KAWASAKI STEEL GIHO Vol.3 (1971) No.3

Computer Control System of a Hot Strip Mill and Operation Results

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	(Kenji Kataol	ka) ⁻	(Takashi Minematsu)	(Takashi
Mikuriy	va)				
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		80			1964
	1970				
Sims					
				±50μ	95

Synopsis :

The development of a computer control system of 80" hot strip mill at Chiba Works began in 1964, and successfully completed in March, 1970. The function of this system covers slab tracking from the furnace delivery to the coilers, mill pacing, roughing and finishing mill set up, coiling temperature control, and data logging. Finishing mill set up is the most important one, and strenuous exertion has been made toward developing

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Table 1Important date of development1964,JulyInstallation of TOSBAC-33001965,FebruaryInstallation of F 6 stand	
1964,JulyInstallation of TOSBAC-33001965,FebruaryInstallation of F 6 stand	· · · ·
1965, February Installation of F 6 stand	
	5
September Data logging, off-line data analysis	
1966, July Start of on-line set-up caliculation	
November First set up experiments	
Installation of F7 stand	······································
December Decision made to install TOSBAC-	-7000
1967, September Second set up experiments	p
1968, January Removal of TOSBAC-3300	
	· · · · · · · · · · · · · · · · · · ·
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November Third set up experiments	
4th set up experiments	
1969, March Start of computer operation	
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Reheating furnace $4 \times 250 \text{ t/h}$ 5-zone			Table 2	Main	specifications	of mill	
		Reheating furnace	-	- <u>.</u>	$4 \times 250 \text{ t/h}$	5-zone	•
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	reversing stand
Rougher	R 2 2-high, 6000 kW, AC drive
_	R 3 4-high, 6000 kW, AC drive
	R 4 4-high, 6000 kW, AC drive
	Stand 7-stands
	Main motor F-1 4500 kW
	F-2 through F-6 5250 kW
	F-7 4500 kW
	Roll speed F-1 $31 \sim 81$ rpm
	F-2 52~127 rpm
	F-3 76~185 rpm
	F-4 110~275 rpm
Finisher	F-5 150~365 rpm
	F-6 175~430 rpm
	F-7 200~460 rpm
	Roll 698 $\phi \times 1524 \times 2032$ mm
	Screw down motor DC $75/150$ HP $\times 2$
	Ward Leonard Control
:	Finishing Thickness 1.20~16.0 mm



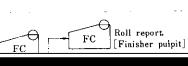
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Table 3 Computer specifications Arithmetic unit Circuit Si solid state logic circuit Word 24 bits+1 bit parity Arithmetic operation binary parallel fixed point, floating point with program Operation time ADD 6.8 µ sec DVD 30.9 µ sec I/O Channel I/O Channel 6 channels I/O Channel 6 channels Core memory Cycle time 3.2 µ sec Index register	Arithmetic unit Circuit Si solid state logic circuit Arithmetic operation Dinary parallel fixed point, floating point with program Operation time ADD 6.8 µ sec MUL 15.98~26.18 µ sec DVD 30.9 µ sec I/O Channel 6 channels I/O Channel 3.2 µ sec I/O Core memory 16,384 Words I/O Channel 5.2 µ sec			
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	Vol.3 No.3 ホットストリップミルの計	算機制御システムと運転実績	299	
<u>La 64</u>	ーが使用されている。38グループ(16ビット/グ ループ)が実装されており、このうちの数グルー	1) 検 出 器 スラブトラッキング用の板検出器に	t,板の赤外	
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	出力点選択用にあてられる。これにより出力数を 増やしている。	より検出するロードリレーなどを使用 板の表面温度は、仕上出側までは、		
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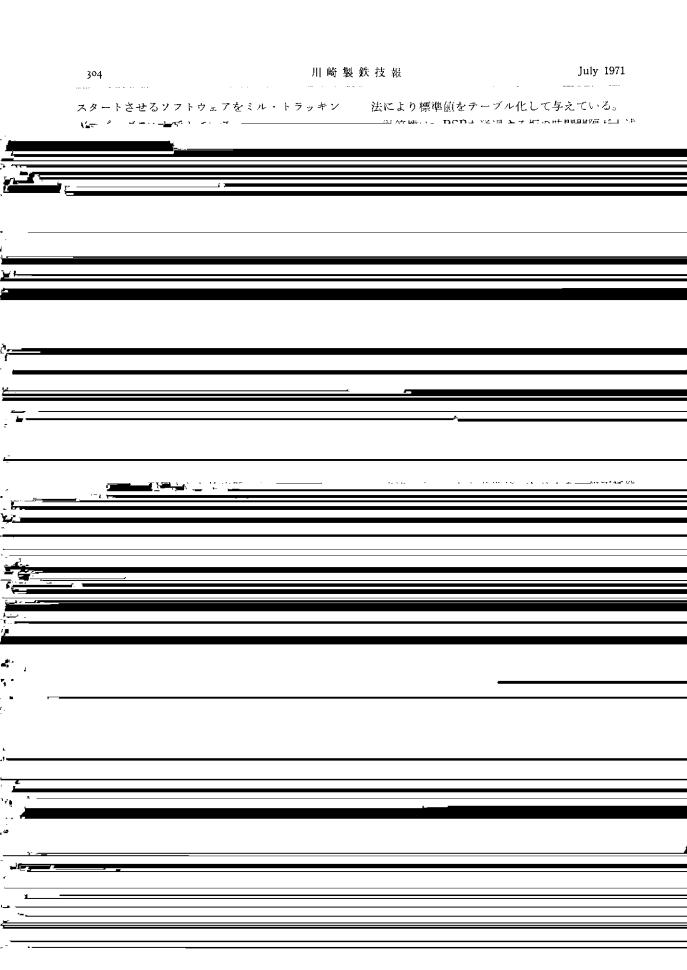
July 1971

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		ypical sensors
Measured value	Location	Sensor specifications
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		load relays with load cells
Rolling force	$R_1 \sim R_4$, $F_1 \sim F_7$	Pressductor, 2×1800 t (each stand)
	R₄ delivery	Photo-electric pyrometer, 800~1400°C
	· · · ·	Photo-electric pyrometer, 600~1200°C
Bar temperature		Photo-electric pyrometer, 600~1000°C
	· · · · · · · ·	total radiation pyrometer, 400~800°C
		total radiation pyrometer, 400-2000 C
Strip thickness	F-7 delivery	Raymike—600 X ray gauge, 0~16.00 mm
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Poll gan		Chaft position anonder with celeve drive
Roll gap	$R_1 \sim R_4$, $F_1 \sim F_7$	Shaft position encoder with selsyn drive, increment 0.01 mm
Roll gap Roll speed	$R_1 \sim R_4$, $F_1 \sim F_7$ $F_1 \sim F_7$	
	Rolling force Bar temperature Strip thickness	Measured value Location Image: Description of the second

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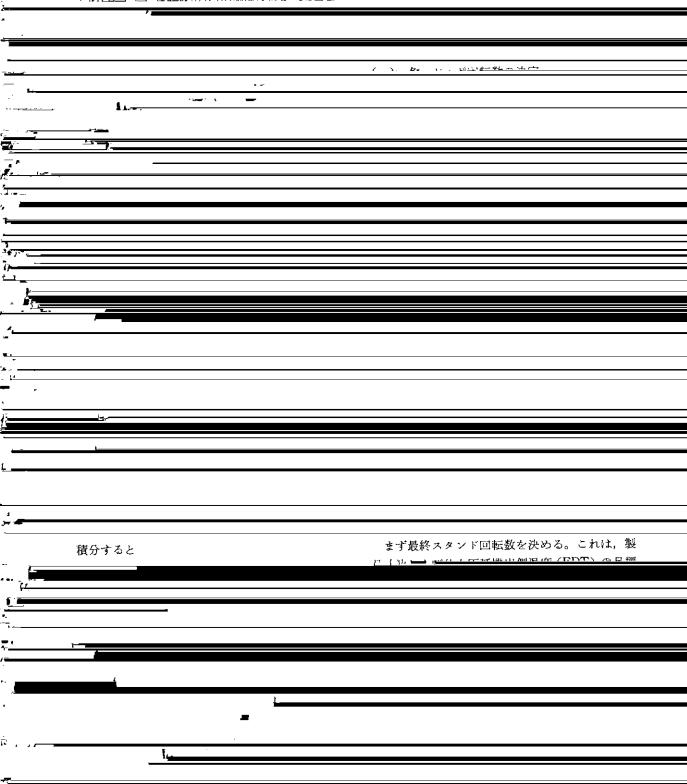
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Strip spec	· · · · · · · · · · · · · · · · · · ·		期データ項目を	Table 6 に示す。	
Customer	Card			とに,オペレータがコイ をインプットする必要は	
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	Table 6 Initial Data		ることができる。	抽出時に必要なデータ	は,スラ



	Vol.3 No.3	ホットストリップ	ミルの計算機制御システムと運	転実績	305
をチェックし,また 設定完了か否かをチ は, 警報を発信する		ェックし異常な場合	Start	· · · ····	
}	3.5 _件 片圧延機の	白動設宏	To predict FET from	T · J t Jond	
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σ : ステファン・ボルツマン定数 (4.88 kcal/m²h^oK⁴) T:板の温度(^oK) T_a:周囲温度(^oK) であ<u>ζ.</u>(1) 式を板がR4出側温度計から仕上圧 である。 a_i , b_i の値は,実際の圧延データから求める。

なお形状調整のために、オペレータがF5~F7 板厚を修正できる機能を備えている。



$$\frac{R_{i}^{\prime}}{R_{i}} = 1 + \frac{2C_{i}F_{i}}{B(h_{i-1} - h_{i})} \quad \dots \quad (8)$$

$$C_{i} = \frac{8(1 - \nu_{i}^{2})}{\pi E_{i}} \quad \dots \quad (9)$$
人上の式で

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Ľ F_i : 圧延荷重(t) B :板幅 (mm) K_i :平均変形抵抗 (t/mm²) R'_i : 偏平変形したロールの半径 (mm) r_i : 圧下率 **b**,:由立古の城垣(mm)

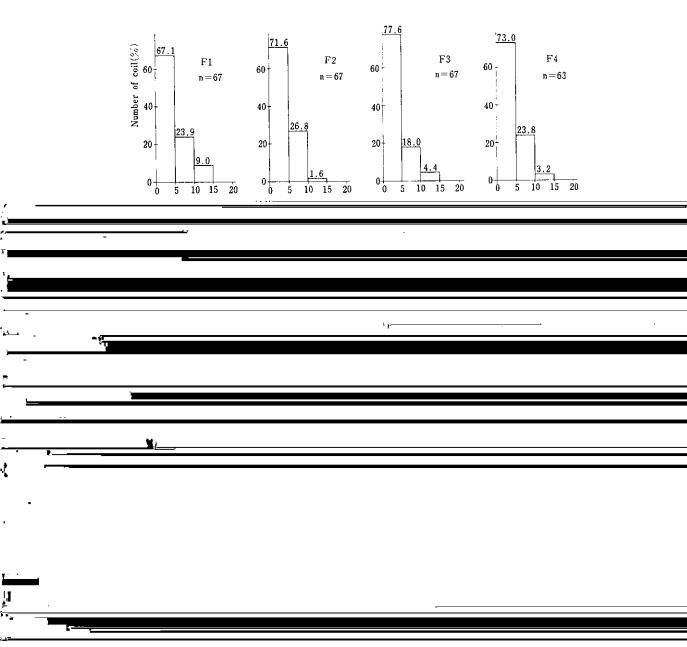
.....(13)

$$f_2(r_i) \equiv \sqrt{\frac{1 - r_i}{r_i}} \cdot \log_e (1 + x_i^2) \cdot (1 - r_i)^{\frac{1}{2}}$$
.....(14)

となる。この結果 (5), (8) 式は, F_i , R_i' の 連立2次方程式に帰着され,簡単に解が求められ る。この方法によれば、近似精度は5%以内であ り,計算時間は繰返し法に比して約1/5に短縮さ れる。

次に(5)式を使う場合に、平均変形抵抗 Ki の値が必要である このためにけ 試片を試験機

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	3.6 卷取温度制御		4 海村中体144月	
	板の先端が最終スタ	ンドを出てから,一定長さ	4. 運転実績と効果	
		よび板の温度(FDT) を測		
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	極的に使用されている。とくに45年4月より4直	れ, 生産量が増大する。本システムでは, 以上を <u>ぬみ, マール 在宅ま 15+76 の点 しがみらわる</u>
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ットの平均本数が約3本であり、セット替が多

著しく低下する結果となっている。 これは 1 ロニニー ミスロール本数の減少による圧延歩止りの向」: は 0.1 %,板厚・板幅および温度不良コイルの減

