ROLLING BEAMS IN UNDRIVEN UNIVERSAL STANDS

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One way of improving the efficiency of rolled-product manufacture is to reduce its energy content. This can be done by using undriven roll stands in the line of continuous rolling mills.

The Institute of Ferrous Metallurgy (IChM) has completed a series of studies of the rolling of steel shapes and examined the use of undriven stands to deform the metal. The stands were installed in the gaps between the existing stands of a continuous section mill in the mill line. The technology is based on the use of the reserve of the compressive frictional forces developed in the deformation zones of the adjacent driven stands.

The process of deformation of metal in the stands of a continuous mill with the use of intervening undriven stands consists of the following. The bloom arriving at the undriven stand from the first driven stand of a "driven-stand — undriven-stand — driven-stand" system is forced into the undriven stand and pushed through it into the following driven stand. This process offers the following advantages over conventional rolling:

- **energy efficiency** — a reduction in energy costs due to an increase in the efficiency of the rolling operation and a reduction in power losses in the transmission of the drive of the regular mill stands;
- **compact mill layout** — a reduction in the size of the area occupied by equipment, including when mills are rebuilt to accommodate semifinished products of larger cross section;
- **low capital costs** for the construction of mills and rolled-product shops thanks to a significant reduction in the dimensions of the vertical stands;
- **the technical flexibility of the mill** — the compact undriven stands can be positioned at any place between the normal stands of a continuous section mill in the mill line, which makes it possible to roll a wide range of sections.

The IChM has developed a technology for rolling beams [1-3] with the use of undriven universal stands [4, 5]. Here, the main goal was to increase the number of four-high universal shaping passes in the mill line. The technology was tried out on the 450 continuous section mill at the West Siberian Metallurgical Plant in the production of Nos. 14 and 16 I-beams in accordance with GOST 8239. A prototype of an undriven universal stand (UUS) was used in the tests. The UUS was installed on the exit side of mill stand No. 7 in the mill line, taking the place of driven vertical stand No. 8 (Fig. 1). The roll-changing stand normally used to change rolls on the mill was used to put the test stand in place. During the installation, the four-high universal pass of the UUS was adjusted and positioned on the rolling axis.

To evaluate the performance characteristics of the UUS, first we adjusted its pass (Fig. 2a) in accordance with the parameters of the closed beam-shaped pass in driven stand No. 7 (Fig. 2b); the gaps between the horizontal and vertical rolls were set at 15.4 and 163 mm, respectively.

Thus adjusted, the UUS performed the function of driven vertical stand No. 8 (Fig. 2c). Here, the UUS operated in the bending-sizing regime and bent the flanges of the bloom before sending it into the open beam pass of driven stand No. 9 (Fig. 2d). This scheme eliminated the previous deviations of the geometric parameters of elements of the bloom cross section from the specifications. Also, the universal pass of the UUS (in contrast to a box pass) not only bends the flanges of the semifinished beam, but also eliminates differences in the thickness of the flanges formed in the roughing group.

The UUS was operated in the bending-sizing regime for nearly three shifts. The pass of the UUS was adjusted as wear progressed in the pass of stand No. 7. Figure 3 shows templates of the shapes obtained after stand No. 7 and the UUS in the operation of a unit comprised of a two-high stand and the UUS in the bending-sizing regime.

An emergency situation was simulated to find the weak link in the system used to connect the UUS to the two-high stand. The UUS was adjusted so that the deforming forces in the stand reached the critical values at which the beam loses longitudinal stability in the gap of the two-high — UUS unit. The result was movement of the UUS off the mill line. The
Fig. 1. Sketch of the section of the 450 mill with the prototype of the undriven universal stand (UUS): 1) UUS; 2) guide; 3) transfer chute; 4 and 5) driven mill stands Nos. 7 and 9 of the roughing group, respectively.

Fig. 2. Diagram of the passes of the stands in the experimental section of the 450 mill: a) universal pass of the UUS; b) closed beam pass of driven stand No. 7; c) box pass of driven vertical stand No. 8; d) open beam pass of driven stand No. 9.

presence of the weak link in the system joining the UUS to the two-high stand (bolting of the guide of the UUS) preserved the integrity of the main working elements of the UUS's mounting.

Studies showed that partial loading of the UUS, installed on the exit side of stand No. 7 in place of driven stand No. 8, provides for stable rolling in the bending-sizing regime. In addition, the favorable conditions for deformation of the metal in the universal pass and the optimality of the pass system in the roughing group for rolling beams [6] makes it possible to use the UUS with the same set of rolls for a long period of time.