Pipes don't come much bigger!

Sif backs TM steel from Dillinger: Weldable, tough, dependable

The challenges faced by the offshore industry are typified by extreme working locations subject to arctic temperatures and enormous mechanical and dynamic loads. The demands made on the design and materials selected for drilling rigs and wind turbines are also correspondingly high. Sif Group B.V., of the Netherlands, is one of the most important fabricators of steel tubular elements ("cans") for the construction of oil and gas platforms and the foundations of offshore wind farms. The company has - from conviction - for decades used heavy plates sourced from Dillinger. This also applies, for example, to the jacket structure for the Edvard Grieg oil and gas platform and to the monopiles for the 150 wind turbines that make up Gemini, one of the world's largest offshore wind farms. For these projects alone, Sif used more than 100,000 tonnes of Dillinger steel, primarily thermomechanically (TM) rolled plates.

Sif has more than 450 employees at its home site in Roermond and in Rotterdam, and is capable of producing up to 300,000 tonnes of tubular steel annually for use in offshore foundations. The company, set up in 1948 and converted to a joint-stock corporation in 2016, is a leader in welding technology and productivity, having completed more than 1,700 offshore foundations, in the form of deliveries of tubular elements for jacket fabricators or offshore wind projects, in the seventy years of its existence. Sales in 2016 totalled 400 million euros. At the parent site in Roermond, tubular shell sections are produced around the clock using highly automated processes in twelve fabrication buildings housing five production lines. These sections are then joined together to make XL monopiles (large-calibre tubular elements) with diameters of up to eleven metres and up to 2,000 tonnes finished weight. Pipes with diameters of up to 3.5 metres are typically used for the steel structures, known as jackets, required in the oil and gas industry. The legs for the jackets are connected by means of a sophisticated network of struts, via so-called bracings, i.e., thinner tubular elements and tube nodes. Stabilising sleeves at the lower intersections of the truss structure are used to drive three to four piles into the seabed like nails for anchoring in each case. In the case of the Edvard Grieg drilling rig, this foundation structure supports a platform - also known in offshore jargon as a "topside module" - equipped with highly complex technology, living quarters for 100 persons and a helideck, and weighing in at 22,500 tonnes.

TM plates for greater fabrication efficiency

Offshore facilities like these are exposed to high static and dynamic loads generated by water, wind, waves and low temperatures. In some locations, such structures are required to reliably withstand waves of over 25 metres in height and gale-force winds gusting at up to 160 kilometres per hour or more. In the North Sea, or even further north, in particular, temperatures can reach 10° C or below, demanding dependable material toughness properties at test temperatures of 40° C or even lower. The requirements made on the grades of steel used for the construction of jackets, topsides and monopiles are correspondingly high. Only absolutely excellent mechanical properties appropriate to the application, consisting of yield strength, tensile strength and toughness, can give such structures the necessary stability and safety. In addition, the availability of large plate formats, with excellent dimensional and flatness tolerances and weldability properties which have already been verified in a welding-qualification inspection at the manufacturer's plant, are definitive preconditions for cost-efficient production for fabricators such as Sif. The offshore industry uses two differing groups of standards, which are selected on the basis of construction conditions. The differentiation criterion is, above all, the precise origin of the Charpy V-notch impact test specimen, which is taken either at one quarter (the EN 10025, series of standards on hot-rolled structural steels for offshore use) or at half plate thickness (the classical EN 10225 series, dealing with "Weldable structural steels for fixed offshore structures"). The origin of the samples from zones of differing solidification morphologies makes it possible to achieve differing maximum thicknesses, depending on the group of standards.

Dillinger meets these offshore industry requirements with thermomechanically rolled heavy plates of up to 35 tonnes in weight, which can be supplied with maximum degrees of deformation in thicknesses of up to 150 millimetres in the case of structural grades and of up to 110 millimetres for classical offshore grades. The delivery range also includes normalised and quenched + tempered (QT) steels, in some cases in even greater thicknesses. This performance profile assures safety at all points. These plates, with their specifically tailored properties, large formats and high item weights, also assure optimum preconditions for efficient production and constantly dependable fabricated structures at Sif. This Dutch steel fabricator mainly puts its trust in thermomechanically rolled steels supplied by Dillinger. These combine high savings potentials on fabrication time and costs with excellent mechanical and technological properties. For William Lafleur, head of Welding Technology at Sif, Dillinger plates are therefore the best anyone could wish for in materials for the offshore industry. His department's first step in checking a draft design for a jacket is to verify the technical requirements stated. Sif will then draft, on the basis of the customer's finalised design drawings, its own welding schedules, in which the distribution of the shell sections, the circumferential and longitudinal welds, bracings, and all welding details, such as weld preparation operations, are shown. The plates are ordered from Dillinger as soon as these workshop drawings have received approval. "Our good cooperation with Dillinger is extremely important to us", William Lafleur notes. "In many cases, we don't know the precise dimensions, but we reserve tonnage amounts for specific calendar weeks". Plate length is in all cases the circumference of the planned shell section, and plate width its height. The large dimensions available from Dillinger thus make a decisive contribution to cost-efficient fabrication, since the size of the plates supplied means that the scope of welding work can be reduced significantly compared to the use of smaller plate formats. In close coordination with the experts at Dillinger, Sif supplies specifications for every individual plate, on the basis of graphical product overviews of steel grades, delivery condition, wall thickness, length and maximum weight. In the case of the sixteen jacket piles ordered for the Edvard Grieg platform, for example, this specification included twenty-four items, with the result that it was necessary to draft specifications for 384 plates for the piles of this rig. Also to be added, for the shell sections of the pile sleeves, were twelve further plates per sleeve, in addition to the material for bracings and for the platform's four main legs. It was also necessary, and not only for this project, to repeatedly shorten even further the in most cases already short delivery times of twelve weeks typical for this industry: in some cases, Dillinger in fact achieved delivery of urgently needed plates within six weeks.

Four welds simultaneously

The order of component fabrication at Sif always differs greatly, since it always depends on customers' individual requirements. A single leg, with a sleeve, for example, could just as easily be needed first as three sleeves and specific bracings. The first working operation is the making of welding edges on the plates - this can be done at Sif or at Dillinger. Plates for wind turbines are generally ordered from Dillinger ready-prepared for welding, with milled edges and a coat of weldable primer to protect against corrosion. The milled edges made precisely to the customer's specifications using two large-format milling machines assure the making of significantly better welds at Sif. For William Lafleur, the necessary plate dimensions and quantities also argue in favour of this solution on economic criteria. Sif cold forms plates of Grade S355 of up to 160 millimetres in thickness and 4.20 metres in width into cylinders or half-shells. The half-shells are then welded together firstly internally, and then externally, using a longitudinal weld, to produce shell sections of a maximum weight of 70 tonnes. Circumferential welds of a diameter of 6.8 m, as needed for the monopiles of the Gemini offshore wind farm, are by no means unusual in this context. The shell sections are dimensionally and geometrically inspected after every welding operation. Assembly of the completed ring elements takes place in a parallel process: a system operator controls four welding heads, which make four circumferential welds simultaneously. Each welding head operates with four electrode wires, thus assuring an extremely high deposition rate.

Pre-qualification - a plus for piles

Dillinger supplied 12,400 tonnes of thermomechanically rolled steel in grades S355G10+N/+M, S420G2+M and S500G2+M for the 134 metre high jacket of the Edvard Grieg platform. Sif used this steel to fabricate sixteen jacket piles, two gripper piles and eighteen pile sleeves. S420G2+M steel was used for the funnel-shaped, 12 metre long sleeves, with wall thicknesses of up to 35 millimetres. The diameter of these elements expands from 2,736 millimetres at the bottom to 3,292 millimetres at the top. The closing element of the two-piece sleeve, which also performs the function of guiding the piles correctly during fixing, takes the form of a 1.5 metre high so-called catcher plate with external reinforcements on the 30 millimetre thick wall. In addition, Sif applied in each case thirty-one single-layer welded beads - each twelve millimetres in height and 24 millimetres wide - onto the inner side of the sleeves. In the case of the piles, these welds were applied externally with an analogous height but slightly offset horizontally, and thus served as the anchoring system during subsequent "grouting", the filling out of the space between the sleeve and the pile with concrete. The Edvard Grieg jacket is permanently anchored to the seabed at a depth of around 100 metres by means of the four main legs located at its four corners. The 134 metre long legs, with a diameter of 1,800 to 3,300 millimetres and welded together from three sections, have wall thicknesses varying between 60 and 120 millimetres. Extremely high wall thicknesses are needed at the nodes, in particular, and are, in fact, also additionally reinforced. Sif selected Grade S355G10+N for the 120 millimetre thick plates, and thermomechanically rolled Grade S420G2+M for all the other plates. The extremely fine grain structure of TM plates assures the high required mechanical strength and toughness data with simultaneously excellent weldability. Thanks to higher toughness reserves, the structure also assures particular safety and stability even in the heat-affected zone of the welds. The significantly lower CET carbon equivalent at the same time has a positive effect on the weldability properties of these plates. They thus require, despite the high plate thicknesses involved, significantly less preheating, as is also reflected in correspondingly shorter cooling times and thus greater overall cost-efficiency. For William Lafleur, an important factor, in addition to the high wall thicknesses and yield strengths available in TM plates from Dillinger, is the pre-qualification already performed by the rolling mill, thanks to which he is able to read off the safety reserves of the material directly from the welding report - an additional, time- and money-saving plus which Dillinger also offers on all offshore grades. Whether Charpy V-notch impact testing, CTOD (crack-tip opening displacement) testing, minimal segregation (thanks to the Soft Reduction technology used during continuous casting at Dillinger), or the high degree of deformation from slab to plate assured by the large feed-material thicknesses - on the criterion of safety, these steels easily beat conventional grades.

Thick plates in large amounts and short times

For this reason, Sif also put its trust in the outstanding quality of Dillinger's TM plates for the monopiles of the Gemini offshore wind farm. This facility is situated at one of the windiest locations off the Dutch coast, around 85 kilometres to the north of Groningen, and occupies an area of 68 square kilometres, with water depths of up to 36 metres. The 150 wind turbines installed here have rotor diameters of 130 metres and a total output of 600 MW. Sif used a total of 94,500 tonnes of Grade S355ML - with individual plate weights of 32 tonnes - for the monopiles and transition pieces ordered. The length of the piles varies from 66 to 73 metres, with the same diameter, depending on the exact position of the turbines in the overall field, and thus as a function of differences in the seabed or in water depth. The diameter tapers from 6.8 metres for the bottom shell sections to 5.5 metres at the top, on the flange, on which the tower is supported. The piles consist, in total - depending on their length - of twenty to twenty-two shell sections with wall thicknesses of up to 85 millimetres and a weight of up to 914 tonnes. Dillinger's capability of supplying such large quantities in short times is indispensable for Sif when working, in particular, on such major projects. "Dillinger not only has extremely good competence in thick-walled plates, and constant high quality in such large series, but also great capabilities in steels with high yield strengths, which are what we need for our offshore projects", affirms William Lafleur. "We are thus always pleased to choose Dillinger, because the price and the quality are right". He also emphasises yet another benefit resulting from this cooperation: "Dillinger has its own welding laboratory and thus an extremely large range of pre-qualifications. We use these findings for cost and time reasons, in order to economise on our own process tests". William Lafleur has been at Sif for twenty-seven years, but the two companies were working together even before he joined. Trusting cooperation between equal contact partners is typical of this decades-long business relationship. "We understand each other", Lafleur continues. "When we place an enquiry, Dillinger knows what we need - in many cases, even without us having to state our requirements in detail". At the same time, he knows from experience that he can always rely on the steel producer, even for urgent needs. "We then get the help we need!" One item takes the foreground, in addition to this mutually trusting cooperation and, for both parties, also technically highly useful interchange, however: "The main reason Sif puts its faith in Dillinger steel is its excellent weldability. That is what makes Dillinger our preferred supplier."

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AG der Dillinger Hüttenwerke

A literally weighty success product has driven Dillinger for more than 325 years: steel, from the ore to the tailor-made heavy plate and ready-for-installation structural element. This unique range of experience makes this heavy-plate producer the global quality and technology leader, with grades of steel, the majority of which are less than ten years old. These high-performance materials for applications that demand extreme durability under the most adverse conditions of service make the building, earthmoving machinery, mining and mechanical engineering business unit the valued and preferred partner for the best in the industry.

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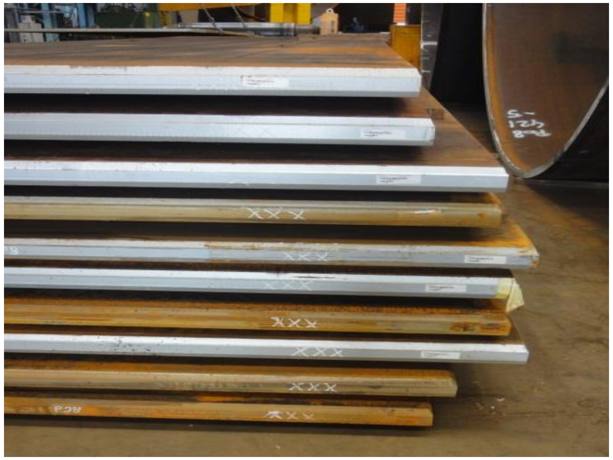
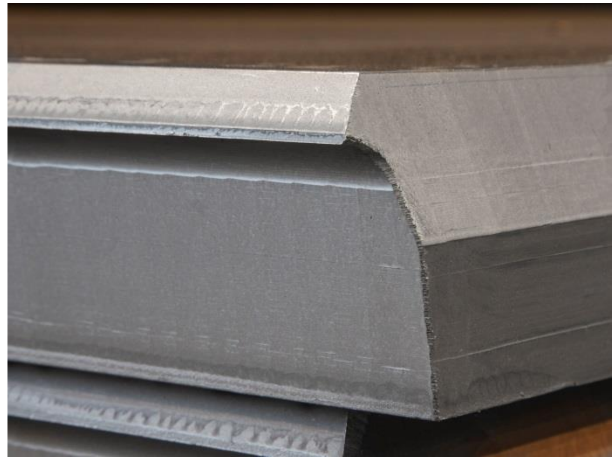
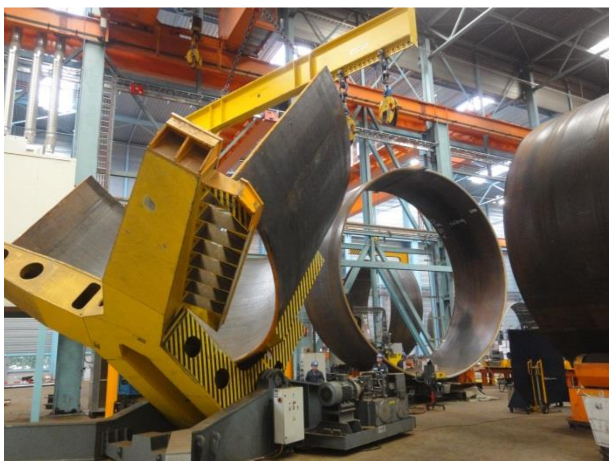




Picture 1-2: Dillinger supplies Sif with heavy plates weighing up to 32 tons and with thicknesses of up to 500 millimeters, some with milled edges already attached.



Picture 3: Rolling machines form the Dillinger plates into half-shells.

Picture 4: The formed plates are welded together internally and externally by a longitudinal weld.

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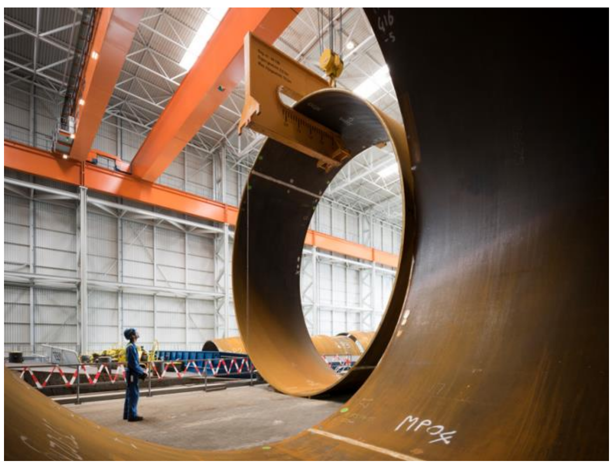
Picture 5: After each welding process, the shell sections, which are up to 11 meters in diameter, are calibrated in a ring roller.

Picture 6: The shell sections are waiting for the next processing step.


Picture 7: Huge crane systems transport the shell sections to the welding area.


Picture 8: Up to four circumferential welds are made simultaneously by four welding heads, which are controlled by a single system operator.

We would be pleased to send you these or other images in printable resolution via email.

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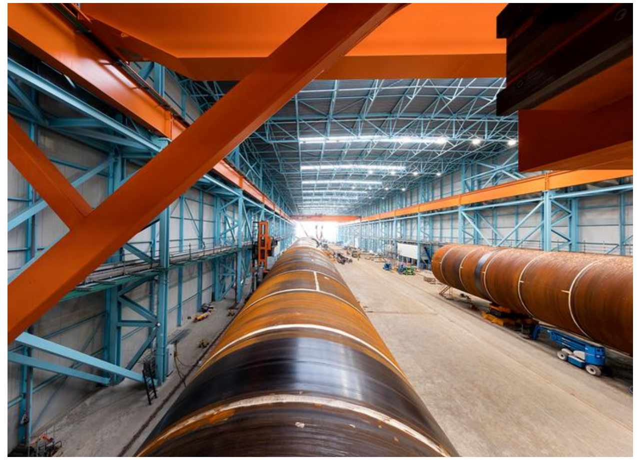
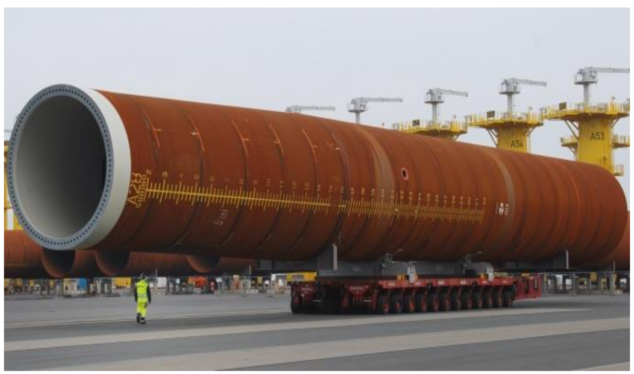


Picture 9-10: At the Roermond site, the large shell sections are assembled into XL monopiles.



Picture 11-12: Sif manufactures XL monopiles from thermomechanically rolled steels from Dillinger in thicknesses of up to 140 millimeters.

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Picture 13-14: The monopiles or shell sections made of Dillinger steel are transported by ship from Roermond to shipyards or to the Rotterdam factory.

Picture 15: For the Edvard Grieg platform jacket, Dillinger delivered 12,400 tonnes of thermomechanically rolled steel of the grades S355G10+N/+M, S420G2+M and S500G2+M.

Picture 16: The 22,500 ton topside module of the Edvard Grieg platform, which is equipped with highly complex technology, 100-person living quarters and a helicopter deck, is built on a foundation structure made of Dillinger steel.

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Picture 17: Wind turbines with a rotor diameter of 130 meters were installed on transition pieces made of Dillinger steel.

Picture 18: For the 150 monopiles for the Gemini offshore wind farm, Sif relied on the quality of Dillinger's TM plates.

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