The PyRoll Zouhar Contact Model Plugin

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The Zouhar approach to contact areas

The simplest method to estimate contact areas in elongation groove rolling is to use a trapezoid. However, this method is quite inaccurate. Zouhar extended this method by applying several empirical correction coefficients dependent on the pass type. His function for the contact area is:

$$A_\mathrm{d} = \left[b_1 C_2 + \frac{1}{2} \left(b_1 + b C_1 \right) \left(1 - C_2 \right) \right] C_3 L_\mathrm{d}$$

This function includes three empirical coefficients L_i, the contact length L_d, the out profile width b_1 and the initial contact width b. For $C_1 = 1$, $C_2 = 0$ and $C_3 = 1$ the model collapses to the trapezoidal rule. The initial contact width b for some pass types approximated with the roll gap of the last roll s_0, since the profile first contacts mainly with its tip. For other types it is just the width of the rotated profile b_0.

Zouhar gave the following coefficients:

In	Out	b	C_1	C_2	C_3
diamond	diamond	s_0	1	0.3	1
diamond	square	s_0	1	0.28	1
square	diamond	s_0	1	0.28	1
oval	square	s_0	1	0.1	1
square	oval	b_0	0.82	0.2	1.02
round	oval	b_0	0.45	0.18	1
oval	round	s_0	1	0	1

Usage of the Plugin

Load the plugin with the module name `pyroll.zouhar_contact`.

Coefficient Hooks

The plugin specifies hooks for the three coefficients as `zouhar_contact_c1`, `zouhar_contact_c2` and `zouhar_contact_c3`. on `RollPass`. Default implementations of them result in $C_1 = 1$, $C_2 = 0$ and $C_3 = 1$, which is essentially the trapezoidal rule.

For the pass types listed above, implementation are provided, which check for the type of the in and out profiles.

Initial Contact Width Hook

The plugin specifies a `zouhar_contact_in_width` hook on `RollPass`, to deliver the width of the initial contact b. For the pass types listed above, implementation are provided, which check for the type of the in and out profiles.

Contact Area Hook

The plugin provides an implementation of the `RollPass.Roll.contact_area` hook, which calculates the contact area according to the model function. It asks the roll pass for coefficients and initial width. If one of these is not available, the function returns `None`.

References

- Zouhar, G.: Umformungskräfte beim Walzen in Streckkalibern, 1960, Phd Thesis, TU Bergakademie Freiberg
- Hensel, Poluchin: Technologie der Metallformung, Deutscher Verlag für Grundstoffindustrie, Leipzig, 1990, ISBN: 3-342-00311-1