A Complete Fabrication

BY GEOFF WEISENBERGER

PHOTOS JESSICA SLADEK

An AISC Certified steel fabricator gives us an inside look at its processes.

WOLCOTT, IND. IS ABOUT 100 MILES SOUTHEAST OF CHICAGO. It's what you might call an "average" Midwestern small town. It's surrounded by farmland, the people are friendly, and there's a little diner nearby that serves great country-fried steak. (The waitress had no idea what I was talking about when I used the Texan term "chicken-fried steak" to describe what I wanted for lunch, but we eventually worked things out.)

And in a soybean field just east of town, there's also an AISC Certified Cives Steel fabrication plant. Employing approximately 135 people, the plant has been producing construction-ready structural steel now for 11 years. Last summer, Brian Raff, AISC's manager of certification business development, and I took a tour of the facility to see just what happens to a steel member as it makes its way through a fabrication plant.

The short answer is: a lot! Preparing a steel member for erection involves several processes, including cutting, drilling, welding, cleaning, painting, buffing, and waxing (just kidding about the last two). After a steel mill rolls the steel into structural shapes or plates, the fabricator purchases it and performs most or all of the above processes, converting shop drawings into a physical product.

Tracking the Beam

If you've never been to a fab shop before, perhaps the best way to illustrate the fabrication process is to follow a beam on its journey through the plant. The process starts in the front office, where the raw materials—structural shapes—are purchased. With an advance bill of materials, or on some projects an exact piece list from detail drawings, Cives' purchasing department considers quantities and lead times to find the most efficient way to buy its material from a mill or service center.

Included in a recent batch direct from the mill is the beam we're tracking: an ASTM A992 W18×35 section. It's organized, along with a plethora materials of all shapes and sizes—wide-flanges, angles, HSS, curved members, you name it—in an outdoor materials storage area at the west end of the plant.


BDL
1250/9
CAUTION
CAUTION
TOP
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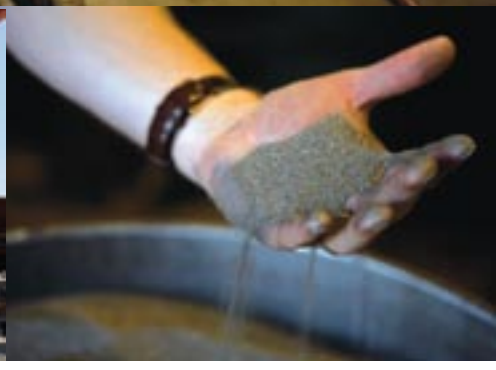

There's a lot of steel here. Walking through the area, you'll notice white numbering written with a paint stick on each bundle of steel. This is for tracking purposes. These same numbers also appear on what's called a cutting sheet. Produced from detail drawings, a cutting sheet is a steel member's record of its visit to the fab shop and gives the fabricator essential information about the steel: shape, size, material grade, special testing (like Charpy V-notch), order number, heat number (from the mill), and weight—everything he needs to know to select the appropriate steel from the materials storage area. It also tells him everything that needs to be done to the member: how long it needs to be, where bolt holes need to be placed, etc.

The cutting sheet also serves to control the flow of material in the early stages of fabrication, traveling with a group of beams through each stage in the plant, allowing employees to know where a beam is at all times and which processes have already been performed on it.

Big Tools

After the material handler locates our W18×35 section in the yard using the cutting sheet, it's transported via a conveyor system into a small building—the saw house—adjacent to the main plant. This is where the beam is cut to the proper length—per the shop drawings entered via computer numerical control (CNC)—with a large band saw using a tungsten carbide blade.

Once our beam is cut to the proper length, it travels along another conveyor to the drill house, where a massive drill—again, using information input via CNC—makes holes for bolted connections. Holes can be drilled in both flanges and the web at the same time.

An impressive aspect of the drilling and sawing operations at the fab shop is the sheer size and power of the machinery. If you've never seen fabrication machinery in person, either in a shop or at NASCC (www.aisc.org/nascc), the machines are like Incredible Hulk versions of the drill and saw in your garage.

At our next stop, our W18×35 is put into a cambering jig, a steel frame with hydraulic rams that bend it to achieve the specified camber. Since every beam is different, the

Quality Procedures in Action

Cives' bolt storage area provides a good example of quality certification in action. Here, bolts are stored in large sealed kegs to protect the manufacturer's lubrication. The buckets are labeled to show the bolt size, length, grade, and manufacturing lot. Per AISC Certification requirements, three bolts of each length and diameter must be put through a tensile strength test for each lot, performed on a Skidmore Wilhelm tension-testing machine secured to a steel column. The machine measures the tensile force in the bolt and converts this to kips, and a chart on the wall shows the required load for each bolt size.

Cives considers itself to be a "bolting shop," which means that in situations where bolting and welding are both economical options, it chooses to bolt. Where connection geometry permits, Cives opts for tension-control. These bolts must be delivered with the bolt, nut, and washer all in a container together, ensuring that the installed assembly consists of the lots tested by the manufacturer and that the appropriate tension is achieved.

Of course, quality certification goes far beyond bolts, even to areas as simple as tape measures. Over time, the tape measures used to measure the beams become stretched out, so they are calibrated to a "master" tape measure that is usually kept off the shop floor so as not to become damaged.

Another certification procedure involves calibrating the amperage on the welding power supply. This is accomplished with an amp meter, which confirms the amperage in the welding lead near the arc. Amperage (and hence calibration) is an essential variable in a Welding Procedure Specification, because the current affects weld metal tensile properties and toughness.

cambering takes a couple of pushes with the rams and is measured by the operator to assure that the camber is correct.

Next, the beam moves into the main fabrication building. The long, open building has an overhead crane runway and flexible workstations with horses for supporting the work pieces, hoists for moving beams and the pieces that assemble to them, and welding equipment. It's currently full of beams in various stages of fabrication. Looking across the large, open space, you'll notice frequent blasts of light: welding arcs and sparks from cutting torches and grinding wheels.

Welding Time

Speaking of welding arcs, that's where we're headed, as it's time for our beam to be fitted and welded. Fitting involves measuring, layout, and locating welded attachments, such as stiffener plates, to the beam. In contrast to the automated drilling and sawing processes, the welding is performed using a hand-held semi-automatic wire-fed process. Smaller steel pieces such as plates are welded to beams to ready them for connection in the field.

Shielded metal arc welding rods are used for tacking and some smaller welds. These electrodes must be kept in an oven and can't be exposed to the outside atmosphere for more than four hours at a time, or they'll absorb moisture, which can cause hydrogen-induced defects in the welded connection. As such, welders must keep track of how long their electrodes are kept out of the oven.

We watch a welding job in action. The welder attaches a stiffener plate to our beam using the gas-shielded metal arc method of welding. The electrode is stored on a coil that rotates slowly as it's fed to the welding gun. A current from the power supply is used to create an arc that melts the electrode and the base metals, fusing the connected parts.

Learning to Cope

After the plates are welded to our beam, a fitter/welder copes it by hand with a torch. Coping is where small sections of a beam flange and web are removed to make the beam fit together with supporting members in the field. One of the shop personnel mentions that Cives has purchased a coping machine, which is faster and more accurate than coping by hand. Chuck Hentzell, the human resources manager for Cives Wolcott and one of our tour guides, tells me that while the fitter will no longer be performing coping duties, he will be trained on other processes within the plant.

A Fresh Coat

After our beam has been cut, drilled, welded, etc., it's blasted with fine steel shot, the consistency of sand, to remove mill scale, corrosion, and contaminants if required. In addition to cleaning the steel, shot-blasting also creates an anchor pattern, texturing the metal so that paint can better adhere to it.

Following the shot-blasting, the beam is finally ready to be painted. While our beam requires painting, steel members that will be enclosed in normal ambient conditions—i.e., most of them—typically do not need to be painted.

At the opposite end of the building from where we started is the painting area, in its own separate bay, just beyond the welding operation. Paint is applied via sprayers. Once it is applied, a paint gauge is used to check the thickness of the paint. In addition, shop personnel must check the atmospheric condition of the paint bay before applying it, as temperature and humidity conditions can alter how well the paint will adhere to the metal.

What is Certification?

Cives' Wolcott facility happens to be an AISC Certified fabricator. But what does this mean?

Certification acts as a statement to owners, engineers, and the construction industry that "Quality is built in." An AISC Certified shop, by implementing a rigid quality management system, can reduce production errors and increase the quality of steel it produces.

To become Certified, a fabricator must undergo an audit of its quality management system—a standardized and documented set of procedures—by Quality Management Company (QMC), an independent, ISO Certified auditing company. There are many facets to the process, including quality verification of a shop's operational procedures, equipment, training, management, and personnel.

Here's how it works. A fabricator looking to become Certified contacts AISC to get the process started. QMC sends the fabricator an application packet, which the fabricator completes and submits (with payment). QMC reviews the package, sometimes requesting additional information from the fabricator, then performs a document audit. After the fabricator responds to any questions regarding the document audit, QMC coordinates with one of its client auditors to schedule an audit of the fab shop.

During the audit, the auditor will notify the client of corrective actions, if any, that need to be taken. This notification is called a corrective action request (CAR). After the audit, which generally takes two days, the QMC auditor writes an audit report, and the fabricator responds to any CARs and has 30 days to provide evidence of CAR resolution. After QMC reviews these responses, certification is printed and mailed. The shop is now an AISC Certified Fabricator!

For more information on QMC and AISC Certification, visit www.qmconline.com.

Out in the Open Again

Once the paint is dry, the beam is ready to leave the building. Exiting at the opposite end of where it entered, it is placed in another outdoor material storage area, much like the one it resided in when it first arrived. However, it is no longer a raw beam, fresh from the mill—it is now fully fabricated. After a final inspection against the cutting sheet, is ready to be transported to the construction site.

Change orders, of course, are typical in the construction industry, and even after a beam has been fabricated, a design change can effectively "shelve it." If a beam becomes part of a change order, Cives tags it in this storage area to keep it from being shipped to the job site until the proper modifications have been made.

Well Prepared

Hopefully, our tour has given you a better appreciation for and understanding of steel fabrication. Shops like Cives puts a tremendous amount of time and effort into producing quality fabricated products. Speaking of which, I'm not sure where our beam will end up, but I wish it well. No doubt it will do a fine job wherever it goes, considering the preparation it received in Wolcott. And now it's time for that chicken, er, country-fried steak. MSC