KAWASAKI STEEL TECHNICAL REPORT
No.4 ( December 1981 )
Special Issue on Steel Pipe

# Steel Sheet Deformation Behavior and Form ing Load Determination in the 26-inch Cage Forming ERW Pipe Mill

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Synopsis :
Behavior of steel sheet deformation as expres sed in strain history, projection trace and forming flowers, and methods of determining forming load as fin pass rolls and squeeze rolls have been investigated in the 26 in. cage forming ERW pipe mill. For the longitudinal strain of the sheet edge, only a gentle deformation is observed in the cage forming zone, while a considerably rapid defo rmation consisting mainly of tension and including compression is noticed at the ti me when the sheet passes through each fin pass roll. The local increase in wall thickness around the shee t edge is caused mainly by No.1 fin pass roll forming. On the contrary , almost uniform compressive deformation is conducted by No.2 fin pass roll forming. Th e forming load, which depends strongly on the strength and wall thickness of sheet, can be expressed by the summation of forces which are necessary for the circumferent ial reduction and the bending of sheet.



The body can be viewed from the next page.

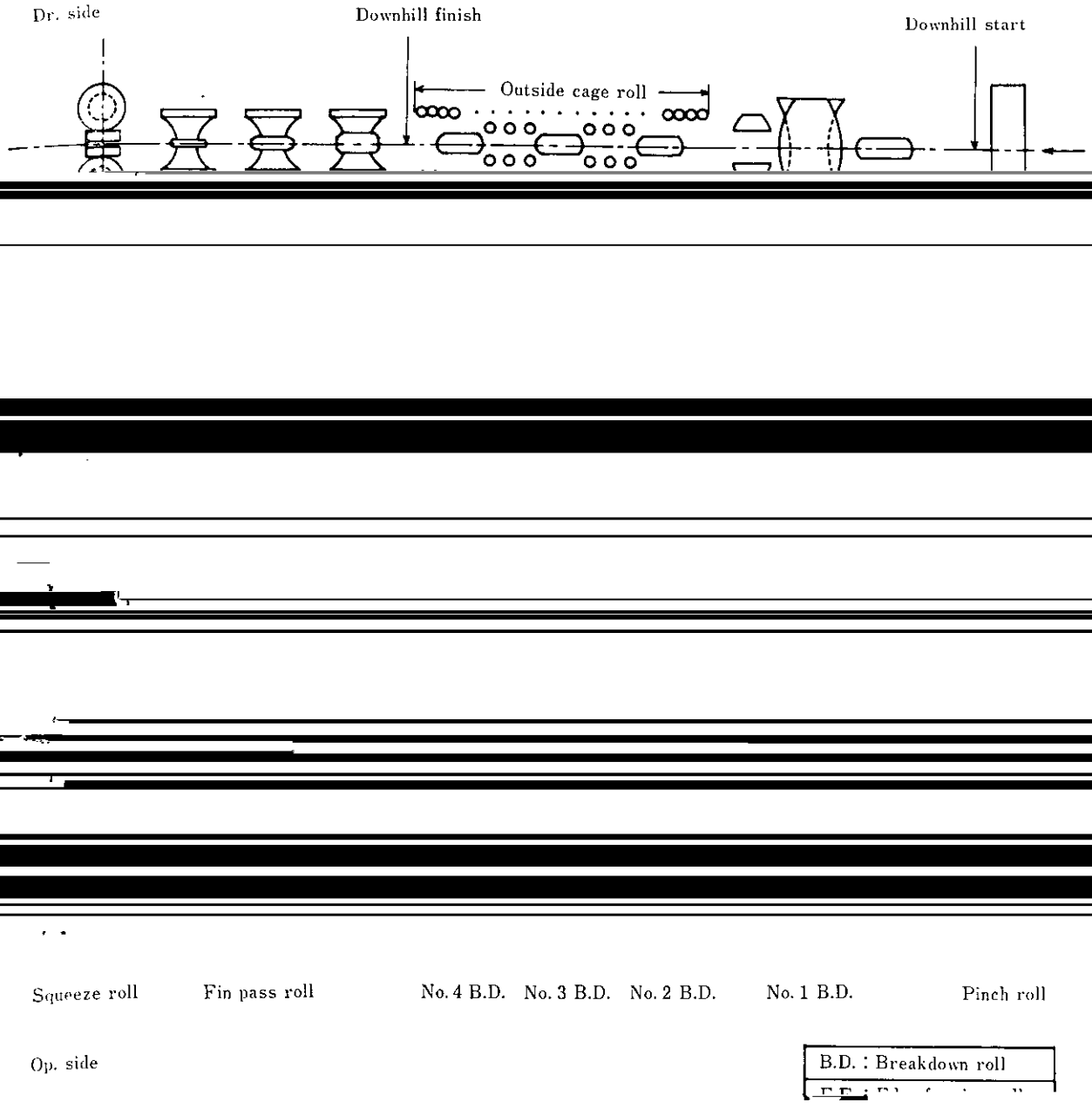
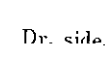
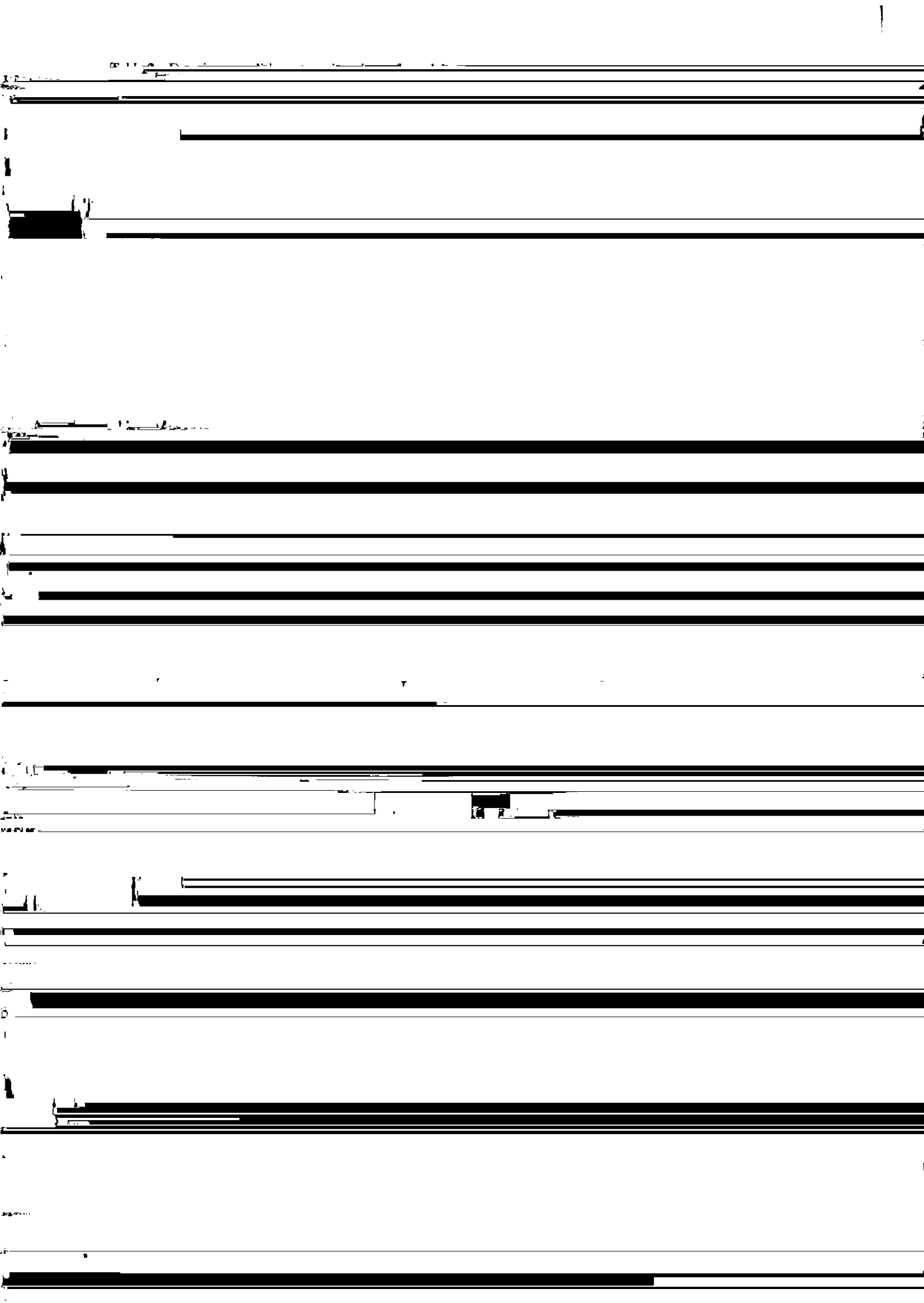



**Fig. 1** Layout of 26 inch cage forming ERW mill

in order to prevent strain gage damage due to contact



## 3 Experimental Results

### 3.1.1 From the pinch roll to edge forming roll

### 3.1.2 From edge forming roll to squeeze roll

The longitudinal strain is shown in **Fig. 7. Photo.**

zone, and **Photo. 2**, that during the entry to No. 1 fin pass roll. In the cage zone, little variation is

increase in tensile strain is observed

caused by its fitting to the roll.

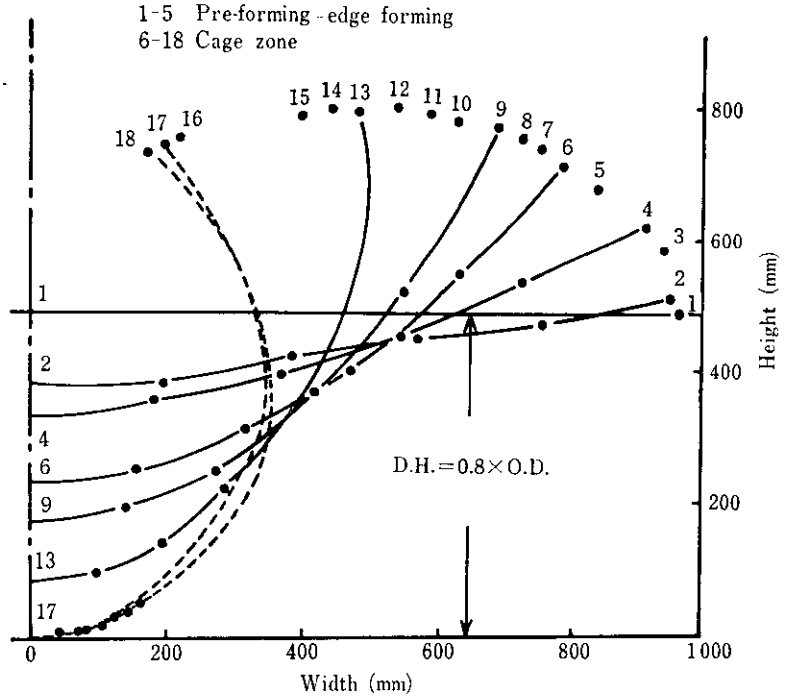
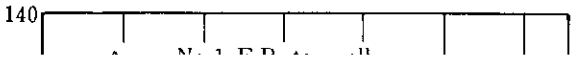
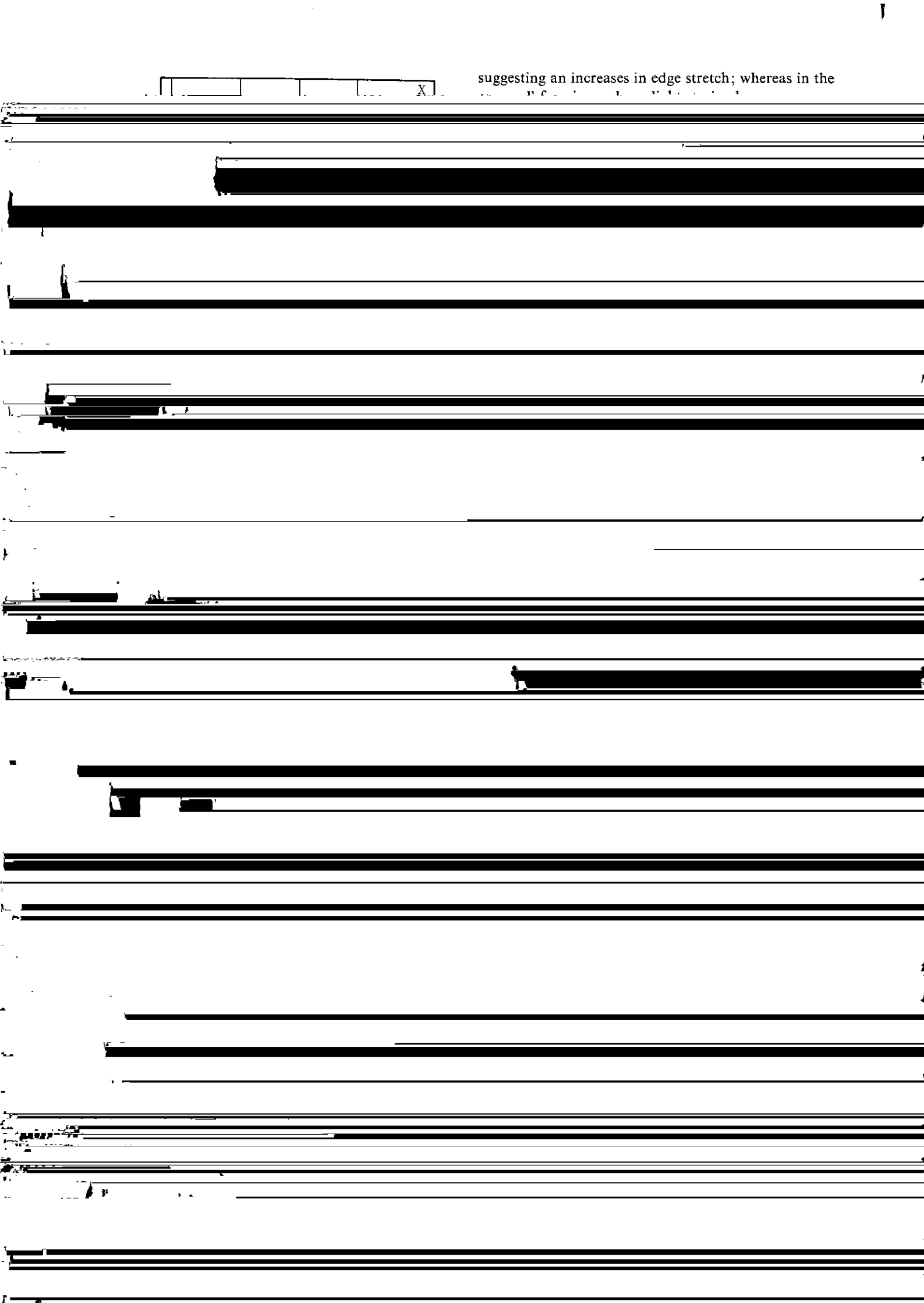


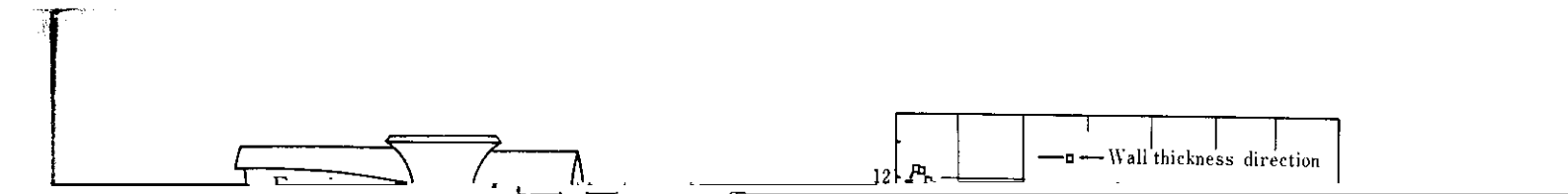

**Fig. 10** Forming flower in the case of 0.8 × O.D. downhill height

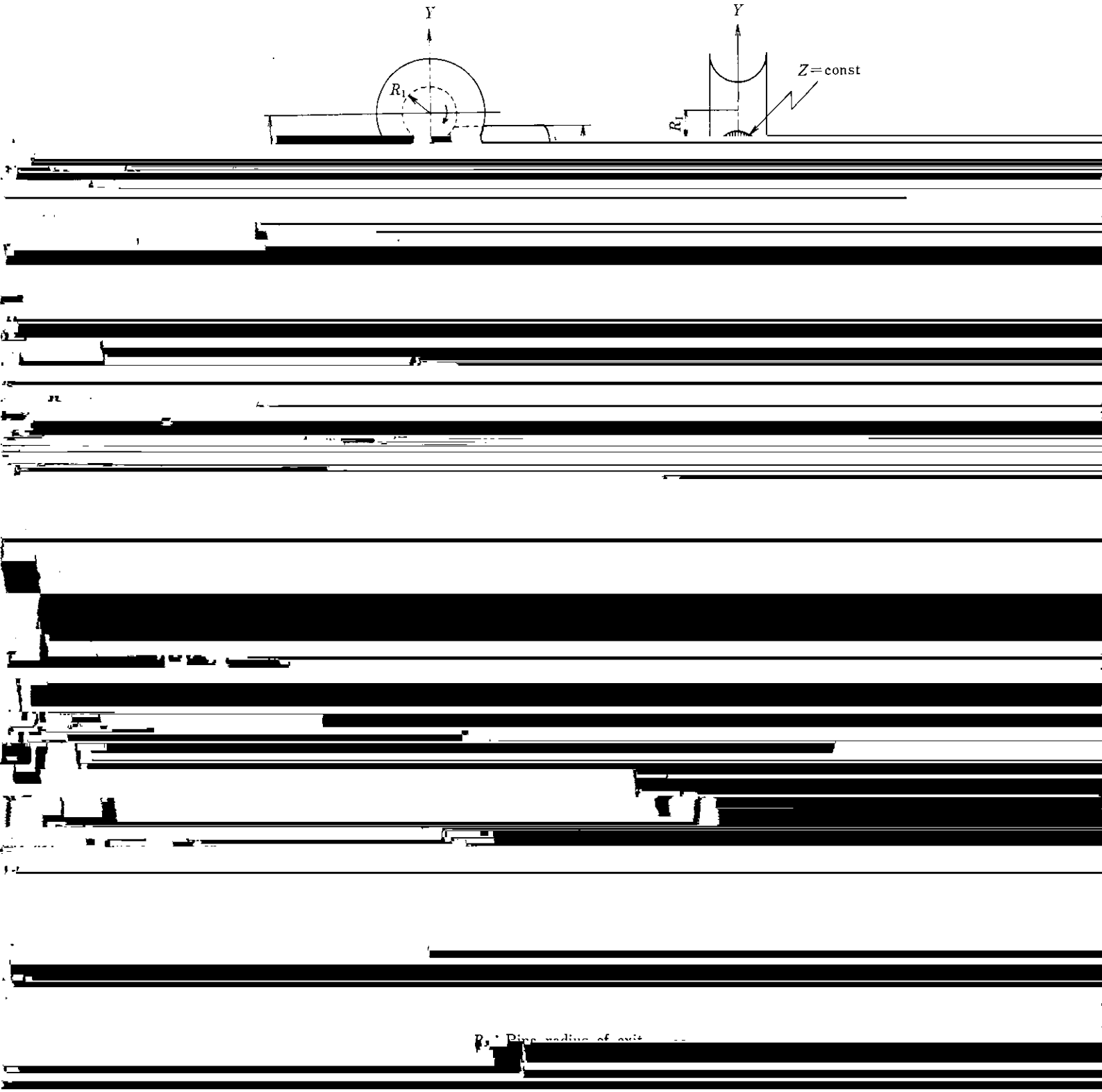
cage zone ($\Delta H_{max} \cong 0.5 \times$ O.D.), and then gradually






suggesting an increases in edge stretch; whereas in the


12
Wall thickness direction




$a$ : Roll radius
$R_1$ : Roll bottom radius

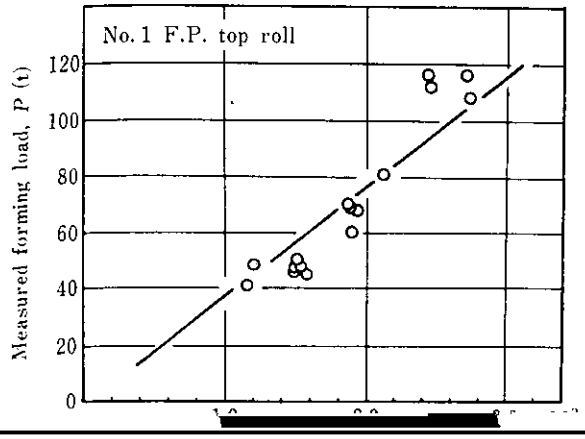
**Fig. 16** Schematic diagram of contact area on the outside surface of pipe reduced by two rolls[24]

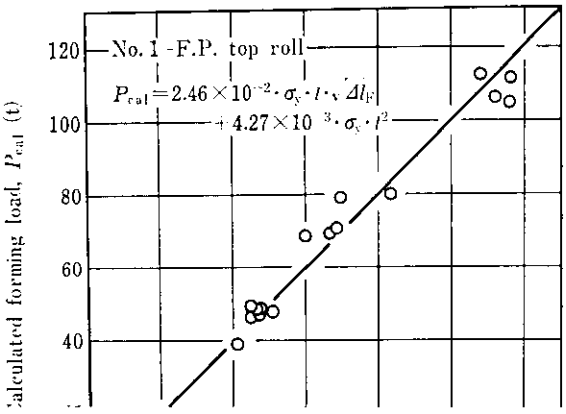
steel sheet, but it also behaves differently depending on a steady or unsteady state in tandem forming[23].

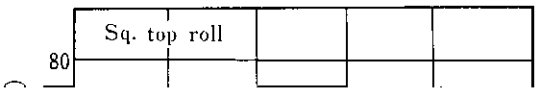
Therefore, the explicit analysis of forming load has been said to be considerably difficult. In the simplified two-roll-type true circular roll as shown in Fig. 16

$$P = 2\sigma_y \cdot t \cdot \sin\theta \cdot \sqrt{2R_1/\pi} \cdot \sqrt{\Delta l_C} \quad \cdots\cdots(3)$$

(It is assumed here that eq. (1)′ is approximately true also for fin pass and squeeze roll with two rolls or more.)


No. 1 F.P. top roll
Measured forming load, P (t)
120
100
80
60
40
20
0


No. 1 -F.P. top roll
$P_{cal}=2.46\times10^{-2}\cdot\sigma_s\cdot t\cdot\sqrt{\Delta l_F}$
$+4.27\times10^{-3}\cdot\sigma_s\cdot t^2$
Calculated forming load, $P_{cal}$ (t)
120
100
80
60
40




pressive and then tensile strain directly before No. 1 fin pass roll.

(4) Circumferential reduction is apparently much

## References

17) Y. Azuma, N. Torii et al.: *The57th Symposium of J.S.T.P.*, (1976), p. 64