Do's and Don'ts of roll forming design

Here in a nutshell is what designers should and should not do when designing roll formed shapes.

Only the imagination limits the potential applications for roll formed shapes. When designing a product, do not limit thinking to shapes already seen, to straight shapes or to shapes which appear easy to make. Think in terms of bending metal into the shapes really wanted. Two shapes can even be joined to make one.

The roll forming process produces a high quality product. By its very nature, it permits close tolerances for either heavy- or light-gauge material and provides uniform shapes and dimensions. Finished shapes have an excellent appearance (with no die marks even on precoated material), and the roll forming process lends itself to fine detail.

As these attributes have become more widely known, designs and applications using roll formed shapes have increased steadily, so that nearly every industry in the country utilizes these shapes in its products. As the benefits of using a custom roll former to help design and produce desired shapes become apparent, more and more companies are turning to custom producers for their needs. They have found that the custom roll former can supply needed parts because it is his full time job, not a sideline, and he has had experience in creating many shapes in the most economical manner possible.

Curving

Because roll formed shapes have uniform cross sections, they are easily bent. When rings or segments of rings are required, shapes can be curved to uniform radii at the rolling machine without wrinkles and without disturbing a prefinished surface. Helices are also possible. Consider material elongation in designing parts for rings to help eliminate wrinkles and fractures. Usually, the more elongation a material has, the easier it is to bend. Where curves are not a constant radius, the uniformity of roll formed shapes makes them ideal for stretching or tangent bending.

Prepiercing is the fabrication of a series or pattern of holes in the flat strip before forming. It is done in one continuous operation together with roll forming and, therefore, can be a cost saver. Repetitive piercing, as in a wallboard plaster bead or shelf posts, will minimize the piercing tool cost, because a small die can be used.

Postpiercing is piercing in the line with forming, but after the part is formed. It is part of a sequence of operations, all of which are performed without handling, and is therefore very efficient. If piercing, notching or tabbing is required at either or both ends of the part, keep the pattern of holes and notches close to the end of the part, so that these operations need not repeat throughout the full length of the part. Often, this is less expensive and more desirable than prepiercing, because better dimensional accuracy from the end of the part is attainable.

Forming in line

Welding dimples or projections can be formed while the parts are being rolled to improve accuracy in the finished part and save money. Tabs, stops or raised areas can also be formed.

Almost any material obtainable in coils can be roll formed. The material should be as ductile as design strength will allow; this allows crisp design, sharp corners, and easy bending. When high-strength alloy steels, heat-resistant steels, titanium and other alloys are used, bend radii specified by the mill should be followed. In many circumstances, bend radii can be reduced.

Guides for economy

- The shape should not be too deep.
- Since the raw stock is sheet metal, the part should have uniform thickness throughout. However, thickness may be increased by folding the material to double thickness.
- If wide, flat areas are required at the edge of a part, consider using small stiffening ribs. The part will stay flatter and be much stronger.
- When planning a leg, as with an angle or a channel, the length of the leg should not be less than three times the thickness of the material. This also applies when hemming or bending the material back on itself.
- When planning prepiercing where location is not critical, design the pattern to be repetitive without specifying the location of the beginning of the pattern from the end of the part.
- When the prepiercing pattern is critical and not repetitive within the part, try to design it to be less than 6 ft long.
- If a piercing pattern is used which requires holes in a specific area relative to the end of the part, try to keep it more than 1/2 in. (but within 4 in.) from the end of the part.

The following tolerances are guidelines only. If more restrictive tolerances are required, define them clearly and discuss them with the roll forming producer. If possible, a sample assembly drawing should be supplied to illustrate the use of the part and the areas where tighter tolerances are required. When agreement with the roll former is reached, the drawing of the part becomes part of the purchase order.

Cross-section tolerances

± 0.031 in. on fractional dimensions

± 0.010 on decimal dimensions

± 1° on angular dimensions

Straightness tolerances (bow or camber)

0.015 maximum deviation per ft of length

Twist tolerance

1/2° maximum deviation per foot of length

Length tolerance for parts 0.026 thickness and heavier

± 0.015 in. on parts up to 36 in. long

± 0.030 in. on parts 36 to 96 in.

± 0.060 in. on parts 96 to 144 in. (more on longer lengths)

Length tolerance for parts 0.015 through 0.025 thickness

± 0.020 on parts up to 36 in. long

± 0.047 on parts 36 to 96 in.

± 0.093 on parts 96 to 144 in. (more on longer lengths)

A few more do's and don'ts which may help product designers when considering roll forming for a particular shape:

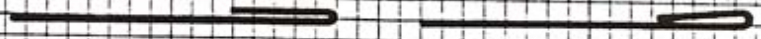
- Use maximum bend radii permissible. An inside bend radius of less than the material thickness will lessen roll life and increase power requirements.
- Design the parts to be as symmetrical as possible to eliminate twist in the finished part.
- Design parts so that holes, slots and notches are not distorted due to placement too close to or directly on a bendline.
- Do not ask for tolerances which are closer than necessary. This will greatly increase the cost of both the tooling and the finished part.

SOLUTIONS FOR BETTER DESIGNS

To the uninitiated, the roll forming process might appear to be an easy business to work in and understand. However, there is a host of engineering guidelines and technical solutions that rollformers and experienced customers need to know. This small group of "Do's and Don'ts of Rollforming" does not seem to be very sophisticated, you might suppose — but it is.

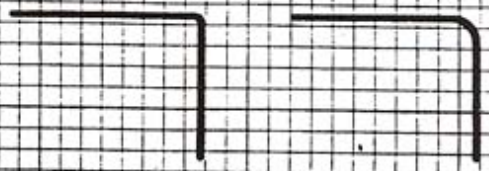
Instead of this . . . **Consider this**

The outside leg on metal building panel stock, when rolled straight, will be wavy. Forming a slight bend in the leg will help to flatten it.

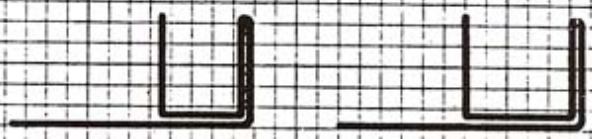


The flat 180° hem, when roll formed, will be wavy. By forming a tear drop hem, the edge will be flat.

90° legs on metal building panels add more forming passes and will mark the legs. Forming a 75° leg reduces the number of stations and does not mark the leg.

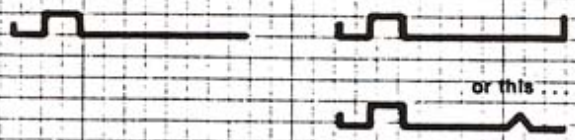


Avoid sharp inside radii; they are difficult to form without marking the outside radius or cracking the paint on prepainted material. A larger radius reduces this problem.

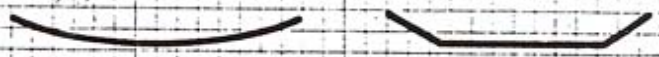


When roll breakage occurs because of a narrow slot design, a wider slot design will alleviate the breakage.

When the rolled leg is too short as shown, use approximately three times material thickness on the legs to achieve stiffness.



When a section has a roll form on one end and a wide flat on the other end, put a leg on the end or a groove near the end to maintain straightness.



If a wide sweeping radius is impossible to control, put a bend in each end to keep it straight.