THE PRODUCTION OF ECONOMIC COLD-BENT SECTIONS

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An extensive use of bent sections is one of the greatest possibilities for saving metal. In comparison with the usual rolled products the use of bent sections assures, on the average, about a 25% savings in metal due to the more efficient distribution of the metal along the section and because it is possible to manufacture thin-walled shapes with any cross-sectional form.

The production of bent sections on the shaping and bending mill is a highly efficient process assuring a good quality of the finished product. In addition, the capital investment for the construction of shaping and bending mills is less, the time needed for installation is considerably shorter, and it pays for itself faster than hot-rolling mills.

The "Zaporozhstal" Plant has installed two shaping and bending units, completely mechanized assemblies consisting of a group of machines that shape the starting billet, forge the bent section, and transport and pack the finished product. The arrangement of the equipment provides two continuous unidirectional flows of metal for each of the units.

The coiled starting material is delivered from the feeding device to the uncoiler, is then straightened and cut by flying shears into measured lengths. These lengths are shaped in the grooved rolls of the shaping and bending mills, then covered with a layer of lubricant and stacked in packs.

The sections are shaped by cold deformation in the roll passes by a gradual bending. The number of stands in which shaping occurs depends on the complexity of the configuration and dimensions of the section of the finished shape, and also on the quality of the starting metal.

Bent sections at the "Zaporozhstal" Plant are manufactured from pickled and unpickled hot-rolled and cold-rolled flat products with trimmed edges of steels St. 0-St. 3, 08, 10, 15, 20, 25, 30 (rimmed and killed), 09G2, 10G2, 14KhGS, 15Kh, 20KhGS, NL-1, and NL-2.

One of the shaping and bending mills is designed to produce irregularly shaped sections with a very diverse cross-sectional contour from billets 2-8 mm thick, 80-500 mm wide with a maximum height of the section to 160 mm. The length of the flat products being shaped can be 3-12 m. The mill has 14 working stands with a common drive from two 480-kw motors with a shaping speed up to 2.5 m/sec.

The second mill can produce wider sections, such as ribber plates, corrugated sheets, castings of various types, large angles, C-shapes, and U-shapes. These are manufactured from low-alloy steels 1-6 mm thick with a width of the starting material of 400-1500 mm, a thickness of 1-5 mm at a width of 400-1100 mm with a tensile strength of 50 kg/mm², and a thickness of 1-5 mm at a width of 400-900 mm with a tensile strength of 60 kg/mm². The maximum height of the sections being produced is 200 mm at a length of the flats being shaped of 3-11 m. The mill has 20 working stands with a common drive from two 300-kw motors with a shaping speed up to 3 m/sec.

The experience of mastering the production of bent sections at the "Zaporozhstal" Plant revealed certain shortcomings in the planning of the shop, in the design and operation of the equipment, and in certain characteristics of the planned technology.

The problem of manufacturing shaped collars, from which the work rolls of the mill are assembled, was not solved in the plan of the shop. To assure normal operation the shop should have a separate roll-turning shop with a hot-working section and a section for building up the collars of the rolls where the working surface has been worn.

The disparity between the area set aside in the warehouse for the finished goods and the productivity of the shaping and bending assemblies is a shortcoming in the planning of the shop. When designing and constructing new shops it is necessary to provide for considerably larger areas for storage of finished goods and also for areas to place the needed amount of shelving under the shaped collars of the work rolls.
The complicated adjustment of the flying shears and the unsatisfactory cutting of the coiled material to measured lengths on the 2-7 × 80-500 mill considerably hampers normal operations, as a result of which deviations are obtained in the longitudinal dimensions of the strips being cut from the leading and rear ends of the coil.

The structure of the vertical rollers mounted between the roll stands is inadequately rigid and does not hold down tightly flat stock of irregular cross-sectional form or accurately guide them between the stands. Due to this shortcoming we cannot use the vertical rollers for bending sections to angles greater than 45° and this makes it necessary to have a greater number of pairs of horizontal rolls for shaping sections.

The design of the shaping and bending mills limits the dimensions of the work rolls such that the thickness of the body of the lower roll at the site of the key groove is only 19 mm. This is completely inadequate for restoring the shape of the groove by regrinding after wear. The life of the rolls is shortened.

Operational experience has shown that roll changing when transferring from one shape to another requires rather considerable time since it is necessary to dismantle and assemble numerous parts of the roll stands.

Tables with vertical guiding rollers were installed along the shaping axis between the mill stands to hold down the strips. However, it was not possible to prevent shifting of the strips along the axis of the rolls by using rollers. The strips of the finished section were produced with different widths of the flanges, considerably exceeding the deviations permitted by the standard. The distance between the stands of the mill is 1400 mm. The strip exiting from the stand could not be delivered properly to the following stand.

Slide guides (Fig. 1) consisting of a cast iron base, in the upper part of which a channel was formed corresponding in shape to the configuration of the angle of the section in a given pass, were designed, manufactured, and installed on the mill to assure normal operation of the mill. Angles are fastened from the sides to the base by screws. Their height is regulated by means of an oval hole under the screw.

![Fig. 1. Guides for angle strips.](image)

The guides are fastened by screws to a beam installed in place of the bed roller and to a plate welded to the table of the vertical rollers. The guides were installed on the delivery side of the work rolls and kept the strips from shifting laterally as they moved from the rolls to the vertical rollers.

The use of slide guides completely eliminated ejection of strips from the mill, improved the quality of the sections, and made it possible to manufacture them with small deviations from the requirements of All-Union State Standard 8276-57. However, when manufacturing small angles (40 × 40 × 3, 50 × 50 × 3) deviations nevertheless occur that exceed those permitted by a factor of 2 or 3.

Several thousand tons of angles have presently been manufactured, experience in their production has been accumulated, but it is still necessary to improve appreciably the quality of small angles.

To eliminate the differences in the flange widths of the sections, a new design has been worked out for a rolling role guide, which will soon be tested.

The quality of bent sections when shaped piece-by-piece is worse than when produced continuously because the conditions of deformation of the leading end, the center, and the rear end of the strip are different. As a result, the cross-sectional dimensions of the shape at the ends of the strip are produced with certain deviations. The productivity of piecemeal shaping is also lower than continuous shaping.