BAR AND MERCHANT
BAR MILLS
This mill ideally combines limited investment cost and simplicity with high productivity, a solution guaranteeing the fastest return of investment. Generally these mills are sized for a medium range production up to 500,000 tpy. The typical product sizes range from 8 to 32 mm diameter round and rebars, which are the predominant sizes in commercial bar rolling. The layout mainly consists of:

- Reheating furnace
- Roughing mill, with stands of cantilever or housingless design, in alternating horizontal-vertical (H-V) arrangement with quick-changing device
- Intermediate mill, with stands of housingless design, in alternating horizontal-vertical (H-V) arrangement with quick-changing device
- Finishing block
- Quenching and self-tempering facilities
- Single-strand HSD\textsuperscript{®} High-Speed Delivery System
- Cooling bed
- Finishing facilities with cold shear, bundling system with bar counter and wire tying machines

**SINGLE-STRAND HIGHSPEED BAR MILL**
THE FINISHING BLOCK
The “ultra high speed/high precision” block version is employed either for rolling demanding steel grades or for production of concrete reinforcement grades at high rate, both coiled through wire rod lines. The reliable operating speeds of this block can reach 120 metres per second, with a design speed of 140 metres per second.

The “high speed” block version, generally used for production of concrete reinforcement grades at a high rate, in straight condition and delivered onto cooling bed, reliably achieves operating speeds up to 80 metres per second, with a design speed of 100 metres per second.

In this last case, the use of the finishing block in combination with the HSD® High-Speed Delivery System for the production of straight bars on cooling bed, besides higher productivity, close tolerances and excellent surface on final product, allows the total number of stands in the finishing mill to be minimised.

All passes in the blocks come in V arrangement (45° inclined to the vertical).

UNINTERRUPTED PRODUCTION AT T.D.C., THAILAND
T.D.C. Steel Group Co. Ltd, a manufacturer of rebar based in Samutprakarn, Thailand, runs a single-strand bar mill operated at high speed. The mill, commissioned in 1996, has a nominal capacity of 200,000 tpy. Remarkably, production has run uninterrupted since start-up, other than for planned maintenance and ordinary shut-downs.

The product range covers 6 to 28 mm diameter rounds and rebars starting from a square billet of 130 or 150 mm.

Rolling campaigns, which include the smaller 6 mm size rebar, regularly achieve a speed of 31 metres per second through an HSD® High-Speed Delivery System. The impressive billet-to-billet time of 3 seconds, now a standard working practice, combined with the advantages of the HSD® system, a technology characterised by less cobbles and trial bars, leads to a high utilisation factor together with higher yield.

The mill, equipped with housingless rolling stands in alternating horizontal-vertical configuration and a 10-pass finishing block with 210 and 180 mm rings, is fully automated and requires a limited number of personnel for operation, short mill set-up times and minimum routine maintenance.
This bar mill operates at relatively low speed in multiple lines, normally consisting of 2 to 4 strands, with a common starting material stock. Even though the slit rolling process is employed only for production of rebars, this process is a very economical solution to achieving high rolling production, even for small sizes. The annual production may vary, depending on the number of strands, but tonnages in the range of 1,000,000 tpy can be achieved with product sizes from 10 to 50 mm.

The layout mainly consists of:
- Reheating furnace
- Roughing mill with horizontal-vertical stands either of housingless or cantilever design
- Intermediate mill with horizontal-vertical stands, housingless design
- Finishing mill with horizontal, vertical and convertible stands, housingless design and quick-changing device
- Quenching and self-tempering facilities
- Drop wall roller way with lifting aprons
- Cooling bed
- Finishing facilities with cold shear, bundling system and wire tying machines
THE SLITTING PROCESS

Many steel producers operate mills based on multi-slit technology. The majority of those mills have a size range of 10 or 12 to 40 mm. In some applications, 8 mm is also rolled. Depending on furnace capacity and product size, 4-slit, 3-slit and 2-slit operation is used. Even if the design speed of the mills may be higher, these mills run at rolling speeds ranging in most cases 13 to 18 meters per second. The reason for such low speeds is the fact that operation is sensitive at small sizes and mill setting requires fine accuracy. In this regard, the experience of the rolling crew plays a key role. The design of the guiding equipment inside the mill (even for looper arrangement) and the cooling bed run-in system have to take account of the special requirements of the multiple running strands.

FOUR WAYS TO REACH 1,000,000 TONS PER YEAR AT HAMRI YAH STEEL, UNITED ARAB EMIRATES

Metalloinvest, one of the major Russian groups of companies in the metallurgical industry, decided to produce long products in the United Arab Emirates to supply the growing local market. Thus Hamriyah Steel was born, a joint venture between Metalloinvest and the Emirate of Sharjah. In 2007, an order was placed with SMS Meer for the supply of a new bar mill.

The mill with a capacity of 1,000,000 tpy with diameters from 10 to 40 mm can operate in single strand, 2-slit and 4-slit mode.

A 180 t/h walking-beam reheating furnace for 125 to 170 mm square billets up to 12 m in length will feed the rolling mill formed by horizontal, vertical, and convertible stands of housingless type equipped with quick-changing system. A water box for quenching and selftempering of the steel bars will allow the mechanical properties specifically required by the local construction industry to be achieved.

The mill is complete with cooling bed and downstream finishing facilities.
Among the most flexible configurations, the combined bar and wire rod mill using a single finishing block can either be operated to produce straight bars via the HSD® High-Speed Delivery System or switched to the production of wire rod in coils.

The highest speeds and hence the highest productivity rates can be obtained for both types of product. The annual production averages around 600,000 tons and products may include rod from 5.5 mm and straight bar from 8 to 36 mm.

The layout mainly consists of:
- Reheating furnace
- Roughing mill with horizontal-vertical stands, cantilever or housingless design
- Intermediate mill with horizontal-vertical stands, housingless design with quick-changing device
- Finishing block
- Quenching and self-tempering facilities
- HSD® system, single strand
- Cooling bed
- Finishing facilities with cold shear, bundling system with bar counter and wire tying machines
- Wire rod line with laying head and Loop Cooling Conveyor (LCC®)
- Coil forming and handling line with compactor and wire tying
NO SPEED LIMITS AT GERDAU AZA COLINA, CHILE

Gerdau Group, a major manufacturer of long product steel with several locations in the Americas, produces bars and wire rod for civil construction and for mechanical industry at its two plants located just north of Santiago, in Renca and Colina.

In 1999 SMS Meer supplied a complete mill with a nominal capacity of 400,000 tpy for the Colina works, with a target production of steels for concrete reinforcement, including quenched and self-tempered bars, as well as for low and medium carbon grades.

The size range includes 8 to 36 mm diameter rounds and rebars as well as 5.5 to 16 mm diameter wire rod in coils. All products reach finishing speeds among the highest in the world for the respective process routes selected, such as 40 metres per second for straight bars using the HSD® High-Speed Delivery System and 100 metres per second for wire rod in coils.

The 10-pass finishing block is used either to produce wire rod or to supply straight bars at high speed delivered onto a 100 m long cooling bed via the HSD® system.

On the bar route, after commercial cut by a 350 t cold shear, straight bars are conveyed to bundling and tying stations where six simultaneous tying machines handle the sub-bundles and two larger units apply ties on the master bundle. On the wire rod route, the rolled stock is looped onto an 86 m loop cooling conveyor. After formation, coils are moved further for cooling, pressing, tying and transfer by means of a pallet-based handling system.

THE COIL HANDLING SYSTEM

Two alternatives are offered for coil handling:

- A pallet-type conveyor, where the coils are collected vertically at the coil forming chamber and continue in this orientation through the compacting and tying machine (thus arranged vertically) down to the discharge area where they are finally turned into the horizontal position.

- A hook (power-and-free) conveyor where coils are rotated at the coil forming chamber and then handled by an overhead hook system through the horizontal compacting and tying machine down to coil delivery.

A pallet-type conveyor, where the coils are collected vertically at the coil forming chamber and continue in this orientation through the compacting machine and tying machine (thus arranged vertically) down to the discharge area where they are finally turned into the horizontal position.

A hook (power-and-free) conveyor where coils are rotated at the coil forming chamber and then handled by an overhead hook system through the horizontal compacting and tying machine down to coil delivery.
A highly flexible and productive solution is the bar mill combining 2-slit rolling via high-speed finishing blocks and a double strand HSD® High-Speed Delivery System. The presence of the finishing blocks allows a further extension either for the production of wire rod (normally for 5.5 to 16 mm in coils) or for the production of bar in coils with the VCC® Vertical Compact Coiler line (normally for 8 to 16 mm in compact coils), which is the most innovative way of producing rebar today. A typical mill of this kind has a capacity of up to 800,000 tons per year and mainly comprises:

- Reheating furnace
- Roughing mill with horizontal-vertical stands, cantilever or housingless design
- Intermediate mill with horizontal-vertical housingless stands with quick-changing device
- 2 finishing blocks
- Quenching and self-tempering facilities
- Double strand HSD® system
- Cooling bed
- Finishing facilities with cold shear, bundling system with bar counter and wire tying machines
- VCC® line (or wire rod line with laying head, controlled cooling conveyor, coil forming and handling line with compactor and wire tying)
THE STAND QUICK-CCHANGE
SYSTEM
In order to reduce changing times, the intermediate and finishing stands are usually equipped with a quick-change transfer table. Stands for the next rolling cycle are positioned via the plant crane on a transfer table. Stands to be sent to maintenance are pushed off-line by hydraulic cylinders on the table alongside the new stands. A single shift of the transfer table positions the new stands in front of the mill before they are pulled in-line hydraulically. Customers report changing times of approx. 20 minutes using this system.

A DOUBLE HIGHWAY AT DREAM STEEL

Stefana S.p.A., a steel producer located in Ospitaletto, Brescia, started operations in 2007 with a complete new bar mill supplied and installed by SMS Meer under the project name Dream Steel. The plant with an approximate annual capacity of 700,000 t is one of the most productive Italian mills.

The product mix of the bar mill includes straight rebars with diameters of 8 to 16 mm produced by 2-slit rolling through 2 finishing blocks – 6 passes each, which combined with a double strand HSD® system allow speeds of 40 metres per second to be achieved. 18 to 40 mm diameter rebars and 8 to 40 mm plain rounds are rolled in a single line.

Two VCC® Vertical Compact Coiler lines, complete with dedicated cooling boxes, shears, spooling equipment, spools manipulator, tying machines, transport facilities and weighing station, allow the production of spools of 3.2 t with 8 to 16 mm diameter at speeds up to 35 metres per second. The mill is fed by a 120 tph furnace (140 tph when hot charged).
A modern merchant bar mill has the capacity to produce a variety of products such as angles, squares, flats and small channels. Round bars can naturally be produced, too. A mill of this kind has a capacity of 500,000 to 600,000 tpy and a product ranging from 40 to 150 mm angles.

This mill mainly consists of:
- Reheating furnace
- Roughing mill with horizontal-vertical stands, cantilever or housingless type
- Intermediate mill with horizontal-vertical housingless stands
- Finishing mill with horizontal and convertible housingless stands with quick-changing device
- Drop wall roller way with lifting aprons
- Cooling bed
- Multi-line straightener
- Finishing facilities with cold shear, stacker and strapping or tying machines
Smooth commissioning and steep run-up curves were the factors contributing to the success in the start up of the complete rolling mill for sections supplied in 2005 at Pomina Steel, Binh Duong, a manufacturer of steel with headquarters in southern Vietnam.

The mill is equipped with 10 horizontal-vertical and 4 convertible housingless mill stands, shears, a 65 m long cooling bed and conveyors, a multi-strand straightening group, cold shear, short bar recovery, a pendulum-type stacker for fast packing, tying machines and all the necessary ancillary facilities.

As a full-line supplier of mechanical equipment, process engineering as well as electrical and automation systems, SMS Meer had the chance to manage all these facets and allow a smooth start-up and rapid learning curve.

The mill is characterised by great flexibility and has an annual capacity of 300,000 t producing a broad product mix including plain rounds and rebars from 16 to 40 mm, flats up to 100 mm, tees up to 80 mm, angles and channels up to 120 mm and I beams up to 120 mm.
A continuous section mill with high flexibility and the capacity to roll beams, angles, channels and flats of small and medium size. A mill of this kind has a capacity of 600,000 to 700,000 tpy of sections with a product ranging from 100 to 200 mm. Continuous mills are also possible for beams up to a web height of 350 mm. The mill mainly consists of:

- Reheating furnace
- Roughing mill with horizontal-vertical housingless stands
- Intermediate/finishing mill with horizontal, convertible and universal stands with quick-changing device
- Drop wall roller way with lifting aprons
- Cooling bed
- Straightener
- Layer transfer facilities
- Finishing facilities with saws, stacker and strapping machines
THE UNIVERSAL HOUSINGLESS STAND

The key benefit of rolling sections in universal stands is that the entire section is simultaneously and harmoniously shaped. The symmetrical arrangement and the separate adjustment of horizontal and vertical rolls allows stresses in the section to be reduced and improved tolerances to be achieved.

The design of the stand is based on the proven HL series (housingless) with a sturdy vertical roll being added for universal operation. The configuration ensures quick program changes. This solution allows high rigidity combined with extreme flexibility, as the modular design allows the stands to be prepared either in a 2-high configuration or in a universal configuration.

FLEXIBLE SECTIONS FOR UNITED GULF

United Gulf Steel Mill Company Ltd. is a producer of light and medium sections in Al Jubail, Kingdom of Saudi Arabia. Installed in year 2000 with a designed capacity of 350,000 tpy, this mill exceeded 400,000 t in 2007.

The product range includes angles up to 140 mm, channels up to 200 mm, beams up to 200 mm and a large variety of flats, squares and rounds.

For products of this type and size, shaping, intermediate edging and universal passes are all required and thus the mill is equipped with horizontal, vertical, convertible and universal stands in key positions. SMS Meer provided comprehensive in-house roll pass expertise for this challenging project allowing United Gulf to rapidly master this new production.

All together the train is made up of 6 housingless roughing stands in H, V and convertible configuration, 5 housingless intermediate stands in H and convertible configuration and 4 housingless finishing stands in H, convertible and universal configuration.

After air-mist cooling on a 54 m long cooling bed, the sections are straightened and cut on-line. A pendulum-type stacker is used to accumulate and lay the stack in a preset geometrical pattern while downstream, automatic machines provide for the necessary tying.
THE HL HOUSINGLESS STAND

The housingless design, in short HL, are the backbone of modern rolling mills. The modular design allows the use of the HL stand cartridges in all the possible configurations: horizontal, vertical, convertible and universal.

Thus the HL concept is suitable for roughing, intermediate and finishing mills. Mill stand sizes are varied in accordance with the required dimensions of rolls and necks, the pattern of pass, the groove design as well as the transmission and drive characteristics. SMS Meer design department models all load data to determine all the process variables and select the correct stand size.

The HL stands operate in bar mills, wire rod mills, section mills and combined plants. The main features of the HL design are:

- Conservative component sizing criteria and general philosophy in order to achieve rigidity and compactness of each unit
- Low roll deflection modulus (favorable ratio of roll neck to roll working diameter)
- Long life multi-roller bearings with chocks selfalignment under load
- Balancing of backlash between chocks
- Rest bars designed to allow easy and fine adjustment of guiding devices

Hence, these are the major benefits during operation:

- Finished product matching required tolerance on geometry and size, thus stricter weight control
- Time saving during stand changing with off-line roll replacement
- Flexibility of operation, same stand unit used in horizontal, vertical, convertible and universal configurations, thus minimisation of spare parts inventory
- Highly reduced maintenance time and costs, due to a reduced number of components and easy access
- Automated gap adjustment
- Integration in fully automatic control

FINISHING MILL UPGRADE AT NUCOR DARLINGTON

Nucor Steel is the largest steel producers in the US. The plant in Darlington, South Carolina, is the historic foundation of the Group. It operates two bar mills, and in 2008 SMS Meer received the order to modernise the No. 1 mill. The new intermediate/finishing continuous mill comprises four horizontal, one vertical, and three convertible groups, all equipped with housingless (HL) stands. The convertible groups are of dual drive arrangement, with motors and gears keeping their position regardless of the stand configuration (either H or V), with benefits for maintenance and plant fitness, easier access to these facilities, while minimising the depth and size of the necessary foundation.
FLEXIBLE HIGH-PERFORMANCE WIRE ROD MILL AT GERDAU ACOMINAS, BRAZIL

Since 2003 Gerdau Acominas in Ouro Branco, Minas Gerais, Brazil has been operating a single-strand high-performance wire rod mill for quality steels with a nominal annual capacity of 550,000 t. The main grade families are low, medium and high carbon steels, cold heading steels, PC wire and low alloy steels. SMS Meer supplied the whole rolling technology.

Apart from all the possibilities of temperature-controlled rolling, the plant is characterised in particular by its enormous flexibility. The concept permits practically non-stop production with correspondingly high plant availability. Compared with a conventional plant layout, this offers a potential increase in productivity of approx. 70,000 tons per year. The 160 mm square billets supplied at 130 tph are initially processed in a 16-stand roughing and finishing mill with a free runout into a heat holding roller table behind stand 4.

These 16 HL stands are grouped as follows:
- 6 roughing stands, HL 630-26 in H and V configuration
- 6 intermediate stands, HL 630-26 and 450-20 in H and V configuration
- 4 finishing stands, HL 355-16, in H and V configuration

The key equipment for the high-speed section then begins with 2 cantilever stands, type 200, followed by an 8-stand finishing block and the 4-stand FRS® (Flexible Reduction Sizing) mill. The whole size range from 5.5 up to 22 mm will be finish-rolled in a “one-family” pass series on the FRS® mill. The finishing block and FRS® are designed for minimum entry temperatures of 750°C that combined with the “LOOP” technology, offer optimum preconditions for thermomechanical rolling. A total of 14 water cooling sections and the 105 m long LCC® (Loop Cooling Conveyor) ensure optimum temperature control of the products.
As early as 1971, SMS Meer started with the development of the HSD® High-Speed Delivery System, a superior technology for the fastest processing of straight bars on a cooling bed. Speeds have constantly increased from 18 metres per second in the first installation up to current tests at 45 metres per second (9000 fpm). Installations include both single strand and double strand operation.

Advantages of the HSD® system can be summarized as follows:
- High productivity
- Better product tolerances
- Easy rolling management
- Easy equipment maintenance
- Optimisation of bar length on cooling bed
- Minimised losses
- Faster cycle on cold shear due to better distribution of bars (one bar per notch) and best alignment

The main advantage of the HSD® system, however, is the yield increase compared with the traditional slitting philosophy.

In 2002 Alfa Acciai, a steel manufacturer based in Brescia, Italy, decided to upgrade its production by installing a new rolling line. The challenges faced were to combine a massive production capacity increase with very limited space availability. The SMS Meer concept was selected as an ideal solution: a two-strand delivery from the intermediate mill to two separate finishing blocks and transfer to a single cooling bed using a HSD® system with rotating channels grooved to receive 2 bars at a time.

The 550,000 tons per year mill, with a product range of rebars with diameters from 8 to 16 mm, is equipped with 14 stands in alternating horizontal and vertical configuration and with 2 finishing blocks, 4 passes each, with future provision for 2 additional passes.

This HSD® High-Speed Delivery System designed to match the production capacity of the overall mill operates at a max speed of 36 metres per second, which, thanks to the 2-slit method, results in a production equivalent to single-strand rolling at double that speed.
A COMPARISON: HSD® VS 4-SLIT ROLLING TECHNOLOGY

The apparent slight advantage in the theoretical production using 4-slit rolling for small sizes, such as 8 and 10 mm, is more than recovered by the much higher utilization of a single-strand mill operating at high speed. Great savings in production costs are achieved when employing the HSD® system due mainly to:

- Better control of the bar tolerance, since each line finishes with a finishing block with much higher tolerances than either a regular stand or a 2 to 4 slitting process, where the production is driven by the smallest size bar, thus having larger dimensions than necessary, on average. When products are sold by the number of bars, as is the norm in the vast majority of applications, rolling with close tolerances in the lower part of the tolerance band results in considerable yield advantages.
- Guide cost difference, since with the HSD® system there is no need of slitting boxes or twister guides.
- Less cobble and crop end losses and less trial bars with the HSD® system due to the demanding and delicate set-up operation during multislitting of small sizes.
- Optimisation of bar length since single-strand finishing means that each bar can be optimised independently.
- Less short bars are also a result of the fact that there is only one short (final) bar per billet. When slitting there are as many short bars as there are strands, since the bars are all cut by the same divide shears.
- In addition, when laying multiple bars on the same cooling bed notch, alignment for final cold cutting to customer’s lengths is very difficult. Thus this operation generates a large number of crop ends and several short bars that in most cases have to be removed manually.

Depending on the bar sizes, the savings using the HSD® system are considerable and can grow into millions, rapidly off-setting higher initial investment costs.
ANOTHER “ROCKET” FIRED IN GANSU, CHINA: THE HSD® HIGH-SPEED DELIVERY EXPERIENCE AT JISCO

Gansu, an eastern province of P. R. China, hosts several launching pads for spacecraft blasting off for the Chinese space agency programmes, among them the Jiuquan satellite launch pad. In the same Gansu province, another “rocket”, but firmly anchored to the ground and steel propelled, sets records in bar rolling technology.

Jiuquan Iron and Steel (Group) Co. Ltd., JISCO, is a steel manufacturer with headquarters and works in Jiayuguan City. JISCO decided to revamp the existing high-speed wire rod mill production line (100 tph, 90 metres per second) by installing the HSD® system and bar counter to meet the developing market demand, widen the product mix and improve the product quality. An order was placed with SMS Meer in 2001.

The system is suitable for processing quenched and nonquenched ribbed bars with dia. 8 to 32 mm as well as plain round bars in low and medium carbon and low-alloy steel grades.

Just two months after start-up in October 2001, the system was operating at a rolling speed of 40 mps thanks to the skill of the JISCO staff and the cooperation with SMS Meer.

In 2007, this combined bar and wire rod line rolled 620,000 tons of finished product, including straight bars. The great customer satisfaction for the overall performance of the HSD® High-Speed Delivery System is also due to the fact that the same rotating drums, original from the very first installation in 2001 have been used and are still in place, with negligible wear of the channels. This is the first HSD® system installed in PR. China and it is remarkable since it is one of the few mills in the world operating at the fastest speed to produce straight bars on the cooling bed.

THE SOFT-BRAKING ROLLS

The key to effectively discharging a bar onto the cooling bed at very high speeds is the braking of the bar with a precise and sensitive pinch roll. Enough pressure has to be applied to slow the bar down, but without marking or deforming the bar. The rolls have a pressure regulation ranging from 1 to 6 bar controlled via proportional valves, depending on the bar size and surface temperature. This ensures smooth braking and vibration-free operation.
THE HIGH-SPEED ROTATING CHANNELS
The bars are delivered onto the cooling bed by rotating channels. In order to discharge one bar per notch, the channels are synchronised with the soft bar braking unit device, the continuous monitoring of the rolled bar position and the cooling bed cycle movement. In order to avoid cobbles, the proper position of the channel is continuously monitored by a pulse generator and proximity switch. The acceleration and deceleration of the rotating movement is 500 ms max.

The “revolver” type channels are supported by a water-cooled beam and rotate on low-friction bearings. The material of the channels is low-friction cast iron.

CEASELESS ROLLING AT RECORD SPEED AT STEFANA, DREAM STEEL
The results of the performance tests at Stefana S.p.A. set a milestone in technology. The 2-slit lines with a double-strand HSD® system operating at a real average speed of 40 metres per second for several hours in succession per shift, producing merchantable bundles of 8 mm dia rebar, totalling 80 metres per second of straight bars onto the cooling bed, is now a reality, and a springboard for further increases in speed soon.
SMS Meer offers a variety of solutions for bar and section finishing. A typical bar line would include a cold shear with gauge beam while a section mill would have a straightening machine feeding the cold shear. The goal is always to achieve maximum profitability by reducing manpower and downtimes, with safety ranking first.

Correct layer preparation for the straightener is the key to this goal and this is achieved by an automatic profile feeding system. Cold shears, flying type are also available when the rate of production increases.

THE MULTI-LINE STRAIGHTENER
This machine has been in use for many years for the production of traditional sections at high productivity rates. The concept is to straighten cooling bed lengths in order to have less feeding operations and better utilization of the straightening roll drives. The problems on which equipment manufacturers had to concentrate were mainly alignment and centering of the bars under the rolls, feeding, quick change of roll sets, roll adjustment and good straightening performance. Recent technologies applicable to the improvement of the operation in this area are:

- Use of automatic section feeding to the straightener
- Quick change of roll sets mounted on a stand-by carriage
- Motorized roll gap arrangement (one set of rolls can be used to straighten various sizes)
- The whole unit, including the spare rolls carriage, can be mounted on a platform that can be shifted out of line for maintenance without stopping mill production when sizes not requiring straightening are rolled

In order to pre-align the bar layer on the cooling bed run-out roller table, a chain transfer and carriage-type extraction system is provided so that the bars are inched out of the bed rakes at the required center-line distance between bars and kept this way by gentle depositing on the runout table with the carriages.
ArcelorMittal Zaragoza, S.A. located in Zaragoza, the capital of Aragon, Spain, is a steel manufacturer specialising in angles and flat bars for the construction sector, machine engineering industry and electrical distribution subsector. In 2005 the company awarded an order to SMS Meer to transfer all the production activities, located in the urban area of Zaragoza, to the outskirts of the city in the “López Soriano” Recycling Technological Park, so that residential downtown areas could be freed. This operation required SMS Meer to dismantle, transfer and re-assemble the existing equipment, along with the supply of complementary new equipment for two rolling mills. The transfer of their former activities gave ArcelorMittal Zaragoza the opportunity to revamp their rolling mills, nearly doubling the previous capacity.

A new 80 tph pusher-type furnace was supplied for Rolling Mill No.1, with a possible future increase to 90 tph. The pusher furnace for Rolling Mill No. 2 was revamped. New electrical and control systems for both mills were provided.

SMS Meer proved capable of managing complex projects where services, besides the supply of equipment and technology, play a key role for the final success.

### THE NEW CONFIGURATION CONSISTS OF:

<table>
<thead>
<tr>
<th>MILL #1</th>
<th>MILL #2</th>
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<tbody>
<tr>
<td><strong>Installed 2007,</strong> 400,000 tons per year</td>
<td><strong>Installed 2007,</strong> 400,000 tons per year</td>
</tr>
<tr>
<td>Product range</td>
<td>Rebar &lt; 32 mm, profiles &lt; 100 mm</td>
</tr>
<tr>
<td>Roughing mill</td>
<td>6 HL 715-28, H and V configuration</td>
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<tr>
<td>Intermediate mill</td>
<td>Existing mill stands, relocated</td>
</tr>
<tr>
<td>Finishing mill</td>
<td>3 HL 450-20, H configuration</td>
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<tr>
<td>Cooling bed</td>
<td>78.5 m long, 10.5 m wide</td>
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<tr>
<td>Straightener</td>
<td>9 rolls, 500 mm barrel, 1050 mm dia.</td>
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<tr>
<td>Cold shear</td>
<td>Existing cold shear, relocated</td>
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<td>Bundling #1</td>
<td>Automatic bundling system, 12 m long</td>
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<tr>
<td>Bundling #2</td>
<td>Existing stacker, upgraded</td>
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<tr>
<td>Tying machines</td>
<td>Existing wire tying machines</td>
</tr>
<tr>
<td>Bundle delivery</td>
<td>New bundle storage system</td>
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</table>
BUNDLING AND STACKING

SMS Meer offers a variety of solutions for bar and section finishing. A typical bar line would include a simple bundling machine while magnetic stackers are the norm for sections.

The focus of our technology in this very demanding area is on the reduction of manpower. In fact, all operations have been mechanised and automated, such as the removal of short bars or the labelling in ideal scanning position of tags with all relevant information.

Particular care is given to the final shape of the bundles, with optimum arrangement of the bars and sections, even in very small sizes.

Stackers have different designs, depending on the customer needs:
- For precise stacking of light sections, the overhead pendulum system
- For light-medium sections, the stacking system with magnets underneath

ALL SHAPES AND SIZES AT GERDAU ACEROS CORSA S.A

Gerdau Group, a major manufacturer of long steel products with several locations in the Americas, produces sections in Tlalnepantla, near Mexico City, at Gerdau Aceros Corsa S.A. The product mix includes an extended range of products and sizes, comprising angles up to 4", channels up to 6", flats up to 6" as well as squares, rounds and rebars. Flexibility of operation for a fast response to market demands and capability to operate either from inventories or by just-in-time production campaigns, were among the priorities when establishing a concept for this mill.

The rolling train consists of horizontal, vertical and convertible housingless stands served by quick-changing facilities at the intermediate and finishing mills. A cooling bed with double-pitch rakes assures handling of the extensive product range while in-line straighteners ensure the required straightness to the material. A pendulum-type stacker with bundling equipment takes care of the proper packing of the sections at the required rates of productivity prior to transfer to the strapping machines for final binding of the packages.

The mill went in operation in 2000 and has a nominal annual production of 300,000 t.
THE SHORT BAR REMOVAL SYSTEM
Short bars are automatically removed from the bundling area. A movable overhead magnet correctly positioned lifts and holds the tail ends of the bars. Shorter bars are not engaged by the system and are free to be removed from the line by a disappearing roller table.

THE PENDULUM-TYPE STACKER
The pendulum-type stacker offers high productivity rates with the capacity of handling more than one layer per cycle thanks to short automated sequence time. The set up of the equipment is fast and allows various sections such as equal-unequal angles, channels and beams as well as flats, hexagons and squares in a variety of sizes to be processed. Suitability to various commercial lengths is ensured by the multiple section design with stacker sections electrically coupled for machine synchronisation. The precision machine control assures high accuracy and repeatability in the geometry of the formed stack. As the machine is arranged above the bars supported on columns, it requires very limited excavation for the foundation works, allowing savings in investment costs and project time. At the same time this configuration enables maintenance staff to easily reach all components, avoiding frequent maintenance work in confined underground space.
AUTOMATIC BAR COUNTING

SMS Meer precision bar counting system guarantees 99.9% accuracy with a reliable and simple user-friendly mechanism. There are no wear parts such as screws or mechanical devices to count the bars as the system operates on an optical principle.

The bar counting equipment provides automatic bar counting and separation for forming bundles. The group is composed of three fixed chain transfer devices between which the counting system is installed. The working cycle can be summed up as follows:

- The first chain conveyor collects the bars from the discharge line of the cold shear
- The second chain conveyor performs the bar separation, by traveling at a higher speed than the upstream conveyor
- This second conveyor transports the bars under the optical transducer keeping them separated and aligned enough, while the chain transfer unit located downstream carries them to the bundle forming device

PERFECT COUNTING AT GERDAU AMERISTEEL KNOXVILLE

Gerdau Ameristeel is the largest US supplier of rebar and operates a high productivity rebar mill in Knoxville, Tennessee. This facility, among the most profitable steel mills of the group, needed to improve the performance of the old finishing area. In 2007 SMS Meer installed a finishing line with a capacity of 100 tph for rebar forms #3 (3/8” to 9.5 mm) to #11 (11/8” to 32 mm). The supply included a 650 t cold shear, a bundling machine with automatic bar counting and three wire-tying machines. Excellent results were achieved on the bar counter almost immediately after start-up, exceeding guaranteed performances and reaching 99.9% counting precision. The new system allowed Gerdau Ameristeel Knoxville to beat previous production records and improve their leading position on the market.
The optical device together with a pulse generator installed on the chain transfer drive performs the counting and recording of each single bar in transit without overlapping or double reading.

When the number of bars required for the bundle is reached, both chain transfer devices start to decrease their speed and stop it by depositing the last bundle at right-angles to the separator axis.

The separation system comprises a series of wedge levers that lift up in sequence and engage between the bars in order to divide the layer.

When all the wedge levers are up, the bundle is on the discharge transfer table, which moves it to the bundler. After the bundling discharge, the separators lower and the cycle restarts with the feeding transfer table going into operation.

THE OPTICAL COUNTER
Within each bar layer travelling on the chain transfer unit prior to bundling, the bars are aligned and sufficiently separated to allow a specially designed sensor to detect the passage of each bar and transmit a pulse to the reading device. The proprietary software monitors the reading process and intelligently compensates for missing pulses when bars are close together.
SMS Meer wire tying and strapping machines are designed for continuous automatic operation. Wire tying machines use commercial size wires. The machine head is hydraulically operated. The wire strapping machines are pneumatically operated and use commercial steel straps of different available widths. Solutions with either welded or clamped joints are available. SMS Meer wire compactors and tying systems are of both vertical and horizontal configuration.

AUTOMATIC LABELLING MACHINE
The labelling machine is a fully automatic system to reliably attach individual tags, each specifically printed, to the end of the bundles for perfect visibility when they are vertically stacked.

The system’s main components are:
- A label printing machine
- A wire shaping device
- A robot arm to properly insert the label

The sequence of operation is as follows.
1. A label printing machine prepares a metal or paper label with all the necessary information
2. The printer discharges the label into the wire shaping device
3. A piece of steel wire is fed into the wire shaping device and goes through the label hole. The wire device cuts the wire at the correct length (wire is fed by a small drum) and shapes the end to ensure solidity of connection to the bundle on the one hand, and retention of the label on the other

WIRE TYING IN RUSSIA ...

Among the several dozen installations of SMS Meer wire tying machines, some recent successes include the Chelyabinsk Metallurgical Plant, a unit of the Mechel group, one of Russia’s leading mining and metals companies. The plant, located in Chelyabinsk to the east of the Ural Mountains, was equipped with a complete finishing line including 3 tying machines in 2007.

... AND KOREA

Kia Steel, now renamed SEAH Besteel, in Gunsam, Republic of Korea also installed SMS Meer tying machines in a high quality SBQ bar mill supplied in 1992.
4. A robot arm picks up the wire and positions it correctly on top of the bundle during strapping or tying. This is performed before the last strap is started and the position is such that the wire is strapped on the bundle.

5. After the strapping is performed, the arm may move the wire so that the end is hooked and securely engaged in the strap.

The bundle with the protruding label then continues to the storage area. The label positioning device is therefore located in the immediate vicinity of the last strapping or tying machine. Lines printed on the label include all relevant information required, including weight if bundles are weighed before tying (on the stacker delivery cradle).

**COMPACTING IN ITALY AND BRAZIL**

Cogne Acciai Speciali, a prime quality steel producer in Aosta, Italy, has operated a horizontal compactor since 1998. A different type of compactor, this time vertical type, was installed in Gerdau Acominas, and has been operating since 2003. Both these producers make bundle quality and defect-free surface tying their primary concerns.

**OPERATIONS UPGRADED AT DUFERCO DANISH STEEL A/S**

Duferco operates SMS Meer equipment at the finishing end of their Duferco Danish Steel A/S in Frederiksvaerk, Denmark.

The supply, integrated into an existing mill and designed to meet 70 tph, went into service in 2007. A new water treatment system at the cooling bed, straightening facilities, stacker and automatic labelling machine are the core additions that made it possible to upgrade this northern European mill. However, other interventions on existing parts, modifications and additions, all catered for by SMS Meer to meet the new layout, also formed part of this revamping project.

The highly automated new components contribute significantly to the optimisation of the working environment at the finishing end, meeting the prerequisites for satisfying the stringent EU directives for industrial sites.

The product mix at Duferco Danish Steel A/S comprises angles up to 75 mm, channels up to 80 mm, flats up to 150 mm, tee sections up to 50 mm as well as squares, all in an assortment of intermediate dimensions control of the products.
Final packaging is a key operation in modern production facilities: It is the business card with which steel producers introduce themselves to their customers. Long product rolling mill operators also have to pay particular attention to the form and quality of the bundles as, after this operation, the bundle of bars is delivered to the market. Each and all single bundles produced in the mill are bound by a tying machine. This operation is critical on several levels and must be:

- Safe: bundles have to be tied securely and consistently
- Reliable: any problem at the tying machines requires the whole operation to be stopped
- Aesthetic: bundles should be neatly tied and free of oil

Highly reliable equipment is what plant operators expect in this area.

In the past, SMS Meer developed hydraulic tying machines that were characterised by:

- Heavy-duty design for severe conditions
- Fully-hydraulically driven operations
- Built-in automation systems
- Hydraulics, electrics and automation: all systems "turnkey" and fully tested prior to shipment
- Single or double binding options
- Utilisation of high quality components

Hydraulic operations requiring oil were essential. Yet hydraulics always require special maintenance – for hoses, valves, pumps and there is always a risk of oil leakage. This no longer applies today.

Today, SMS Meer develops the most advanced and reliable tying machine without using hydraulic controls. With more than 200 tying machines running successfully worldwide, SMS Meer is the leader in this field and the natural developer of the newest technology.

**BENEFITS AT A GLANCE**

- Oil-free operation
- Clean and safe technology
- High-precision operation and repeatability
- Significantly reduced maintenance
PLANT OPERATORS ASK FOR:

- Reduced maintenance
- Higher precision operation and repeatability
- Cleaner technology
- Reduced operational costs
- Increased safety
- Reduced criticism of the tying operation in the rolling mill
- Improved knot quality

SMS MEER’S ANSWER: AVOID HYDRAULIC OPERATION!

1. Brushless motor and gearbox for vertical movements
2. AC gearmotor for out of service positioning
3. Brushless motor and gearbox for knot forming and wire cutting
4. Brushless motor and gearbox for pinch roll

GENERAL CHARACTERISTICS OF THE ELECTRICAL TYING MACHINE

<table>
<thead>
<tr>
<th>WIRE BINDING GROUP</th>
<th></th>
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<tbody>
<tr>
<td>Bundle dimensions (round or rectangular) mm</td>
<td>Ø 150 to 1000</td>
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<tr>
<td>Single knot</td>
<td>Yes</td>
</tr>
<tr>
<td>Double knot</td>
<td>Yes</td>
</tr>
<tr>
<td>Cycle time (single) Seconds</td>
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<table>
<thead>
<tr>
<th>TYING WIRE</th>
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<tbody>
<tr>
<td>Material</td>
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<tr>
<td>Diameter</td>
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<tr>
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<tr>
<td>Tensile strength</td>
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<tr>
<td>Yield point</td>
<td>kg/mm² 28</td>
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<tr>
<td>Elongation</td>
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SMS Meer’s Vertical Compact Coiler line (VCC®) is today’s solution for obtaining a compact coil.

This machine concept fulfills the best criteria in modern mechanical engineering for rolling mill applications: heavy duty service factor, focus on maintenance minimisation, ease of erection and startup, safety features and particular attention to the demands of the process.

Among the most important features of this system is coiling the bar directly in vertical position. Benefits include avoiding the need for turning manipulators but, more importantly, the savings in process cycle time because coils are already formed in their natural final position. The coils are ready to be delivered to storage immediately after coiling and cooling. The limited amount of handling minimises the overall risk of damage.

The VCC® Vertical Compact Coiler line has the following general characteristics:

- Capability to process plain rounds dia. 8 mm to 32 mm, rebars dia. 8 mm to 32 mm as well as flats, squares and hexagons
- Coil weight: up to 3.5 t
- Design speed: up to 40 m/s
- Indicative coil dimensions: inside diameter 700 or 850 mm, height 700 or 800 mm

Advantages of the coiler are:

- Compact and good coil geometry
- Heavy coil weight
- Torsion-free coiling (no axial torsion)
- High productivity, with the possibility of installing the system downstream of two rolling strands or slitting rolling mills

THE COMPACT COIL

A crucial step forward in improving the quality of the pack up of the final product is the compact coil. These coils have pre-selected dimensions that, thanks to the VCC®, are constant for all the products processed out of the same line. Needless to say the compact shape of the coil makes it ideal for storage, transport and handling. Such advantages are even more appreciable when coils are reworked next to the construction site where rebar stirrup and other concrete reinforcing structures are built, particularly in metropolitan areas with their major space constraints.

The hot rolled condition of the compact coil makes it suitable for direct cold working with high ductility during elastic deformation and low energy demand for final forming.

The geometry assures smooth de-coiling during the downstream process. The coil weight significantly contributes to reducing the time for downstream coil changing and to the enhancement of the yield due to minimal losses.
The successful operations at Acciaierie di Sicilia, Megara, Italy, a manufacturer of bar steel that placed an order with SMS Meer, for the supply of a VCC® line for production of rebar and plain round in spool, confirms the validity of our design for ease of implementation and start-up performance. The line, in operation since 2004, includes online heat treatment units, shears, wap distributors, coilers, discharging facilities, tying equipment for strapping spools at four points, cooling bed and handling equipment and all ancillary facilities.

This VCC® line is designed for rolling speeds of 36 metres per second, has an output of 80 tph and produces coils up to 3 t in weight.

Performance tests were carried out on several products and the results showed that the mill performed well within the design parameters.
BAR INSPECTION, TESTING AND CONDITIONING LINES

SMS Meer is a supplier of bar inspection, testing and conditioning lines with equipment for secondary working for rounds and squares for SBQ producers.

Operations include:
- Unbatching, unscrambling of bar bundles to feed to the processing line
- Pre-straightening and straightening
- Head and tail cropping
- Reeling
- Chamfering
- Testing
- Reconditioning
- Re-stacking and bundling

Critical are the operations of bar handling since scratches have to be avoided at all costs. This requires rubber-coated rollers and soft handling systems. All handling, straightening, conditioning and testing equipment is provided and integrated. Customised solutions and customer-preferred brand components are used.

BAR CONDITIONING AND INSPECTION LINES AT LUCCHINI PIOMBINO

SMS Meer supplied two inspection lines to Lucchini Piombino works in Italy:
- Round bar inspection line, including prestraightening, head/tail cropping, reeling, chamfering, NDT testing, separation of defective bars, reconditioning and automatic bundling
- Squares and flats inspection line, including straightening, head/tail cropping, reeling, chamfering, NDT testing, separation of defective bars, reconditioning and automatic bundling
ONE STEEL (FORMER BHP) INSPECTS

In 1997, SMS Meer supplied a bar inspection line to BHP for their Newcastle Works, New South Wales, Australia. The line starts with a descaler to prepare the bars, followed by a roller straightener before the bars enter the advanced inspection line with its NDT facilities. Bars are automatically marked according to the inspection result. After the operations, bars are bundled again and delivered for final storage.

TESTING STATIONS

NDT testing stations include several different options for checking internal quality and detection of surface defects.

Systems are installed in-line and bars are securely guided through the instruments. The automated control system allows colour coding of non-compliant stock and/or colour identification of the good bars according to final customer specifications.
SMS Meer has numerous references for the electrical and process control system for the entire product line. Having the OEM for the mechanical equipment also involved in the process control has obvious advantages. The close relationship between the mechanical and automation designers allows for a smooth and seamless operation without any type of communication problem.

SMS Meer electrical and process control packages are characterised by:

- Integrated and seamless operation between mechanical equipment and automation system
- Exclusive focus and extensive competence on rolling mills and processing lines
- Choice of major brand components and systems, perfectly integrated with the mechanical design
- Complete range of services, from design, procurement to start-up and training
- Power distribution, level 1, level 2 and integration with level 3
- Capability of integration with existing automation systems
- Availability of open-system supply

SMS Meer provides controls for top applications such as the HSD® High-Speed Delivery System, the VCC® Vertical Compact Coiler and the closed-loop control of thermo-processing lines for SBQ and commercial steel grades. In these systems, it is critical to combine mechanical and automation design so that a high level of performance is reached. Very fast cycle times require both superior mechanical components but also advances and fast automation controls. The software developed by SMS Meer matches the mechanical systems to reach the required performance.

SMS Meer is perfectly suited to seamlessly integrate new supplies with existing facilities.
CASE STUDIES: INTEGRATION OF MECHANICAL AND AUTOMATION SYSTEMS WITH EXISTING EQUIPMENT

The majority of the projects worldwide involve upgrades of existing production facilities. Two case studies:

- In July 2007 Hellenic Halyvourgia, Volos, Greece started up an HSD® system in an existing plant. This complex system was seamlessly integrated into the existing automation system and was commissioned in record time. One year later, Hellenic Halyvourgia’s productivity for 8 mm diameter rebars with the new system is running 50% higher than with the former mill configuration.

- The Timken Company, Canton, Ohio placed an order with SMS Meer in 2007 for a three-roll PSM® Precision Sizing Mill and new cooling bed with finishing facilities, including abrasive saws. SMS Meer provided the control system for the entire scope of supply and integration with the existing control system.
The information provided in this brochure contains a general description of the performance characteristics of the products concerned. The actual products may not always have these characteristics as described and, in particular, these may change as a result of further developments of the products. The provision of this information is not intended to have and will not have legal effect. An obligation to deliver products having particular characteristics shall only exist if expressly agreed in the terms of the contract.