The Roux Spreading PyRoll Plugin

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This plugin provides a spreading modelling approach with Roux's formula for flat rolling, adapted on groove rolling by an equivalent rectangle approach.

1 Model approach

1.1 Roux's spread equation

Roux [1] proposed Equation 3 for estimation of spreading in flat rolling. Where h and b are height and width of the workpiece with the indices 0 and 1 denoting the incoming respectively the outgoing profile. A and B are parameters introduced by Roux. R is the roll radius.

$$A = \left(1 + 5 \left(0.35 - \frac{\Delta h}{h_0} \right)^2 \right) \sqrt{\frac{h_0}{\Delta h} - 1} \tag{1}$$

$$B = \left(\frac{b_0}{h_0} - 1 \right) \left(\frac{b_0}{h_0} \right)^{\frac{2}{3}} \tag{2}$$

$$b_1 = b_0 + (h_0 - h_1) \frac{1}{\left(1 - \frac{\Delta h}{h_0} \right) + \frac{3A}{\left(2 \frac{R}{h_0} \right)^{\frac{3}{4}}}} \frac{\frac{b_0}{h_0}}{1 + 0.57B} \tag{3}$$

To archive consistency with previous models, equation 3 is reformulated to calculated the spread β of the roll pass. Values denoted with $'$ are equivalent values, these are calculated using a suitable approach for calculation of a equivalent flat roll pass.

$$\Delta b' = (h_0 - h_1) \frac{1}{\left(1 - \frac{\Delta h}{h_0} \right) + \frac{3A}{\left(2 \frac{R}{h_0} \right)^{\frac{3}{4}}}} \frac{\frac{b_0}{h_0}}{1 + 0.57B} \tag{4a}$$

$$\beta = 1 + \frac{\Delta b'}{b_0'} \tag{4b}$$

Table 1: Hooks specified by this plugin. Symbols as in Equation 3.

Hook name	Meaning
`roux_parameter_a`	Parameter A of Roux's spreading equation
`roux_parameter_b`	Parameter B of Roux's spreading equation
`equivalent_height_change`	Height change of the equivalent flat roll pass

2 Usage instructions

The plugin can be loaded under the name `pyroll_roux_spreading`.

An implementation of the `spread` hook on `RollPass` is provided, calculating the spread using the equivalent rectangle approach and Roux's model.

Several additional hooks on `RollPass` are defined, which are used in spread calculation, as listed in Table 1. Base implementations of them are provided, so it should work out of the box. For `roux_parameter_a` and `roux_parameter_b` the equations 1 and 2 are implemented. Provide your own hook implementations or set attributes on the `RollPass` instances to alter the spreading behavior.

References

[1] M. J. Roux. "Étude sur le phénomène de l'élargissement dans les laminoirs". In: *Rev. Metall* 36.6 (1939), pp. 257–270.