Rolled formed section

Roll forming is a process in which strip or coiled sheet metal is fed continuously through a series of contoured rolls arranged in tandem. When the stock passes through the rolls, it gradually takes a shape with a desired uniform cross section. In this process, only bending takes place and metal thickness essentially remains constant. The pair of rolls is called stands. The number of stands may be 3 to 4 for simple sections and goes up to 28 or 30 for complex cross–section. The process is shown in the Figure M4.4.1.

![Figure M4.4.1: The process of roll forming.](image)

Typical parts and applications

Roll forming has great application in large quantities of parts with uniform complex cross-sectional shapes. This process produces parts mostly of long length. However, short parts can be produced by cutting the formed strip to the desired length. The thickness of the sheet stock which can be processed varies between 0.13 mm to 25 mm. Except for few cases; the normal commercial limits are 0.25 to 4 mm. Width of the stock ranges from 25 mm to 2.5 m. However, commercially a maximum width of 1 m can be processed and 400 mm is the widest stock possible to process on the most commonly available machines.

When mass production is involved, roll forming is very useful. Various components manufactured through this process for construction industry include roof and siding panels, purlins, joists and studs, window frames, door-trim ridge rolls, downspouts, architectural trim, and copper electrical conductors. Apart from these, parts of various appliances made by roll forming include panels for stoves, refrigerators, lighting-fixture parts etc. In fact, dual
layered components also can be made at one time. For example, production of bimetallic parts wherein, a thin stainless-steel facing sheet and a carbon steel support sheet are formed together or fiber, paper, asbestos, or rubber inserts are placed in a metallic form. Some typical cross-sections that can be produced by this process are illustrated in Figure M4.4.2.

![Figure M4.4.2: Representative cross-sectional shapes that can be made by roll forming.](image)

**Suitable materials**

In this method, any metal suitable for any bending or forming processes can be used. However, best results are obtained from ductile alloys. Low-carbon steels are the most frequently processed roll-forming materials. Among other materials aluminium (preferably the non-aging alloys), brass, bronze, copper, and zinc are common.

**Design recommendations**

The first and universal rule is that the designer should understand the roll-forming operation, equipment, and tooling. Careful review of sequence of operation can avoid unnecessarily high tooling costs, high tool wear, and forming problems.

**Bending radii:** Sharp corners should be avoided and the corner radius both inside and outside should be as generous as possible. The minimum radius used is one stock thickness; however, 2 times stock thickness is preferable as shown in Figure M4.4.3. Bending radius smaller than one stock thickness is possible to use but the life of rolls reduces significantly.
Part length: It is preferred to produce the stock in longer lengths and to cut the desired length after forming. This operation need to carry out in a continuous automatic manner. A thumb rule on this says that the parts shorter than 3 times the centerline spacing of rolls of the machine employed will not feed or form satisfactorily.

Depth of form: Depth of a roll formed section should be kept as small as possible to simplify tooling, reduce tooling wear and preserve stock finish. One rule-of-thumb is maximum form depth that has been established for average-size forming machines are 100 mm. This is illustrated in Figure M4.4.4.

Wide Sections: Wide parts show some kind of waviness unless unformed areas are less than 125 mm wide. Waviness or other type of irregularity in wide areas can be avoided with the
help of longitudinal stiffening ribs. Similarly, waviness or unevenness at the edges can be avoided by incorporating a flange, hem, or rib near or at the edge as shown in Figure M4.4.5.

**Symmetrical or balanced forms:**

Shapes that are symmetrical about a vertical centerline are the most satisfactory for roll forming.

**Vertical sidewalls:** Exact vertical sidewalls are avoided to reduce excessive roll wear and scoring. A draft angle of 0.5° or more is preferred. This is illustrated in Figure M4.4.6.

![Figure M4.4.5: Stiffening bends in wide areas and near edges.](image)

![Figure M4.4.6: Avoid exactly vertical sidewalls.](image)

**Blind corners:** Blind corners and radii are feasible but should be avoided. Because, they are less accurate than the corners formed with rollers in contact with both sides of the stock.
**Minimum leg length:** The recommended minimum practical leg length is 3 times the stock thickness.

**Dimensional factors and tolerances**

Various factors responsible for dimensional variation are:

- Spring back
- Variations in hardness
- Thickness
- Yield point of material
- Tooling deviations
- Tooling wear
- Machine deflection
- Variations in setup and adjustment of tooling

Recommended tolerances for roll formed sections are shown in Table M4.4.1.

**Table M4.4.1:** Recommended Tolerances for Roll-Formed Sections *(Source: Design for Manufacturability Hand book by James G Bralla, 2nd Ed)*

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section or leg width or height dimensions up to 50 mm or critical dimensions over 50 mm</td>
<td>±0.25 mm</td>
</tr>
<tr>
<td>Section or leg width or height dimensions over 50 mm or any noncritical dimension</td>
<td>±0.4–0.8 mm</td>
</tr>
<tr>
<td>Angle</td>
<td>±1°</td>
</tr>
<tr>
<td>Twist</td>
<td>3.5 mm/m</td>
</tr>
<tr>
<td>Camber</td>
<td>0.8 mm/m</td>
</tr>
</tbody>
</table>

*Note:* Tighter tolerances are possible, but it increases the cost of the component.