



Swiss army fighting

Concept plow blade carries multiple options

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Agencies purchasing snowplows have more choices than they used to, with recent design innovations like wing plows, tow plows and underbody blades among the options.

But today's standard snowplow—the plow that tends to make up most of an agency's fleet—still looks a lot like it did a half-century ago: a single, rigid cutting edge of steel or carbide. Since a single, rigid blade cannot conform to the road's surface, it may miss some snow and ice, which can affect traffic safety and make deicing chemicals less effective.

In 2008 winter maintenance staff from five Midwestern state DOTs set out to move snowplow design to the next level. Working with vendors, they hoped to create a plow that would be effective in all conditions, from hard-packed snow and ice to watery slush. The ideal snowplow also would be able to remove more snow in a single pass than standard plows can.

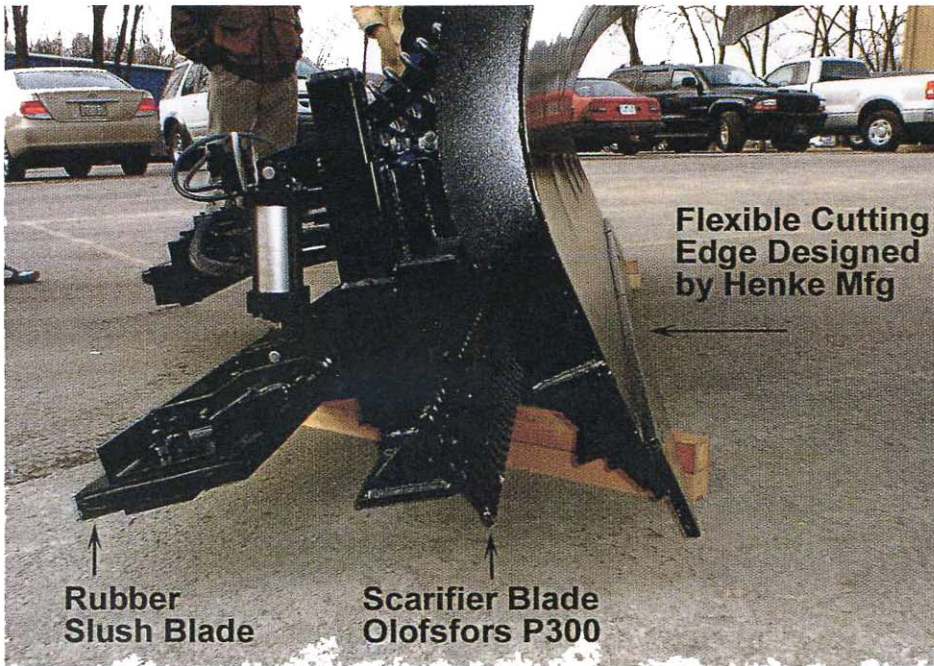
The five states envisioned a plow with multiple blades:

- A flexible cutting edge that adjusts to the contours of the roadway;
- A scarifying blade that cuts into hardpack and ice; and
- A rubber squeegee blade that removes excess liquids and solids that the other blades miss.

The scarifying and squeegee blades would be operated independently from the main cutting edge—engaged only when needed—and would be expected to leave the roadway cleaner than a single rigid blade.

“The multiple-blade plow was conceived as a way for operators to apply the most appropriate blade based on roadway conditions—snowy, slushy, ice-covered or hardpack—to clear the roadway with a single pass, without swapping out blades or plows,” said Jim Dowd, winter operations research analyst at the Iowa DOT, who managed the project.

The Iowa DOT partnered with the Indiana, Ohio, Minnesota and Wisconsin DOTs on the project. The states have a history of working together to achieve common goals as members of the Clear Roads pooled-fund



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research program (www.clearroads.org), a consortium of 22 states that funds research aimed at rigorous testing of winter-maintenance materials, equipment and methods for use by highway-maintenance crews. Clear Roads helped sponsor this project.

Four vendors rose to the challenge of supplying a prototype multiple-blade snowplow: Flink Co., Henderson Products Inc., Henke Manufacturing and Monroe Truck Equipment. Each state field-tested a plow developed by one of the vendors, evaluating the plow's performance over one or two winter seasons. Three states tested three-blade prototypes, while two tested plows without scarifying blades.

To assess the plows' performance in different situations, the five states field-tested the prototypes on a range of roadway types. The Indiana and Ohio DOTs tested the plows on interstate highways, while the Iowa DOT and the Brown County (Wis.) Highway Department plowed sections of two-lane highways. Mn/DOT deployed its prototype on a two-lane city route.

The five states had varying assessments of the four prototypes. They identified strengths and weaknesses of the designs,

and the vendors worked with the states to resolve issues that arose with the prototypes, some of which were newly developed specifically for this project.

Squeegee majority

Across multiple prototypes, the squeegee blade yielded the best results of the three blade types in field testing. Operators reported that the blade performed as designed, following the contours of the roadway more closely than a traditional rigid cutting blade. They noted that the squeegee blade had the greatest impact when the roadway was very wet and the front cutting edge could not clear the snow and slush from the roadway.

"The squeegee blades were so well received that our operators reported a preference for outfitting all existing plows with them," said William Burton, special projects manager with the Indiana DOT.

Video cameras mounted on the prototype plows helped demonstrate how much snow and slush the squeegee cleared and how clean they left the roadway. With the excess slush removed, crews were able to return roads to normal driving conditions more quickly and use fewer deicing chemicals.

Operators reported that the squeegee blade worked well when it was just warm enough for wheel tracks to form in the roadway. The blade had less impact in colder temperatures, when the cutting edge removed most of the snow from the pavement.

Some are flexible

The flexible front cutting edge was more effective on some prototypes than others. In contrast to the continuous single blade mounted on a traditional plow, a flexible cutting edge consists of several shorter blades mounted to the plow individually. This segmented blade system is designed to conform to the road's surface and clear it more completely.

Three of the four vendors used off-the-shelf solutions as the prototypes' flexible cutting edges, while the fourth developed its own flexible-edge blade system. The Iowa DOT reported good results with the PolarFlex flexible cutting edge (manufactured by Valley Blades Ltd.) on the prototype supplied by Flink Co., which consists of 12-in. carbide-tipped steel blade segments and reusable flexible elements made of synthetic rubber. Operators found that the flexible cutting edge conformed to the road's surface as expected and allowed for better cleaning of the roadway.

"The flexible cutting blade was a little more expensive than a traditional cutting blade, but we found that it lasted twice as long," Dowd said. "The rubber-mounted blades were very quiet and produced very little vibration, which should increase the life of the truck and plow components."

Operators in Wisconsin reported a smoother ride and reduced vibration and noise from the rubber-encased blades on that state's prototype. Vendors noted that the rubber-mounted blades' reduced vibration has many benefits, including longer blade life, less required plow maintenance and reduced operator fatigue.

The Indiana DOT had a more problematic experience with the flexible cutting edge on its prototype plow, which was equipped with a custom-made flexible blade edge developed specifically for this project. The bolts used to mount the segmented blades to the steel moldboard came loose, requiring repairs.

Not everyone's a fan

The scarifying blade included on the prototypes tested in Indiana, Ohio, and Wisconsin received a less favorable response from operators, who conveyed concerns about blade wear and a preference for using underbody scrapers to remove hardpack.

Scarifying blades are used to scrape and loosen hard-packed snow and ice by cutting grooves into its surface, allowing salt and sand to penetrate and accelerating the deicing process. Operators reported that the scarifying blade worked as anticipated, but that the blade wore down faster than expected.

"Our standard practice is to scrape the pavement before applying salt to limit the amount of salt we use," said Larry Adlebush, shop superintendent at the Brown County Highway Department in northeastern Wisconsin. "We found that the scarifying blade had to be replaced frequently, and



The multiple-blade plow is just one element that is expected to raise the playing field when it comes to winter maintenance. In the cab, operators also use a monitor that shows four different viewpoints of the plow truck.

underbody scrapers did a better job of scraping the pavement with a single carbide blade that took a lot of wear. The issue of blade wear was significant for us—some operators reported checking the scarifying blade for wear every hour."

Some states concluded that a two-blade plow that incorporated either the scarifying blade or the squeegee blade rather than both would be sufficient for their needs, depending on the type of winter weather and road conditions they encounter most often.

Testing for this project concluded in 2010, and the project's final report and videos of the prototype plows in action are available on the Clear Roads website (www.clearroads.org/multiple-blade-plow-prototypes.html).

Multiple possibilities

Through their partnerships with the four vendors, the five states achieved their objective of building interest in multiple-blade plow designs among the private sector.

"This project succeeded in completing those first critical steps in moving a new idea from concept to production," Dowd said. "It brought the multiple-

blade plow out of test mode and into general use. Vendors are now making multiple-blade plows part of their standard product offerings."

All four vendors that participated in the project currently offer some form of a multiple-blade plow, and all reported interest in the plows within the winter-maintenance community. Some of the vendors are offering flexible blade systems on the multiple-blade plows they currently market.

Clear Roads is funding a follow-up research project that will begin later this year focused on improving the design of front-mounted and underbody snowplows.

"We expect the design of multiple-blade plows to continue to be refined to take agencies' real-world experience into account," Dowd said. "More multiple-blade plows on the market will mean more users—and more feedback—to encourage vendors to continue developing innovative approaches to snowfighting in the 21st century." **WM**

Brown is director of snow and ice operations with the Massachusetts Department of Transportation and a member of the Clear Roads technical advisory committee.