AMPELMANN

Degrees of freedom:

A gangway for every sea

Motion compensated gangways have become a familiar feature within global offshore energy sector. Greatly enhancing the safety of marine based offshore operations, these systems increase efficiencies by extending weather windows and increasing vessel uptimes. But if these gangways have led to an infrastructural diversification of the global offshore energy sector - no longer dominated by helicopters, swing ropes and basket transfers - the maturation of Walk to Work (W2W) has also led to the development of an increasingly variegated industry.

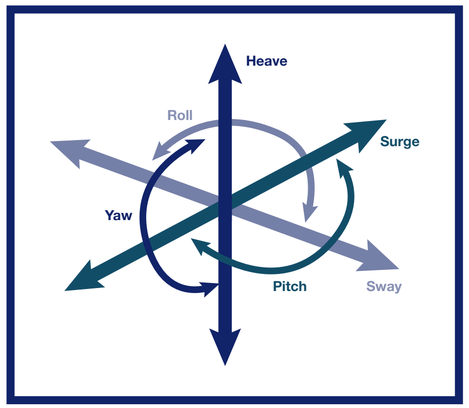
For over 15 years Ampelmann's systems have become widely used throughout the world's offshore energy sector and have been partially responsible for the growing reliance of W2W throughout the Seven Seas. Well-known for their signature hexapod – the core technology that allows its systems to compensate for motions in six degrees of freedom (6DOF) – the company's unique systems and innovative spirit has contributed to the increasing proliferation of diverse offshore access solutions.

Today, gangways come in many different forms and shapes, with underlying technologies that are superficially as diverse as their applications. If high workability was once considered the conceptual lens with which to assess the use of these systems, now a layered landscape of unique gangway systems exists that provide specific solutions to different environmental, incidental and infrastructural challenges. From high intensity work scopes that require quick turnovers, to customised solutions for smaller vessels or larger ones, like C/SOVs, these systems are tailored to different markets in order to maximise safety and workability during offshore operations.

Deconstructing workability

While safety requires little explanation, workability is a term that is often misunderstood. Very loosely defined, it refers to the specific conditions under which a gangway can be safely used. Commonly, however, it is represented as a measurement, otherwise known as significant wave height, that describes the capacity of a gangway to withstand the mean of a third of the highest waves within a given timeframe. Nevertheless, the workability of a gangway system is determined by much more than the intensity of waves alone.

Difficult to adequately capture in a single unit of measurement, conditions at sea vary considerably, and, consequently, a gangway's workability is influenced by a large number of factors. Both wind waves and swells have unique characteristics, especially when combined, that greatly impact whether a gangway can maintain a stable connection to safely transfer personnel and cargo. Different wave shapes, periods and heights, as well as their incoming direction(s), exert complex motions on a vessel that are by definition multi-directional, leading to variable motions (in all degrees of freedom) that influence the behaviour of a stationary vessel.



All motions exerted on a vessel at sea

Simply put, seas are dynamic, and one wave is never the same as another. Waves come from different angles and directions, never evenly nor regularly. Crests break erratically at different moments and places. Winds can turn at a moment's notice, creating ripples across the sea's surface that creates a scattered wave pattern.

But if sea conditions can partially underline the potential performance of motion compensated gangways, it is also contingent on the combined capabilities of the vessel and the gangway to operate in those conditions. Size is important, as are the dynamic positioning (DP) capabilities of the vessel. A large array of technical specifications such as hull shape, strength and deck elevation above sea level further influence, whether, at any given moment, it heaves or pitches, rolls or yaws, surges or sways.

For the same reasons, the approach angle to an offshore installation, especially bearing in mind the prevailing wind, the gangway's exact positioning on the vessel, its height above sea level as well as the degree to which the connective object is exhibiting divergent motions of its own, are critical components when measuring the workability of a gangway.

In other words, significant wave height tells only part of the story and is only one of the factors that determines the workability of W2W systems. Specific climatological, meteorological, seasonal and/or incidental conditions, as well as operational procedures and vessel designs, complicate the effective workability of a gangway. Equally, if not more important, however, is the underlying technology that drives the motion compensation of these systems.

The hexapod

Developed at the Technical University (TU) in Delft from 2002 to 2007, the Ampelmann system was based on a simple, yet technologically complex idea. A gangway placed on a hexapod, commonly known as a Stewart platform, would be able to compensate for all motions of a vessel at sea. Six hydraulic pistons not only actively compensate for the motions a vessel makes while heaving, swaying and surging, but also while rolling, pitching and yawing. As every critical component is redundant, backups ensure that in case of any type of technical issue the system remains safe.

The heart of these gangways is the motion reference unit (MRU) that measures the required level of compensation. Backed by software that converts the measured vessel motions into setpoints to actuate the cylinders, the Ampelmann control systems ensures that each cylinder retracts and expands at the right time to counteract the motions exerted on the vessel. It is this that sets them apart from earlier W2W systems, especially those that relied on passive compensation alone.

Because the hexapod compensates for all of the vessel's motions, the gangway remains stable in spite of the movements of the vessel. The result is a significantly reduced telescoping speed that is equivalent to that of an escalator, and a gangway system that can be safely used by offshore personnel and cargo in a large variety of weather conditions and sea states.

Six degrees of freedom:
Navigating calm and rough seas alike

From calmer oceans around the equator, tumultuous seas in Northern Europe to seasonal climates characterised by monsoons or shamals, the hexapod has already been used in over 40 different countries around the world. Simply put, operations that require high reliability and consistency have benefitted from the flexibility and operability of the Ampelmann system in order to reduce costs and improve uptime. Because the hexapod is capable of compensating for all motions, in all directions, simultaneously, it is especially well equipped to work in highly variable sea states and weather conditions, or, more generally, when, and most importantly, wherever, high workability is required.

Especially in circumstances when both the vessel and other offshore structure, such as a floating wind turbine, FPSO or other moving installation or vessel, are exhibiting divergent motions, the hexapod offers significant advantages. Its ability to handle complex, multi-directional movements caused by the concurrent buoyancy of both objects ensures safe and stable access in challenging conditions. During the construction of Hywind Tampen, the world's largest floating offshore wind farm to date, the hexapod proved instrumental in safely extending weather windows in the rough conditions of the Norwegian North Sea.

Ampelmann's portfolio includes several gangway systems that rely on the hexapod for active motion compensation. The first of these was the A-type, brought to market in 2008. By the turn of 2024, the system, including the A300 which has a crane with a lifting capacity of 300kg, had already transferred nearly 7,500,000 crew members and three million kg's of cargo, representing approximately 75 per cent of the total number of transfers since Ampelmann's foundation.

If the A-type has earned its place as the workhorse of the company's fleet, the one-and-a-half times larger E-type has increased operational versatility at the cost of more demanding deck space requirements. With cylinders that have a stroke length of three meters, the E1000 can not only compensate for more extreme motions caused by rough, variable seas, it also has a higher load bearing capacity than the A300. This has made it the premier choice for operators in the offshore wind and floating wind sectors.

A second version of the E-type has been developed that combines the versatility of a heavy-duty crane with that of a gangway. Additional bracers and plating strengthen the gangway so that it can lift heavier payloads. Illustrative of the robustness of the hexapod, the E5000, as it's known, is the only system in its class that can hoist nearly 5 tonnes of cargo.

The hexapod can also be made 'winter proof' for use in icy cold conditions by adding a protective coating and heating elements to shield both the hydraulics and the crew using the gangway. Two fully integrated systems, the N-type and the Winterised A, have been developed for arctic conditions, making Ampelmann's hexapod based gangways a viable offshore access solution for every climate in the world.

Three degrees of freedom:
Electric solutions for regional markets

In many ways, the hexapod can be considered the core technology that drives Ampelmann's success as a W2W specialist. Notwithstanding, the company has long since offered electric gangways that utilise other forms of motion compensation in order to align with the varying requirements of local and regional offshore energy markets.

Operational since 2011, the L-type is a three degrees of freedom (3DOF) system that is specifically designed to compensate for the more intense motions, especially rolling ones, of smaller vessels in seas with more prominent swells. This lightweight, easily mobilised and transportable, fully electric gangway system plugs directly into the vessel, but foregoes the hexapod in order to minimise its weight and footprint. Not without reason is it prominently used in East Asia and the Arabian Gulf, where smaller vessels (frequently without DP) are the backbone of offshore logistics. The L-type is a consistent alternative access methodology that especially compared to swing ropes, baskets and conventional gangways, provides high uptime, safe and continuous offshore access.

If the L-type is flexible and easy to mobilise on smaller vessels, the W-type, is a fully integrated tower gangway purposedly designed for the C/SOV market. Fully electrically controlled, the gangway is both hydraulically and electrically driven and utilises 3DOF to maintain a horizontal connection to the offshore structure. This allows cargo trolleys to cross at variable heights. The gangway can also convert into a crane to enable cargo operations. The system shares much with the Electric A-type's regenerative technology, but through its integration into a dedicated vessel, it is the combination of gangway and vessel that makes it tick, allowing for very high workability in a variety of sea states.

Though the company's 6DOF systems provide very high workability in variable conditions, 3DOF gangways like those above are uniquely tailored to solve very specific challenges. Either through full integration or quick mobilisation, Ampelmann's 3DOF systems all share that they are tailored to meet the requirements of specific segments of the vessel market rather than the intensity of sea states.

From 3DOF to 6DOF:
Electrifying the fleet

That the company's non-hexapod based systems are fully electric is no coincidence. As the L-type is designed for smaller vessels, the omission of a hydraulic power unit (HPU) saves deck space and weight, allowing it to directly tap into the vessels internal power supply. As the first electric system within the company's portfolio, it sparked further interest into how energy savings could be achieved through electrification.

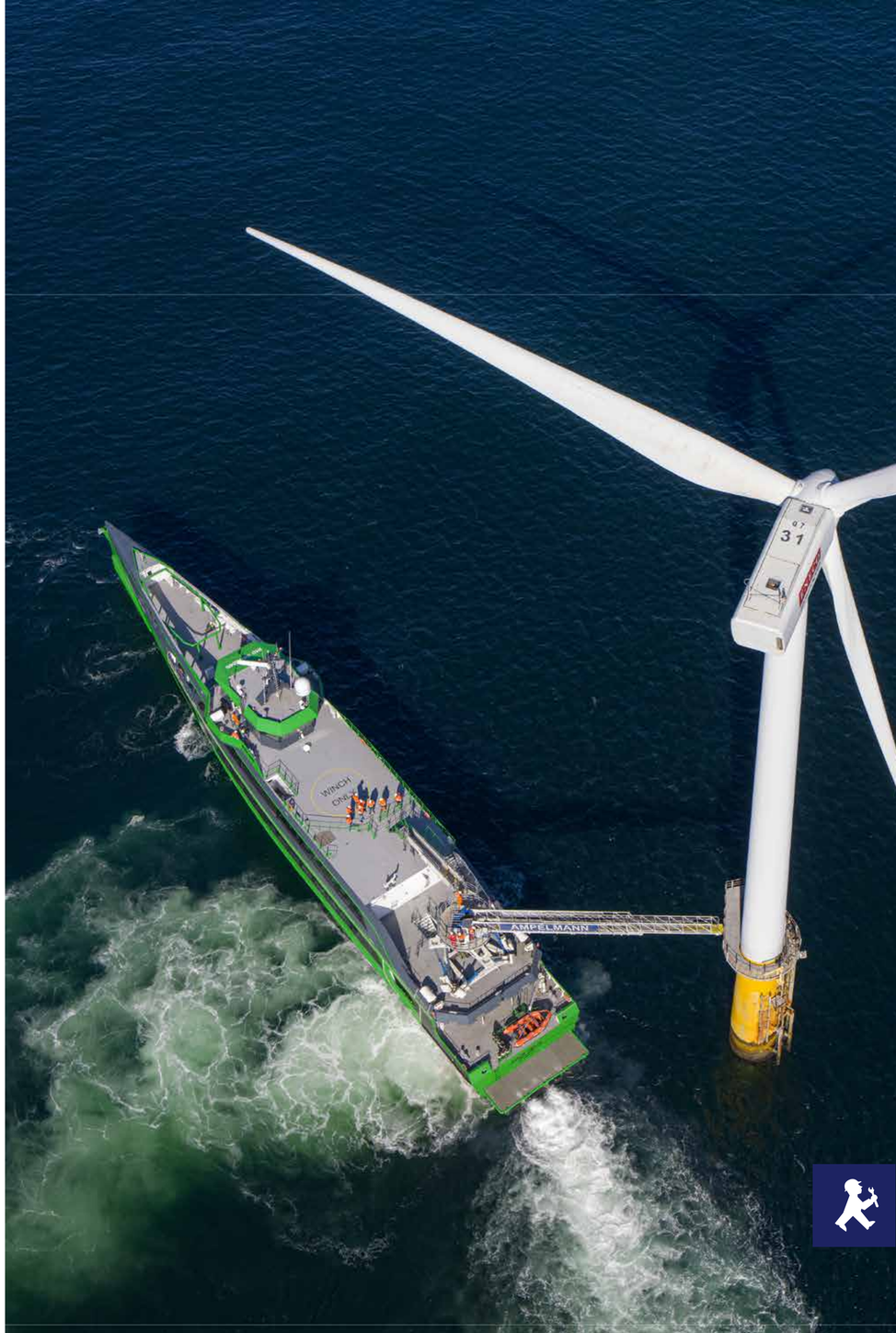
Though the A- and the E-type rely on hydraulic actuators, powered by HPU's, Ampelmann has developed an electro-hydraulic version of its flagship system. The Electric A-type, and the lightweight, fully integrated, S-type, are still hydraulically and electrically driven, but also fully electrically controlled. Electric actuators provide the exact amount of power to the right cylinder, precisely when needed, meaning that almost no energy is lost in the process. Residual and regenerative energy is stored in ultra-capacitors and subsequently reused for peak shaving and back-up.

The result is a gangway system that has the same performance as an A-type but consumes 90% less energy. Without an HPU, the system requires less deck space, weighs less and does not need extraneous cables, hoses and generators, requiring less maintenance and repairs.

With several such systems already operational, and many more currently in the pipeline, this proven technology will have major implications for the development of the offshore service industry. Designed purposedly as a modular technology, both the Electric A and W-type are fully electrically controlled. Built from the same blocks, they use electric regeneration to reduce their environmental footprint.

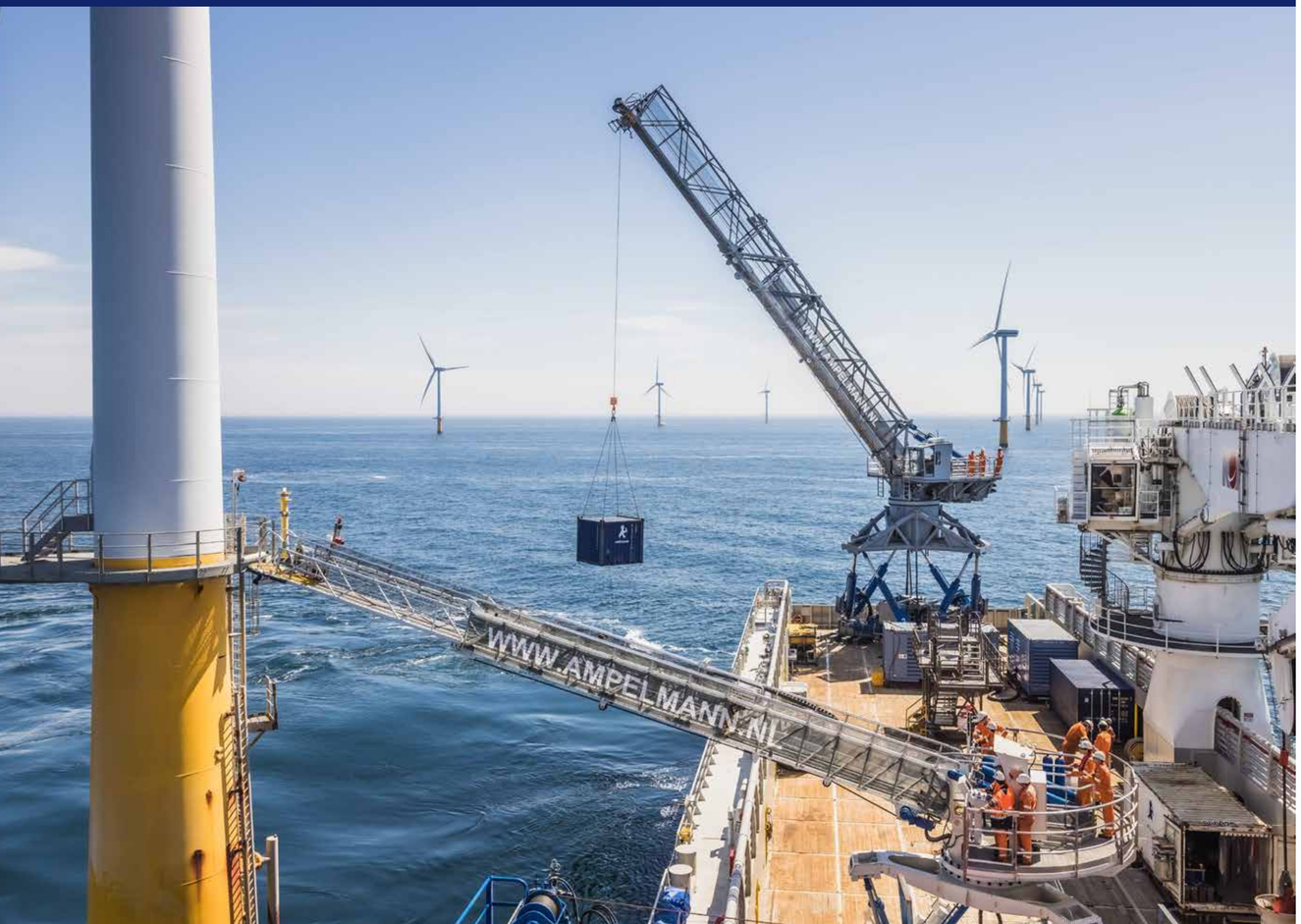
Because the Electric A does not require an HPU, its lighter overall weight and smaller footprint not only make it highly efficient but also broadens its potential beyond high-performance environments. The system is particularly well-suited for compact vessels like Mini SOVs, which occupy the intermediate space between traditional SOVs and CTVs — offering a cost-effective solution without compromising on workability. This makes it ideal for operations in relatively benign seas, such as those in the Baltic, where access needs are substantial, but full-scale SOV deployment is suboptimal.

Electrification will be particularly relevant in light of the decarbonisation efforts in the global vessel market. As battery-, ethanol- and hydrogen driven vessels will need to make more effective use of their internal power supplies, greater energy efficiencies are required to lower fuel consumption and/or electricity usage. Electric W2W solutions such as these will not only lead to technological alignment in the short term, but will also be of critical importance in order to reduce carbon emissions as the offshore service sector develops.



A system for every market

Whether electric or fully hydraulic, 3DOF or 6DOF, Ampelmann has tailored each of its gangways to suit the infrastructural needs of the global offshore energy market. With their enhanced flexibility and adaptability, the company's hexapod-based systems, like the A- and E-types, are particularly effective at addressing dynamic marine environments and irregular ship movements. Because they can compensate for all motions, from all directions, they can ensure maximum safety and operational efficiency in rough seas or when performance needs to be at its highest.



Though Ampelmann's electric 3DOF systems offer a more straightforward package, they cater to the specific needs of the vessel market. Here precise tailor-made solutions are often desirable because of the relatively predictable conditions in which these W2W solutions need to perform. The L-type and the W-type might solve very different challenges, they are both designed to provide a high level of consistency in well-defined operational contexts.

The first electric 6DOF systems have already been operational for years, but the trend towards electrification marks a pivotal shift in the offshore access industry. As Ampelmann electrifies its fleet, in support of global sustainability goals, its modular design approach will greatly enhance the development and implementation of new technologies and innovations.

By leveraging the specific capabilities of 3DOF and 6DOF gangways, maritime operators can tailor their choices to their operational contexts, ensuring optimal safety and workability wherever needed. With a portfolio of systems that covers every market in the world, Ampelmann is prepared for the future of offshore access.