Non-Linear Bending Control for Temper Mills


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Although proper bending force is critical to maintaining good strip shape, temper mill bending control is often relatively simplistic. This paper presents the sources of bending-related shape defects and the solutions used to overcome them.

By the nature of the design of a 4-high rolling mill, work rolls (WRs) and backup rolls (BURs) bend in the transverse direction under the rolling force. As a result, the roll gap profile is reduced more at the edges than at the center of the mill. Without any compensation for roll deflection, this would result in over-rolling of the strip edges, producing edge wave.

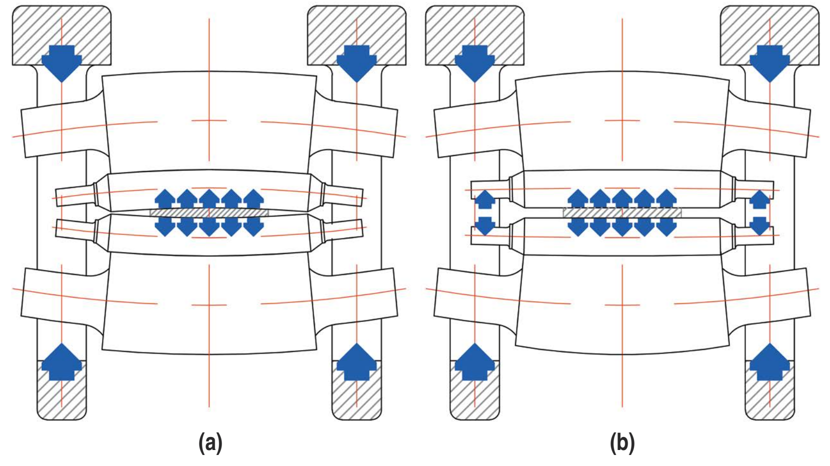
To overcome this issue, rolls are prepared with a crown profile and work roll bending force is applied to compensate for roll deflection. A crown profile is often applied to both the work roll and backup roll. Roll crowns provide a static, coarse compensation, while work roll bending force provides dynamic, fine corrections to achieve flat strip.

Ideal Work Roll Bending

In order to produce flat outgoing strip when rolling, the loaded work roll face profile must match the crown shape of the strip. The factors that determine the ideal work roll bending force for a given coil can be separated into static and dynamic components:

- Static:
  - Mill setup: Roll diameters, roll face width, roll profile, bearing center distances.
  - Product: Strip width, strip profile.
- Dynamic:
  - Rolling force.
  - Indirectly via rolling force: Product hardness, reduction, strip tension.

Figure 1



Cross-section of uncompensated mill (a) and cross-section of mill with roll crown and work roll (WR) bending (b).