

Meet the Experts at MSC's Online Chats

Bending STEEL

On December 1, 2001, David Marks from Marks Metals, George Wendt from Chicago Metal Rolled, Ed Libby from Oakley Steel and other representatives from the rolling and bending industry joined *Modern Steel Construction* readers online to answer questions about bending steel shapes.

Q. Are there any rules of thumb for calculating the cost of camber on a per beam basis?

A. Since most of the work is "custom bending," we really do not have a formula for determining this.

Q. How tight can you roll a hollow structural section (HSS)?

A. It depends on the size of the section.

Q. Can you give us some ranges?

A. When bending a specific length and width HSS, three factors are critical: wall thickness, radius, and acceptable distortion of tube. The heavier the wall thickness, the less distortion (many people incorrectly think the opposite).

Q. What's the best way to determine if a steel member can be bent to a certain radius? I know there are lots of variables, but as an engineer, I need to know if something is ballpark-possible when I talk to an architect.

A. From my experience, it is best to call the bending shop of your choice to find out what their experience has been with the member that you have a question on. However, Marks Metals has available a CD that gives the minimum radius for wide flanges rolled in the X-X axis. This is only good for their Diamond Curve process to curve beams, but it is a reference for you. To receive a copy, email david@marksmetal.com.

A. Typically, though, a phone call can go a long way. Chicago Metal keeps records of what sections can be rolled. For example, we can roll an HSS8x8x $\frac{3}{8}$ to a 10 ft radius without much distortion.

Q. What "tricks" do you use in the shop to keep the thin walls of some HSS from distorting? Someone once told me they were filled with sand.

A. Some shops use sand; water can also help prevent distortion.

Q. To cool the shape, or as a filler?

A. As a filler—sometimes the tubes are filled with water and then pressurized.

Q. Does the steel bending change the steel allowable stress?

A. The bending process "cold works" or "work hardens" the steel. The tensile and yield strength goes up as the bending process is being performed and the ductility of the material goes down at the same time. When material fractures during rolling the extreme point was reached and you have scrap.

Q. Anyone experienced in free-form helical coiling of channels or HSS?

A. Chicago Metal has experience in helical rolling...we can roll any size channel, large tubes (we've done 20x4).

Q. From a very basic standpoint, in our shop there has been a significant amount of disagreement concerning the proper dimensioning for plate bending. Some say inside dimensions, some say centerline and some say it depends. Is there a rule of thumb for

plate thickness before you change from inside dimensions to centerline dimensioning?

A. When we process plate we ask what is the critical dimension to hold. During forming and rolling the neutral axis moves. This is really true in profile rolling and bending too. Since the material is moving about the neutral axis there is a thickening and thinning occurring that has to be taken in account. Say you want to have a cylinder and hold 48" o.d. with a 2" wall thickness. I would start my layout by going to the outside surface and establish my square blank. As the plate is pre-bent and rolled up almost to closing the plate length will have elongated a little and my intended cut line will need to change because of the material movement. The same holds true even if I needed to HOLD an i.d.

Q. How do you design a curved beam? Do you have any design guides for curved steel beams?

A. AISC's *Design Guide No. 9, Torsional Analysis of Structural Members*, is a good resource. Order it from AISC at 800.644.2400 or online at www.aisc.org.

Q. What would you say is the most common question people ask you about bending steel? Also, if there were one piece of wisdom you'd like to offer a steel fabricator, or structural engineer, or architect, what would it be?

A. The most common question we hear is "can some tube be rolled to a specific radius?" The wisdom we offer to designers: don't be afraid to incorporate rolled structural sections into your designs. In working with our customers, we have achieved cost savings using curved versus "segmented" or straight designs.

A. My piece of wisdom would be for the designer to have a relationship with a rolling house to call and ask

questions early on in the design process. It would save a lot of unmet expectations down the line.

A. Design a lot more. We need the market to grow. Build a relationship with a rolling house where the architect can call and ask questions on what is possible and still stay in the budget. Anticipate distortion if the budget allows only for cold rolling. If distortion is not acceptable, induction bending and fabricated tubes are good alternatives.

Q. There are many ads in MSC about the tube bending capabilities. However there is no specific information as far as what is the maximum size and minimum radius one can bend the tubes. Are there any rules of thumb to know as far as what is the minimum radius for W-shapes and HSS about strong and weak axis?

A. We can answer this based on our past experiences: samples that we have done and the records that we keep. When in doubt, though, call your bending supplier.

Q. Are pipes easier to bend the square tubes? Engineers are asked many times the premiums for bending the steel. I understand that this can vary for size and curvature, but can you give us the range for the cost? Thanks.

A. I find pipe much easier to meet Architecturally-Exposed Structural Steel (AESS) conditions to tighter radii than HSS. There is "ovality" to worry about.

A. I believe pipes are easier the bend than square HSS. Also, the distortion is less on round sections than square and rectangular sections.

Q. I'm looking for some costing info (cost factors would be fine as opposed to hard dollar figures) for rolled members with respect to shape, size and "hard way" vs. "easy way."

A. I don't know of a formula to figure costs of rolling. This is custom work and is pretty much like an art. Every piece that you bend is a little different. For each job you should call your bending supplier to get a quote on what you need.

A. When I am asked for a quick cost for rolling with only general information, I give \$0.25 per pound. Most of the time that is more than enough on a smaller project. If secondary processes are required, then allow accordingly. And rolling a 3" x 3" x 1/4" x 20'-0" long angle and a hard way beam will not cost the same.

A. Remember, though, dollars-per-pound pricing can lead to inaccurate quotes.

Q. Are there any rules of thumb regarding the limitations on rolling of W-shapes the hard way and/or the easy way?

A. For rolling W-shapes the easy way, look at the flange width and multiply times 10 to 15. The thicker flange the tighter the radii. This is very rough rule of thumb. Machine capacity and centers on the rolls adds another variable. For the hard way, refer to the Marks Metal CD referenced above. This tool will tell you what I can achieve using this process. Other rolling houses use different equipment and can achieve different results.

Q. How much extra material do you need at each end to roll any given shape? I realize this can vary depending on the section and the bend radius.

A. With our equipment, smaller sections need about 1'-0" each end. The larger sections need up to 6'-0" each end.