Latest technology for medium and heavy section mills

A modern section rolling mill must achieve desired mechanical properties, high dimensional tolerances and good surface finish, yet be cost competitive and flexible. The latest technologies from Danieli have been designed to achieve these objectives.

Authors: Loris Maestrutti and Luca Gori
Danieli Morgárdshammar

Competitiveness is the main goal common to all steel producers aiming for a leading position in today’s tough and demanding market. Competitiveness means top quality products and high output capacity at lowest possible costs. The plant manufacturer’s mission is to provide steel producers with the most advanced technology, both in terms of machinery and production processes to help them reach their goals. Continuous efforts in R & D have made it possible for Danieli to introduce significant innovations in the production of structural steel sections. Some of these will now be described.

PROFILE SIZING PROCESS (PSP)
Key aspects of a modern section rolling mill are the ability to achieve the desired mechanical properties, high dimensional tolerances and good surface finish, and the PSP has been designed to achieve these objectives. For medium sections, following initial rolling in a break down mill (see Figure 1), the process consists of a pre-finishing 3-stand Ultra Flexible Reversing (UFR) mill comprising two roughing universal stands, UR1 and UR2, and an edging stand E (see Figures 2 and 3), followed by an independent universal continuous finishing/sizing stand UF, where a single finishing/sizing pass is performed on the free length bar coming from the UFR mill. For heavy sections, or where there is restricted space, the rolling line is made up of one UR stand, an E stand and a UF stand.

Within the Section Control System (SCS) a dedicated mill pass schedule program calculates the main rolling parameters, the rolled stock temperature development along the mill and the intermediate dimensions. It provides pass to pass roll settings generated by a design computer and controlled by the mill automation system so that the mill operator will have a supervisory role only. The model links the web and flange elongation to avoid web buckle or flange wave. The use of the SCS and hydraulic stand capsules enables automatic adjustment of the rolling parameters within the same bar, or from bar to bar.

In addition, it verifies the uses of the motors (allowing the correct reduction ratio choice for each gear unit) as well as
to a balanced roll wear between the plain and radius area of the rolls. This also means that only a limited number of spare rolls are required in the workshop since deep roll re-dressing is not needed.

Furthermore the PSP allows:

- Reverse rolling through the roughing and edging stands until the bar is ready for the final pass in the finishing stand
- Precise set-up of the rolls and guides of the UF in the workshop (clean and protected area) without any stand adjustment in the production line
- No tension between the penultimate and the last pass
- Possibility of thermo-mechanical rolling by applying high reduction in the correct range of bar temperature

Additionally the PSP process provides:

- Increased productivity when rolling channels and sheet piles
- More flexibility for future products due to the separated finishing stand
- High plant productivity also for small product sizes thanks to the independent finishing stand
- Easier installation of a gauge measurement system

Figure 4 indicates cost differences between PSP and section mills not having a separate finishing stand.

**STAND CORE CONCEPT (SCC) STANDS**

The UFR mill consists of three identical super heavy-duty mill stands, which can operate in universal or two-high mode depending on the optimal roll pass design requirements. The most important features of the stands are:

- High mill stand stiffness due to a short stress path and hydraulic capsule design resulting in very limited deflection under load
- Fully hydraulic adjustment system featuring under-load adjustment
- Fully automatic guide and roll set changing procedure (only 20 min)
- No manual operation during stand changing thanks to the roll unlock robot provided
- Zeroing and mill modulus determination after each changing procedure
- Completely sealed hydraulic circuit during roll change (no flushing needed)
- Different H-chock centreline for universal and two-high mode resulting in close guiding of the stock during the reversing passes
- Adjustable guiding system for automatic, simultaneous movements resulting in close guiding of the stock during the reversing passes
All stands are shiftable thus the rolled stock always remains on the roller table centreline (fixed pass-line concept)

- Standardisation of components on the UFR mill and in the UF stand resulting in capital investment savings for spare parts
- Possibility of rapidly and automatically changing half of a stand for maintenance, allowing for off-line maintenance in a clean environment

To achieve high rolling schedule flexibility the SCC stand is designed in such a way that only the rolls, guides and vertical chocks package (the so-called stand core) is changed and automatically replaced with a previously prepared new one.

Special care is given to the automated, simultaneous roll and guide changing procedure to ensure the minimum possible production lot size and highest mill availability, so minimising rolling to stock and reducing cash costs. The complete stand conversion operation from two-high to universal (or vice versa) is performed without using the main building crane, with associated reduced converting times and lower investment cost for main cranes and buildings. The mill crane is only necessary for new rolls and guide set handling in the preparation area.

*Figure 5* shows detail of an SCC stand during manufacture.

**LATEST INSTALLATIONS AND NEW ORDERS**

**ArcelorMittal Differdange (Luxembourg)** In September 2007, the Grey mill at Differdange restarted after completion of a major modernisation project carried out by Danieli Morgårdshammar aimed at enhancing plant operation, efficiency and final product quality. The product range includes parallel flange beams up to 1,100mm wide and 120m long.

Danieli was responsible for the supply of equipment and services on a turnkey basis, including the replacement of the existing intermediate stands and mechanisation equipment with a 2-stand UFR mill with an automatic fast changing system installed in-line with the existing UF finishing stand, all electricals and an advanced automation system (see *Figure 6*).

**Siderurgica Balboa (Spain)** A new 750,000t/yr medium section mill (RM No.1) at Siderurgica Balboa (part of the Alfonso Gallardo Group) for the production of up to 600mm beams and medium size profiles was commissioned in 2008 (see *Figure 7*). This was part of a new 1.2Mt/yr minimill supplied by Danieli that includes a 130t EAF, conticasting plant for billets, blooms and beam blanks, 180t/hr walking beam reheating furnace and a 500,000t/yr multi-line super flexible mill (RM No.2) for production of round bars, spooled bar-in-coils, wire rod coils, and smaller sections. The complex already features another minimill for bars and a combined galvanising/colour coating line, also supplied by Danieli.

Orders for complete minimills have also been received from the European AFV Beltrame Group and the Brazilian Gerdau Group.

**CONCLUSIONS**

The PSP is the right tool for the production of superior products combining the best tolerances and surface quality and at reduced conversion cost and maximum flexibility for our customers’ future needs. **MS**

**CONTACT:** a.fragiacomo@danieli.it

Loris Maestrutti is Executive Vice President Medium & Section Mills and Luca Gori is Vice President, Sales, both at Danieli Morgårdshammar, Buttno, Italy.