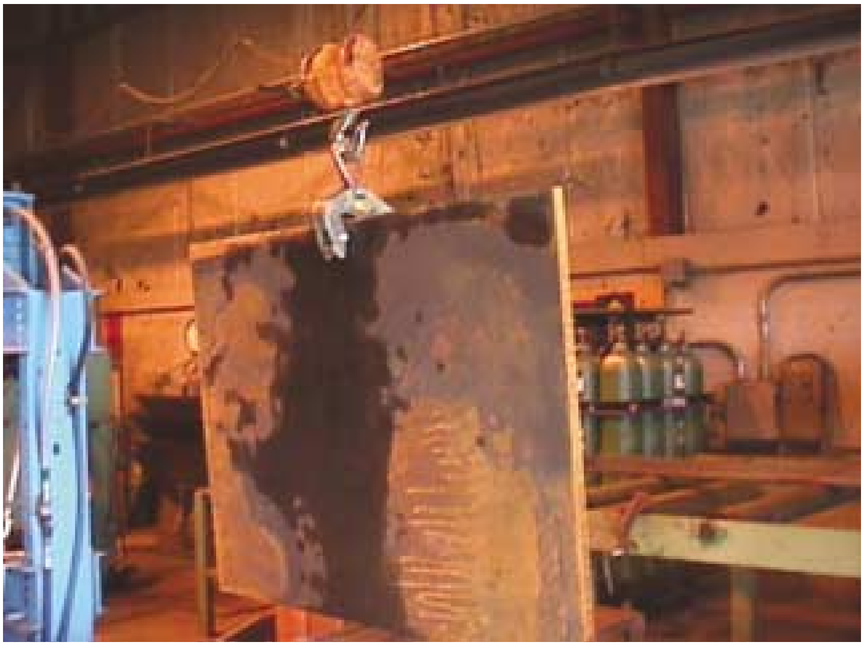
Plate Progress

Lyle Menke, with Joe White



C-type clamp "dogs" are commonly used to grip the width of the plate for hoisting. The weight of plate material quickly adds up: a 10' by 10' by 1"-thick steel plate weighs over two tons.

The need for safety, efficiency and productivity has sparked new ways to fabricate steel plate components in fewer steps.

The need for sophisticated plate fabrication equipment has increased over the last few years due to the popularity of the single-plate (or shear-tab) connection. The shear tab helps to expedite on-site steel erection and lower overall erection costs. Unlike single- or double-angle connections, the shear tab provides a relatively simple field connection that is easy to spot and bolt into place. In addition, moment connections and requirements for base plates, splice plates, cap plates, gussets and wing plates create additional demands for improved plate-fabrication equipment.

HISTORICAL PERSPECTIVE

Historically, plate fabrication needs were met with hand-held oxy fuel and plasma torches. Operators cut the piece parts to shape and length by following scribe or chalk lines on stock plate. Manual shearing was also performed, based upon plate thickness and dimensional limitations.

Hole production was addressed by locating hole locations with a measuring tape and soapstone. A fit-up man moved a portable hydraulic punch or magnetic drill to the part, located the center, and created the hole. This was a tedious process, even when creating a simple square-base plate. For multiple-part production, shop personnel created paper templates. However, in a typical structural fabrication shop environment, this paper soon disintegrated.

As steel structures used more plate-connection components, fabricators required new machine-tool technologies to meet production demands. Universal ironworker machines and single-end punching machines were equipped with coordinate template tables that were operated via a stylus mechanism. Within a short time frame,

Large magnets and cranes can be used to manipulate large pieces of steel plate during fabrication.

Fork trucks are commonly used to unload steel plate from flatbed trucks or rail cars. Plates must be carefully balanced to avoid handling disasters.

a cut-to-length stock piece would have holes accurately punched.

CNC INTRODUCED

As the demand grew for bolted-plate connections, fabricators required repeatable accuracy. Identifying X and Y coordinates in two-axis computer numerical controllers (CNC) provided the key to automating this technology. Material clamps were added to a support table mechanism, and motors powered lead screws that supplied the positioning accuracy needed for this machine tool application.

This machine, known as a Fabripunch, provided 177 tons of hydraulic punching power with a retractable datum zero reference point to generate repeatable-hole location requirements. Program software became more sophisticated. Holes could be programmed to a point off the plate (referenced to a column location, for example). Skewed-hole patterns could be programmed to a rise or run, and multiple-hole patterns could be identified and duplicated easily.

The Fabripunch machine was a progressive step in automating plate detail, but still required the laborious tasks of loading and unloading individual pieces.

MATERIAL HANDLING

A key to the efficient production of plate detail components still had not been achieved: automated material handling for a systematic, one-pass machine application.

Some current methods employed by structural fabricators to process plate detail include the following:

- Based on the process employed, plate is ordered from the mill (or supplier) in compatible width sizes 20”, 60”, 96”, etc.
- Plate is delivered via flatbed truck or rail car, and must be off-loaded and stored.
- Great care must be taken in off-loading due to the size and weight of each individual plate. A 96”-wide by 2”-thick, by 20’-long plate is one of the most difficult “picks” a crane operator can make. Teetering the section on a large fork truck during off-loading is also tricky. C-type clamp “dogs” are commonly used to grip the width of the plate for hoisting. Magnets and chain are also commonly used. Needless to say, they must be evenly secured to avoid catastrophe.

A real fear is that a 100-sq.-ft plate, weighing more than 5 tons, could break free from a clamp and come crashing to the fabrication shop floor. The safety ramifications alone are chilling.

Eight labor-intensive, time-consuming and expensive tasks can be eliminated with one single-pass machine.

Additional material handling occurs if the plate is made of a special alloy. This requires the use of a cord-like strap to eliminate the possibility of marring the plate as it is off-loaded via a crane.

- Many fabricators employ burn tables with a water reservoir, where the plate is dimensionally cut via oxy-fuel or plasma torches. The next step, however, is to again move the cut piece part with a clamp or magnet via a crane from the raw stock "skeleton." It must be transported to another machine for hole production via a punch or drill.
- The hole production requires identifying a zero (or start) point for dimensional location of the series of holes. This is especially challenging as many plate-detail components contain angle slopes, skews, etc. The burden of hole production falls upon the machine operator to insure the proper plate orientation is always met.
- In the case of base plates on which full-bearing surface is needed, the plates require a milling process to ensure a uniform connection for the column member.

Provided the above steps are met, the operator then moves the finished plate component to the fitter or layout worker for welding and / or bolting.

MATERIAL HANDLING

Cranes and fork trucks are "necessary evils" in a structural fabrication shop. Productive time slows, safety risks skyrocket, and efficiency screeches to a halt when materials must be moved.

With this in mind, how can a structural fabricator provide a cost effective means of plate fabrication? Simple: new machine-tool technologies have provided for multi-functional machines, which can process a raw stock plate and provide a finished part in a one-pass operation. Drilling, punching, oxy-fuel, plasma, and mill cutting are all employed in one machine—with one operator.

This one-pass concept provides finished plate components cut to exact shape and length, with accurate hole locations, and with the part marked by a mill cutter. It works for plate component sizes from stock plate components up to 96" wide, 3" inches thick and 20' (or more) in length.

Special alloys require special handling to avoid marring the plate. In this case, a heavy-duty, cord-like strap is used during handling.

The use of a single multi-purpose machine, such as the Peddinghaus FDB 2500 eliminates the traditional shop problems of off-loading, storage, movement to a shear or burning device, parting operation, part removal to a punch or drill, identification of program for CNC processing, hole production, and removal to the fitters.

BENEFITS FOR FILLET WELDS

An added benefit for the fitter or welder is a by-product of the plasma cutting process—a swirl or bevel is introduced to the plate. The observant programmer identifies and locates the correct edge on the plate component within the raw stock length. Thus, a finished part can be achieved properly beveled for a fillet weld—common on many connection plates.

SUCCESS BRINGS INNOVATIONS

As the structural steel fabrication and erection industry continues to progress, new technologies will be introduced to meet new challenges. Endemic to our industry is the creativity displayed to identify and engineer new devices to meet immediate demands.

The need for quicker field erection brought the shear tab connection. The demand for creating multiple shear tab components produced the machine tool industry. Machine tool firms employed multiple innovative technologies—which reduced material handling delays and hazards—to deliver fabricated steel on time and under budget.

This type of resourcefulness and ingenuity creates a "can do" attitude in the structural steel industry. It is what separates steel construction from other building methods, and solidifies steel's position as the construction material of choice for the 21st century. ★

Lyle Menke is vice president of marketing for Peddinghaus Corporation in Bradley, IL. Joe White is plant manager at Havens Steel in Ottawa, KS.