



Intelligent production concepts for offshore wind foundation pipes

Harnessing wind energy through offshore turbines frequently necessitates the use of monopiles as integral foundation components. These structures have now grown to such vast proportions that novel manufacturing techniques and equipment are essential. HAARNE is a company that addresses these evolving demands by offering a variety of welding systems that ensure stability and dependability.

HAANE welding systems is a privately owned company that has been working in the field of turnkey factory solutions for welding technologies for more than 70 years. Its young and very flexible team of engineers, software specialists, process engineers, and welding specialists supports customers all over the world. Due to our internal expertise, including E-Pan, 3D design using Solidworks, and in-house production capabilities, our team is adept at promptly implementing tailored solutions.

Most recently the focus has been on renewable energies for turnkey production lines or individual machines for the production of monopiles, towers and foundation pipes.

The company's journey in this field began in 2000 with the construction of its first monopile installation for a European client. Since then, it has gained expertise in managing workplace systems and providing welding solutions.

Renewable energies are driving the trend towards ever-increasing wind turbine capacity. However, this growth is continually placing new and increasing demands on production and handling of offshore wind-foundation pipes.

Monopiles with diameters of up to 15 metres and weights of up to 4000 tons need to be manufactured and managed. This has led to the construction of new giga factories worldwide. These facilities have to adapt to the ongoing evolution of larger pipe dimensions and innovative designs.

Rather than having to build new factories every five years to align with the evolving monopile design cycles, HAANE offers a complete turnkey solution, providing continuous support to the customer in their production. This entails developing sustainable and forward-thinking solutions, from the initial concept to the complete turnkey factory, with the capacity to expand to accommodate larger dimensions in both planning and machinery implementation.

As well as the significant welding technology that HAANE provides for monopile and



Roller bed equipped with Fit-Up leveler for HAIZEA Bilbao SL in Spain

plate production, Can assembly, section growing lines, and field weld lines, this article specifically highlights the intelligent roller bed program.

Roller beds are more than turning devices

Within HAANE's modular system designed for roller beds capable of handling up to 4000 tons, various functions need to be addressed. Welding remains of paramount importance, given its critical role in the entire process, from Can production to the final monopile welding.

Manipulation and safety

Safety always takes precedence in the production of Cans, particularly because conical components, with diameters exceeding 10 metres, need to be tilted up to 10 degrees to attain the ideal welding position. In accordance with the comprehensive approach, tilting tables are used to ensure the secure handling of Cans weighing up to 150 tons.

Optimisation of duty cycle

The control sequence, facilitated by the in-house developed and Siemens-supported software, is employed for layer formation and secure rotation, enhancing overall productivity. Often, the emphasis is solely on the actual welding time, which accounts for just 40% of the total cycle time for

longitudinal Can welding. However, this duration can be significantly extended through effective control optimization of the movements.

Crane-less transport

Like the other processes, the time and costs associated with crane handling are inefficient. So these roller beds are also used as crane-less transport units to the next production steps.

Intelligent production layout

HAANE provides two assembly line solutions. The layout and arrangement of these are consistently tailored to the specific monopile, which is to be manufactured. Irrespective of the design, the production steps must always be streamlined.

The same principle applies to the machinery, which needs to be adaptable for various combinations. This approach leads to the development of a production plan, defining the sequence and plant configuration. This strategy can follow the traditional growing line model, or be implemented without as triple, or in-section production.

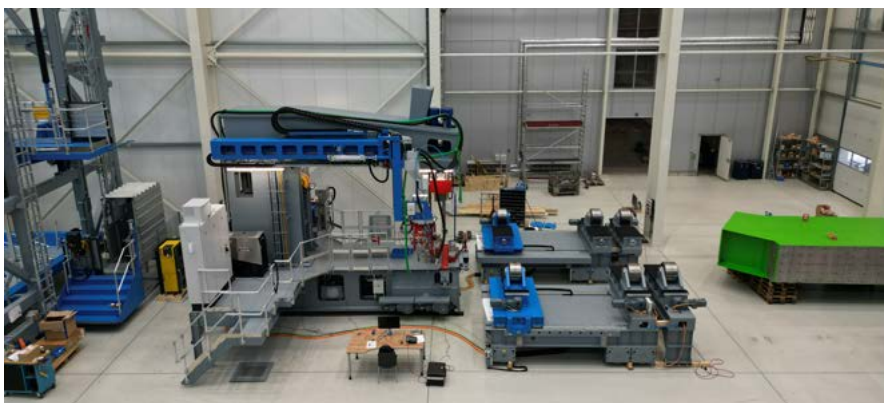
Intelligent Fit-Up Roller beds

For safe and fast assembly, Fit-Up roller beds are used, securely aligning and assembling Cans or sections.

This method involves safe assembly in combination with drive units. To do this, software guides the operators throughout the assembly process when using the Fit-Up roller beds. All cylinders undergo pressure and position monitoring. The lateral Fit-Up arms enable accurate section alignment, while an additional centrally located bottom Fit-Up leveler simplifies the alignment of the tube ends. This guarantees a safety-monitored assembly for these crucial connections.

Faster alignment process with Fit-Up leveler

The Fit-Up leveler assists the operator in achieving a smoother and more efficient



Crocodile



Welding portal

alignment process. Also, for loads of up to 4000 tons, the roller beds are furnished with multiwheelers, to comply with the rail load restrictions.

Fit-Up Crocodile as the future for diameters over 15 meters

An alternative option is the HAANE Crocodile. Unlike the Fit-Up roller beds, which primarily apply external forces, high-precision assembly has been a practice for over four decades with submarine bodies. In this process, assembly forces are not only externally introduced, but central cylinders are employed to align the additional monopile from the inside and minimise height differences. Thus guaranteeing a secure and highly precise assembly.

These lines are combined with subsequent circular welding gantries to further increase productivity.

Welding portal

In the milling and circumferential welding assembly lines, the focus is on high-precision positioning of diameters of up to 15 meters. With intelligent anti-drift controls, the wheel is equipped with two redundant axial drift sensors, as in a car, to change direction.

The weld joint for milling or welding, is thus controlled with high precision, in combination with the sensor system in the axial position. With associated laser tracking systems on the circumferential weld gantries, the remaining tolerance of the component is compensated via the servo axes of the multi-wire welding heads to enable automatic layer buildup.

Roller bed for transportation

Combinations of roller beds and Self Propelled Modular Transporter (SPMTs) are often used for further handling for sectional

or field weld production. In many cases, the crane capacity is not sufficient, and therefore, the roller bed system can partially take over the job of SPMTs.

Here, the in-plant transport, as well as the associated assembly handling process, is needed to assemble sections. These systems can also be equipped with self-propulsion, allowing them to autonomously perform transportation on rails in outdoor areas.

The mechanical design at HAANE is thoroughly calculated to account for the weights and safety requirements too. The systems have been subjected to FEA and durable strength analysis.

Modular design prepared for the future

With the modular roller bed system the functionalities can be downgraded and upgraded to accommodate ongoing and growing productions. Moreover, design variations and diameters are adapted to accommodate larger sizes. Consequently, roller bed systems originally designed for 11 meter diameters are transformed and enhanced to handle a diameter range of up to 15 meters within the modular concept.

The roller stands are used in different configurations throughout the entire production process, from welding, milling, NDT testing to the blasting and painting system.

Taking an all-inclusive approach, HAANE accompanies the customer up to the interface planning within the factories, with intelligent bus-coupled conductor rails, to save resources and increase efficiency.

This technology is also used for offshore handling tasks, such as on specialised ships, where the company assists customers with their monopiles throughout their entire lifecycle, ensuring their long-term performance.

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Anti Drift unit



Build 500 ton carriage with 500 ton lifting capacity for HAIZEA Bilbao SL in Spain