

「Rectangularity in Slab Rolling」

Rectangularity in Slab Rolling*

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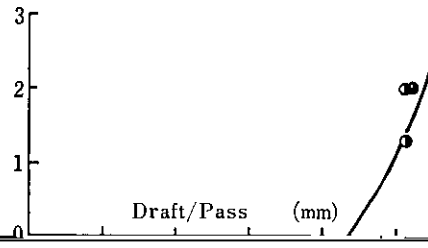
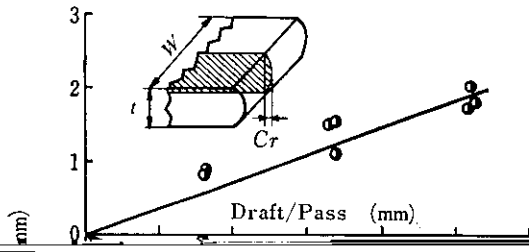
| Condition | Parameter 1 | Parameter 2 | Parameter 3 |
|-----------|-------------|-------------|-------------|
| 1 | 0.5 | 0.5 | 0.5 |
| 2 | 0.5 | 0.5 | 0.5 |
| 3 | 0.5 | 0.5 | 0.5 |
| 4 | 0.5 | 0.5 | 0.5 |
| 5 | 0.5 | 0.5 | 0.5 |
| 6 | 0.5 | 0.5 | 0.5 |
| 7 | 0.5 | 0.5 | 0.5 |
| 8 | 0.5 | 0.5 | 0.5 |
| 9 | 0.5 | 0.5 | 0.5 |
| 10 | 0.5 | 0.5 | 0.5 |
| 11 | 0.5 | 0.5 | 0.5 |
| 12 | 0.5 | 0.5 | 0.5 |
| 13 | 0.5 | 0.5 | 0.5 |
| 14 | 0.5 | 0.5 | 0.5 |
| 15 | 0.5 | 0.5 | 0.5 |
| 16 | 0.5 | 0.5 | 0.5 |
| 17 | 0.5 | 0.5 | 0.5 |
| 18 | 0.5 | 0.5 | 0.5 |
| 19 | 0.5 | 0.5 | 0.5 |
| 20 | 0.5 | 0.5 | 0.5 |
| 21 | 0.5 | 0.5 | 0.5 |
| 22 | 0.5 | 0.5 | 0.5 |
| 23 | 0.5 | 0.5 | 0.5 |
| 24 | 0.5 | 0.5 | 0.5 |
| 25 | 0.5 | 0.5 | 0.5 |
| 26 | 0.5 | 0.5 | 0.5 |
| 27 | 0.5 | 0.5 | 0.5 |
| 28 | 0.5 | 0.5 | 0.5 |
| 29 | 0.5 | 0.5 | 0.5 |
| 30 | 0.5 | 0.5 | 0.5 |
| 31 | 0.5 | 0.5 | 0.5 |
| 32 | 0.5 | 0.5 | 0.5 |
| 33 | 0.5 | 0.5 | 0.5 |
| 34 | 0.5 | 0.5 | 0.5 |
| 35 | 0.5 | 0.5 | 0.5 |
| 36 | 0.5 | 0.5 | 0.5 |
| 37 | 0.5 | 0.5 | 0.5 |
| 38 | 0.5 | 0.5 | 0.5 |
| 39 | 0.5 | 0.5 | 0.5 |
| 40 | 0.5 | 0.5 | 0.5 |
| 41 | 0.5 | 0.5 | 0.5 |
| 42 | 0.5 | 0.5 | 0.5 |
| 43 | 0.5 | 0.5 | 0.5 |
| 44 | 0.5 | 0.5 | 0.5 |
| 45 | 0.5 | 0.5 | 0.5 |
| 46 | 0.5 | 0.5 | 0.5 |
| 47 | 0.5 | 0.5 | 0.5 |
| 48 | 0.5 | 0.5 | 0.5 |
| 49 | 0.5 | 0.5 | 0.5 |
| 50 | 0.5 | 0.5 | 0.5 |
| 51 | 0.5 | 0.5 | 0.5 |
| 52 | 0.5 | 0.5 | 0.5 |
| 53 | 0.5 | 0.5 | 0.5 |
| 54 | 0.5 | 0.5 | 0.5 |
| 55 | 0.5 | 0.5 | 0.5 |
| 56 | 0.5 | 0.5 | 0.5 |
| 57 | 0.5 | 0.5 | 0.5 |
| 58 | 0.5 | 0.5 | 0.5 |
| 59 | 0.5 | 0.5 | 0.5 |
| 60 | 0.5 | 0.5 | 0.5 |
| 61 | 0.5 | 0.5 | 0.5 |
| 62 | 0.5 | 0.5 | 0.5 |
| 63 | 0.5 | 0.5 | 0.5 |
| 64 | 0.5 | 0.5 | 0.5 |
| 65 | 0.5 | 0.5 | 0.5 |
| 66 | 0.5 | 0.5 | 0.5 |
| 67 | 0.5 | 0.5 | 0.5 |
| 68 | 0.5 | 0.5 | 0.5 |
| 69 | 0.5 | 0.5 | 0.5 |
| 70 | 0.5 | 0.5 | 0.5 |
| 71 | 0.5 | 0.5 | 0.5 |
| 72 | 0.5 | 0.5 | 0.5 |
| 73 | 0.5 | 0.5 | 0.5 |
| 74 | 0.5 | 0.5 | 0.5 |
| 75 | 0.5 | 0.5 | 0.5 |
| 76 | 0.5 | 0.5 | 0.5 |
| 77 | 0.5 | 0.5 | 0.5 |
| 78 | 0.5 | 0.5 | 0.5 |
| 79 | 0.5 | 0.5 | 0.5 |
| 80 | 0.5 | 0.5 | 0.5 |
| 81 | 0.5 | 0.5 | 0.5 |
| 82 | 0.5 | 0.5 | 0.5 |
| 83 | 0.5 | 0.5 | 0.5 |
| 84 | 0.5 | 0.5 | 0.5 |
| 85 | 0.5 | 0.5 | 0.5 |
| 86 | 0.5 | 0.5 | 0.5 |
| 87 | 0.5 | 0.5 | 0.5 |
| 88 | 0.5 | 0.5 | 0.5 |
| 89 | 0.5 | 0.5 | 0.5 |
| 90 | 0.5 | 0.5 | 0.5 |
| 91 | 0.5 | 0.5 | 0.5 |
| 92 | 0.5 | 0.5 | 0.5 |
| 93 | 0.5 | 0.5 | 0.5 |
| 94 | 0.5 | 0.5 | 0.5 |
| 95 | 0.5 | 0.5 | 0.5 |
| 96 | 0.5 | 0.5 | 0.5 |
| 97 | 0.5 | 0.5 | 0.5 |
| 98 | 0.5 | 0.5 | 0.5 |
| 99 | 0.5 | 0.5 | 0.5 |
| 100 | 0.5 | 0.5 | 0.5 |

Top line and

Trail and

Draft/pass (mm)

Draft/pass (mm)



3 "Bite and Back" Rolling Method

shown in (a) and the leading portion of an ingot, then

1.

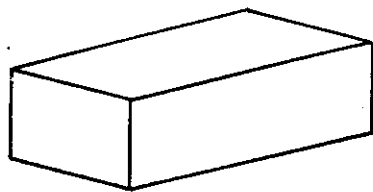
From the experimental studies mentioned in Chapter 2, the following conditions were determined:

material to make recessed portions. Then, shift rolls

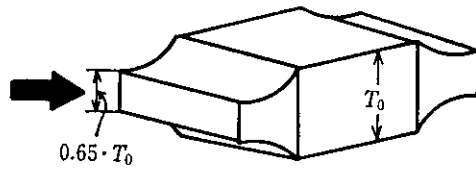
rectangularity have been obtained:

(1) In view of the fact that crop length in the thickness direction at the center of the width direction be-

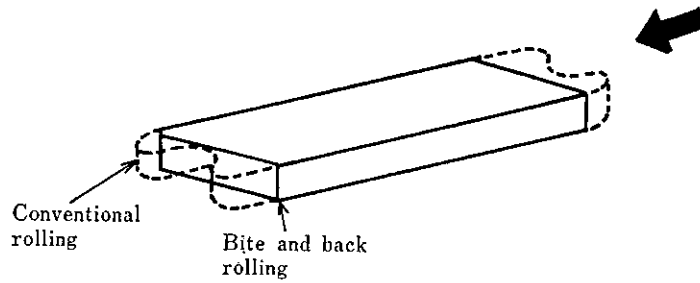
(b). Set rolls at a proper gap (T_2) and roll the portion not yet rolled in the reverse direction as shown in (c) so that the hatched areas ηA_1 , ηA_3 , A_4 , and A_5 , which may develop into a crop at the tail end, are checked



(a) Ingot



(b) Bite and back rolling in the direction of thickness



(c) Plan view patterns of slab

$$2(1 - \eta)\Delta H_1^{3/2} - 3\Delta H_0 \cdot \Delta H_1^{1/2} - (1 + 2\eta) \times \Delta H_0^{3/2} = 0 \dots\dots\dots(7)$$

Here, numerical calculation is made under conditions of no swelling or no sagging of metal, that is, $\eta = 0$, and draft at the proper recess, ΔH_0 , is approxi-

Proper biting-stop length, Ld , is obtained by eq. (10):

$$Ld = (2R \cdot \Delta H_1)^{1/2} \dots\dots\dots(10)$$

On the basis of this calculation result, succeeding model experiments and mill experiments were con-

$$\Delta H_1 \doteq 1.866\Delta H_0 \dots\dots\dots(8)$$

In order to prove the validity of eq. (8) by model

actual-mill experiments was obtained as follows: Assuming that $R = 610$ mm and rolling reduction from the reverse direction $\Delta H_0 = 60$ mm, proper rolling reduction at the recess $\Delta H_1 = 62$ mm and proper

3.2 Confirmation Experiments by Using a Model

Prior to actual mill rolling, model experiments were conducted for confirming the effectiveness of "Bite and Back" rolling.

As the first step, efforts were made to clarify the effects of draft per pass and the number of "Bite and Back" rollings exercised upon the slab end, rectangu-

50 mm in thickness. Crop shapes on the width sides will give concave shapes under all conditions. These concave crops can be corrected if "Bite and Back" rolling in the width direction is properly incorporated in the "Bite and Back" rolling in the thickness direction.

As the second step, a rolling schedule was prepared which embodied the idea of the above mention-

3.3 Mill Experiment

shows the rectangularity of the slab resulting from the rolling schedule of Fig. 9. Photo. 3 proves that com-

