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NEW ROLLING STANDS FOR LONG PRODUCTS ROLLING MILLS*

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Abstract
Today's steel market is characterised by high competitiveness and tight profit margins; therefore, the operational costs of rolling mills must be as low as possible, while ensuring a final product of the highest quality standards. PERT SRL is an engineering company with a long-term experience in the international steel market, specialised in the design and supply of highly innovative and bespoke solutions for siderurgical and environmental plants. Because of its strong commitment to deliver excellent products and services, and its ability to innovate and adapt to the fast-changing market requirements, PERT has studied a new generation of BI-SUPPORT rolling stands, designed to be used in rolling mill plants for the production of rebars, rounds and sections in special quality bars (SBQ) steel grade, wire rod, light and medium section, suitable also for special steel plants. This paper will provide a deep insight into the key technical and economic features that have revolutionised the rolling technology for long products, such as the absence of spindles and piping on board, the considerably reduced number of spare parts required, a ring gap regulation system, and the compact dimensions, which lead to significant savings in investments and production costs; at the same time, the BI-SUPPORT stands guarantee excellent standards to the final product, an increase in plant productivity and a general improvement in the plant management.
Keywords: Rolling stands; Rebar mill; Innovation; Housingless stands.

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1. INTRODUCTION

For many years now, the first generation of PERT BI-SUPPORT rolling stands have been working with success in the international steel market. Because of its strong commitment to deliver excellent products and services, and its ability to innovate and adapt to the fast-changing market requirements, PERT has continuously improved its equipment and plants, and has studied a new generation of BI-SUPPORT rolling stands. PERT has revolutionised the concept of rolling stand, by introducing the new model of BI-SUPPORT stands, which has immediately become a milestone in the field of rolling technology for long products.
Today's steel market is characterised by high competitiveness and tight profit margins; therefore, the operational costs of rolling mills must be as low as possible, while ensuring a final product of the highest quality standards.

Figure 1. 3D view of a roughing mill in H/V arrangement

2. DISCUSSION

2.1 Bisupport Stand Advantages

To meet such stringent market requirements, PERT has developed the second generation of BI-SUPPORT rolling stands. While maintaining the benefits of first generation stands, they introduce new and innovative advantages:

- Absence of spindles;
- Absence of piping on board;
- Absence of chocks;
- Use of rings instead of rolls (less grooves consumption per ton of production);
- Smaller dimension for easy handling;
- High stiffness;
- -85% of spare parts;
- Increased bearings working life (min 50'000h);
- Ring gap regulation starts from 5 micron;
- Horizontal and vertical stand with the same design, fully interchangeable;
- Mono-groove or multi-groove (roughing mill) and multi-groove (intermediate and finishing mill);
- Roll gap regulation with eccentric system;
- Easy maintenance;
- Increased safety for changing and maintenance operations.

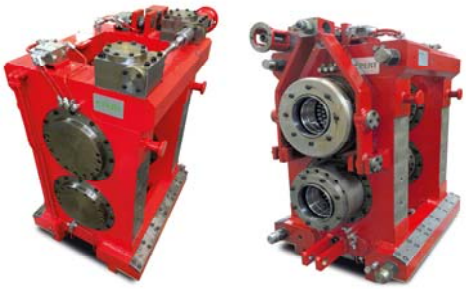

Figure 2. PERT BS Spindleless® Stand – Rolling unit

2.2 Project Objective

The aim of the development project of second generation BI-SUPPORT stands is:

1. To improve the final product quality;
2. To reduce downtimes of the plant for the production changes and maintenance;
3. To reduce the investments for buildings, cranes and civil works;
4. To reduce spare parts costs;
5. To increase the safety of changing and maintenance operations.

New BI-SUPPORT Stands have been designed to be used in rolling mill plants for the production of rebars, rounds and sections in special quality bars (SBQ) steel grade, wire rod, light and medium section, and they are suitable for special steel plants.
BI-SUPPORT Stands can be supplied in different configurations: horizontal, vertical or convertible, mono-groove (roughing mill) or multi-groove (intermediate and finishing mill).

2.3 Final Product Quality Improvement

2.3.1 Reduction of reactions on constraints

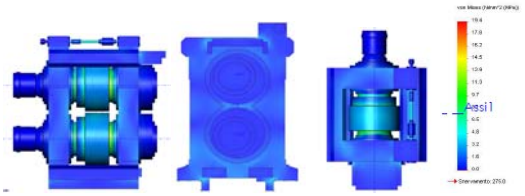

Figure 3. 3D model of rolling load distribution in the first roughing stand with Billet 150x150mm,T=1050°C.

Distributed rolling load (see figure 3) on housing allows reducing the stand mechanical yielding that assures Standard tolerance in the final product. In the housingless stands, the rolling load is concentrated on the tie rods, so the adjusting screws are subject to mechanical stress; this means wear and mechanical yielding.

2.3.2 Constraints surface

The BI-SUPPORT stands have a reaction surface 5 times higher than housingless stands, so housing elongation, under a load variation, is reduced to 1/5 compared to common housingless stands.

2.3.3 Length of stress path

BI-SUPPORT stands have a stress path with approximately half of the length compared to common housingless stands, so the elongations are also proportionally reduced.

2.3.4 Ring-holder shaft flexion

Constraints are very close to the rolling load, so the rigidity of the stand becomes higher and, consequently, also the deflection of ring-holder shaft is reduced. Flexion is reduced of approx 3 times when compared to common housingless stands and halved when compared with cantilever stands. Therefore, we can prove that the rigidity of PERT BI-SUPPORT stands is approx. 3 times higher when compared with other types of rolling stands today available in the market, guaranteeing the highest standard of quality to the final product (see figure 4).

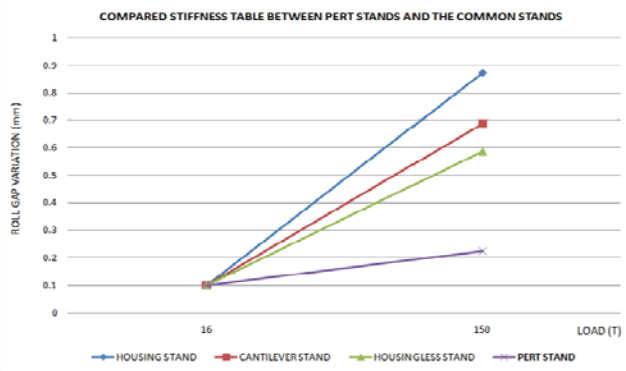

Figure 4. Stiffness comparison table

2.4 Reduction of Plant Downtime for Production Changes and Maintenance

The changing stands process, from motor stop to restart, requires approx 10 minutes including also the rings-holder shaft changing. When a complete stand is available, as spare, changing times fall down to approx 2.5 minutes. It is therefore possible to reduce changing times because the second-generation BI-SUPPORT stand does not include container and piping on board, which are typical in housingless.
The rolling unit unlocking, lifting, replacement and re-locking is fully automated, both in horizontal and vertical configuration.

2.5 Investment Reduction for Buildings, Cranes and Civil Works

Greater efforts have been turned toward the containment of total stand size and, as shown in figure (5), toward the reduction of the stand's height in vertical configuration. For example, the BI-SUPPORT 650 vertical stand, part of the roughing mill, has an height of just 4.30 m, against the average height of 7-8 m of common housingless stands.

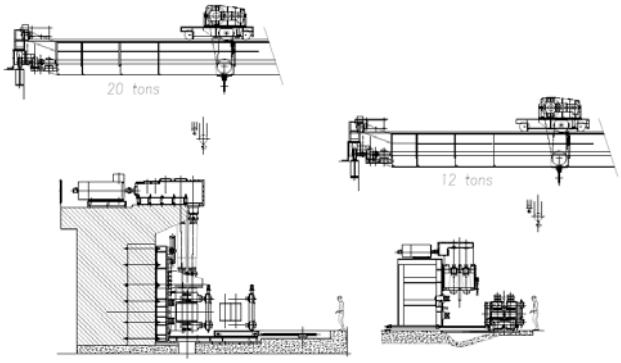

Figure 5. Difference of dimension between housingless stands and PERT BI-SUPPORT stand 650, with vertical configuration and with rolling rolls/ring diameter of 650 mm

The key competitive advantages provided by containing the size are:

- The rolling mill building is lower in height hence the steel structure is smaller and lighter;
- Because of the reduced height of the second generation BI-SUPPORT stand, the runways of the cranes are just at a height of +7.50 m and crane capacity is 40% lower in respect of a standard mill;
- The civil works for roughing, intermediate and finishing mill are reduced by 60%;
- For plants on the ground level, the building can be of concrete prefabricated type; this option allows to reduce the initial investment and the construction time schedule.

2.5.1 Comparison table for civil works and excavations for roughing stands

Figure 6 shows the comparison table for civil works and excavation for foundations using BI-SUPPORT stands instead of common housingless stands, regarding a 6 stand roughing mill equipped with stand size 550 in Horizontal and Vertical arrangement.

Figure 6. Comparison table for excavations and civil works

	HOUSINGLESS STANDS	PERT BISUPPORT STANDS
EXCAVATION FOR FOUNDATIONS	366 m^3	145 m^3
CIVIL WORKS	327 m^3	126 m^3

2.6 Spare Parts Costs Reduction

Unlike common housingless stands (for example the tie rods), the new BI-SUPPORT stands have no machined working parts directly in contact with water and scale. All moving parts are positioned into the housing and are protected by adequate gaskets. (See figure 7).

Figure 7. Differences between PERT BI-SUPPORT stand and housingless stand.

BI-SUPPORT stands do not need operational intervention in rolling line, as for the cantilever stands where the rings change is made; the changing operations in the working area of the plant are quite cumbersome and the risk to damage the stand shafts is high.
BI-SUPPORT stand components have been reduced by half compared to common housingless stand.
This allows to drastically reduce the number of spare parts and the total weight of the stand.
In the BI-SUPPORT stands the rolling rings are installed on a heat-treated steel alloyed shaft, which ensures high levels of security against possible crack due to overload during rolling mill operations. Furthermore the worn rolling ring only (grooves at the end life, no possibility of re-machining) may be replaced, as the steel shaft where the rings are installed can be re-used. In the housingless stands the whole rolling cylinder has instead to be scrapped. The BI-SUPPORT stand bearings have a working life 2.5 times longer (min. 50'000 h) than the common housingless stand, because in the housingless stand the rolling load is always fixed on the external ring of the bearing (see Figure 8 and Figure 9).

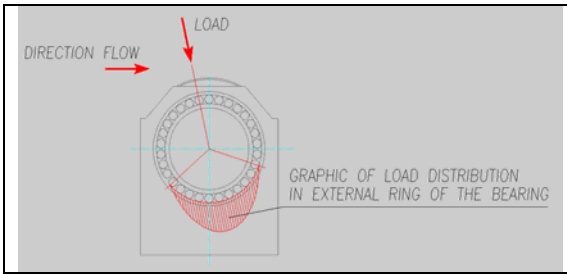

Figure 8. Housingless stand: load distribution is always in the same position. The bearing working life is "x" time

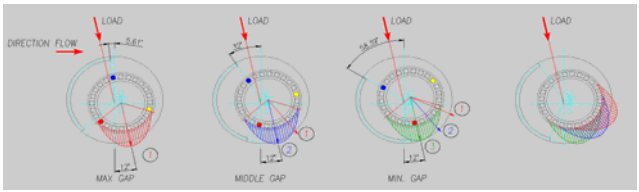

Figure 9. BI-SUPPORT Stands: load distribution is not always in the same position because it depends from the gap between the rings. The bearing life is "2.5x" times.

The second generation of BI-SUPPORT stands have been designed and developed avoiding the use of cardanic spindles. In place of cardanic spindles, gear couplings connect the gearbox outlet with the ring holder shaft, which are always aligned on the axis of the ring holder shaft; they are not subject to wear and therefore there is neither the necessity for their replacement nor for spare parts.
Lubrication system of BI-SUPPORT stands is very simple, since it is like a lubrication system of a normal gear box. BI-SUPPORT stands do not need any special device for water removal from oil, such as cantilever stands.

3. CONCLUSION

Finally, the key technical-economic strengths of second-generation BI-SUPPORT stands can be summarised as follows:

1. A net saving on initial investment due to reduced costs for building and civil works;
2. A saving in production costs due to a highly reduced number of spare parts needed;
3. An increase in plant productivity due to lowest changing times and plant downtimes;
4. Excellent standards of quality of the final product;
5. A significant improvement in plant management, due to lower maintenance and manpower costs;
6. Each group of stands (basement, gear box and stand), when assembled, is tested in our workshops to be “ready to roll”;
7. Cost reduction of machine tools for grooves re-machining;
8. Cost reduction for lubrication oil and grease.