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# Elasto-Plastic Finite Element Analysis of Strip Curvature and Internal Stress Imparted by Roller Leveler

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Synopsis :
An elasto-plastic finite element analysis has been performed to estimate the curvature and internal stress of a cold rolled steel strip, passing through a roller leveler. In the analysis, plane strain assumption was adopted. Strip regions were divided into finite element meshes in longitudinal and thickness directions and non-steady boundary conditions were applied. Thus, there was established a simulation model for calculating, the process of levelling, while judging, the contact of a steel strip with rolls. The effects of leveller rolling conditions on curvature and residual stress were studied. Results calculated with this model are as follows: In case that tension is relatively low, the effect of tension on strip curvature is relatively large. The bow of a sheet was reduced by decreasing the diameters of leveler rolls. Residual stress was reduced by increasing the number of leveler rolls.

# 弾塑性有限要素法による 極薄鋼板のレベラ矯正時の残留応力・反り解析*

川崎製鉄技報
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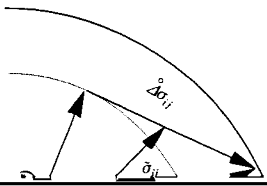
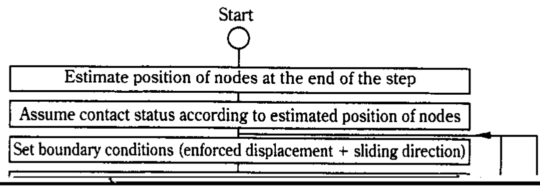
# Elasto-Plastic Finite Element Analysis of Strip Curvature and Internal Stress Imparted by Roller Leveler

## 要旨

極薄鋼板のローラレベラ矯正仮定において鋼板に発生する残留応力と反りを予測するために弾塑性有限要素法による解析を実施し




Start
Estimate position of nodes at the end of the step
Assume contact status according to estimated position of nodes
Set boundary conditions (enforced displacement + sliding direction)

[redacted]

Table 2 Conditions of case 1

| | | |
|---|---|---|
| Thickness of strip | (mm) | 0.19 |
| Yield stress of strip | (MPa) | 420 |
| Work hardening coefficient of strip | (MPa) | 700 |

$$\varkappa = \frac{6h'}{p^2} f(\alpha)$$

$$f(\alpha) = \frac{\alpha^2(e^{\alpha} - e^{-\alpha})}{3\{\alpha(e^{\alpha} + e^{-\alpha}) - (e^{\alpha} - e^{-\alpha})\}}$$

$$\alpha = \sqrt{\frac{Ttp^2}{\ldots}}$$

$\varkappa$: Curvature (maximum)

$h'$: Intermesh

$p$: Half roll pitch

$T$: Tension

[redacted]

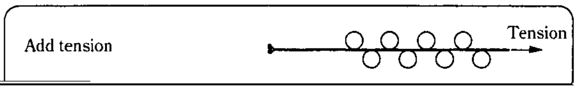
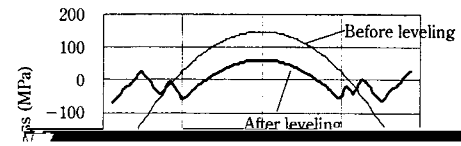



Table 4 Contact point at each roll

| Contact roll | Distance (mm) | Direction |
|---|---|---|




ここで，初期 L 反りは −18 mm（上に凸），出側インターメッシュ 3.2 mm，実験における張力は 20 MPa であり，反り量は長さ 1 m あたりの値である。美坂の式を用いた場合に比べ FEM による計算結果は実験結果に近い結果が得られている。また，張力の変化に対す