Tackling the large radius bend

■ There are many ways to make a large radius bend; the trick is to find the method and equipment that works best for your particular need.

By Ralph Schmidt
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There are several ways to achieve the large radius bends required for curved handrails and other ornamental metalwork projects. These may, of course, be heated and manually manipulated to match a template or they may be bent "cold."

Three cold roll bending options

One: Hossfeld bender

A popular method of cold bending a handrail is with a Hossfeld bender. Although that tool is designed for tight radius bends, fabricators often employ the Hossfeld to perform a series of very slight bends along the length of a handrail. This process creates the illusion of a curved piece with a constant radius.

Two: Brute force and leverage

Another method of cold bending is by combining brute force and leverage. Some years ago a fabricator was faced with the dilemma of supplying a curved handrail to match a walkway at a customer's residence. Lacking the proper equipment to perform the necessary bend, this ingenious NOMMA member fixed one end of the handrail in the fork of a tree. By pulling on the other ends of the handrail, using the rail itself as a lever, he was able (with some effort) to achieve the required bend. Pass the Ben Gay, Hoss!

Three: Roll benders or angle rolls

It is generally accepted, however, that the most efficient and economical method of producing large, variable radii, cold bends is to "roll" the work piece. The machines employed for this purpose are called roll benders or "angle rolls." The latter label is actually a misnomer because of the machines' wide assortment of uses, but a popular roll bending application is to form rings out of angles.

Roll benders are usually constructed with three roll shafts in a triangular configuration. Beyond that common feature roll benders are available in a wide variety of sizes and styles, including: manual, hydraulic, pyramid, initial pinch, double initial pinch, digital, analog, two roll driven, three roll driven, etc.

The version favored by most ornamental fabricators, however, is the pyramid type machine with manual positioning of the forming roll and electric motor drive. Regardless of the vendor, these benders all share some common characteristics. They are usually compact, ruggedly built, and affordably priced, which accounts for their popularity for ornamental ironwork.

Common questions about roll benders

Because these roll benders are quite similar in design, they offer some universal advantages but there are also *challenges*. The following addresses the most often asked questions about these machines:

Repeatability

Roll bending is not an exact science, but it's not voodoo either. The process simply involves drawing the material through the roll dies and allowing the inherent resistance of the material to work against the strength of the machine shafts to curve the work piece. There

File Photo

Sometimes extra large radius bends call for extreme measures—like getting on the roof! Fabricator: William Henry Ornamental Iron Works, Willow Grove, PA.

For your information

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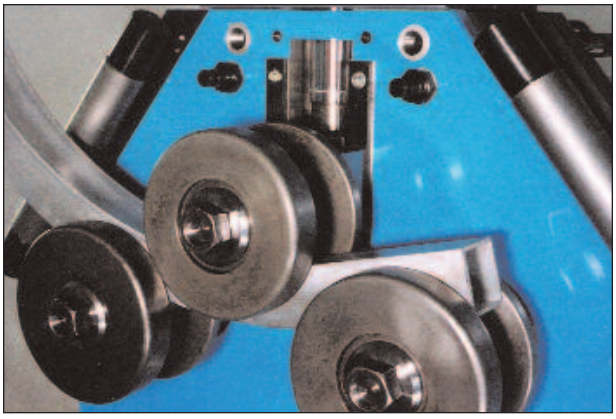
are two variables. One is the location of the machine's forming roll and the other is the amount of resistance offered by the material itself. The machine operator can control the first variable but not the second. The bending properties of metals, particularly of hot rolled steel, are such that the radius of each individual piece should be checked as it is rolled, especially when tight tolerances are required. The good news is that there is no material "spring back" in the rolling process (unlike rotary bending processes). As the material exits the roll dies, the finished bend is displayed. It can, therefore, be measured with radius calipers or matched against a sample or template.

Jack Klahm of Klahm & Sons Inc. reports that he often cuts material into three-foot lengths and feeds each piece through his roll bender in a single pass, lowering the forming roll slightly for each new piece and noting the location. When he achieves the desired radius, Jack will use that piece as a sample to match against the material he will use for his job. He will also know, as precisely as possible, the required location of the machine's forming roll to produce that radius.

It also helps to keep a record of the bends that are performed. Keep a notebook at the machine. Require operators to record the material type and size, the radius achieved, and the location of the forming roll. This can form a useful "database" that will save time during future operations. Such data is only useful when pieces have been rolled in a single pass.

Fabricators, who are not familiar with the process, often ask how a roll bender may be used to open a piece up that has been rolled too tightly. The machines do not have such capability, so when working with expensive materials like bronze, brass, or polished stainless, it's a good idea to roll in multiple passes to increase the



Benders like this Promaco Model RBM 2-40H can accommodate a wide variety of dies for different shapes and materials. The machine also accepts custom dies for nonstandard applications.

radius incrementally. Although this process is time consuming, it may actually prove more cost effective in multiple passes, if the (final) location of the forming roll is at the same depth for both bends.

Avoiding material deformation

Any fabricator with experience in roll bending has faced a project in which rolling the material caused the inside radius to ripple or simply crushed it. For example, Alan Lavoie with Custom Ornamental Iron tells us that large radius bends of 20 feet or more on thin wall box tubing are not a problem. But when smaller radii are required (even as large as 6 feet) the tubing will be crushed while rolling. Alan recommends simply using a thicker wall tube ($^{3}/_{16}$ inch) for tighter bends.

In some cases, deformation can be somewhat controlled by closing the clearances of the tooling. But most often, the problem does not lie with the tooling or the machine, but rather with the material thickness. Thin materials do not allow sufficient compression of their molecules inherent to the roll bending process. But suppose a specific light gauge material must be rolled for a certain project. Jackie Johnson of Allen Iron Works had just this problem with a piece of round tubing. Jackie's solution was to cap one end of the tube and to fill it with sand before capping the other end. Jackie advises that the key to success is to "pack and tamp" the sand tightly, because any voids will cause the tube to kink.

Angle rolling without twisting

This is one of the most problematic roll bending applications because the bending pressure is applied asymmetrically to the material, causing it to twist when rolled. Initial pinch type roll benders with hydraulic guide roller adjustments are designed specifically to address this issue by controlling and rectifying the angle as it is rolled. For most pyramid type roll benders, optional rectifier assemblies are available for rolling angle leg-in, but they are expensive and cumbersome.

The fabricator who may only have to roll angle occasionally may want to

follow these simple guidelines:

One: Always use the heaviest angle possible.

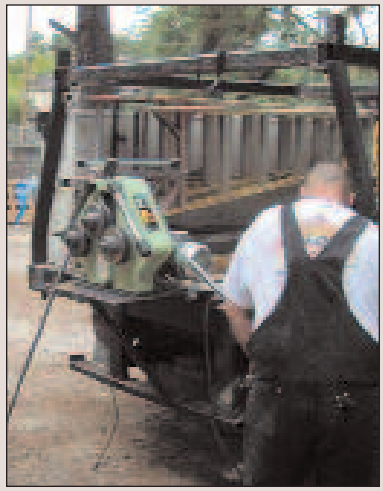
Two: Unless the angle itself is less than 1 inch by 1 inch, avoid using angles with 1/8-inch toes.

Three: Use some suitable tool to manually rectify the angle, such as a bending fork, forge tongs, or even a large crescent wrench. As the angle rolls, stop the machine every few seconds and straighten the rolled section with the tool you have selected.

Four: It may also help to warm the angle. A slight increase in temperature helps facilitate the bending of any metal. If weather permits, lay the material in direct sunlight for at least half an hour before rolling it, so that the material is warm to the touch. The material will then be "more receptive" to being rolled and easier to manipulate if it needs to be rectified.

Decrease material slippage

Most roll benders being used by ornamental fabricators are two-driven roll machines (two roll shafts are powered). Sometimes an absence of friction between the material and tooling will cause the material feed to stall. This "slippage" may be because the radius is too tight to create in a single pass. In such a case, the forming roll should be retracted and the material rolled to a large radius. A second pass should be used to bring the material to its final size. Sometimes, especially on round tubes, slippage may be caused by an oily residue on the tube's surface. In this case, it is helpful to wipe the tube down thoroughly with scouring powder (like Comet or Zud). This removes the residue and creates a more "gritty" surface, which will enhance material feed.



LARGE RADIUS BENDS IN THE FIELD

One of our most popular articles, which appeared in the Nov./Dec. 2000 *Fabricator*, told about a resourceful craftsperson who secured a bender to the back of his truck. The unit is ideal for making adjustments at the job site and can save trips back to the shop. A forklift is used to place the bender into a specially made platform and sockets, which keeps the machine secure. To power the unit, it's necessary to have a three-phase power source on board, such as a heavy duty welder or generator. Fabricator: Pro-Fusion Ornamental Iron Inc., San Carlos, CA.

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