A clear edge: more precision; less time and expenditure

Innovative weld-edge preparation for a major steel arched bridge

With a staff of over 350, the Hollandia B.V. group is a leading Dutch steel construction specialist for infrastructure projects. One of its latest projects – the 296-metre-long Thomassentunnel Bridge in the Port of Rotterdam – is set to become the biggest bridge in the group's long history. It will incorporate the staggering sum of 4,200 tons of heavy plate. Construction, engineering, production, assembly and installation at the bridge's final destination – as well as project management – are all in the hands of one of the group's subsidiaries, Hollandia Infra B.V. In cooperation with Dillinger's Heavy Fabrication Division, this Dutch company developed a new design for weld-edge preparation for the steel construction. Thanks to this innovation, Dillinger was able to deliver 188 heavy plates measuring up to 120 mm thick and 17 metres long – ready for installation and just in time.

Founded in 1928 and headquartered in Krimpen aan den Ijssel, the Hollandia B.V Group specialises in the development and construction of complex steel structures like bridges, locks or flood protection systems. Its reference list also boasts such prestigious projects as the London Eye, Wembley Stadium, the 162-metre-high *British Airways i360* viewing tower in Brighton, and the renovation of the Wuppertal Suspension Railway. But it is the 500 bridges Hollandia has built in Northwestern Europe over the past decades – a quarter of them for rail traffic – that impressively demonstrate its proven expertise in bridge building. For the last ten years or so, Hollandia Infra with its staff of 100 has been responsible for these kinds of projects. Constructing the Thomassentunnel Bridge is this company's contribution to a milestone infrastructure project in the Port of Rotterdam. A consortium of five construction companies – one of them being Hollandia Infra – has been commissioned to build the substructure for the so-called Theemsweg Route for rail traffic. The objective of the project is to redirect rail transport to this new route in order to expand capacity for the ever-increasing flow of goods being transported between the western port area and the Betuwe Route to Germany. Up to now, the transport route has led over the Calandbrug at Rozenburg – a vertical-lift bridge for trains and cars – which is regularly lifted to allow passage of shipping to and from Brittanniëhaven. In future, rail traffic will use the new route along a raised viaduct that will include two steel arch bridges. One of these bridges will be the twin-track Thomassentunnel Bridge, which will lead over the existing road tunnel of the same name.

A challenging construction task

Hollandia faced a complex of challenging tasks associated with the construction of this steel arch bridge, ranging from detailed planning, material sourcing and production of the bridge's components through to section-by-section assembly of the steel arch bridge on a designated assembly site close to its final destination and, finally, installation of the complete bridge in its ultimate location. But – as the responsible Hollandia project manager, Guus Olierook, sees it – the real challenge lay in the preparation of the assembly schedules. "The big question was, 'How do we get this huge bridge to the assembly site directly next to the tunnel, and from there to its ultimate location?'" In addition, the assembly had to be carried out in the middle of a densely built-up industrial area with a large number of companies operating there – including petrochemical plants with a highly sensitive subterranean cable and piping infrastructure. Hollandia decided to go for the greatest possible degree of prefabrication at its own yard in order to minimise the number of necessary transports to the assembly site. So the steel constructors divided the bridge construction into five segments that would only be connected to each other after they had been transported to the assembly site. The completely assembled bridge is scheduled to be installed in its ultimate location – in a single, giant transport operation with SPMT's – in May 2020. When deciding on the dimensioning of the five segments, the steel constructors also had to take the size of their paint shop into account. None of the components could be longer than 60 metres. Hollandia Infra conceptualised three of the five segments as combinations of individual sections of bridge deck and arch. These were produced by first erecting the arch section, then constructing the bridge deck section. Four mobile cranes were then used to lift the arch section onto the deck section for the components to be welded together. Once assembled and painted, the segment was then transported to the assembly site. But, first of all, Hollandia constructed the bridge's western approach span. Only then were the three combination segments of bridge deck and arch sections fabricated. The production process was completed with the fabrication of the eastern approach span. Parallel to this, Hollandia produced 22 suspenders for the Thomassentunnel Bridge. All in all, the bridge is 269 metres long – including the two 52-metre-long and 58-metre-long approach spans. Its simple design with an extremely slender arch fits harmoniously to the surroundings. Its total height of 28 metres is made up of the 23-metre-high arch and the main girder. Including the arch, the 14-metre-wide bridge has a span length of 157 metres – and a considerable weight. The steel construction is designed to have a maximum load-bearing capacity of 12,750 tons. Alone the heavy plate used in the construction weighs 4,200 tons. Then there's the 3,550 tons for the concrete surface, the 4,250 tons of ballast and rails, and the maximum variable burden of the trains in the region of 850 tons. To cater for this enormous weight while keeping vibrations to an absolute minimum, an extremely strong and rigid steel construction was required. To this end, four so-called cross girders were welded between the flanks of the 5.5-metre-high and 1.6-metre-wide main girder for bracing. These transmit the vertical forces through the girder directly into the concrete.

A combination of complex processing methods

For many decades now, Hollandia has relied on quality steel from Europe's leading producer of heavy plate, Dillinger, and, for this project, it put in an order for 4,200 tons of steel grade S355 heavy plates in the variants S355J2+N, S355K2+N and S355NL. "There aren't many steel producers in Europe that can deliver this high steel quality in such thicknesses, lengths and unit weights," says Guus Olierook, explaining Hollandia's choice of supplier. For the first time, 2,500 tons worth of the order was delivered directly ex works by Dillinger's Heavy Fabrication Division as flame-cut and edge-machined components. A crucial factor in this order was Hollandia's request for an innovative technology to be applied to the preparation of the weld edges: a machine-produced combination of a very flat tapering and a tulip-shaped edge for very thick and very long plates. In the construction of the Thomassentunnel Bridge, Hollandia was convinced that this method of edge preparation by Dillinger's Heavy Fabrication Division would make a substantial contribution to cost-efficient production and enable better adherence to tight tolerances and tight timelines. Normally, the contours of girder plates are flame cut and then given the required edge treatment. Without additional handling and testing expenditure, minor variances in the measurements are unavoidable and, depending on the thickness and length of the components, deviations of three to five millimetres may occur. However, the specifications of the Port of Rotterdam authorities permit a maximum tolerance of only ± 1 millimetre. In addition to direct access to raw plates from the rolling mill, Dillinger's Heavy Fabrication Division offers flame cutting and milled-edge-preparation under a single roof, so there is no need for intermediate transport. Through pre-production of components for the highly automated processes of offshore wind and offshore oil/gas industries, Dillinger has also accumulated a wealth of experience with complex flame cutting and high-precision weld-edge preparation. However, in bridge construction projects, other parameters apply. In view of increasing automation in the field of welding technology, Patrick Regnery, General Manager of the Heavy Fabrication Division, has anticipated an increasing demand for an integrated, highly project-specific approach to component and weld-edge preparation. For this reason, his division has already made a timely start on the development of a suitable procedure, and has invested in new machine technology. Sample plates produced on the basis of this new technology met with the spontaneous approval of technicians from Hollandia when they were visiting Dillingen during the enquiry stage of the current project: "We immediately recognised that this new weld-edge preparation would be a perfect supplementary service for the Thomassentunnel Bridge," says Guus Olierook.

Close cooperation between steel construction and heavy fabrication

Intensive communication between Hollandia and Dillinger ensued, in which the detailed wishes of the bridge designers and the technical possibilities at the Heavy Fabrication Division were discussed and negotiated. The outcome: the innovative edge preparation method was applied for the complete main girder. Zoltan Szabo, who manages Dillinger's sales office in the Netherlands, was closely involved in the discussion process. As he recalls: "Compared to the demands involved in monopile production for offshore applications, the weld-edge preparation Hollandia was asking for was a whole new challenge. So, for this application, the Heavy Fabrication Division at Dillinger developed an individual edge geometry that met Hollandia's specific requirements." Project Manager Olierook explains the specifications by citing an example: the job of precisely positioning a 120-millimetre-thick plate on the main girder – at a height of over five metres. "We have to be absolutely sure that all delivered parts have exactly the right size and edge preparation." And he adds, "In this regard, the pre-production work done by Dillinger's Heavy Fabrication Division perfectly fulfilled the requirements of our assembly system." The edge-milling machinery in Dillingen is designed for fast throughput. A heavy plate can be processed – without the need for intermediate turning – on all four edges at the same time with varied edge shaping and precisely to the required dimensions. This enabled Hollandia, for the first time, during production of the 20 sections of the approx. 27 meter long main girder, for the total main girder length of 2 x 269 meter, to immediately install all the components exactly as they were received from the supplier – already machine-processed on all edges and precision-cut to exact lengths and widths. "To begin with, we still checked all the measurements again," says Guus Olierook. "But we soon realised that we could completely rely on the quality system of Dillinger's Heavy Fabrication Division." So post-processing of the delivered parts was not necessary and, thanks to the innovative weld-edge preparation, welding took substantially less time to complete than would have been the case with the conventional edge geometries used in steel construction. Furthermore, there was no need for time-consuming intermediate transports, or for any switching between typically different processing contractors in the supply chain – something to be avoided if possible in projects where adherence to tight tolerances is crucial. "With a conventional solution, we most certainly would have lost four to six weeks," Guus Olierook estimates. And there was yet another benefit for Hollandia through ordering from Dillinger's Heavy Fabrication Division. Unlike other heavy plate mills, Dillinger can individually tailor the production of components to the customer's specific requirements. As a result, Dillinger not only ensured punctual delivery of the right components at the right time, but also gave Hollandia more flexibility in production, including the possibility of having last-minute adjustments taken into account during ongoing order processing. When Hollandia suffered minor delays in their schedule, Dillinger was able to provide interim storage and postpone the deliveries. And if they got ahead of schedule, the already finished heavy plates were also available – just in time. Under these conditions, Hollandia managed – within nine months – to produce all the components for the Thomassentunnel Bridge and to transport them all to the assembly site. After the final lift – the middle section of the bridge at the beginning of December 2019 – the suspenders will be installed by the beginning of 2020. Then, in May, the transport of the whole steel construction onto its ultimate location will take place – right on schedule.

For Guus Olierook, the extremely good project flow is also due to the open communication with Dillinger's Heavy Fabrication Division. "You need this kind of exchange of ideas on an equal level in order to understand the other side's process." And this is why Dillinger's Heavy Fabrication Division, with its enormous expertise and experience in welding and forming technology, was already involved as a technical development partner during the tendering process. With corresponding success: "In a joint effort, we found this innovative solution," the Hollandia Project Manager says, praising the constructive cooperation with the processing experts in Dillingen. As an experienced development and implementation partner, Dillinger's Heavy Fabrication Division successfully facilitated the technical implementation of the desired steel processing "in a living project," as Patrick Regnery proudly calls it. What has come out of the project is not only the excellence in steel Hollandia was looking for, but also a trustworthy partnership as the basis for a further joint bridge-building project.

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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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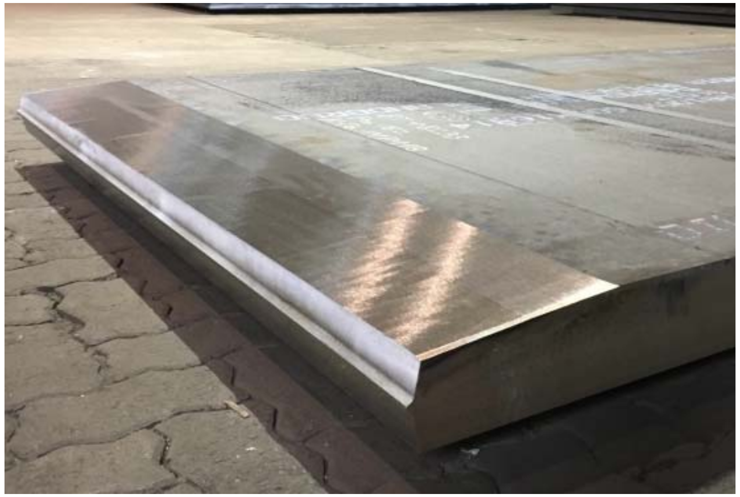
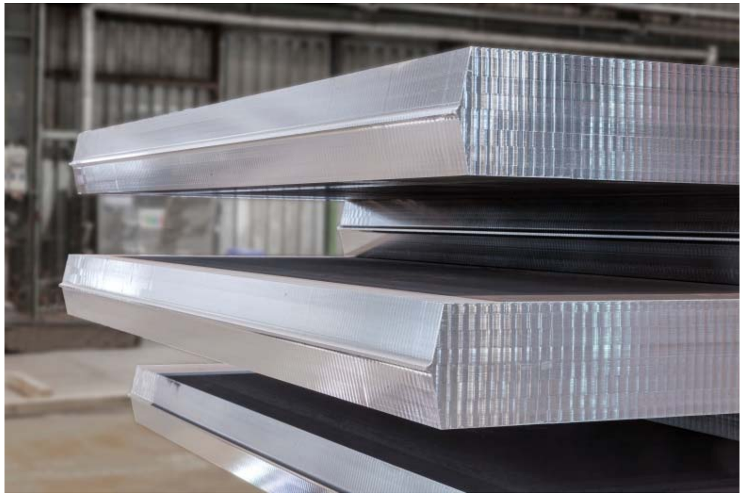
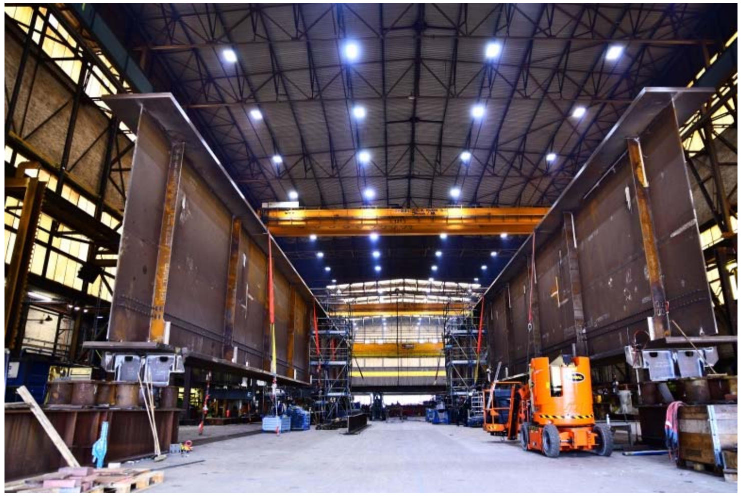


Picture 1: The innovative weld-edge preparation of Dillinger's Heavy Fabrication Division combines a very flat tapering and a tulip-shaped edge for very thick and long plates.



Picture 2: For the construction of the steel arched bridge Dillinger's Heavy Fabrication Division delivered 2.500 tons of steel as flame-cut and edge-machined components.

Picture 3: The 3D model of the Thomassen Tunnel bridge at its final location.



Picture 4: In the first step, the bridge's western approach span was constructed in the yard of Hollandia.

Picture 1-2: © Dillinger Weiterverarbeitung
Picture 3-4: © Hollandia Infra

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Picture 5: In the production of the elements for the main girder and all other girder plates, Hollandia benefited from the innovative weld-edge preparation of the Dillinger Heavy Fabrication Divison.

Picture 6: Four mobile cranes were used to lift the arch sections onto the respective deck sections for the components to be welded together.

Picture 7: The combination section of the middle bridge deck and arch was prepared for the transport to the assembly area.

Picture 8: The middle bridge component at the yard of Hollandia before transport to the assembly site.

Picture 5-8: © Hollandia Infra

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Picture 9-10: The eastern bridge deck and arch were prepared for transport on the yard premises of Hollandia.

Picture 9-12: © Hollandia Infra

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Picture 11: Loading of the combination segment of the eastern bridge deck and arch.

Picture 12: The combination segment of the eastern bridge deck and arch on the way to the assembly site.

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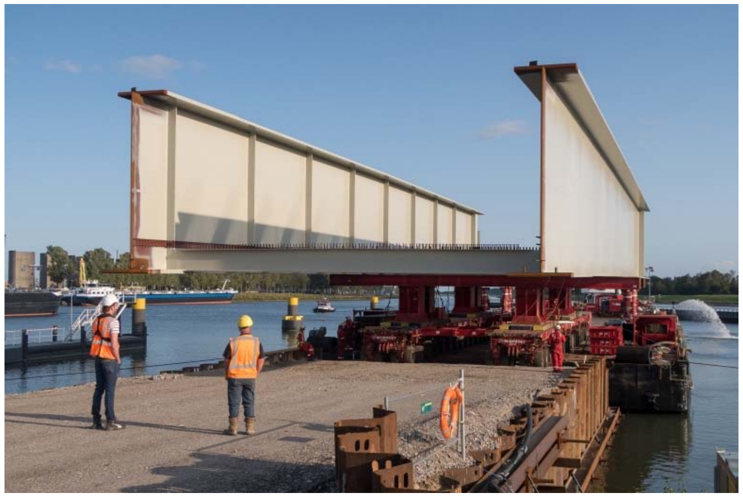
Picture 13: The combination segment of eastern bridge deck and arch section upon arrival at the assembly site.

Picture 14: The assembly of the eastern bridge deck and arch section.



Picture 15-16: The production process was completed with the fabrication of the eastern approach span.

Picture 13-16: © Hollandia Infra

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Picture 17: The completed eastern approach span is transported to the assembly site.

Picture 18: Assembly of the various sections took place on the assembly area close to the final site.

Picture 19-20: The assembly of the various sections on the assembly area close to the final site..

Picture 17-20: © Hollandia Infra

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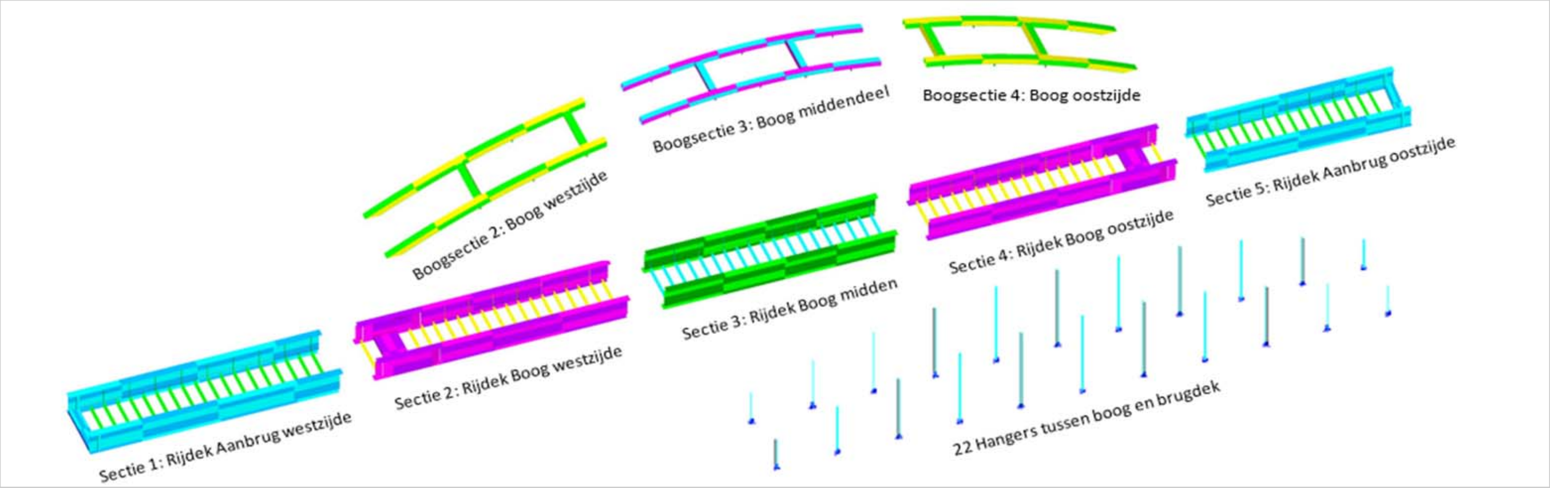

Picture 21: Hollandia divided the bridge construction into five segments that would be connected to each other after they had been transported to the assembly site.

Picture 22: Patrick A. Regnery, General Manager of Dillinger's Heavy Fabrication Division.

Picture 23: Guus Olierook, project manager at Hollandia.

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Picture 21+23 © Hollandia Infra
Picture 22 © Dillinger Weiterverarbeitung

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