Lightweight Work Roll Flattening Model for Severe Rolling Conditions


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Rolling models assuming a circular deformed roll profile have been successfully used for many years. They are known to have deficiencies on hard materials, thin gauges and low reductions. Modern numerical models with fully elastic roll deformation are a solution, but the computational cost is too high to have widespread use. A simplified model is presented that captures the essential elements of the fully elastic deformed roll shape and can be applied on Bland-Ford-style rolling calculations.

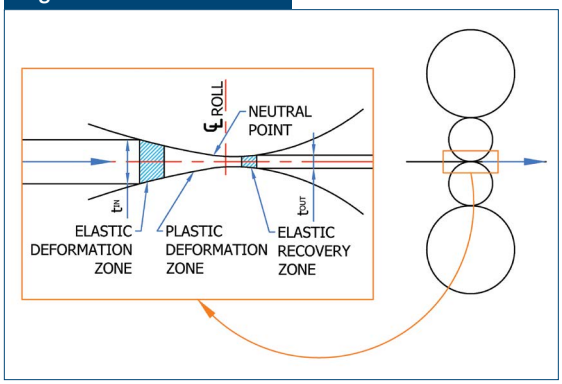
An accurate prediction of work roll flattening in the bite of a rolling mill is critical for accurate rolling force and torque predictions. This is of practical importance for both on-line mill setup and for off-line calculations.

Traditionally, roll flattening has been calculated using Hitchcock's equation,[1] which assumes the deformed roll surface remains circular. Despite both theoretical and practical shortcomings of the correlation,[2] variations of Hitchcock's equation remain widely used in industry.

To overcome these shortcomings, fully elastic roll deformation models have been developed based on stress functions derived from the theory of elasticity.[3,4] While these models provide a significant improvement in accuracy, the associated increase in computational effort has restricted their usefulness.

Braho Machinery has also developed rolling calculations using a fully elastic roll deformation model. Because of the severe computational cost, a simplified solution was needed for both large-scale historical data analysis and low-overhead, on-line applications. The goal was, therefore, to identify a roll flattening model to bridge the gap between Hitchcock's equation and fully elastic models. The resulting A2 model provides greater accuracy than Hitchcock's equation, while maintaining low computational effort.

Figure 1



Layout of roll bite.

Limitations of Existing Models

Hitchcock's Equation – Despite dating to 1935, Hitchcock's roll flattening equation remains widely used due to its simplicity and its reasonable accuracy in many rolling conditions. The equation predicts a circular deformed roll surface with an offset centerline. It is noteworthy

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