Cam technology advances rotary punch/shear capabilities

Moving punches and shear blades almost double the thickness capacity, and servo drives with PLCs change hole spacing and length on the fly at 600 fpm. By J. Neiland Pennington, Executive Editor

In-line rotary punching for roll forming lines is nothing new. Technology patented by Hill Engineering, Inc. a half century ago continues to operate profitably, particularly in the production of wall studs. The rotary punches are simple, reliable, relatively low cost and can keep pace with the fastest forming lines—up to 600 fpm.

Nevertheless, the design imposes limitations. The maximum practical thickness is 0.060 in. (16 ga.) because the punches are stationary on the arbor. They enter and exit at an angle, causing interference between the punches and the edge of the strip as the thickness increases. And the punch spacing is fixed; the distance between holes cannot be varied.

Hill Engineering has solved both problems in one fell swoop. The Villa Park, Illinois, tool and die specialist—a Mestek company—has developed what it calls the B&K rotary punching and shearing machines that process strip up to 0.105-in. thick (12 ga.), and vary both hole spacing and cutoff length. There is no sacrifice of speed; 600 fpm is well within their capability.

Hill's B&K rotary punches and shears are being marketed to the steel framing industry, for the manufacture of products ranging from 2x4 drywall studs to large structurals. While the punch and shear are integral to the new computer-controlled Supermill engineered by Dahlstrom Industries, Cleveland, Ohio (also a Mestek company), the units can be retrofitted to any make of roll former.

A sample of the structural shapes produced by Hill Engineering's B&K cam-action rotary punch and shear. DC servo drives operated by a programmable logic controller vary hole spacing and part length on the fly. ***Photographs by the author.***

Developing the concept

The name for the new punching and shearing technique comes from B&K Rotary Technologies, a Toronto firm that Mestek purchased—at Hill's urging—2½ years ago. With the acquisition came both the Supermill design that was assigned to Dahlstrom, and the concept for a cam-operated punch and shear system that Hill developed from a promising idea to production-ready hardware, with four installations in the field.

A cam within the upper rotating head extends and retracts the punch. Visualize a rotary version of a stamping press in which the cam acts as the eccentric, suggested Jeffery S. Monahan, sales engineer at Hill.

"The cam technology delays the entry of the punch into the strip and reduces the angle between the punch and metal surface," he explained. "The punch moves in a straighter line relative to the strip.

"You never get a perfect 90-degree wall. But the B&K method greatly reduces the angle of entry, which nearly doubles the thickness that can be punched."

The same cam technology that operates the punch also fires the V-shaped rotary shear blade. This shear is factory-set for all the thicknesses and widths in its range, up to 0.105 in. and 22 in. "Whether you're shearing a light-gauge 2x4 or a heavy-gauge 2x14, no adjustments are required," said Monahan.

Hole spacing, lengths changed nonstop

Both the punch and shear have DC servo drives operated by programmable logic controllers, with one 50-hp motor for the punching unit and two motors of the same output for the shear. The servo drives vary the hole centers and cutoff lengths on the fly.

The only time the punch and shear units rotate in synchronization with the strip speed is when they are actually punching or cutting. Otherwise, the rotary units accelerate or decelerate according to programmed hole and cutoff spacing.

"You set the PLC to run batches of parts," Monahan explained. "Let's say you want to run 100 of a particular stud and punch on 2-ft. centers, then form 100 more punched on 3-ft. centers. When the computer completes the first batch, it automatically shifts to the next without a pause.

"To change spacing with a linear flying die punch, you have to stop the line and either move the tooling on the carriage or add another die. And you can't change spacing at all with a fixed rotary punch."

Tooling can be changed on the cam-action rotary punch in no more than 20-30 min. by a beginning operator, and in half that time with practice. The reason: Only punches and die cartridges or inserts are replaced. The punch in the upper head is retained by two Allen-head cap screws, and the lower head contains a die cartridge and insert that each use two and four cap screws.

No die sets to change

"On a linear flying die line, you change complete die sets," Monahan pointed out. "On most high-speed hydraulic punch lines, the cylinder is an integral part of the die set. So you have to remove the entire assembly and disconnect the hydraulics.

"We know of some stud manufacturers that have two hydraulic setups, so they don't have to purge the hydraulic lines. The changeover still requires a couple of hours, at least four times the rotary tooling change time."

Replacing the shear blade is similar to a rotary punch. It is held in place on the upper head by four screws, and changeover is a 10-min. job. Also, the blade requires no shimming after it is sharpened.

Not only are setups faster with the B&K system, fewer die changes are necessary. The punching unit can run the full range of thicknesses—up to 0.105 in.—as adjusted from the factory, although for metal above 0.060 in., Hill Engineering recommends that the user change to a die insert with additional clearance to extend tooling life.

"When you punch heavier gauges with a tight-clearance insert, you break down the die edges rapidly and increase the clearance excessively," Monahan cautioned. "Once you've run your thick stock and go back to thin gauges, you may get a poor-quality cut—or no cut at all."

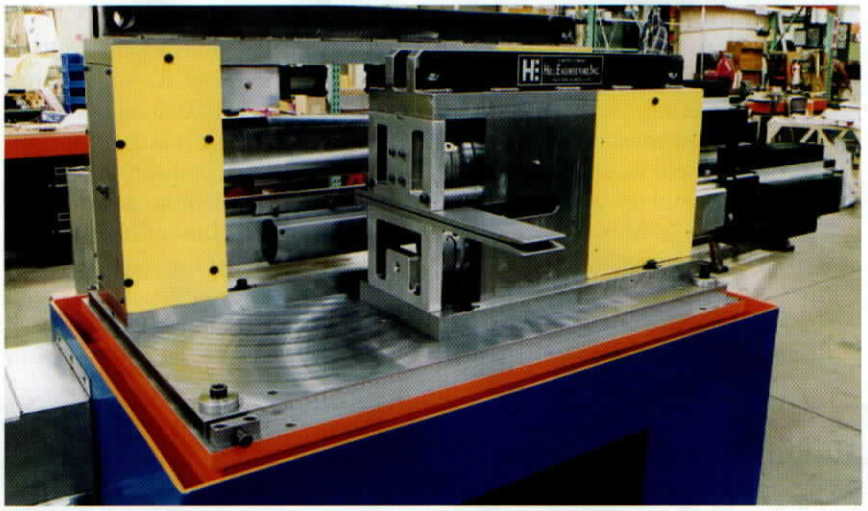
Changing inserts on a linear flying die is complex, he continued. "You remove the dies from the line, give them to a diemaker to replace the inserts, then reinstall the tooling in the line. Rotary die inserts can be changed by the line operator."

Design saves floorspace

Compactness is a feature of the B&K equipment. While not as small as a fixed-punch rotary unit, the cam-operated punch and shear have a far smaller footprint than a linear flying-die punch.

With linear flying dies, the faster the line speed, the more distance the dies need to accelerate, fire and decelerate. The size of the B&K machine is the same, regardless of line speed.

The punch and shear can be built as separate units or combined on the same sub-plate and base. They are keyed to the sub-plate so that lateral positioning can be adjusted relative to the passline. The sub-plate is on a pivot pin, enabling the units to be squared to the strip.



The combination punch (foreground) and shear runs strip from 0.016- to 0.105-in. thick and 22-in. wide at feed rates up to 600 fpm. The units can also be built on separate sub-plates and bases.

The punch and shear are installed immediately adjacent to the roll forming mill. The only additional equipment needed is a set of entry guides on the mill to handle the strip after it is sheared.

For the B&K equipment, Hill Engineering guarantees a tolerance of ±1/16 in. on both hole position and length, regardless of line speed. In practice, however, they've obtained ±1/32 in.

Tolerances for the rotary system are said to be more consistent than for flying dies, Monahan indicated. "Flying dies are keyed to line speed. The faster you run in a closed-loop system, the more error you'll have. The rotary delivers the same tolerance at all speeds."

One-third faster than flying dies

Line speeds for the B&K technology are at least 1/3 faster than for linear flying dies. Monahan placed the upper limit

for flying dies at about 400 fpm, which he characterized as "really the starting point" for cam-action rotary tooling.

For employees who endure the percussive slap of pneumatic flying die presses or the whine of hydraulic press pumps, the B&K punch and shear are mercifully quiet. The rotary punch shears the strip; the tool does not strike the metal. Michael McGuire, Hill's manager of marketing and new sales, maintains that *Modern Metals*' interview with Jeff Monahan could have been conducted next to an operating punch and shear—in conference-room tones.

Hill Engineering made its reputation building sophisticated linear flying-die installations, so it was logical to ask if the older technology is still relevant. "Absolutely," was Monahan's answer. "Linear flying dies still have a market. Not everyone needs the high-speed capability of the B&K punch and shear. Rotary technology isn't for shops that produce 10,000 studs a week for local and area contractors. It's for roll formers that make 100,000 studs a day.

More than meets the eye: A disassembled B&K rotary punch demonstrates the complexity of the cam action that accommodates thicker metal than conventional fixed-punch units.

"If you need line speeds of 200 fpm and above, you're probably in the market for rotary punching and shearing. Below that speed, linear flying dies may be more cost-effective, particularly if you're running dedicated lines without many tooling changes. But it's our belief that if you want to be competitive in the high-volume stud and structurals industry, and need flexible manufacturing with high line speeds, and minimum changeover and maintenance times, you should investigate the cam-action rotary technology."■

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