GEKA Newsletter

Presented by Neiman Machinery Sales Inc. Feb. 2011

CUTTING WITH AN INDUSTRY WORKHORSE

Shearing using an ironworker is simple, with the right setup

By Don Letourneau

To gain the most benefit from an ironworker's cutting stations, fabricators should select one with the right tonnage and blade characteristics for their applications.

Much has changed in the fabrication shop over the years, but not the need for ironworkers. With little fuss or fanfare, these industry workhorses have punched, notched, sheared, and cropped metal for decades.

Although mechanical versions still exist, hydraulic ironworkers make up the brunt of sales for these multipurpose machines, which come in single- and dual-cylinder versions. Single-cylinder machines typically have three or four workstations, dual-cylinder models usually have five: one for punching, another for shearing flat bar and plate, one for notching and coping, another for cutting angle iron, and still another for cutting channel and beams. On dual-cylinder machines, the punch and shear stations operate independently, so two operators can use the machine at the same time.

Specialty tools allow ironworkers to perform more than they used to. It's not uncommon, for instance, to see an ironworker with a brake punch for bending flat sheet. But most of the work and the majority of workstations still are devoted to cutting metal. To gain the most benefit from an ironworker's cutting stations, fabricators should select one with the right tonnage and blade characteristics for their applications.

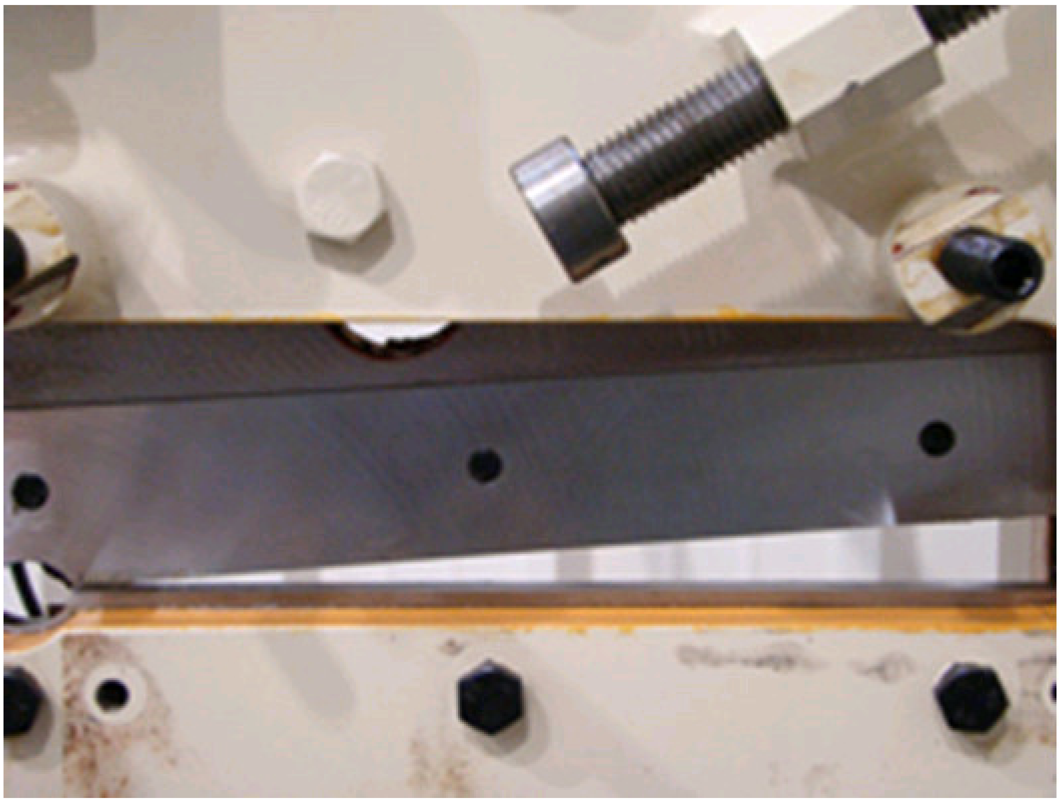

Figure 1
This high-rake-angle plate shear pivots down and slices through metal like scissors.

Raking in Productivity

Every ironworker has a plate shearing station in which the top blade descends to the workpiece at a certain rake angle. An ironworker with a high rake angle has a smaller space between the blade edges on one side, close to the blade pivot point, usually on the left side if facing the machine (see Figure 1). The space becomes wider when moving toward the end of the shear blade on the right. The blade pivots down and slices into the metal like scissors (why high-rake-angle shears often are called scissor shears). A plate shear with a low rake angle descends toward the workpiece in guillotine fashion (see Figure 2).

Ironworkers have plate cutting stations that come with either fixed or variable rake angles. With a fixed-rake-angle machine, the operator never needs to change the rake of the blade. Distortion problems can emerge, though, particularly if the operator is cutting both light- and heavy-gauge material. If the rake angle is set for heavy material, the operator will see a fair amount of distortion in the falloff piece if he switches to lighter material. Variable-rake-angle systems allow operators to change the rake angle from low (for thick material) to high (for thin material).

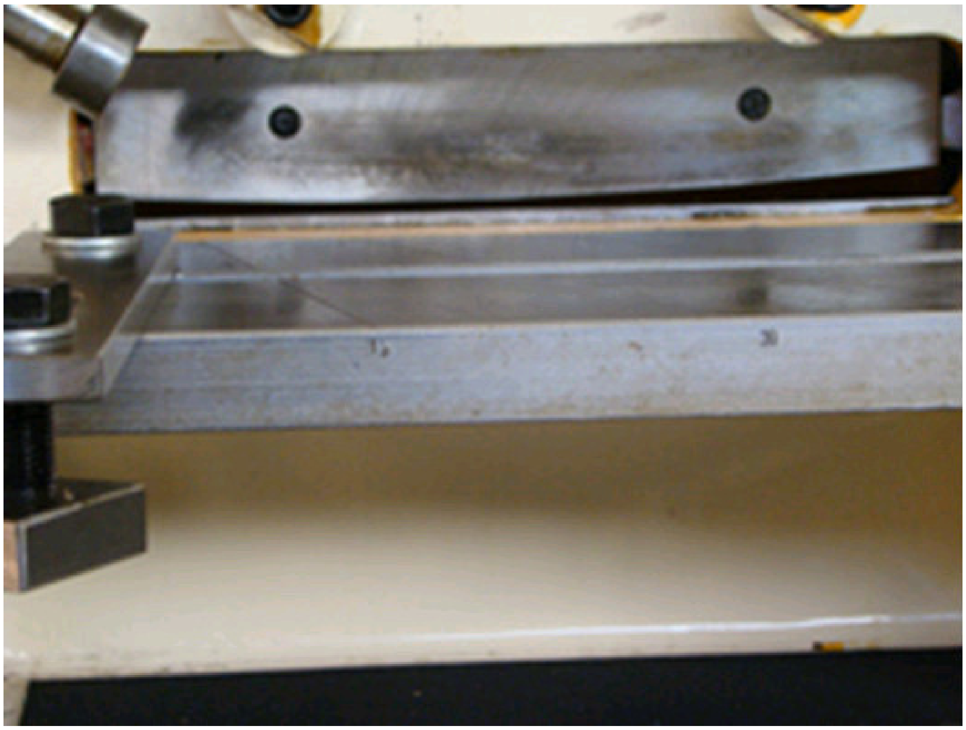

Figure 2
A low-rake-angle plate shear descends toward the workpiece in guillotine fashion, cutting more metal at one time. The center of the blade bows downward to reduce distortion during the cut.

The blade's rake angle affects how much material the blade actually cuts at once. A low-rake-angle blade usually is closer to horizontal. The closer to horizontal it is, the more it descends like a guillotine shear, and the more material it contacts and cuts at once. The low rake angle does have a significant downside: It takes more tonnage to make the cut. However, that cut can be made quickly and accurately, giving the falloff piece a square, flat edge. A high rake angle on a blade exerts a scissor action that places a lot of force in a very small area, "biting" away at the metal from left to right. Because the cutting power is concentrated on a single area, the high-rake shear cuts more using less tonnage. From a pure power standpoint, it's a more efficient way to cut metal, which is why it's often preferred, particularly if precision cuts aren't absolutely necessary. To understand why this happens, think about cutting through a thin bar of clay. A sharp knife, positioned parallel to the clay bar, slices through and makes a clean break—but it takes a lot of force to make it happen. Scissors, on the other hand, do not take so much force to initiate the cut, but the scissor blades tend to "pinch" the clay as they make their way through.

The same happens with the ironworker's shear. A low-rake-angle, guillotine shear makes a clean break but requires high tonnage; a scissor shear can cut more with less tonnage but, in doing so, distorts the falloff piece. So much force is concentrated in a small area during the cut that, upon contact of the shear, portions of surrounding metal (like the pinched clay) are actually pulled into the cut. The part of the workpiece held in place on the gauge table usually has less distortion. But the falloff piece—the one that usually ends up being used—has nothing to stop the shearing action from pulling metal into the cut, creating a small roll indentation at the top shear edge.

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Many ironworker applications involve cutting base plates or gusset plates, foundational components that need to be virtually free of distortion. Because of this, ironworker applications, more often than not, call for precision cuts. As with many machines, there's a trade-off to consider. A higher-tonnage ironworker costs more and takes more energy to run, but it gives enough power to push a low-rake-angle shear through thick metal. A lower-tonnage ironworker costs less and can cut through less, although it can expand its cutting capability slightly with a higher rake angle. Distortion in the cut, however, can create quality problems. Advances in machine design have made it possible for low-rake-angle shears to cut through thick metal with less tonnage. For instance, certain systems offer an upper shear blade in which the center of the blade bows downward; toward the workpiece (see Figure 2). This causes the blade to contact the workpiece in the center first. Not only does this improve efficiency, it also reduces distortion, meaning there's a better chance the falloff piece will remain perfectly flat.

Blade Gap: Finding a Happy Medium

The blade gap is defined as the space between the blades at the end of the shear stroke. (Think of the space between scissor blades when the scissors are closed.) Some space between the blades is necessary to allow room for the small pieces of fractured metal during the cut. If the gap is too narrow, that fractured metal has no place to go, placing tremendous pressure on the blade itself; in fact, the shears most likely won't be able to cut the material at all. For instance, if an ironworker with a 0,25mm (0.010-in). blade gap were to cut 18mm (¾-in.) material, the hydraulics would most likely shut down, because the machine just couldn't handle it. A blade gap that is too wide will produce a tremendous burr on the part, as metal is pulled into the blade gap when the shears approach the end of their stroke. This brings up a key difference between an ironworker and standard guillotine shear. A 250 mm (10-foot) guillotine shear might be rated for 6mm (¼-in.) material, using a very narrow blade gap of about 0.008 in., and 6mm (¼ in.) is just about all the guillotine shear will cut. With an ironworker, a machine might be rated to cut material 610mm (24 in.) long by 16mm (5/8 in.) thick, but if the material is shortened, the ironworker's plate shear can cut through greater thicknesses. To keep this flexibility requires, among other things, a blade gap able to handle varying demands. The blade gap should be set at a happy medium for the range of cutting thicknesses your applications will require. A 120-ton ironworker, rated to cut mild steel from 3/16 to 1 in. thick, normally has a factory-set blade gap of about 0.022 in.; an 88-ton machine rated to cut up to 18mm (¾ in.) thick might have a 0,5mm (0.018-in). blade gap. These settings by no means fit every application; the appropriate gap depends on the material and thicknesses the ironworker will be cutting. A lighter-tonnage machine might have a blade gap set at 0,5mm (0.018 in.) But if the shear will be cutting material between 3mm (1/8 in.) and 12mm (½ in.), the blade gap may need to be reset to about 0,3mm (0.012 in.) This happy-medium setting will allow the machine to cut between 3mm (1/8-in.) and 16mm (5/8-in).-thick material. However, if the ironworker then needs to cut 16mm (5/8 in.) and up, the blade gap will need to be opened up slightly to handle the increased thicknesses.

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Cutting Angles and Shapes

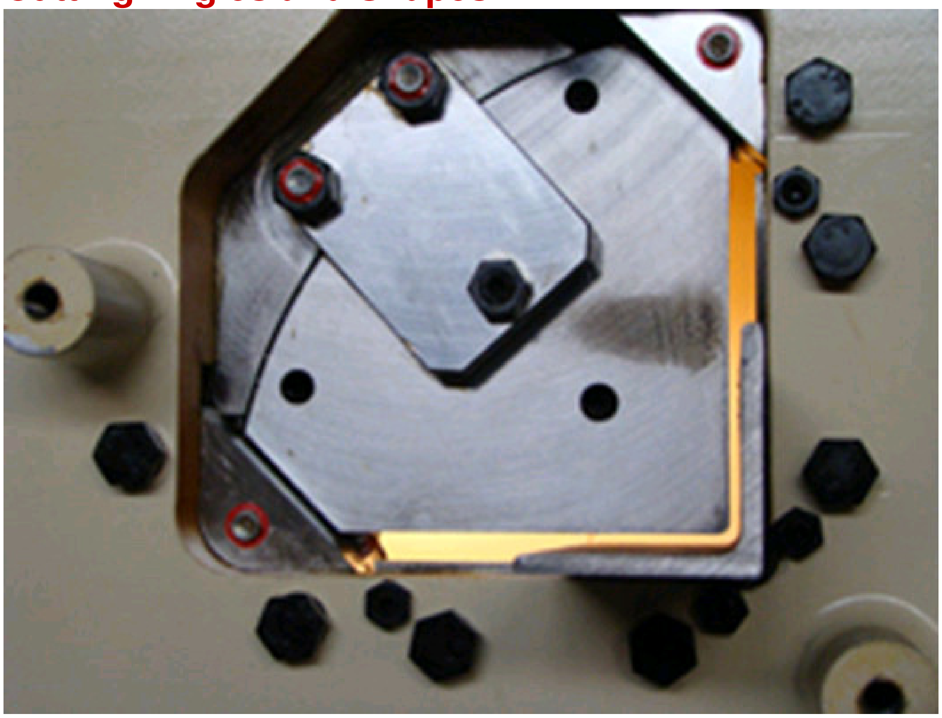

Figure 3

This angle blade is positioned such that it cuts both legs of the angle iron simultaneously. The market offers varying blade styles to cut through angle iron and similar angled parts. Some systems cut through each leg one after the other, while others offer a blade that can cut both legs simultaneously (see Figure 3). This allows fabricators—particularly structural shops that often process uneven angle iron such as 127x75mm (5- by 3-in.) or 150x50mm (6- by 4-in.) material—to cut angles without distortion. The blade turns on a cam within the machine. During the shear cycle, the blade descends until the tip seats into the V of the angle; as it does this, both the horizontal and vertical legs are cut at the same time. Ironworkers also offer other stations that can cut specialty shapes, such as C channels, T bar, and H beams.

Still a Workhorse

Ironworkers have advanced significantly through the years. Today indexing tables and CNCs are automating one of the last bastions of manual operations on the floor. But be they automated or manual, ironworkers are still some of the most straightforward machines to operate. They are indispensable tools for structural and plate fabricators, truck body builders, ornamental fabricators, small welding shops, and any other business needing a quick way to shear, notch, and punch metal. If a shop has invested in the tonnage and tools it needs—including the correct shear setups—the multipurpose ironworker will likely remain the industry's workhorse for decades to come.