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Development of Heavy Section Steel Plates with Improved Internal Properties through Forging and Plate Rolling Process Using Continuous Casting Slabs

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400 MPa 240 mm

1.3

Synopsis :

Heavy steel plates with thickness of over 150 mm have usually been manufactured by using materials obtained through ingot casting process, in consideration of the internal properties. The possibility of applying a forging process before plate rolling was investigated to secure both homogeneous and sound internal properties by using continuous casting slabs, instead of ingot casting slabs. When a certain annihilation of center porosities is considered, a forging method with reduction in widthwise direction before reduction in thicknesswise direction of slabs was found to be very effective. As a result of the application of this process for TS: 400 MPa class steel, it is concluded that excellent internal properties can be obtained in the manufacture of heavy steel plates with thickness of up to 240 mm (reduction ratio: 1.3).

連続鋳造スラブ鍛造による
内質特性の優れた厚肉鋼板の製造技術*

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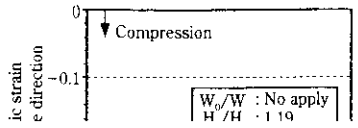
要旨

連続鋳造スラブを用いた厚肉鋼板の製造において、厚板圧延前にセンターポロシティの圧着に有利な鍛造プロセスを適用する方法を

Table 1 Condition of elastic-plastic stress calculation

Dimension of slab (mm)	310 × 2 240 × 3 000
Heating temperature (°C)	1 250



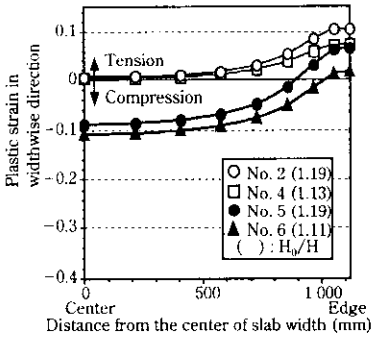


Fig. 4 Plastic strains by simulation in widthwise direction at the center of thickness ($B/H_0 = 0.74$)

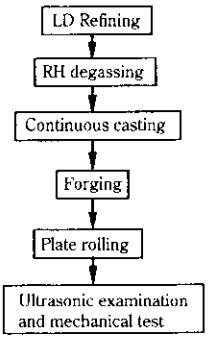


Fig. 6 Manufacturing process

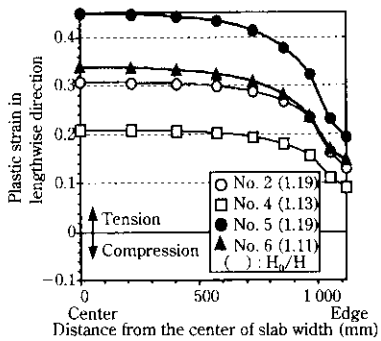


Fig. 5 Plastic strains by simulation in lengthwise direction at the center of thickness ($B/H_0 = 0.74$)

じたスラブ幅体積の分、長さ方向へのメタルフローが大きくなるこ

Continuous casting machine	Type: Vertical and bending Section of slab: 310 × 2 240 or 2 400 mm
Forging press	Type: Free hydraulic forging Capacity: Max. 7 200 t Anvil block: 800 × 3 800 mm Stroke: 3 000 mm
Plate rolling mill	Type: 4-Hi reversing Rolling force: Max. 8 000 t Work roll: ϕ1 220 × 5 490 mm

Table 4 Chemical composition

(mass%)

C	Si	Mn	P	S	Al
0.18	0.20	0.96	0.015	0.003	0.028

Table 5 Condition of forging and plate rolling (B/H_0: 0.74)

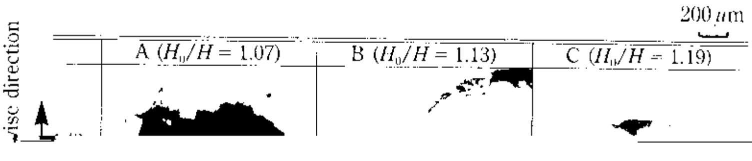


Photo 1 Micrographs of center porosities

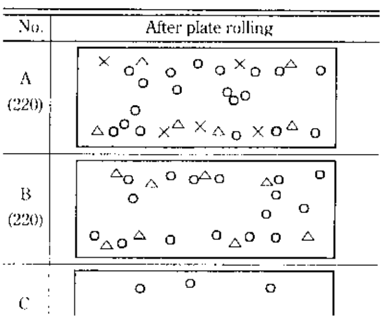
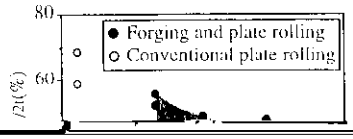


Table 7 Results of tensile test

No.	Location	Direction	YP (MPa)	TS (MPa)	El (%)	RA (%)
A			219	432	20	28
			217	426	19	27
			217	425	19	22
B			218	432	25	36
			216	430	20	29
			217	428	24	35
C	1/2 t	Z	218	435	25	37
			[illegible]	[illegible]	[illegible]	[illegible]



スでの $RA(Z)_{1/2t}$ は，製品厚 150 mm 以上で急に低下する傾向があるが，本製造プロセス適用鋼板では高位であることが分かる．