Unique brake setup streamlines thick plate bending

Custom tooling—designed for one job only—eliminates secondary ops

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A heavy-equipment OEM's forming department develops a unique tooling setup for bending extremely thick, high-strength plate-- designed for one application and one application only.

Figure 1

Thick, high-tensile-strength plate is bent with a specialized tool. The material is bent to no more than a 176-degree inside angle for each bend.

The CNC press brake at Peterson Pacific Corp. would make people with bending know-how stop in their tracks. In the brake sits a specialized tool set, comprising a 1½-inch-radius punch and a 5½-in.-wide die opening, bending up to 1½-in. AR400 and HARDOX® 450 wear-resistant plate (see Figure 1).

Say that again?

"I'll make this statement: If people see those numbers and are familiar with forming … they're going to freak out. But we don't bend more than 4 degrees in that tool—ever."

So said Karl Slechta, department lead for the plate processing department at the Eugene, Ore., heavy equipment OEM, clarifying some eye- popping numbers. Most setups would require much larger dies with immense die openings. But Peterson's application is different. The bend angles are extremely slight. Each hit produces a 176-degree inside angle, at most. The operator performs 12 hits, with bend lines about 1¼ in. apart, to bump a 20-in.-radius part (see **Figure 2**). Company sources repeatedly stressed that they use this tool for one job only, nothing else. Performing conventional bending of thick, high-strength plate with such a setup could cause serious damage.

The company worked with a supplier that "engineered the tool for it to withstand a certain amount of tonnage per foot," Slechta explained. "The maximum tonnage we'd be pushing worked out to be 860 tons over a 72-inch length. That's 143 tons a foot, approximately, and the tool was designed around those parameters."

"We're actually only pushing about 42 inches of it," added Chris Brewer, press brake operator.

Brewer's measurement accounts only for the metal being bent. This part, a heavy-duty grate, is hole-intensive, which creates its own challenges. Some plate might have 20 large holes, another might have more than a hundred 2-in.-diameter holes, all cut on the plasma table. The plasma cutting creates hard edges that require the operator to adjust brake parameters to accommodate for the hardness variation.

Overcoming Challenges

Operators must compensate for more than work-hardening effects. Besides obvious springback considerations, which can be a bear for such material, "the material thickness varies as well from plate to plate, so that can affect things," said Tim Adair, press brake operator.

Mill tolerance windows cause issues too. Generally speaking, the plates' thickness tolerances aren't any worse than other grades'. It's just that for such thick, high-strength plate, a little thickness variation can greatly affect a bending operation.

Hole placement has an impact as well. Trying to bend a plate with an asymmetrical hole arrangement can cause twisting, with one side of the part bent slightly less than the other side, because such parts have more solid metal (that is, a thicker web portion) on one side than the other. Ensuring hole arrangements are symmetrical solves the problem.

Cracking also becomes an issue on certain grades, often if the brake bends with the grain, a common problem with high-tensile-strength material. For this reason, Peterson bends much of its high-tensile plate against the grain, adjusting the nesting in the plasma cutting operation to suit.

Cost Analysis

So why build such tooling, with that 5½-in. die opening, for this kind of material?

Peterson sources noted that they didn't choose the design simply to save on tooling costs. If Peterson had chosen a conventional tooling setup, with an extremely tall die height and wide die opening, the die would have required significantly more tool steel and, hence, cost more.

The principal reason, as Slechta explained, is that the part had to be bent as close as possible to its edges. The larger die opening would have required the first and last bend on the 20-in. part to be performed farther from the edges and, thus, would have left tangent portions on both sides that couldn't be bent to the required angle. Under this scenario, shop workers would have needed to trim the part edges using equipment the company didn't have. So Slechta and his plate processing team decided to go with the specialized tool.

"The tool is designed specifically for this grade of product," Slechta explained, "leaving the [die] opening as wide as we possibly could leave it, but also allowing us to carry the radius as close to the edge of the plate as we can."

Eliminating that trimming operation "is really the driving force behind what we're doing," added Adair.

Healthy Savings, Good Product

Going this route did produce significant savings. Slechta estimated that "we would have spent about a half hour to 40 minutes a grate just trimming the tangents off and getting them cleaned up, adding significant labor costs. And none of our burn tables are designed to do work like this, so we likely would have had to build something or purchase equipment."

The scrap costs would have been significant as well. High-strength plate doesn't come cheap. Sources estimated that each scrap piece, cut from either side of the part, would have been about 5 in. wide by 72 in. long. "So you're looking at roughly $150 to $160 for each grate, and we process 25 to 30 grates a day," Slechta said. "You're talking a lot of money."

Bending Collaboration

- The forming department at Peterson Pacific Corp., Eugene, Ore., works with AR400, HARDOX® 450, as well as high-strength, low-alloy (HSLA) plate, among other material. Such a combination creates a challenging environment for bending, to put it mildly. Springback can be a bear, and material variability—due to both mill tolerance variation and work-hardening effects from upstream plasma cutting— requires brake operators to think on their feet.
- This, sources said, is why close collaboration between engineering and manufacturing is paramount, a fact Peterson has embraced since bringing high-tensile-strength plate bending in-house more than a year and a half ago. The plate processing team works with engineers to catch any bending problems before they hit the floor, ensuring variables such as bend allowances are considered upfront.
- The team also ensures that parts have sufficient flange lengths to make the bend, a significant issue for such material. "Flange lengths make up a lot of the discussion," said Karl Slechta, lead for Peterson's plate processing department. "We need to determine the minimum flange length we can achieve on these parts."