

MENADŽMENT KVALITETA U POZICIONIRANJU ZAGRIJEVNIH PEĆI U RASPOREDU POSTROJENJA MODERNIH VALJAONICA

QUALITY MANAGEMENT IN POSITIONING OF THE RE/HEATING FURNACES AT A LAYOUT OF THE MODERN (SECTION, BAR OR WIRE ROD) ROLLING MILLS

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REZIME

U ovom radu su predstavljene neki aspekti menadžmenta kvaliteta u pozicioniranju zagrijevanih peći u rasporedu postrojenja modernih profilnih, žičnih i valjaonica za šipkaste proizvode. Teoretska i praktična rješenja u prethodno spomenutom polju su predstavljena za žične i sitne pruge. U vezi tih spomenutih valjaonica, data su obrazloženja, koja potvrđuju da i neočekivana rješenja, s teoretskog aspekta, mogu biti uspješna opravdana u praksi, posebno ako su potrebna neka unapređenja, koja treba da budu urađena na već postojećim postrojenjima, tj pri postojećem rasporedu postrojenja valjaonice, ili ako su u blizini vitalnih postrojenja te valjaonice, ili pak susjednih postrojenja, kao što su koninuirane ljevalice itd. Kao praktična potvrda tog zaključka, u radu su predstavljene i objašnjeni su primjeri pozicioniranja zagrijevanih peći iz ŽELJEZARE ZENICA (tj sadašnjeg ARCELORMITTAL-a ZENICA).

Ključne riječi: Pozicioniranje, zagrijevne peći, raspored postrojenja na modernim valjaonicama

ABSTRACT

Some aspects of Quality Management in positioning of the re/heating furnaces at a layout of the modern section, bar or wire rod hot rolling mills are presented in this paper. Theoretical and practical solutions in the above mentioned (further a.m.) field are presented for both, wire rod and light section bar mills. Some of the a.m. aspects regarding these rolling mills are explained, confirming that even unexpected solution, from the theoretical point of view, could be successful and justified in practice, especially if some improvements are needed to be carried out on an existing layout of the concerned rolling mill, or in a vicinity of the other vital facilities on that rolling mill, or on the neighbouring facilities, like continuous casting machines etc. As a practical confirmation of that finding, the examples of the positioning of the re/heating furnaces from ŽELJEZARA ZENICA (now ARCELORMITTAL ZENICA) are presented and explained.

Key words: Positioning, re/heating furnaces, layout of the modern rolling mills

1. INTRODUCTION

Rolling mills technology of the section, bar or wire rod rolling mills is consisted of three basic phases: (1) preparation and heating of semi-products, (2) rolling and (3) adjusting procedures for delivery of the rolled products. Accordingly, in a layout of any modern section, bar or wire rod (hot) rolling mill it is a necessary to position one or more re/heating furnace/s, to be in an optimal position regarding the other main and auxiliary modern rolling mill equipment. In this paper it is presented an overview of the above mentioned (further a.m.) positioning, with a special view to the differences between theoretical v.s. practical approach and with some explanations from a practice, related to the IRON AND STEEL WORKS – ZENICA (now there is a new owner). Regarding the theoretical consideration of the a.m. positioning which is presented, as well as from the practical point of view in case of theoretically non-corresponding case, some explanations are given, concerned with specific requirements in a practice, from both technological and economic aspects. These specific requirements confirm that some practical solutions can be economically justified, although they are not in a compliance with theoretically technological recommendations.

2. MAIN THEORETICAL CONSIDERATIONS IN A POSITIONING OF THE RE/HEATING FURNACES AT A LAYOUT OF THE MODERN ROLLING MILLS

Most of modern section, bar or wire rod rolling mills have the same or a very similar position the re/heating furnace/s at their layouts. Main general and theoretical recommendations for the positioning of the re/heating furnace/s in modern rolling mills layout are the following [1,2,3,4,5,6,7,8]:

- Proximity to the roll stand/s,
- One way of product travel,
- Under a crane,
- In a compliance with the other auxiliary equipment,
- Enough space for the concerned workers in control, maintenance and repair works,
- Optimum costs in building and operating, concerned with a rolling mill requirements.

Actually, modern section, bar or wire rod rolling mills are supplied with walking-beam type of the reheating furnaces (pusher type is old-fashioned, and the other types are not appropriate for the a.m. rolling mills)

It is clear from Fig. 1, that a walking beam type re/heating furnace (under symbol 1) is in all cases (from a) to d), although the cases a) and b) are common for both, wire rod and bar mills, until the cases c) and d) are mostly concerned with wire rod mills, although could be applied at the bar mills with only coiling products) in an optimal position, because of the exit of the billets (from sq. 80-150 mm) from that furnace is in the line of rolling, but on top of it, it gives supreme opportunity that the first part of the billet is already in one way rolling process, until the remaining part is still in the furnace, since there is one way product travel.

Otherwise, these are the symbols at the fig. 1:

- 1-re/heating furnace,
- 2-rougher group of rolling stands,
- 3-intermediate group of rolling stands,
- 4-finishing group of rolling stands,
- 5-water cooling boxes for thermo-mechanical treatment (TMT),
- 6-cooling bed-area.

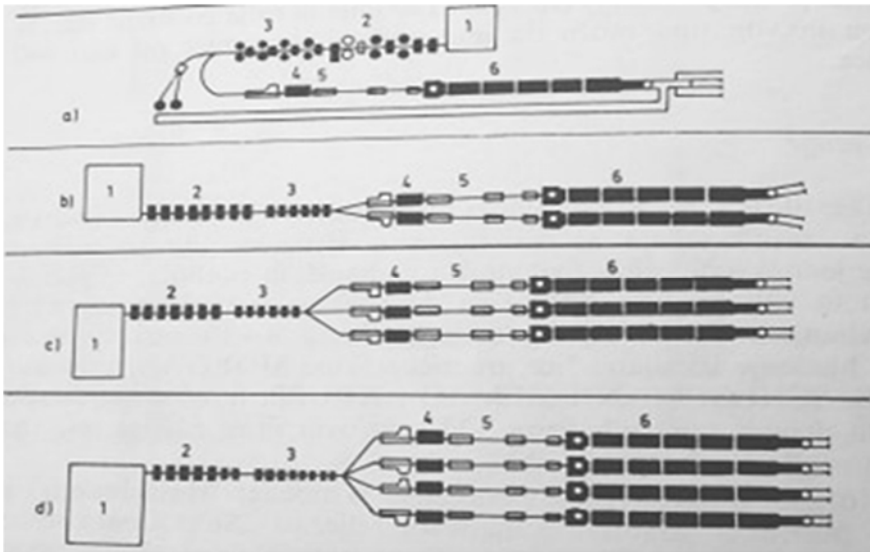


Figure 1. A layout of a modern generation of the rolling mills [4]

Theoretical example of a modern light section-bar two strands continuous rolling mill layout is presented at the Fig. 2.

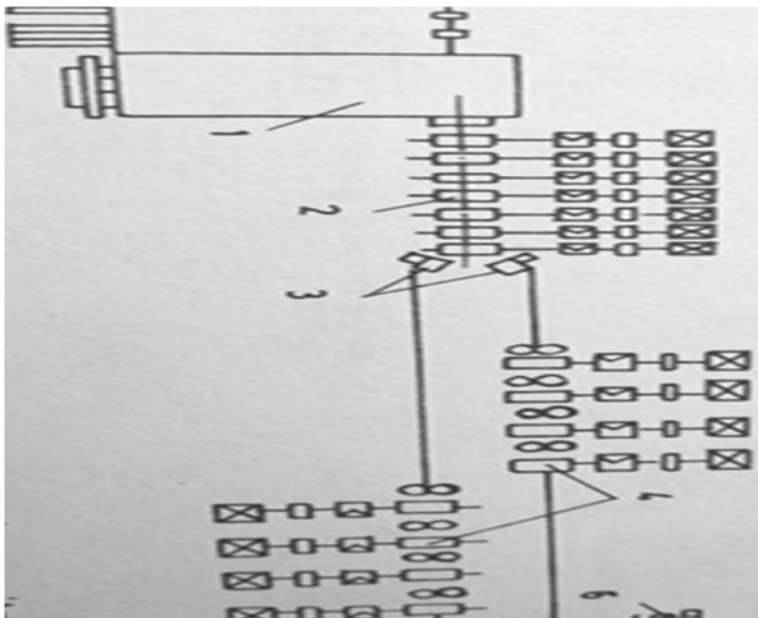


Figure 2. A layout of a modern generation of light section-bar rolling mill [5]

It is clear from Fig. 2 that a walking beam type re/heating furnace (under symbol 1) is again (like at Fig. 1.) in an optimal position, because the exit of the billets from that furnace is in the line of rolling, but on top of it, it gives supreme opportunity that the first part of the billet is already in rolling process, until the remaining part is still in the furnace (since there is one way of product travel). The symbols at Fig. 1. are the following:

- 1-re/heating furnace,
- 2-rougher group of rolling stands (common for the rolling in both strands – only horizontal rolling stands),
- 3-direction device,
- 4-intermediate groups of rolling stands (one strand rolling only – vertical and horizontal rolling stands in alternating disposition).

Nowadays there are almost no modern section, bar or wire rod wire rod mill which is not in the compliance with the a.m. recommendations regarding re/heating furnace positioning in a layout of modern a.m. mill and further development will go for a better computer control systems, from a re/heating furnace and TMT to a delivery coiler & conveyer or a cooling bed, and for an increase of rolling speed.

Additionally to this, there are very rare cases regarding that positioning in these mills, which are not in a compliance with that.

3. PRACTICAL CONSIDERATIONS IN A POSITIONING OF THE RE/HEATING FURNACES AT MODERN ROLLING MILLS

The example of modern light section-bar (two strands) continuous rolling mill layout in the IRON AND STEEL WORKS – ZENICA is presented at the Fig. 3.

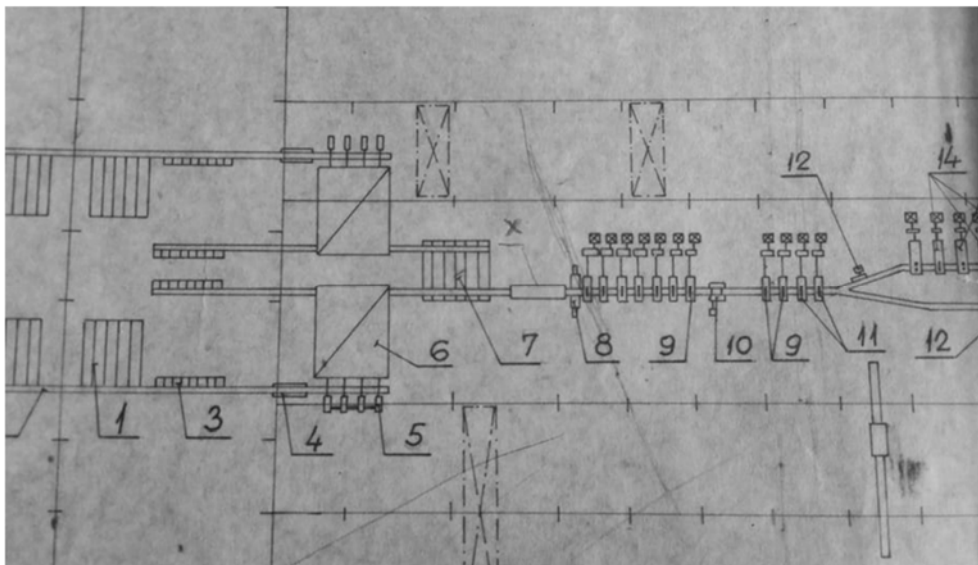


Figure 3. The layout of modern light section rolling mill in the IRON AND STEEL WORKS – ZENICA (built in 1977 technologically belonging to 1970-ies [1])

Modern light section-bar rolling mill in the IRON AND STEEL WORKS – ZENICA was built in 1977, technologically belonging to 1970-ies. Since it is the type of fully mechanized, digitalized and automated light section continuous rolling mill consisted of one rougher and one intermediate group of roll stands, both having only horizontal rolling stands, with two finishing mills, each one consisted of six two high stands, with alternatively horizontal-vertical position of the rolls. Such a modern, high capacity rolling mill had two (same) walking beam type re/heating furnaces (each one having capacity of 80 t/h), and they are under the symbol 6 at the a.m. Fig. 3. The other only relevant symbols are the following:

1-area with drag-over for the supply of the billets to the re/heating furnace,
3-roller transportation for the supply of the billets to the re/heating furnace,
4-in-line positioning device for the billets before entering to the re/heating furnace,
5-pusher of the billets before entering to the re/heating furnace,
6-re/heating furnace/s,
7-area with drag-over for the supply of hot billets to the line of rolling,
8-de-scaler,
9- rougher group of 7 rolling stands (common for the rolling in both strands – only horizontal rolling stands).

It is important to notice that the exit of the billets from one of the furnaces (which is not indicated under symbol 6) was not in the line of rolling, and one additional drag-over was installed there. Accordingly that was a sort of small technical inconvenience, without serious technological disturbance, although it is a sort of design concerned with modern light section rolling mills.

In a vicinity of that Light section rolling mill, which was using sq 80 mm billets, was modern Wire rod mill using sq. 110 mm billets, which layout with one re/heating furnace was in full compliance with main theoretical considerations in a positioning of the re/heating furnaces at a layout of the modern rolling mills.

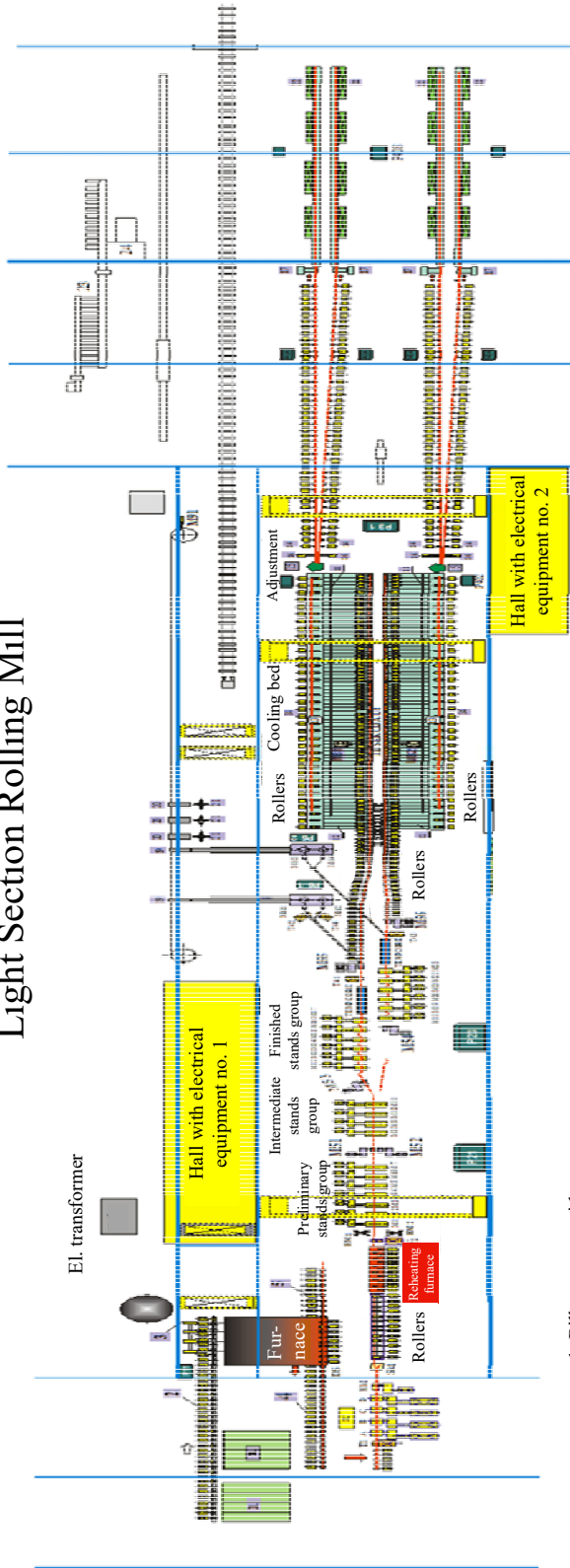
After process of privatization was done, new owner had changed the layout of the Light section-bar mill, to fulfill the requirement to use for both rolling mills sq. 120 mm billets, from newly built Continuous caster (CC). For that purpose, it was easy to adapt Wire rod mill, since the difference between sq. 110 and 120 mm is not big and with an adaptation of roll pass design everything was fixed properly and without the problems. But it was not the same case with Light section rolling mill, since the difference between sq. 80 and 120 is big, and another preparatory roughing group of rolling stands was needed.

The layout of the a.m. rolling mill, presented at Fig. 3 was according to the a.m. requirement changed, due to larger conception considerations concerned with production process at continuous casting (CC) unit, which was already unified for the billets of sq. 120 mm (instead of sq. 80 mm, which was rolled at Continuous billet mill, from CC blooms 320x280 mm earlier), which was used, when that rolling mill was built and commissioned in 1977. Accordingly the roll pass design was carried out starting from sq. 80 mm. That is why new owner, after the unification of sq. 120 mm billets at new radial CC machine, decided to do a reconstruction of that rolling mill.

Both re/heating furnaces were dismantled and one new one of 60 t/h capacity walking beam type furnace was built in area of one of these two furnaces, and in the area of the other furnace, new compact type pre-rougher group of 4 rolling stands was built. For that purpose, it was necessary for hot billets to be transported in the opposite way of normal rolling, and due to loss of time for that additional transportation and rolling, new additional heating current-tunnel type furnace was built. With these two additions, a normal rolling was possible again and that is the way how it works successfully almost 15 years. That is a sort of modern reconstruction of the modern light section rolling mill, which positioning of the re/heating furnace is not in accordance with the theoretical recommendations, but still is good enough to keep a modern concept, reducing production costs and increasing a profit of new owner.

The layout of the Light Section Rolling Mill (Sitna pruga) after the a.m. reconstruction, done in 2004/5, is presented at the next page, at Fig. 4.

Light Section Rolling Mill



- 1 Billet storage grid
- 2 Inlet rollers
- 3 Pusher
- 4 Walkout rollers
- 5 Reverse rollers

Figure 4. The layout of modern and reconstructed light section-bar rolling mill in the former IRON AND STEEL WORKS – ZENICA [1]

The a.m. facts confirm that such a big reconstruction in a narrow area had one inconvenient detail. After the exit from that newly built furnace, hot billets of sq. 120 mm, had to go the opposite way to the product travel, because of necessary reduction from sq. 120 to 80 mm. Since that would cause another technological problem (relatively quick cooling of a rolled billet), and another small current-tunnel type furnace was built, for an additional heating.

That was big and costly reconstruction work, and at that time since production was off, the computer control system was improved at the existing rolling mill. These were quality management measures undertaken by new owner, on time.

Finally it has remained modern light section-bar mill, but with the inconvenient product travel, as well as with the additional current-tunnel type furnace.

The owner considers that inconvenient rolling mill layout is still successful, since it enables to roll the unified sq. 120 mm billets for both Light section-bar mill and Wire rod mill, which is obvious technological advantage. That new layout is presented on Figure 4. It is a modern rolling mill, with a specific layout concerned with a re/heating furnace area within it, although the concept of that general reconstruction (CC machine and the Light section-bar mill) could be the matter of serious consideration, but is not a topic of this paper.

4. CONCLUSIONS

It is important to highlight that on the modern rolling mills, of this group, the exit of the billets from the furnaces is in the line of rolling, but on top of it, it gives the supreme opportunity that the first part of the billet is already in rolling process (even rolled at the modern wire rod mills), until the remaining part is still in the furnace.

Theoretical considerations in positioning of the re/heating furnaces at modern rolling mills are generally used, but in some reconstructions, especially if there is a narrow space, as a main limit, some unexpected solution could occur, even if they are not in the compliance with the a.m. theoretical-technical considerations. Such an example is presented and explained in this paper, confirming full justification of new owner quality management approach, especially from production cost reduction aspect, although that economic part was not the aim of this paper.

5. REFERENCES

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