A FEEL FOR STEEL
The art of casting

CONTINUOUS CASTING PLANTS FOR FLAT PRODUCTS
A feel for steel
FOREWORD

Is casting steel an art? Those involved in it would hardly even think of asking such a question, because they tend to be more down-to-earth. When pressed, they might talk of know-how, competence or innovation...

And yet there is art in steel. It may become a saucepan, a fender, the hull of a cruise liner and many more things. Or an actual work of art. What it always starts with is cast steel. The fact that this huge potential is inherent in any common slab fascinates not only engineers, but also artists like US sculptor Richard Serra.

That inspired him, in 1998, to create a landmark for the Ruhrgebiet, one of Europe’s oldest industrial regions. Strange though it may seem, the work consists of nothing but a giant slab erected on an abandoned mine site in Essen. Its massive silhouette conforms to what everybody expects from steel: a weighty matter, exactly 67 metric tons in this case, 14.5 meters high, 4.2 meters wide, but just 13.4 centimeters thick. Viewed from the side, it reveals that steel can also be a material of great lightness and elegance.

Richard Serra is known for meticulously planning his designs and matching them perfectly to their intended surroundings. This means the way he works as an artist is not that different from our own approach. Imagination, knowledge, experience and persistence to find the best solution are the foundations of our work and our success. We want our customers to be able to coax everything out of steel that the material offers. That’s our mission as a leading manufacturer of machinery and plants for the steel industry.

Whether you call it art or not, our customers worldwide appreciate it, and we are proud of it. What we do, why we do it and how we do it – this brochure is designed to give you an impression.

Photo: H. Spiering, RVR Essen®
The world knows no standstill, neither in technology nor in business. As valid today as ever are the words of the Greek philosopher Heraclitus: All is flux. Recognizing the need to adapt is the only way to survive. We can take Heraclitus at his word when it comes to steel processing, because it progressed from the relatively static ingot casting method to predominantly continuous casting. Our company has played a vital role in this development ever since the mid-1900’s.

The advantages of this technology are obvious. Compared to ingot casting, continuous casting ensures higher productivity and yield, lower investment and operational costs as well as drastically reduced energy consumption. Best of all, continuously cast product is also superior in quality.

Meet Her Majesty, Queen Mary II

We must admit – it’s an honor for us to be of service to a queen. Called QM 2 for short, she is quite an eyeful. The Queen Mary II is the longest, highest and widest passenger ship ever built. This was an order from the renowned cruiser shipping company Cunard, that paid 870 million dollars for the luxury liner. Here are some more facts and figures: over 150,000 t heavy, 345 meters long, 41 meters wide, 72 meters high, making the ship longer than four jumbo jets and higher than the Statue of Liberty. 15 decks provide space for 2,620 passengers and 1,250 crew. Everything on this ship is top-notch, from the service right down to the exquisite furnishings. State-of-the-art design has created a floating city that is glass-walled, elegant and technically cutting-edge.

We, too, had a hand in the robust inner life of the QM 2. Why? Because a large part of the 35,000 t of special steel for the internal struts and the extra-thick hull were manufactured on plants from SMS Demag.
The multi-talent

The two-strand slab plant from SMS Demag supplied to Companhia Siderúrgica Tubarão (CST) in Brazil produces a vast range of steel grades for automotive applications, ship building and tube manufacturing. It casts slabs up to 250 mm thick and 2,100 mm wide, achieving an annual production of 2.5 million t.
ALL IS FLUX

Entirely new prospects in continuous casting have arisen from CSP® (Compact Strip Production) technology, another milestone set by our engineers. The process they developed links thin slab casting with the previously separate stage of rolling steel sheet. This casting technology is now applied throughout the world, due to its enormous economic and quality benefits.

Starting with the first commercial facility in 1989 at NUCOR Corp. in Crawfordsville, Indiana, USA, the installed CSP capacity now exceeds 40 million tons annually.

This exemplifies our groundbreaking innovations and developments that have positioned SMS Demag as the global market leader in all areas of continuous casting. World-wide, companies manufacture the most demanding products based on our technology, experience, dependability and expertise.

Higher, longer, faster – steel is always producing records. A current example is the 2,460-meter long “Viaduc de Millau”, the bridge over the Tarn river near the small town of Millau. What makes the little river in the south of France so famous are its dizzying gorges. Equally impressive is the bridge that has spanned the Tarn since December 2004, forming a key north-south link in France’s freeway network.

How it all started...

Up to the early 1970’s, liquid steel was mainly cast into fixed molds in separate “portions”, otherwise known as ingot casting. This multi-stage process has since been replaced by the continuous method.

The first steps in this direction were taken more than 100 years ago, yet large-scale industrial appli-
Designed by British star architect Sir Norman Foster, the construction shatters several records. It is the world’s highest bridge, with cars driving along at a height of 270 meters above the river. The main pylon measures 343 meters – another world record – standing 19 meters higher than the Eiffel Tower. Yet the bridge over the Tarn is no colossus, but a breathtakingly elegant structure that required a minimum of material – steel, of course. Just as impressive was the extremely short construction time of just 39 months due to ingenious pre-manufacturing in the workshop. So what’s our connection with this fascinating construction? Simple – our customer, Dillinger Hütte, supplied a total of 43,000 t of heavy steel plate for the Millau bridge, produced on plants from SMS Demag.

cation only took off in the early 1960’s. Globally, more than 90 percent of steel is now produced using the continuous casting process.

As early as the 1950’s, engineers at Düsseldorf company Schloemann and Duisburg-based Mannesmann Demag – two forerunners of SMS Demag – recognized the future potential of the new technology. They started casting liquid steel in a continuous caster directly into billets, and later into slabs.

Then, in 1956, Schloemann began working with the pioneer of continuous casting, Irving Rossi, and Concast AG. That was the Zurich-based company Rossi founded, which is now part of the SMS group. A period of intensive engineering improvements in slab, bloom and billet continuous casting technology followed. It led to rapid success, and the Schloemann-Concast group as well as Demag, who joined later, became international leaders in this area of steel processing.
Superior technology provides the basis for outstanding products. We offer more than a technological edge in individual fields, namely integrated solutions at the highest level. Led by market demands, we have advanced from a manufacturer of metallurgical plants to a single-source supplier in the fields of process technology, mechanical electronics and service. Our plant designs, in-house developed process models and technological control systems are ideal for all applications.

You can produce (almost) anything with our plants, including blanks for state-of-the-art sheet metal auto body parts with extreme deep-drawing properties and high-strength light construction steels designed to reduce vehicle weights. Or blanks for high-performance electronic components used in ultra-small engines as well as large tubes for transporting aggressive media such as oil and natural gas.

The range stretches from ultra-low carbon deep-drawing steel to high-alloy, heat-resistant stainless steels.

Our solutions, including the CSP® process of near-net-shape casting, ensure that SMS Demag-supplied plants will meet all requirements for years to come. That gives you a clear added value – rapid response to the market, and, as a result, future-proof investments.

Investing with vision

Our customers don’t approach us intending to buy a certain product, but expecting solutions for their precise requirements. Take for instance Salzgitter Flachstahl GmbH, whose objective was to extend its product range in the area of specialty grades for the utmost quality requirements. Salzgitter is an industry leader known for manufacturing a wide variety of top-quality products primarily for the automotive industry and tube production. The company purchased a tailor-made solution in the form of an SMS Demag single-strand slab caster that went into service in November 2004. It supplements the two existing continuous casters and is designed to eventually replace one of them.

The plant casts 250 mm thick slabs with widths ranging from 850 to 2,100 mm. Included are the most innovative features, such as strand guide segments in our patented CyberLink® technology. They ensure the machine achieves the stringent demands of our customer for both today’s products and future developments. Then, after a successful commissioning phase, our customer commented: “The new plant gives us increased productivity, an extension of our steel grade range and far more cost-effective operation”.

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Good as well as versatile

The continuous slab caster at Salzgitter Flachstahl GmbH is designed for special grades and meets top requirements. It features the latest technologies and automation modules, which give it enormous versatility. The plant is designed according to a vertical bending format, producing the highest-quality applications.
CONVINCING SOLUTIONS

Products and services

Often acting as a consortium leader, SMS Demag plans and builds turnkey plants, extensions and revamps. Added to this are project financing, technical service, know-how transfer, consulting, feasibility studies plus classroom and hands-on training.

We supply:
- Casters for standard, medium and jumbo slabs up to 3,250 mm wide and 400 mm thick.
- CSP® plants for thin slabs.
- Continuous casters for blooms, rounds and beam blanks.
- Electrical and automation systems.

Twice as much, twice as good

Hüttenwerke Krupp Mannesmann (HKM) in Duisburg ranks among Europe’s leading steel producers. They launched the largest investment program in the company’s history – designed to double its annual capacity to six million t of slabs. Crucial to the project was continuous slab caster No. 3. The first cast on this two-strand plant was achieved in record time, just 15 months after SMS Demag had received the order. Incredibly, only three months after commissioning, the plant reached a monthly output of 200,000 t. It produces slabs 260 mm thick and from 850 to 2,100 mm wide. There is a three-meter-long vertical section that, along with the large casting radius, provides ideal conditions for outstanding product quality. Features such as dynamic spray water control and our patented Soft Reduction technology with CyberLink® segments – utilized for the first time in a production facility – ensure optimum internal and surface quality.

All this set new standards at HKM – not only in terms of production, but also in competitiveness.
Quality and quantity

The two-strand slab plant at HKM stands for both quality and quantity. Operating with 15 segments of containment equal to a metallurgical length of 36.245 m, the plant produces three million t of slabs per year for the most demanding applications.
So what’s actually the most important thing when casting steel? The answer sounds so simple, yet it is one of the greatest challenges in metallurgy. The trick is to convert the liquid steel at a temperature of more than 1,500°C over just a few meters into a soft, but shaped strand that subsequently solidifies – a real art. Achieving this masterpiece depends above all on observing the exact temperature and on perfect strand guidance.

There is an enormous dynamic behavior contained in the solidification process. The entire technological development since the beginning of continuous casting has focused on mastering this process. While in the past, single steps often led to progress, today a holistic approach is the way forward. This is achieved by linking individual technical components to maximize the overall effect. Furthermore, SMS Demag holds over 2,000 patents in the field of continuous casting, where we have combined our excellent expertise and process know-how to advance technology. To further our development, we maintain constant communication with plant operators and leading universities specializing in metallurgy.

Hi-tech to the power of 3

Optimum strand guidance is crucial for a perfect product. That’s where our newly designed SpeedMasterSegment® strand guidance strategy, our patented Soft Reduction technology and the associated process automation come together – summed up as Intelligent Slab Casting® (ISC). This is how we meet your demands for increased reliability, faster casting speeds, higher product quality and less maintenance. SpeedMasterSegment® guarantees optimum strand support during the slab solidification process by continuous gap adjustment of the strand guide segments. Our advanced process model monitors the strand solidification profile and adjusts the segments accordingly at the precise position near final solidification. Identifying the liquid-solid transition point is also vital for precisely implementing Dynamic Soft Reduction to achieve minimal core segregation and slab centerline condition. As a combination of technology modules, ISC® is an example of our successful approach, linking design, process technology and automation.
Strand guide with tunnel cooling chamber.
Quantity plus quality

The booming Chinese economy means steel demand is huge, particularly for first-class material grades. The new Shanghai No. 1 steelworks of SBGC Shanghai No. 1 Iron & Steel Co. Ltd. meets this demand. As part of an extensive overall order, SMS Demag supplied two single-strand slab casters for carbon steel and two slab casters for stainless steel. The structurally identical vertical-bending casters feature advanced technology modules, including Roll Gap Control as well as flexible Soft Reduction for optimum strand guidance and product quality. That enables SBGC to produce top grades while providing tremendous operating versatility. We teamed up with our customer to develop the automation and process models. This approach ensured reproducible quality with the Dynamic Solidification Calculation (DSC) cooling model as well as a fully integrated system for extensive production monitoring (IPQS). Our successful technological cooperation has resulted in not only achieving the 3.7 million ton annual output goal, but also excellent product quality standards.

The market

... and innovations made by SMS Demag

from 1940

- Industrial production picks up in Europe and around the world. Continuous casting is adopted as a new casting process.
- First cast on an industrial continuous caster for slabs (1949), Allegheny Ludlum Steel, USA.
- Commissioning of the first stainless steel continuous caster (1952), Atlas Steel, Canada.

from 1960

- Assembly lines are rolling, demand is on the rise. The motto is as much as possible as quickly as possible. Mass production tops the list.
- Commissioning of the first bow continuous caster (1964), Hüttenwerke Krupp Mannesmann, Germany.
- Introduction of slab twin casting (1967), Hüttenwerke Krupp Mannesmann, Germany.
- Beam blank casting (1968) for the efficient production of structural sections pioneered at Algoma Steel, Canada.

from 1970

- Costs become a factor. Higher productivity and enhanced quality is the goal. Continuous casting replaces ingot casting.
- Introduction of dual-media cooling (1975), Hüttenwerke Krupp Mannesmann, Germany.
- Introduction of the dummy bar through the top of the mold (1974), Thyssen, Germany.
- First slab plant in complete segment design (1976), Nippon Steel Corp., Japan.
Duisburg in 1959. Metallurgical factories with their housing estates dominate the scene.

### The market

#### from 1980

- Birth of modern, low-maintenance plant designs and mini-mills for flat products.
- Commissioning of the first tunnel cooling chamber (1980), Nippon Steel Corp., Japan.
- Dynamic secondary cooling water model (1989), LTV, USA.
- Commissioning of the first CSP high-speed thin slab casting plant (1987), Nucor, USA.

#### from 1990

- Computers take over. Classic mechanical engineering and electronics merge into “mechatronics” with new scope for automatic control.

#### from 2000

- Holistic thinking interlinks technologies for processes optimization.
- Use of dynamic solidification models for temperature control in strand guidance.
All the parts and sequences of our plants form a functional unit which resembles an organism. Intelligently controlled, it is designed for top performance. Once again, you benefit from overall solutions, can rely on our expertise and purchase everything from a single source – plants as well as controls and process models for their smooth operation.

Our label for this solution is X-Pact®. It bundles our know-how in the fields of electrical and automation systems into one overall package. So you get integrated systems, precisely harmonized and perfectly controlled to achieve top product quality and productivity. X-Pact® is a holistic automation package with an entirely modular design that can be varied or extended as you require at any time.

X-Pact® electrical and automation systems use globally available software and hardware and adhere to international standards. They can be applied in revamps independently of the system periphery without any interface problems. What that means for you is maximum reliability, service and independence from individual manufacturers. We steadily improve X-Pact® by working closely with our customers and by drawing on our experience from a wealth of supplied plants and automation packages.

X-Pact® in detail

The program covers all tasks of modern plant automation, from drive and sensor control (Level 0) to production planning (Level 3). Turnkey plants are controlled just as efficiently as stand-alone facilities. Our extensive and customized training program optimally teaches your personnel to operate and maintain the automation systems.
Control station for a continuous caster at Arcelor in Chertal, Belgium.
### PERFECT CONTROL WITH X-PACT®

#### X-Pact® for continuous casters

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#### Plug & Work: performance right from the start

“Plug & Work” is our motto, and to make sure it works, we leave nothing to chance. We pre-install the complete automation system of each plant in our workshop, check it inside and out, then optimize it. Included is simulation of the entire production sequence and operator training in this real work environment. That’s why our plants start up and obtain their target performance rate very quickly. Plus, we accomplish revamps without a hitch and with minimal downtime.
Test, then start

The Chinese Anyang Iron & Steel Company is extending its production range in the area of ultra-wide slabs with a single-strand caster from SMS Demag. These “jumbo” slabs come in widths of up to 3,250 mm. The extreme format places top demands on the plant, especially on the mold and the hydraulic resonance oscillation. Crucial here is that the casting process and strand guidance function perfectly at the factory from the first day. That’s why all components and corresponding controls had to pass the toughest operational tests before delivery. The “dress rehearsal” achieved or exceeded all performance values. Once again, our “Plug & Work” strategy paid off for our customer. Plant commissioning at the Chinese facility went quickly and smoothly.
Service
ENSURING SUCCESS

We have a special focus on our customers, because their success is our success. However, it can only be sustained if a first-class product is also backed up by first-class service. This is becoming an increasingly crucial factor affecting purchasing decisions and customer loyalty. So we devote as much attention and innovative energy to services under our X-Cellize® brand name as to our entire product range. Once again, our top priority is to ensure that our services seamlessly mesh with our customers’ requirements.

That’s why X-Cellize® service components are supplied both individually and in packages. Worldwide, our experienced Technical Service Division is your contact point. Also available is a 24/7 hotline for rapid reaction. The advantage for you is optimal plant availability, low costs, and a head start on the market.
X-Cellize®: service based on a system

Consulting and auditing
Consulting services aimed at giving you an edge over the competition and preserving your plant capability over its entire life cycle. Our audits detect weaknesses and identify potential savings.

Spare parts management, inspection and repair service
Preventive maintenance of plant components secures all operational functions. It is supported by sophisticated management of pre-configured, tested spare parts for the entire process chain with guaranteed delivery times.

Integrated Maintenance Management System (IMMS)
Specially designed for metallurgical and rolling mill plants, IMMS supports all aspects of maintenance management. The system increases your plant efficiency by integrating new developments.

Technological control and Level 2 systems
Here we provide an extensive reporting system to ensure constant availability of all automation systems through a combination of on-site support, hotline and tele-service.

Training
Our in-depth training courses focus on practical work, covering all areas of production and maintenance. We hold them on site, at cooperation partners’ facilities, or in our SMS Demag training center, according to your language requirement.
Installing a segment.
Responsibility
FOR HUMANKIND AND
THE ENVIRONMENT

Industrial production involves a tense relationship between humankind, machines and the environment. Just a glance at one of our many continuous casting facilities is enough to show that we bear a special responsibility. The plant dimensions, extreme temperatures and wide variety of utilized resources demand that we make no compromises anywhere. Our awareness of this is an integral part of our corporate philosophy.

Parallel to all production steps, we develop advanced strategies for the protection of people as well as machines and conduct safety analyses. That also has economic consequences, because investments in safety pay off. They add up to fewer accidents, lower stoppage times and therefore increased productivity.

This applies equally to economical energy consumption, which is a special feature of our plants along with low noise and harmful-substance emissions. We make sure all consumed media are used in closed circular systems including filter devices. It goes without saying that our plants meet all statutory environmental protection requirements valid in the countries of deployment. They also fulfill the strict requirements applicable in both Germany and the USA.

To remain at the forefront of developments, we regularly ensure that our plants and internal processes are certified according to DIN safety, quality and environmental standards.
Sustainability is the future

Plants from SMS Demag set standards in terms of both safety and environmental control. This we consider our responsibility to ensure quality life for future generations. We combine strategies for sustainable production with the latest technology, securing our customers’ long-term competitiveness.
There is plenty of mediocrity around. We stand apart from the rest, representing top products and future-compatible innovations. Focusing on automation and metallurgy, our research and development departments are constantly advancing technology.

Like in most areas of work, continuous casting is becoming increasingly automated. Looking ahead, we know the casting process will be almost fully automatic at some point. Already, machinery and plants work more and more self-sufficiently. As they gain “intelligence”, they control, regulate and monitor themselves. And they are capable of “communicating” with their operators, e.g. informing them of system status and triggering maintenance processes. Gaps in the automation chain are disappearing, resulting in successful automation for higher quality, flexibility, lower costs and improved efficiency.

High-strength construction steels featuring extreme rigidity, low specific weight and extra formability are at the center of research into materials and metallurgical technology. This is especially true of the international automotive industry, where new materials are expected to contribute to drastic weight savings in auto construction. Furthermore, high-manganese steels are opening up new horizons in terms of vehicle safety and design.

These near-future technologies are fields where SMS Demag will lead development. Our extensive experience, concentrated expertise and outstanding technical know-how provide a solid basis for this approach. But that alone is not enough. It also takes inventive spirit and imagination, an equal amount of ambition and passion, and a willingness to push the envelope to promote a vision.

Putting all this together in a joint creative process … is an art.
We have the ability.
One material for all purposes

With rising demand, steel is the future. It’s already difficult to grasp the variety of ways this hi-tech material is used. And that’s not all. New types of steel are opening up unimagined possibilities, such as inexpensive, lightweight designs in automotive construction, use in extreme Arctic conditions and under the sea.
PRODUCT RANGE

SMS metallurgy
Partner to all process steps

Sharpening the competitive edge of our customers through intelligent, integrated machine and plant concepts – that’s what the companies of the SMS group in the field of metallurgical plant construction are committed to. The product portfolio covers the entire metallurgical spectrum including electrical equipment and automation, service and logistics.

Steelmaking

Continuous casting
- Plants for flat products
- Plants for long products
- CSP® plants for thin slabs

Hot rolling

Cold rolling

Strip processing

Tubes

Long products

Pressing and forging

Induction and electro heating

Metals logistics systems