Swiss army fighting
Concept plow blade carries multiple options

A
gencies 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.
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 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 accelerate 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 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.