Gottwald
Port Technology

PORT TECHNOLOGY

INTERNATIONAL

INTELLIGENT CRANE FEATURES

as a response to increasing project cargo business

Safe solutions for lifting project cargoes

Gottwald's new Vertical Lift Assistant & Tandem Lift Assistant modules increases accuracy and safety when lifting heavy and outsize project cargoes

Gottwald, Düsseldorf, Germany

A noticeable development in our modern world is that, while electronic devices are becoming smaller and more portable, many goods being shipped around the globe are increasing in size. Globalization and industrialization are driving the need for heavy cargo, and this includes the components used in renewable and sustainable energy developments, such as wind turbines. Wind turbine components provide an excellent example due to their considerable mass. The machinery housings, called nacelles, are one example, while the rotor blades are extremely bulky and awkward to manipulate. With the development of wind farms around the world moving up a gear, turbine design is creating even larger units.

Consequently, moving heavy or oversized loads is becoming an increasingly important new business opportunity for terminal operators, but it poses new challenges at the same time. With lifts increasing not only in weight but also in their overall dimensions, it is not only the demand for more powerful cranes that is growing. There is a growing need for alternative methods of lifting. In view of the problems often posed by awkward shapes, such as the extremely long tower and rotor blade sections, it has become commonplace to handle these items by tandem lifting with two cranes.

Cranes ideally suited for heavy lifts

For a long time now terminal operators around the globe have been using Gottwald Mobile Harbor Cranes both for single heavy lifts, and as an effective solution for tandem lift applications, including railway wagons, boats, marble blocks, generators, gas and, of course, wind turbines. The Port of Aalborg Ltd., Denmark, for example, uses a G HMK 7608 B Mobile Harbor Crane with a lifting capacity of 140 tonnes for moving project cargoes such as components for wind turbines weighing up to 140 tonnes. The Port of Carrara, Italy, relies on two G HMK 8710 Mobile Harbour Cranes, with a capacity of 200 tonnes each, that can be used in tandem to handle loads of up to 400 tonnes. C. Steinweg (Süd-West Terminal) GmbH & Co. KG, Hamburg, Germany uses two Model 7, G HMK 7608 Mobile Harbor Cranes with a lifting capacity of 150 tonnes each, capable of tandem lift operations up to 300 tonnes.

Safe performance

Moving heavy goods is always a challenge, irrespective of whether it is a single or a tandem lift. Safety and lifting accuracy are the most important aspects, and are essential in avoiding the danger of injury to workers and damage to the load and cranes. Rotor blades, to quote a good example, are often transported unpacked because of their size, which makes them prone to damage.

Gottwald has not only a long track record with cranes used in heavy lift applications, including tandem lifts, but also a successful one. To date, these tandem lifts have been manually operated, which confirms the suitability of these machines for this demanding

The Gottwald Tandem Lift Assistant enables safe lifts of heavy or outsized project cargoes with the full capacity of both cranes.

operation. But the company has always been proactive in implementing crane features that enable and secure accurate, safe loading. The Visumatic® Crane Management System is standard equipment on Gottwald Mobile Harbor Cranes and provides many control features that further increase operating safety and crane availability. These features are either available as standard on the crane, or as optional modules that can be installed independently according to individual needs. The load guidance system, available with a range of options, ensures even safer and easier operation with such features as anti-sway, semiautomatic point-to-point handling, load linear motion and hoisting height limiting.

In addition to these there is a radio remote control which is of particular advantage when doing a conventional, manually operated tandem lift where each of the cranes has its own operator. The remote control facilitates communication between the two crane drivers, as both can stand side-by-side and operate the cranes at ground level to control synchronous operation.

Gottwald's new assistants: Vertical Lift Assistant & Tandem Lift Assistant

The Vertical Lift Assistant and the Tandem Lift Assistant were recently launched by Gottwald, and are two new modules and additions to the Visumatic® Crane Management System. The development of the new modules represents a further advance in handling accuracy and, consequently, the safety of the cargo, crane drivers and the cranes. The Vertical Lift Assistant is designed to monitor the angles of the ropes and ensure the ropes remain vertical. It is available as a stand-alone system for single lifts and is also part of the Tandem Lift Assistant.

Vertical Lift Assistant – stand-alone system for single lifts

As a stand-alone system, the Vertical Lift Assistant is a crucial aid for single heavy lifts with Gottwald Mobile Harbor Cranes. For a Mobile Harbor Crane driver, sitting in the tower cab high above the work site, it is difficult to assess whether the boom tip is positioned exactly above the load. Even if he has an excellent view of the working area and load, his view of the hook and load is not from vertically above them. The images supplied by the camera mounted on the boom head to the tower cab monitor are of great help, but might not be sufficient when it comes to project cargo, such as a heavy marble block or a wind turbine component, where absolute accuracy is mandatory.

The Gottwald Vertical Lift Assistant ensures that no load sway can occur when lifting off the ground, even when the crane driver does not have a clear view.

In these applications, the crane driver, to a great extent, has to rely on his visual skills and the instructions from the banksman on the ground when positioning the boom. Even for the most experienced crane driver this is not an easy task and slight deviations in handling accuracy are possible. If the boom tip is not exactly above the load, i.e. the wire rope is not absolutely vertical, the load will sway when it leaves the ground. This load sway may

Background: Regulations and recommendations for tandem lift operations

The level of risk associated with tandem lifting (or 'multiple lifting') is generally regarded as greater compared to single lifts, due to a number of reasons, including human factors. The most important aspects are to synchronize the movements of both cranes, and to prevent lateral forces acting on the crane boom, additional or side loads, unequal load sharing or overturning moments. Lifting at unequal speeds, for example, might result in an unequal distribution of the load on the two involved cranes, which might, in extreme cases, result in an overload on one of them. If the two cranes involved in tandem lifting are controlled by two crane drivers, the human factor comes into play. However, even if the operators do not make any mistakes, it would be virtually impossible to synchronize the operation perfectly, and this might result in a degree of unequal load sharing.

There are various standards and regulations from different countries that address the complexity of tandem lifts and provide crane operating companies with rules for such operations.

The ISO standard 12480-1 gives advice for the crane operating company for safe use of cranes under different circumstances (Cranes – Safe use – Part 1: General/Paragraph 11.4: Multiple Lifting). The main points of this standard are: lateral forces on the crane boom have to be avoided, if possible with appropriate instrumentation and crane movements have to be synchronous.

In addition, ISO 12480-1 allows cranes to use up to 100% of their safe working, provided all the relevant factors can be monitored. If the factors cannot be evaluated, a down-rating of 25% or more will be applied. These ISO recommendations are translated into local regulations and, while in some countries the lifting capacity can generally be used to the full, it is often not permitted to exploit the full lifting capacity for conventional, manually-operated tandem lifts.

Examples of standards and regulations addressing tandem lifts:

- ISO standard 12480-1 (Cranes – Safe use – Part 1: General/Paragraph 11.4: Multiple lifting.
- BS 7121-1:2006: British Standard Code of Practice for Safe Use of Cranes (Part 1: General).
- BS 7121-3:2000: British Standard Code of Practice for Safe Use of Cranes (Part 3: Mobile Cranes).
- Safety and Health in Ports. ILO Code of Practice; Geneva, International Labor Office, 2005.
- Accident Prevention Regulation for Cranes ("Unfallverhütungsvorschrift Krane") BGV D6 issued by the German Institutions for Statutory Accident Insurance and Prevention.

Vertical Lift Assistant

The Vertical Lift Assistant, designed to monitor and ensure a vertical rope position, consists of two rope inclination sensors which are fitted to the boom tip. The redundant system – one sensor would be sufficient – offers double safety. The rope inclination sensors are guided by spring-loaded rollers on the rope and are suspended from the boom tip steel construction to measure the relative positions of the boom tip and hook. The system senses rope angle deviations in two directions. The relative position of the load is displayed on the operator's screen.

result in collisions with other goods. Wind turbine rotor blades, to name only one example, are often not crated and are stored directly next to each other.

This is where the Vertical Lift Assistant comes in. By means of rope inclination sensors fitted to the boom tip, the controller automatically ensures that the boom tip is positioned exactly above the hook and load (i.e. no inclination in the rope), to prevent unwanted lateral movement after the load is lifted off the ground.

Rope inclination sensors fitted to the boom tip automatically guarantee the hook is positioned exactly vertically over the load.

The Visumatic® crane management system enables the crane driver to monitor the Vertical Lift Assistant visually.

In compliance with ISO 12480-1	Gottwald Tandem Lift Assistant
• Lateral forces on the crane boom have to be avoided (if possible with appropriate instrumentation)	✓
• Crane movements have to be synchronous	✓
• If all relevant factors can be monitored, the cranes can be used up to their safe working load (i.e. 100%)	✓

The principle incorporated in the Vertical Lift Assistant is also a considerable aid to handling tandem lifts, which led Gottwald to develop the Tandem Lift Assistant, which includes the Vertical Lift Assistant.

Tandem Lift Assistant

Designed to perform computer assisted, synchronous tandem lifts, with one crane driver controlling both cranes, the new Tandem Lift Assistant addresses risk factors that could be experienced in moves involving multiple cranes, such as lateral forces, overturning moments, deviations in crane speed and the like.

The new Tandem Lift Assistant eliminates the need for de-rating the maximum crane capacity, which is recommended or even prescribed by regulations in view of the complexity of multiple crane lifts. In accordance with the ISO 12480-1 regulations for multiple lifting, the new Tandem Lift Assistant allows two Gottwald Mobile Harbor Cranes to be operated in tandem up to their full working loads. If the maximum capacity of each crane is 200 tonnes, for example, it is not only technically possible but also in compliance with regulations to lift a load weighing up to 400 tonnes.

Basic principle

The three central aspects of the new Tandem Lift Assistant are:

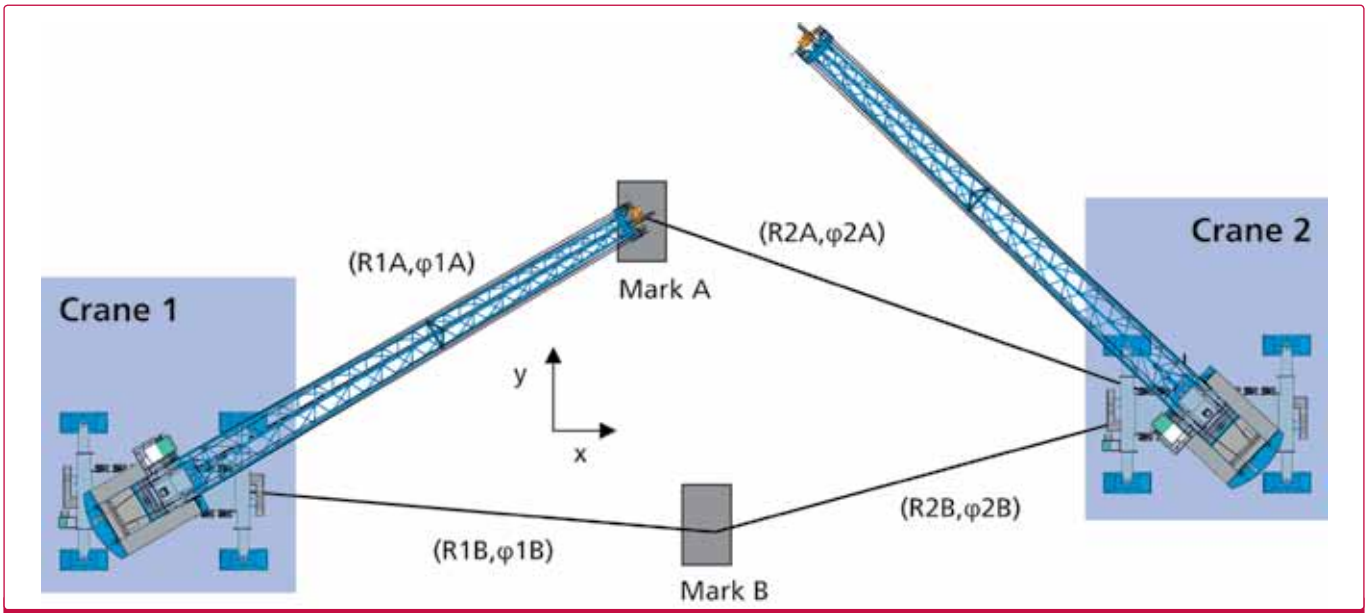
1) The two cranes used for a tandem lift are controlled synchronously by only one crane driver. This can be done either from one of the crane cabs or, more conveniently, by radio-remote control at ground level.

2) Synchronous crane operation is achieved via state-of-the-art hardware and software provided by Gottwald and installed on both cranes. This includes the Tandem Lift Assistant software, safety PLCs, a wireless LAN system with a safe radio link between both PLCs plus the sophisticated Vertical Lift Assistant – the heart and most important hardware element of the Tandem Lift Assistant. The two cranes are operated in a master-slave combination, where one crane (the master) has unidirectional control over the other (slave).

3) In contrast to the conventional working principle of a slewing crane, the crane driver carries out the movement commands relative to the load using Cartesian coordinates. The crane control system automatically converts these commands into slewing and luffing movements of the two cranes. In accordance with official regulations, such as the British Standard Code of Practice for the Safe Use of Cranes, which prescribes the strict use of only one motion at any one time, the vertical and horizontal movements, which usually overlap in duty cycle operation, are decoupled. Simultaneous movements are only possible in one plane, either vertical or horizontal.

How the Tandem Lift Assistant is used

To combine the forces of two cranes with the help of the Tandem Lift Assistant, the two cranes, equipped with the necessary hardware and software, first have to be synchronized with each other, i.e. they need to know their relative distances from each other.



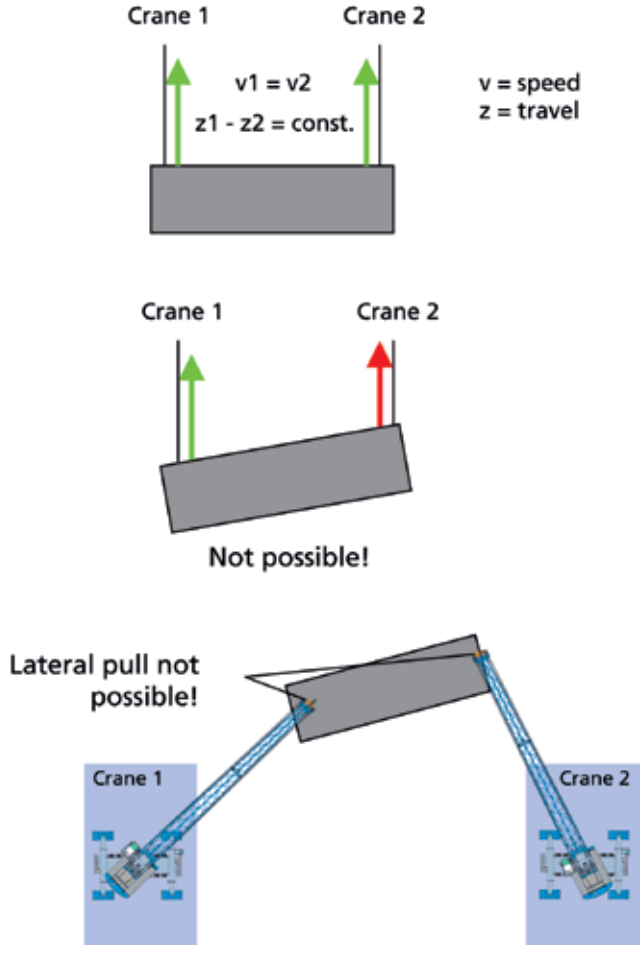
Synchronisation of both cranes is effected by a simple referencing procedure.

System preparations – synchronizing both systems

To synchronize the two cranes, two user-defined marks, i.e. coordinate reference points, on the quay surface have to be approached by each crane manually, one after the other. The positions are stored in the cranes' relative coordinate systems (radius and slew angle). The relative position of each crane's centerlines is then calculated in the x and y-directions. This Cartesian reference is valid until one of the cranes' chassis travels.

This standard manual referencing procedure is very simple but there may be terminal operators that would prefer the referencing procedure to be automated. This is why Gottwald has also developed an advanced automatic referencing system. This allows for automatic distance measuring by radar, and automatic angle measuring.

Now that the two cranes have been synchronized, they can start working together. This involves two steps, the rigging mode and tandem lift operation.

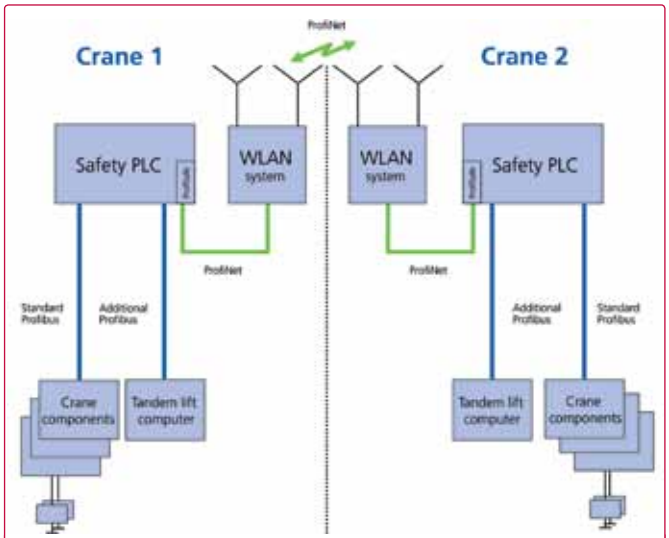


Perfectly synchronous operation of the two cranes ensures the load is balanced and avoids lateral pull on the crane booms.

Rigging mode

In the rigging mode, each crane is still operated individually and the controls of the other crane are blocked automatically.

First of all, the crane driver moves the first crane hook to the right position for attaching the load (by slewing, luffing, hoisting). The crane driver then changes to the second crane and also moves its hook to the right position. The load is then attached and the crane driver applies tension to the hoist ropes without lifting the load off the ground.



The sophisticated safety control layout ensures secure tandem lifts at all times.

Now the Vertical Lift Assistant with the inclination sensor comes into play. As in single lifting, it monitors the rope inclination. If rope inclination is detected, the boom position is corrected automatically, so that the boom tip is located exactly above the hook. As a result, no unwanted lateral movement can occur when the load is lifted clear of the ground.

Tandem lift operation

The scene is now set for the tandem lift. As already mentioned, both cranes are operated from one control point only. The crane driver can either sit in one of the crane cabs or use a radio remote control and operate at ground level. The load, radius and hook height of both cranes are visible at a glance on the operator's control screen. Based on the master-slave principle, the hoisting and lowering actions of both cranes are effected synchronously with only one controller. In the same way, motion in the horizontal plane (based on Cartesian coordinates) and rotation of the load are synchronized.

This master-slave system guarantees synchronous operation. Nevertheless, Gottwald has implemented additional functions as a fail-safe system. A minor difference in the basic crane configuration (for example, with regard to hoisting speed) might cause a deviation, which is where Gottwald's monitoring and safety mechanisms help to take corrective action as early as possible. The PLCs of both cranes monitor any differences in hook height and hoist speeds between the two cranes. In the event of a deviation, corrective action is performed automatically. If, for whatever reason, the deviation cannot be corrected, the hoists are switched off automatically. In the case of deviations in the slewing and luffing speeds, this is detected and, if automatic correction is not possible, the drives are switched off automatically so that no lateral pull can occur.

Safety developed by Gottwald

The complete system, including hardware and software – that is, the tandem lift computer, crane components such as the rope inclination sensors, safety PLC and wireless LAN system – has been designed by Gottwald in compliance with safety category 3, according to European standard EN 954-1 'Safety of machinery – Safety-related parts of control systems' (to be replaced by EN ISO 13849-1 in 2012).

This industrial standard ensures a safe and stable radio network and wireless LAN system, amongst other things. In terms of integrity, it is comparable to a cable connection, which can also be supplied as an alternative if, in a certain application, local regulations require a fixed cable connection between the cranes.

More than just safety

Additional safety features include emergency stop functions, which are transmitted redundantly between both cranes. As soon as an emergency stop button is hit, both cranes stop. Also the main crane switch function is transmitted redundantly and when one main crane switch is turned off, both cranes are switched off. Furthermore, in case one drive is switched off due to a fault on the crane, the relevant drive of the other crane is also switched off. If, for whatever reason, the radio link is interrupted, crane operation is automatically stopped.

New modules for Gottwalds Visumatic® crane management system

Both the new Vertical Lift Assistant as a stand-alone system and the Tandem Lift Assistant (including the Vertical Lift Assistant) are new modules for Gottwald's Visumatic® crane management system, the visualization and control system which optimizes crane performance and enables Harbor Cranes to develop their full handling potential. All the functions required for operation, maintenance and production statistics management are arranged in a simple, accessible form.

The Gottwald Visumatic® features:

- A graphical user interface for crane operation
- A visualization system for all key crane functions
- A facility for recording and evaluating handling rates
- A maintenance system which displays the count-down in operating hours to the next maintenance interval
- A diagnostics system with detailed diagnostics messages.

Further modules of the Visumatic® include:

- A radio remote control for all crane functions
- Teleservice
- A slewing angle limiting function
- A pre-settable lifting height function
- **The new Vertical Lift Assistant as a stand-alone system**
- **The new Tandem Lift Assistant (including the Vertical Lift Assistant)**

Special options for bulk handling:

- Load-sensing mode
- Full use of the truck loading capacity when the crane loads trucks directly
- Point-to-point handling mode
- Hopper control from within the tower cab.

More than just safety – Gottwald Tandem Lift Assistant

Safety features:

- Monitoring of rope inclination in two directions
- Redundant rope inclination sensor
- Comparison of hoist speeds
- Comparison of hook height difference
- Decoupled vertical and horizontal movements
- Lifting from the ground without lateral movement
- Use of safe control systems (Safety PLC)

Further safety features:

- Operation is stopped when radio link is interrupted
- Emergency stop functions are transmitted redundantly between both cranes → both cranes will stop when an emergency stop button is hit
- Crane main switch function is transmitted redundantly between both cranes → both cranes will be switched off when crane main switch is switched off
- In case one drive is switched off due to a fault on one crane, the relevant drive of the other crane is also switched off

ABOUT THE COMPANY

Gottwald Port Technology GmbH, based in Düsseldorf, Germany and a subsidiary of Demag Cranes AG, is a manufacturer of harbor cranes and terminal automation technology. With a total of over 1,300 mobile harbor cranes sold, the company is world market leader in this product sector. In the field of terminal automation, Gottwald Port Technology offers system solutions that incorporate both the company's own software and hardware. Gottwald Port Technology supplies customers in around 100 countries.

ENQUIRIES

Gottwald Port Technology GmbH
Postfach 18 03 43
40570 Düsseldorf
Germany
Tel: +49 (0)211 7102-3353
Fax: +49 (0) 211 7102-53353

www.gottwald.com

Mobile Harbour Cranes in the Port of Carrara, Italy

Top Performers

TOC EUROPE
www.toc-events.com
7–9 June 2011
Booth F 34

> “There is technology available to get things moving in 100 countries of the world.”

Gottwald Port Technology GmbH • PO Box 18 03 43 • 40570 Düsseldorf, Germany
Phone: +49 (0) 211 7102-0 • Fax: +49 (0) 211 7102-3651 • info@gottwald.com • www.gottwald.com

GOTTWALD port technology

Gottwald Port Technology GmbH • PO Box 18 03 43 • 40570 Düsseldorf, Germany
Phone: +49 (0) 211 7102-0 • Fax: +49 (0) 211 7102-3651 • info@gottwald.com • www.gottwald.com

Gottwald Port Technology GmbH – a subsidiary of Demag Cranes AG

GOTTWALD
port technology