KAWASAKI STEEL TECHNICAL REPORT No. 36 July 1997

New Products & Technologies

Production of Trimming Free Thick Plates*

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1 Preface

With the maturation and structural changes taking place within industrial society in Japan, it has become necessary to achieve further reductions in cost and improve the level of quality of steel production in order to maintain and strengthen the international competitiveness of the Japanese steel industry. Competition in terms of cost and quality with newly industrializing economies (NIES) is particularly severe. As part of its ongoing efforts to realize such improvements, Kawasaki Steel responded promptly by introducing the plan view pattern control technique (MAS rolling method) in the area of thick plate production, thus improving yield rates up to as high as 93–94%. In spite of this notable achievement, technological innovations for further rationalization of the thick plate production process along with even higher yields have become necessary due to the circumstances mentioned above. As a result of dedicating itself to developing such newly required technology, Kawasaki Steel has since succeeded in developing the trimming free plate (TFP) production process. This method has made the trimming of plates by shearing during the finishing process unnecessary for the first time in the world by making the plan view pattern and sectional view pattern rectangular. This report introduces an outline of this technique.

2 Required Conditions and Technical Details of the TFP Process

It is essential that the TFP as rolled have an edge sectional profile, a plan view pattern, and a size accuracy which are equal to or better than those of steel plates cut by conventional shearing methods. The conditions required for the TFP process are shown schematically in **Fig. 1**. In order to satisfy these conditions, the TFP process must incorporate technologies for (1) square edge control, (2) rectangular plan view pattern control, and (3) high-accuracy edge cutting. Newly installed equipment and details of control related to these technologies are summarized in **Table 1**, while the main steps of the TFP process are shown in **Fig. 2**. In addition, specifications for the major equipment used in the

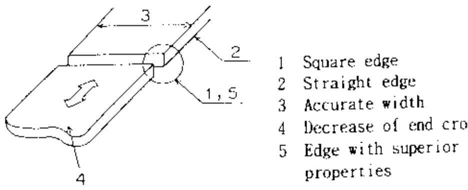

Fig. 1 Requirements for TFP

Table 1 Technology, equipment and control required for TFP

Technology	Newly installed equipment	Control
① Square edge control ② Rectangular plan view pattern control	· Attached edger	· Combined techniques of MAS rolling and edging · FF-AWC control · Camber control
③ High-accuracy edge cutting	· Profile meter · High-accuracy aligning equipments · Edge miller	· High-accuracy aligning control based on data measured by profile meter · High-accuracy edge cutting control based on data measured by profile meter

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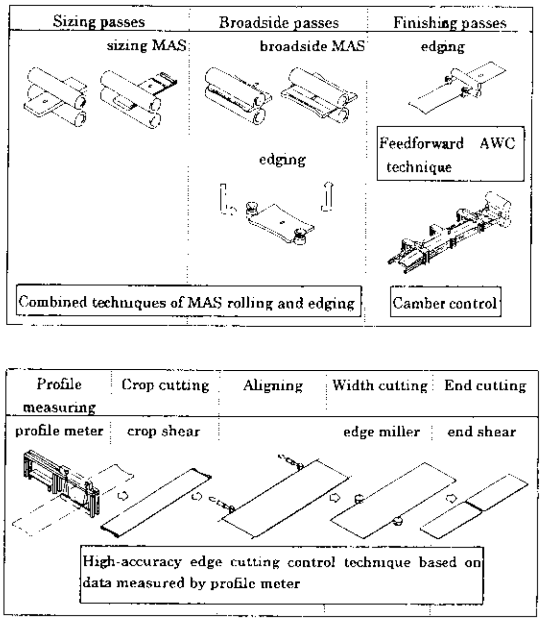

Fig. 2 Main steps of TFP process

Table 2 Specification of the edger

Rolling force	(t)	400
Rolling torque	(kN·m)	490
Rolling speed	(m/s)	2.5 ~ 7.5
Roll diameter	(mm)	ϕ 800/ϕ 700
Speed of motorized screw-down	(mm/s)	60/120
Speed of hydraulic AWC	(mm/s)	100

Table 3 Specification of the milling

Place	Between side shear and end shear
Type	Helical milling
Cutter head (mm)	ϕ 1 000 × 2
Feed speed (m/min)	Max. 42
Depth of cut	20 mm/each side max.
Work thickness (mm)	4.5 ~ 80
Milling control	Center position control (CPC) Edge position control (EPC) Straight position control (SPC)
Motor power (kW)	DC 200 × 2

process are shown in **Tables 2** and **3**.

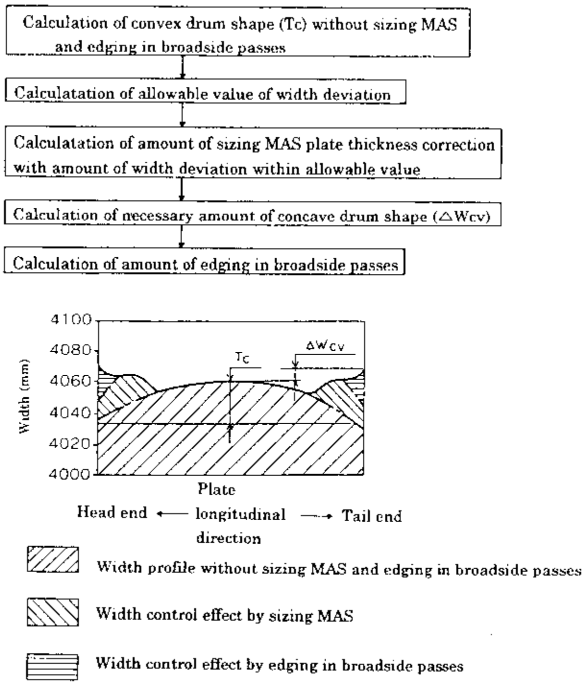

Fig. 3 Optimization of combined techniques

3 Combined Techniques of MAS Rolling and Edging

This section outlines the combined techniques of MAS rolling and edging which together comprise the most important aspects of the TFP production process. The width profile at the end of the broadside pass is affected by MAS rolling during the sizing pass and by edging during the broadside pass. Therefore, it is necessary to formulate a model for estimating the width profile which takes both MAS rolling and edging in these passes into consideration. This estimation model consists of a formula to estimate the value for convex shape (the difference between the middle width and the width of the head and tail ends) and a formula to estimate changes in the value of convex shape due to edging during the broadside pass. The concept of width control using these model formulas is shown in **Fig. 3**. Figure 3 also shows the effect of MAS rolling on the width profile during the sizing pass, the effect of edging during the broadside pass on the width profile, and the width profile achieved by means of the combined technique compared with the ordinary width profile. Kawasaki Steel has been working to optimize this combined process based on the following ideas.

(1) The shortage of width at the head and tail ends due to MAS rolling alone is to compensated by edging.

(2) When deviations in width caused by MAS rolling are large, the ratio of MAS rolling is to be reduced, and the degree of edging is to be increased in correspondence with the reduction in MAS rolling ratio.

Similarly, head and tail end crop cutting is controlled by optimizing the combination of MAS rolling during the broadside pass and edging during the finishing pass. Because of the above, the TFP technique is not simply an AWC control method achieved through the use of edgers. The full effect of the TFP technique cannot be obtained by relying on the AWC technique alone.

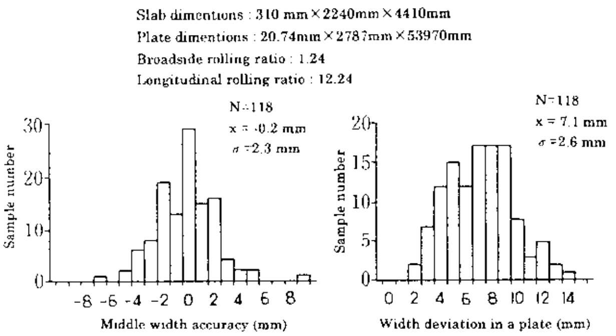

Fig. 4 An example of width accuracy and width deviation with TFP process

4 Present State of the TFP Process

Figure 4 shows the results of middle width accuracy between plates and width deviation within a plate when the TFP process is applied, while **Fig. 5** shows a comparison between the conventional process and TFP process with regard to side crop loss as well as head and tail crop loss. An improvement in yield rate of about 2% was achieved through the adoption of the TFP technique, resulting in the ordered yield rate reaching a rate on the order of 95–96% at present.

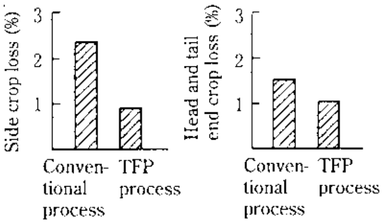

Fig. 5 Crop loss saving with TFP process

5 Conclusion

The Thick Plate Shop of the Mizushima Works of the Kawasaki Steel has instituted the TFP technique using edgers installed just after the finishing mill stand and milling equipment on the shear line, together with various controls relating to these equipments. By adopting this technique, Kawasaki Steel has been able to realize a significant advance in its system of marketing large volumes of steel plates which have a stable accuracy in width and length that is yet further step forward of past achievements.

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