product expert series

THE EVOLUTION OF FABRICATION

BY LYLE MENKE

Steel fabrication facilities in the U.S. have undergone remarkable changes and today benefit greatly from technology's increased role.

THE STEEL FABRICATION SHOP is one area of the steel construction industry that has seen an evolution of technologies paralleling any manufacturing or commercial enterprise in the world.

But unlike common manufacturers, structural steel fabrication does not require mass production. In contrast to Henry Ford's assembly line, which was designed to produce millions of the same "widgets" annually, structural steel fabricators are in the business of building skylines.

Structural steel fabricators must manufacture to specific drawings: one-of-a-kind construction, if you will. All the while, the fabricator must adhere to exacting engineering criteria, safety standards and building codes.

The very uniqueness of the shop fabrication process has led to innovation. While perhaps not as dynamic as the assembly line for making automobiles, technology certainly has played an important role in advancing the steel construction industry.

A Look Back

Less than 40 years ago, the typical structural fabrication shop had a much different look. The structural work was very labor intensive, using equipment like portable magnetic drills, portable C-frame punch presses and radial arm drills.

No CNC or automated tool measuring in those days; it was the era of measuring tape, soapstone and tee square. Welding was predominant, and much of it performed on site during the erecting process.

Crane use was mandatory to move almost every structural shape or section. Preliminary functions such as the lengthy process of sawing a section to length required exacting measurement and employed cold saws or oxy/fuel torches, which required significant grinding to clean the cut.

Then came the innovative tool called the "Beatty Punch," which employed hydraulic presses in a semi-automated (numerically controlled, or NC) system. This enabled a beam profile to be moved to the tool for hole making, rather than moving the tool to the beam profile. The first seeds of automation had been planted.

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A CNC "Systems Approach" to Fabrication Changes Everything

As the steel construction industry moved forward into the 1970s and 1980s, systems technology enveloped the structural fabrication shop. New electronic motors were employed, which provided precise positioning of even large columns. The first computers were seen on the shop floor, pioneered by the HP 85 and 9815 models on the first Peddinghaus drill lines. Thus, the era of computer numeric control (CNC) technology was ushered in.

What exactly did CNC technology, or a systems approach to fabrication, bring to the table? In a nutshell, it enabled the hole making process to be fully automated—and more importantly—increased accuracy and repeatability.

The bottom line for steel construction: welded connections could now be replaced by bolted connections, which were still as strong but faster and easier to fabricate and erect. Steel construction was beginning to boom as a result of this technology.

New electronic technologies streamlined old manual, labor-intensive methods to make the structural fabrication shop more productive, with the benefit of increased CNC accuracy.

Meeting Challenges

As we focus on fabrication shop floor "manufacturing," it is evident that new technologies have always provided a "better mousetrap" for the industry. A quick review of some fabrication shop challenges that were solved with today's technologies shows how positively the industry has been affected.

Consider these three technologies that have effectively changed the face of fabrication shop production.

➤ **Problem:** Today's rolled steel sections are much higher tensile strength—exceeding capacities on a typical beam punch line; additionally, oversized fabricated beams are used in some applications.

➤ **Solution:** Drill line technology, such as the first TDK models, introduced electronic measuring and positioning that enabled fast, accurate positioning, as well as faster hole making via drilling rather than punching the hole.

Fast forward to today where carbide drilling is employed on structural drilling machines. Holes that once were drilled in nine seconds are now processed in three seconds with carbide bits. Today's carbide drill lines capitalize on precision electronic technology to dictate superior positioning speed, precise hole locations, and determine any mill tolerance deviations in just tenths of a second. Today's modern drills also tap, countersink, and create slotted holes via milling.

➤ **Problem:** Today's steel construction methods require many copes, interior cuts, weld access holes, dog bone configurations and other shapes that require thermal cutting. The previous manual method required about 10 steps including laying out the pattern with a measuring tape and soapstone, lighting a torch, manually cutting, and then grinding it clean.

➤ **Solution:** Employing electronic principals of crisp beam positioning, thermal processing, and dynamic software, the automated beam coping system was born.

Fast forward and the 10 steps were eliminated, the quality was perfect, and the production was increased one hundredfold. Plasma units, such as Peddinghaus' Ring of Fire machine, employ plasma technologies for all-thermal cutting including copes, internal cuts, notches, cut offs, miters and even hole making in a one-pass process.

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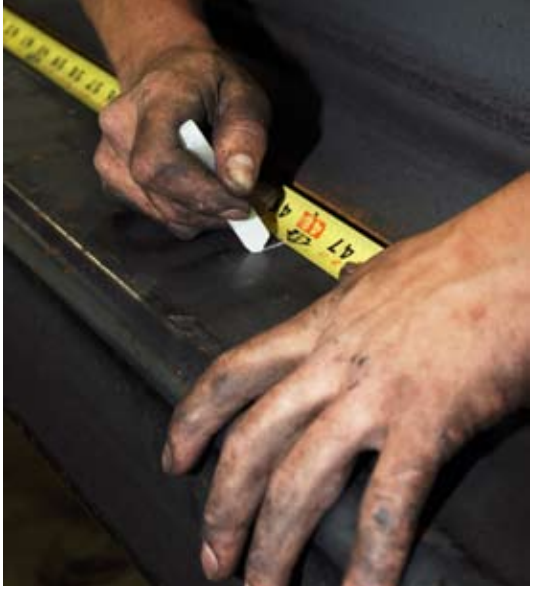
➤ **Problem:** Laying out the beam detail onto any structural section always required a skilled craftsman, accurate drawings, a correct measuring tape—and a sharpened soap stone. This job was always done manually and always created a production bottleneck in the fit-up area. Multiple craftsman were required to keep up with production requirements.

➤ **Solution:** Today's modern BIM software carries all the detail for each component of the building. The location for every connection plate and clip angle, identification numbers and weld symbols are normally included in the data, which can be downloaded to the fabrication equipment via a normal DSTV file.

Fast forward to 2011 and NASCC: The Steel Conference in Pittsburgh where two machine tool technologies were introduced that provide automated solutions to the age old problem of beam layout and fit-up. In one, carbide scribe technology can be employed on all four beam surfaces in a drilling machine. The data is etched onto the steel beam. It is effective, but can delay hole processing productivity on your machine.

Newer technology employs plasma arc writing of all the same layout/fit-up data onto all surfaces of the beam. This technology employs a low voltage plasma arc that provides a clear, legible mark in seconds, not minutes.



Unlike the bygone days when multiple craftsmen were required to lay out each fabrication and keep up with production requirements, today's equipment uses data directly from the building information model.

Today's carbide drill lines use precision electronic technology for quick and accurate positioning, also determining and accounting for any mill tolerance deviations in just tenths of a second. Many can also tap, countersink and create slotted holes via milling.

These three examples show how modern technology has changed the entire face of steel construction on the shop floor. With today's new equipment, one operator working in a safe, quality controlled environment can produce tonnages that in years gone by required multiple laborers.

Fabrication shop floor technologies—spearheaded by the demand for higher tonnage production at lowered costs—continue to improve the odds for steel in the battle of selecting a building material. Today's advanced software and modern machine tools are the "weapons of mass construction" that bring competitive numbers when bidding projects. Fast fabrication leveraged by new technologies that further facilitates fast erection is setting the stage for increased market share, and that's good news for the construction industry. MSC

Automated beam coping systems have eliminated many of the steps previously required to cope beams, including much of the cleanup.

Give Credit Where Credit is Due

The structural steel fabrication shop is the Rodney Dangerfield of the steel construction industry. It just doesn't get any respect!

- The shop floor is not as glamorous as the architect's drawings/renderings, which create all of the buzz and excitement about a new project.
- The shop floor does not generate the accolades from the structural engineers and the detailers that the "techno glitz" of the BIM models do.
- The shop floor does not receive the admiration and awe from spectators when the steel is erected at the job site.
- All the structural fabrication shop does is make or break a project, usually meaning the difference between financial profitability and loss.

Don't you agree that a little respect is in order?