together or separately for best results and provided valuable feedback to manufacturers during testing, which served as good training.

Two-blade combo
DeVries describes the multi-edge concept as the best new technology he has seen for improved snow plowing. McHenry County, just south of the Wisconsin/ Illinois border, first tested the approach two seasons ago. They put one new truck on the road that year fitted with a two-blade configuration of snow blade in front, slush blade behind. DeVries says they did not purchase the scarifying blade because hard pack is not an issue due to an aggressive anti-icing policy.

“The snow and slush blades working together matched conditions on our roads during a snow event and really focused our efforts,” he says, noting that between the new cutting edges that scrape the pavement cleaner of whatever snow is there and the action of the rubber blade, county crews are clearing off 20 percent more slush and snow in one pass. The cleaner road also means the county can “turn down” the amount of deicing salt they use after plowing.

The units have an air-operated slush blade that rises automatically when operators put the plow in reverse. The county worked with Monroe Truck Equipment on the improvement to protect the blade from damage.

“The combination is dynamite,” says DeVries. “We won’t buy a plow without it in the future.” McHenry County will put a total of five multi-edge plows on the road for the 2012-13 snow season.

Early results persuasive
With only one light snow season of testing so far, Dubuque has less experience using their multi-edge plows than McHenry County. But Klostermann says the results from the Clear Roads research helped persuade him the multi-edge approach, together with the new cutting edges, was the answer to upgrading of the department’s winter maintenance fleet. “I usually wait longer to try a new technology but plowing is the main way we remove snow on our streets so this was an improvement I felt would fit our operation.”

Klostermann says Dubuque does not have a bare-pavement policy but the goal is to return city streets to pre-storm driving condition as soon as possible after a snow event. In most cases, the result is bare pavement, which the multi-edge technology supports. The department outfitted three existing trucks with three-blade plows, one from Henke Manufacturing and two from Henderson Truck Equipment. Operators plow primary and secondary routes first. They keep the middle scarifying blade in the up position on these streets because a pro-active anti-icing program prevents snow pack from forming.

Once the main routes are safe for travel, crews focus on residential streets where, if compacted snow exists, the operator has the tools to match conditions. Working three blades together makes sense in these areas, Klostermann says, where the snow pack has time to form. “Even with our limited experience, this appears to be an efficient way to improve our level of service everywhere in the city.”

Improved cutting edges
Some local road officials are putting improved cutting edges by Joma, Polar Flex and Küper to work on their snow plows. DeVries and Klostermann say the tougher, lighter cutting edges contribute to the effectiveness they see in their multi-edge plows. McHenry County uses all three brands on its equipment but the blade of choice on their multi-edge units is the Küper tungsten carbide cutting edge. DeVries reports the edges show little wear after three years. He will test ceramic inserts this season and plans to try them on wing plows.

Klostermann’s department has tried the newest cutting edges from both Polar Flex and Joma in their multi-edge plows. He says the rubber-encased carbide blades cut through snow and cleaned the pavement better than the double-cutting edges they used previously. Klostermann recommends setting the snow plow “angle of attack” according to instructions from the cutting edge manufacturer, adjustments his operators found improved blade performance.

“Providing equipment makers with feedback from the field is critical with any new technology,” Klostermann adds. He and his operators worked with one manufacturer to redesign the plow frame and move the blade about
nine inches closer to the truck to improve maneuverability in tight places and around corners. See details on Joma, Polar Flex and Küber products at right.

Operators as experts

Once he started investigating the potential of adding multi-edge plows three years ago, Klostermann included discussions about the technology in his annual training program for plow operators. He prepared them in the basics of how the plows worked and what results to expect. The on-the-road experience of last season and trouble-shooting the angle of attack fine-tuned their skills. The operators became the experts.

The training process in McHenry County was similar. DeVries began with the basics and, after only a few runs, drivers had a feel for when to use the blades together or separately for best results. The operators also provided much valuable feedback to the manufacturers during testing, he says, which served as good training. “They learned quickly how to get the most out of the plows,” DeVries adds. “Even the skeptics on the staff are convinced now the multi-edge combination does a better job.”

Higher cost, longer life

Costs are higher for the multi-edge plows, a fact born out by what Klostermann and DeVries invested. Dubuque and McHenry County expect more miles from the more durable cutting edges and flexible multiple blades.

Klostermann says the cost for installing a three-blade unit to the three existing city trucks was $15,200 each. He explains that is double what they spent on the much lighter plows they used before. “But we plan to almost double the life of these plows to 15 years of service from the eight years we typically expect.” He hopes to continue adding multi-edge plows to the city’s fleet on an existing replacement schedule.

McHenry County includes its multi-edge plows in a turnkey truck purchase. DeVries says the department paid approximately $190,000 for each truck delivered with the specified two-blade plow. He estimates adding a third blade to his existing configuration would cost $2000 to $3000 more.

Better level of service

Technologies that improve on methods for clearing roads and streets offer a good option for local governments ready to replace or upgrade their plowing equipment. The experience of public road agencies in the region suggests that multi-edge plows and innovative cutting edges can result in a better level of service. Road and street departments using these innovations expect to make fewer passes, which means lower labor and equipment costs. And the cleaner pavements the plows leave behind help winter maintenance crews reduce their salt use.

Local governments can learn more about multi-edge plows on the Clear Roads website and by talking with the manufacturers — Fink, Henderson, Henke and Monroe — who provided prototypes for the Clear Roads studies.

On the cutting edges

Tougher cutting edges are making a difference in winter maintenance operations on paved roads for street and highway departments. Three of the latest are showing up in single- and multi-edge plows, as replacements or in new equipment. Comments summarized here from a Clear Roads survey of local and state highway departments provide a useful profile of each product’s performance in the field.

- Joma 6000 has tungsten carbide inserts encased in rubber. Supplied in three foot or four foot segments. Less vibration, long-lasting edge, cleaner pavement. Less damage to raised pavement markers. Cost more but easy to replace in single sections. Two-to-three times the cost of conventional blades with two-to-four times the useful life. Holds up well on concrete pavement with deteriorated transverse cracks.
- PolarFlex has individual 12-inch rubber-encased carbide-tipped steel segments with a reusable mounting element. Flexible. Less vibration. Runs tight against pavement. Holds up well. Initial cost higher but subsequent insert replacements are less. Handles obstructions easily. Adjust angle of attack to improve performance.
- Küber Tuca SX Blade has tungsten carbide cutting edge imbedded in steel and rubber. Cooling openings control blade heat. Quiet. Long-lasting. Five times the cost, three times the life of standard carbide edge.

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Resource

http://clearroads.org/multiple-blade-plow-prototypes.html
Page on Clear Roads site with links to equipment photos and videos of plows in action.

Technologies that improve on methods for clearing roads and streets offer a good option for local governments ready to replace or upgrade their plowing equipment.

![Two methods of measuring angle of attack](image)

Cutting edges that use new technology may require a different angle of attack. This diagram shows two ways manufacturers measure this angle. It is important to know which method a manufacturer uses and then set the cutting edge at the correct angle. Start with the angle recommended by the manufacturer and adjust as necessary. Adapted from Monroe Truck Equipment illustration.
**DNR creates simplified General Permit process**

**LOCAL GOVERNMENTS** will see a simpler approval process for wetland and waterway permits with the authorization of Wisconsin Department of Natural Resources Wetland and Waterway General Permit for Municipalities to Construct, Reconstruct or Maintain Highways, Bridges, Arches and Culverts in Waters and Wetlands (WDNR-GP2-2012). Wisconsin Department of Natural Resources Transportation Liaisons will now review General Permit requests for small road and bridge projects that have little adverse impact on waterways and wetlands.

The General Permit replaces TRANS 207 rules for many local projects and outlines clear criteria, conditions and timelines so reviews and outcomes are more predictable and consistent with federal requirements. Maureen Millmann, who works in the DNR’s Office of Energy and Environmental Analysis, says the department’s goal is a better application and review process for local road officials and one that effectively protects aquatic resources.

“We wanted a process that is less complex so municipalities don’t have to do more than is necessary for projects that cover a small area,” she explains.

“On the other side, the DNR gets only what we need to evaluate each application. It’s better for everyone.”

**Streamlined process**

Historically, the Wisconsin DNR approved local road projects near vulnerable water resources under TRANS 207, despite the fact it is a Wisconsin Department of Transportation administrative code. Introducing the DNR-administered General Permit for projects under the jurisdiction of counties, cities, villages or towns shortens the steps between application and approval of eligible projects.

Millmann says the streamlined process starts with DNR Transportation Liaisons located in 16 offices across the state. Local road officials should contact the liaison in their region while a project is in the planning stage to determine if it meets eligibility standards under the new General Permit. Contact information for the liaisons is online at [http://dnr.wi.gov/topic/Sectors/Transportation.html](http://dnr.wi.gov/topic/Sectors/Transportation.html).

According to Millmann, the DNR conferred with the U.S. Army Corps of Engineers about the information they request on transportation permits so Wisconsin’s updated general permit was similar and applicants could gather the same information for both agencies. The Wisconsin DNR will forward General Permit applications it receives to the Army Corps of Engineers at the same time they go through the department’s regional liaison.

**Eligible projects**

The new process specifies that highway projects affecting 10,000 square feet or less of wetland or waterway may be eligible. The same goes for projects that involve solely replacing a bridge, arch or culvert if it affects a wetland area no larger than 4,356 square feet.

Millmann notes that an important provision of the new General Permit requires the county highway commissioner or a professional engineer working with a local government on transportation projects to approve and sign the plans for a project that involves a bridge or a culvert greater than 36-inches in diameter.

**Early coordination**

The DNR is training the liaisons and other staff members in details of the WDNR-GP2-2012 General Permit process and is making presentations around the state to introduce it to local road officials.

Millmann says the DNR will continue to emphasize the importance of establishing strong relationships with local governments. “With this permit, we concentrate on roadway projects that municipalities initiate and implement. It’s an opportunity to work closely with local agencies on early coordination of the requirements that will help ensure road safety and protect the quality of local resources.”

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**Contact**

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**Resources**

- Link on the DNR website to map of Transportation Liaison contacts in 16 offices across Wisconsin.
- [http://dnr.wi.gov/topic/Sectors/Transportation.html](http://dnr.wi.gov/topic/Sectors/Transportation.html)
- Click on the Permits tab on this webpage to access WDNR-GP2-2012 and application materials.

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*These photographs illustrate projects where the DNR will work with local governments to improve roads and culverts under the new general permit. The deteriorating culvert at left is a barrier to fish while the replacement on the right creates a good waterway passage.*
RESOURCES

Publications

Setting Speed Limits on Local Roads, 6 pp., 2009. Good overview for local governments provides background on speed studies, information on statutory limits and statewide guidelines. It also details the process for changing limits and covers other speed issues.

Using Weight Limits to Protect Roads, 8 pp., 2003. Discusses process for deciding on seasonal weight limits and determining year-round restrictions. Also explores measures like modifying the route or time-of-day hauling that protect pavements but keep goods moving.

Pre-wetting and Anti-icing, 8 pp., 2005. Explores two techniques for winter road maintenance. Covers methods, materials, equipment, and cost and quality control issues.

Web Sources


Application information for Wisconsin Department of Natural Resources Wetland and Waterway General Permit for Municipalities to Construct, Reconstruct or Maintain Highways, Bridges, Arches and Culverts in Waters and Wetlands (WDNR-GP2-2012) on the DNR website. http://dnr.wi.gov/topic/Sectors/Transportation.html

DVD/Video/Multi-media

Anti-icing/RWIS Training, American Association of State Highway and Transportation Officials, 2003, #18790, self-paced CD. Hands-on learning about the use of anti-icing liquids. Lessons cover topics from weather forecasting to application of anti-icing chemicals.

NEW! Seven interactive programs from the American Association of State Highway and Transportation Officials (AASHTO) Winter Roadway Maintenance Computer-Based Training Series:

Selecting Snow & Ice Control Materials to Mitigate Environmental Impacts, AASHTO, 2009, #19135, self-paced CD. Discusses environmental and infrastructure impacts of winter maintenance materials. Also material selection.

Equipment Maintenance, AASHTO, 2009, #19132, self-paced CD. Reviews winter maintenance equipment types, equipment preparation and equipment maintenance.

Proper Plowing Techniques, AASHTO, 2009, #19134, self-paced CD. Covers snow plowing procedures and techniques.

Deicing, AASHTO, 2009, #19131, self-paced CD. Reviews deicing material selection, ordering, handling, storage and application.

Blowing Snow Mitigation, AASHTO, 2009, #19130, self-paced CD. Identify and analyze blowing snow problem areas and how to mitigate with structural snow fence, living snow fence and changes in road design details.

Winter Maintenance Management, AASHTO, 2009, #19136, self-paced CD. Learn about snow and ice operational plans, levels of service, operational methods, material management, budgeting and staffing.


Print copies of listed publications available free from TIC. Download or request items at Publications on TIC website. Video, CDs, and DVDs loaned free at county UW-Extension offices. Also see Video Catalog on TIC website.

TIC website http://tic.engr.wisc.edu

FEEDBACK

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CROSSROADS Wisconsin TIC UW-Madison http://tic.engr.wisc.edu FALL 2012 7
The snow and slush blades working together matched conditions on our roads during a snow event and really focused our efforts.

– page 4

Strategies for meeting federal and state requirements, and minimizing individual and agency liability. Fee: $80

APR 23 TOMAH
APR 24 BARNEVELD
APR 25 OCONOMOWOC
APR 26 OCONOMOWOC
APR 30 EAU CLAIRE
MAY 1 HAYWARD
MAY 2 WAUSAU
MAY 3 KIMBERLY

Watch the TIC website for details on two upcoming workshops: Asphalt Road Maintenance in March and Gravel Road Maintenance at a later date.

On-Site Workshops
Bring instruction to your shop or office with training tailored to your specific needs. On-site workshops let you train more people for the same cost or less, including staff from other municipal departments, nearby communities, and vendor businesses. Contact TIC to book the program and date you want. Programs include:

• Basic Surveying for Local Highway Departments  • Basic Work Zone Traffic Control  • Flagger Training

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