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50-MPS IN COOLING BED TO ENHANCE PROFITABILITY IN REBAR PRODUCTION[1]

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Abstract

Very high production rate for the smaller bars size range, in order to fully exploit the reheating furnace capacity, has always been a common goal for bar producers, worldwide. But, one of the most common way to reach this goal is to use the well-known Multi-strand Slit Rolling system, a combination of dedicated roll pass design and dedicated guiding equipment to shape and longitudinally separate the rolled stock into 2, 3 or 4 individual strands, rolled together as one single bar down to the final finished size. The alternative technology that will result in a real break-through innovation for the panorama of steel producers worldwide will be the ultra-high speed bar finishing rolling and delivery into the cooling bed through the Danieli HTC "High-speed Twin Channel". This system, originally invented and patented by Danieli in the early 70's of the past century, operates successfully worldwide since then with speeds that, from the original top speed of 20 mps of those years, has now reached the record speed of 50 mps in cooling bed. The HTC perfectly suits the latest generation high-production bar mills where smaller-size bars are slit at the pre-finishing continuous mill stands and are finished on two independent strands through two Delta-type high speed blocks. This paper introduces the technical characteristics of the ultra-high speed bar finishing rolling and delivery system as well as its main highlight and benefits (…among the most significant….the possibility of producing down to 6-mm-dia rebars at very high output rates).

Key words: Cooling bed; Rebar production; Profitability.

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1 HIGH-RATE PRODUCTION OUTPUT OF SMALL SIZE BARS

One of the main goals in modern bar mills is to obtain a high production rate for the smaller bar and rebar size range that, depending on the market demand, has normally the major share in the product mix of the rolling mill plant. Reaching of this goal means full exploitation of the reheating furnace capacity also for the smaller round bar sizes, resulting in a very balanced production of the mill enhancing to the very best its potentiality.
There are basically two ways to reach this target, namely.

1.1 MSR-Multistrand Slit Rolling

This system, at present largely used all around the world to reach the above mentioned goal, is based on rolling two or more slit bars out of the same starting billet, with a reduced number of rolling passes as compared with single-strand rolling.
The Slit Rolling technology is a combination of special roll pass design and designated guide equipment to shape and longitudinally separate the incoming billet into 2, 3, 4 or 5 individual strands. These are then further rolled together (as one bar) down to the finished size in the finishing mill stands, simultaneously cut into multiple lengths and fed together into the cooling bed through the traditional “apron-type” entry roller table at maximum speeds of up to 18÷20 mps for 2-strand slitting and 13÷15 mps for 3 or 4 strand slitting.

Figure 1. 4-strand slit rolling.

This process necessarily need an accurate roller guide set-up on the finishing stands and one constant attention during rolling operation in order to prevent anomalous channel wears respect to another and involves loading of the cooling bed notch with two or more bar multiples, (corresponding to the number of slit strands coming from the mill), with possible consequent worsening of the associated bar heading-up operations at the lining up rollers area.
In four-strand slitting, this problem could be eased thanks of a double apron type cooling bed entry table so that only two bars per notch are loaded, easing bar

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heading-up and layer formation. The slitting process can be used for production of 8 mm/dia to 22 mm/dia plain and deformed bars.

1.2 High-Speed Finishing Rolling and Twin Channell Delivery System

Figure 2. Arrangement of twin DWB high-speed finishing blocks

Several advantages and benefits in achieving high productivity of small size bars, if compared to the above-mentioned slit-rolling system, are offered by the use of high-speed finishing rolling combined to the Danieli Twin Channel bar delivery system.
This technology dates back to the early 70's of the past century, when Danieli invented and patented its Twin Channel system that allows the automatic and even braking of bar multiples coming at very high speed from the finishing stand and their smooth dropping directly unto the cooling bed notch. The system operates successfully worldwide since then, both for new plants and as an expansion/ upgrading of existing rolling mills, with speeds that from the original 20 mps of those years, has now reached the record speed of 50 mps in cooling bed.
The Twin Channel system, allows for even braking and smooth discharging of 6 mm/dia to 40 mm/dia bars at finishing speeds of up to 50 mps, for both single and twin-strand rolling.
The system is based on the concept of dropping bar multiples "one-bar-per-notch" onto the cooling bed both for one-strand and 2-strand rolling (single or double Twin Channel device, respectively) and it is basically composed of a series of channels alternatively opening for bar dropping, plus pinch-roll/tail braking units installed at the incoming side.
The "Twin Channel" system perfectly suits the latest generation high-production merchant bar mills, where smaller-size bars are produced by slitting the rolled stock at the pre-finishing stands followed by high speed finishing rolling at two separate Delta-type blocks (4 or 6 pass each), on two independent strands.
This way, plant capacity is boosted to its maximum, easily achieving output levels well exceeding 100 tph already with 8 mm/dia bars.

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Table 1. Major benefits of this system vs MSR-Multistrand Slit Rolling

Wider product range	Production of down to 6-mm rebars
Better material yield	Accurate lining-up due to one-bar-per-notch in cooling bed, resulting in better layer formation and minimized crops at cold shear. Minimized cobbles, thanks of single strand, twist-free rolling
Better product quality	Higher bar finished quality, thanks of single strand, twist-free rolling at the DWB Delta-type blocks: > use of carbide rolling rings > rebar weight/meter and size tolerance on plain round bars absolutely in accordance to Standards (as per NO-slitted bars production) Higher bar straightness (one bar per notch in cooling bed), resulting in better bundle formation
Better plant MUF (Mill Utilization Factor)	Faster and easier plant set up: > single strand/twist free finishing rolling, with use of carbide rolling rings, resulting in longer groove life and minimized change operations > less guides involved > single strand QTB lines > reduced possibility of cobbles and associated re-setting times thereof
Savings in consumables	Use of “long-life” carbide rolling rings Less number of rolling guides involved and spares/ consumables thereof

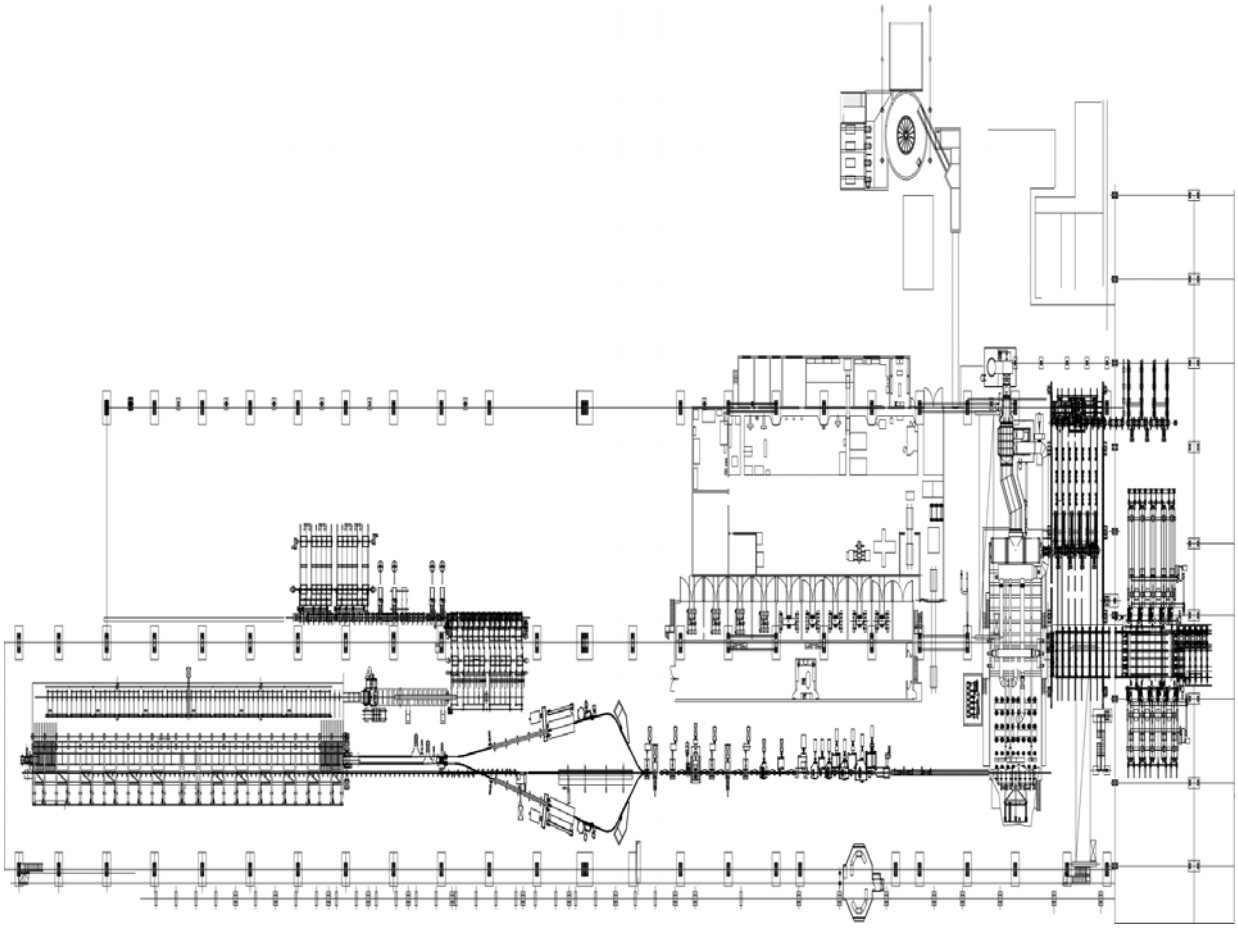

Figure 3. Typical layout of the high-speed bar mill.

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1.2.1 Twin channel system main technological highlights

- Smooth and regular bar-drop from opening channel to cooling bed notch (only 170-mm drop, shorter than any other system available today);
- ultra-compact bar-braking unit with high bar-deceleration ramp, granting surface defect-free product and perfect lining-up of bars on cooling bed, in their “as-discharged” position;
- automatic side-lifting of the whole twin-channel system in offline/ stand-by parking position, when not operating or for maintenance purposes;
- split-type driving system, granting minimized shaft torsion for reduced operating cycle, shorter than other systems;
- short operating cycle making it possible to combine very high finishing speeds with extra-shorter cooling bed lengths, thus reducing investment costs.

The high-speed finishing system mill’s configuration is ideal for allowing possible plant expansions with the addition of wire rod and spooled coils production lines.
The Twin Channel system is a perfect tool available for both new bar mills, or (thanks to its installation beside the traditional cooling bed entry table), as an easy expansion of existing rolling mills.

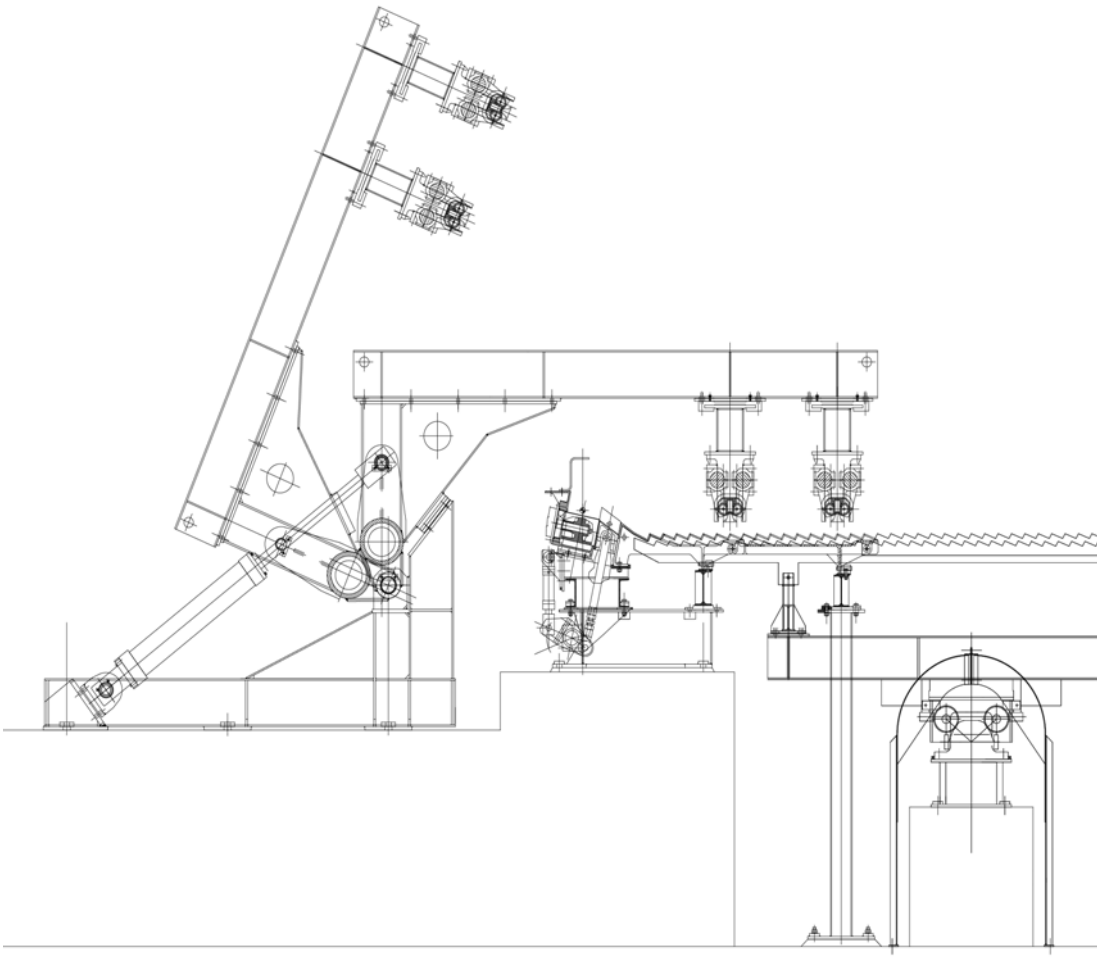

Figure 4. Twin channel typical cross section.

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1.2.2 Twin channel technology and operation process

In the latest generation high-productive bar mills, finished bars, rolled at the two DWB finishing blocks, are delivered onto cooling bed at high-speed through the HTC-High-speed Double Twin Channel system, that is basically made up of “C” shaped conveyors arranged in “twin line”, standing above the first part of the cooling bed (straightening grids area) at a height of less than 170 mm from the same.
The rolled stock, coming from the finishing blocks, is conveyed to the QTB lines and the shears that perform the dividing cut according to the cooling bed length.

HTC-High-speed Twin Channel working sequence

DESCRIPTION:

1. Channel “A” rolling
2. Channel “A” braking and unloading, Channel “B” rolling next bar
3. Channel “B” rolling, Cooling bed makes one revolution
4. Channel “B” braking and unloading, Channel “A” rolling next bar
5. Channel “A” rolling, Cooling bed makes one revolution
6. Channel “A” braking and unloading, Channel “B” rolling next bar
7. Channel “B” rolling, Cooling bed makes one revolution
8. Channel “B” braking and unloading, Channel “A” rolling next bar

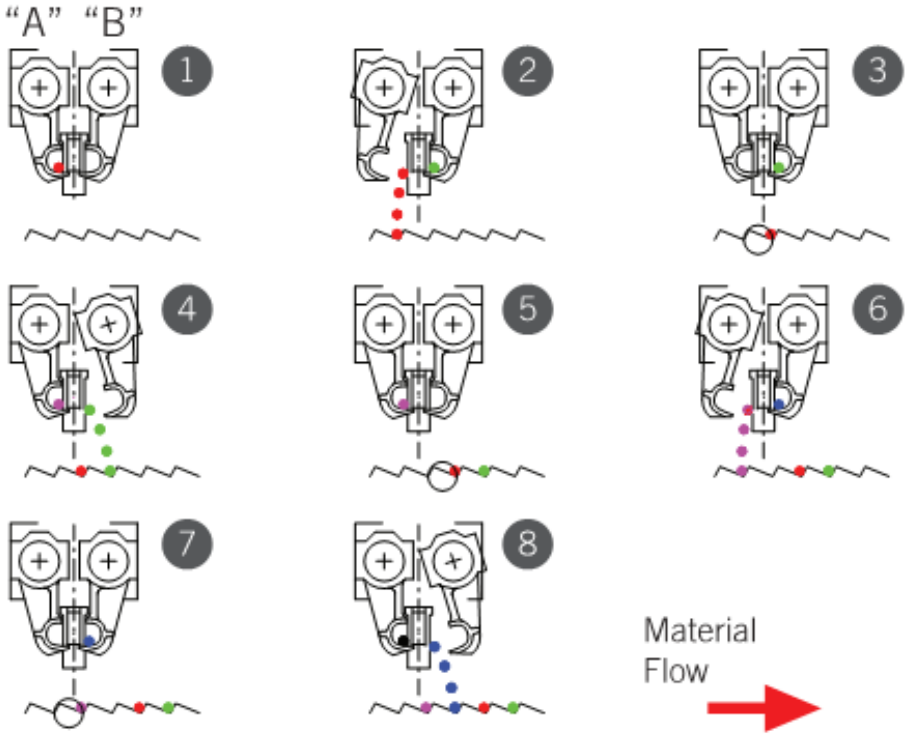

Figure 5. Twin channel operating scheme.

After each shear the line is doubled, and for each cut the multiple-length bars are alternately conveyed on the first or second line of the Twin Channel by a special deviator.
Specially designed compact bar brakers, placed very close to the cooling bed, have the task of decelerate the bar speed, to reach the desired discharging point granting optimized lining up operation.

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Alternative opening of the Twin Channel “C”-shaped conveyors, enable bar dropping onto the cooling bed straightening grids, granting “one-bar-per-notch” condition and absolute bar straightness. This is granted both in case of single and double strand rolling.
A dedicated automation system drives and controls the whole line in order to grant maximum operation accuracy resulting in perfect positioning onto cooling bed as well as in highest surface quality to the processed material.

1.2.3 High-speed finishing rolling: recent installations, scorecard and records

Danieli Morgardshammar, with its scorecard significantly listing 109 HTC systems supplied and installed worldwide since the year 1970, is the world leader in high speed finishing rolling of small size rebars and plain round bars.
The latest generation high-production bar mills (featuring twin DWB high-speed finishing blocks and Double Twin Channel system, as shown in the typical layout), lists a number of twelve complete plants, supplied (or under supply) and in operation since the year 2002 in South America, Middle East, Far East, Europe, India and North Africa.
To date, the top constant production speed of 47 mps has been reached at SN Longos, Portugal, with production of 8-mm-dia rebar. Further tests are presently being carried out at the same plant and the wall of 50 mps was broken down on October 22th 2009. This record set a new milestone in the rolling of long products worldwide.

2 CONCLUSION

Thanks to the various advantages (both technical and economical) as mentioned in this article, introduction of the high-speed finishing rolling technology can be a significant step-forward for the steel market of rebars for construction purposes, giving an edge on traditional slit-rolling-based rolling mills.