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Lifting in tandem

In this month's feature, MARCO VAN DAAL highlights a tandem lift recently performed at a concrete facility

As part of an extension of a concrete facility, together with an upgrade of a dosing system, a silo needed to be placed on top of the facility building. The silo was nothing spectacular with its weight of 26 tonnes, diameter of 8.4 metres and height of 6 m. The light components such as the legs, bracing and platforms were all preinstalled using a single crane. The silo's weight, however, was beyond the capacity of a single crane that could still be manoeuvred in position in the tight corners. A tandem lift was the only solution.

What made this lift extra complex was the fact that the facility was running at the time of the lift. No personnel were allowed in the building during execution but the batch computer was programmed so that the concrete production did not stop. All conveyors, shakers, mixers, dosing installation, pumps, etc continued to operate. This did not hamper the lifting operation in a physical way but it could distract the operator as the raw materials were being moved around in the vicinity of the lift area.

In addition, due to various conveyors running to and from the facility, the two cranes could not be positioned side by side to perform this lift; there was simply not sufficient space to do so. Instead the cranes were positioned at 90 degrees from each other, each on one side of the building. There was no visual contact between the operators during the entire lift. Last but not least, once the silo was swung over the edge of the roof, there was no longer a visual sight of the silo either.

Rigging engineering

OPTION 1: A number of different lifting scenarios were considered to lift the silo into position. The first, and initially thought to be the easiest, was to attach the rigging from each crane to the provided bolt-on lifting eyes inside the silo. This turned out not to be feasible as these lifting eyes were located so close together that the

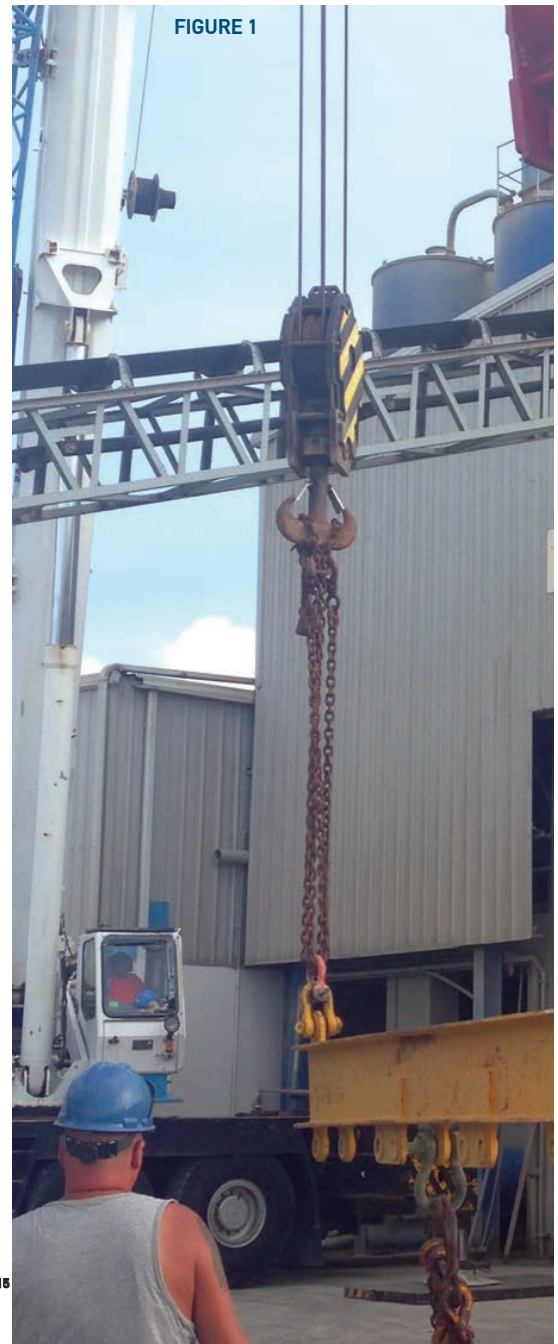


FIGURE 1

ABOUT THE AUTHOR

Marco van Daal has been in the heavy lift and transport industry since 1993. He started at Mammoet Transport from the Netherlands and later with Fagioli PSC from Italy, both leading companies in the industry. His 20-year plus experience extends to five continents and more than 55 countries. It resulted in a book *The Art of Heavy Transport*, available at: www.khl-infostore.com/books Van Daal has a real passion for sharing knowledge and experience and holds seminars around the world.

FIGURE 2

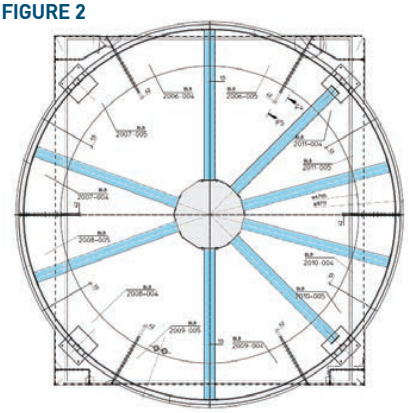
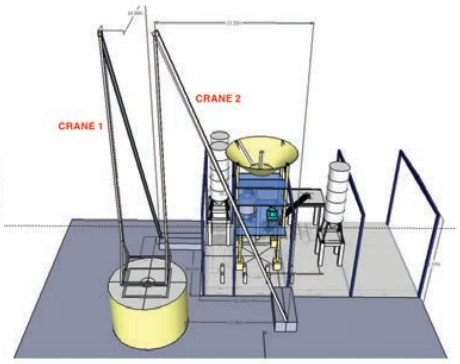


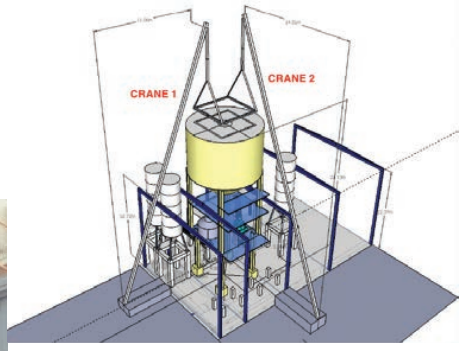
FIGURE 3



crane boom heads would get dangerously close together and possibly even touch during the slewing operation. This option, therefore, was no longer considered.

OPTION 2: The second option was to move

FIGURE 3



these bolt-on lifting eyes further out (away from the centre) and use a spreader frame to keep the boom heads away from each other. With the silo being 6 m in height there was a serious concern that due to a difference in hoisting speed, one crane would "see" an increased load as the centre of gravity (CoG) would shift towards that crane (see theory in article *IC* June 2014). Even though the lift supervisor directing both cranes would be at all times at the elevation of the silo in a man lift, this remained a concern.

OPTION 3: This option entailed leaving the lifting eyes untouched and use a lift beam long enough to keep the boom heads away from each other. The silo would be suspended from a single centre lifting lug so that a difference in hoisting speed would not affect the load of either one of the cranes. The silo would also remain level at all times. This option was selected as the best way to perform the lift. See Figure 1 for the rigging arrangement at ground level.

De-rating of the lift chart

With option 3 the risk of overloading one of the cranes due to hoist differential was mitigated. During the slewing operation, however, there was still a risk of side loading the boom or rigging getting out of plumb when one of the cranes slews to fast or one stays behind. Even with the lift supervisor being in a man lift at silo elevation, they would not be able to see the booms and rigging from every angle

to avoid this. For this reason neither of the cranes would be allowed to exceed 85 % of the rated capacity. In addition, two spotters were assigned, one to each crane, who would constantly watch the plumbness of the rigging and report back to the lift supervisor throughout the lift.

As the silo was shipped in "knock down" condition and was assembled on site, it was also decided to lift the silo with one crane (prior to the installation) and perform a weighing. The bolts and nuts, insulation, cladding, stairs, etc all added to the total weight of the silo and an accurate number was needed. The weight came in at exactly 26 tonnes as the specs had shown. With an additional 2 tonnes for the rigging a total weight of 28 tonnes was to be lifted. The CoG, however, was off centre, so the silo did not lift level.

This silo was designed to function as a batching silo. A batching silo holds various components (raw materials) in the different silo compartments. These components are added to the mix that results in a concrete batch of a certain quality and strength.

These raw materials are needed in different quantities and, therefore, the various compartments are of different sizes. Figure 2 is a section of the construction drawings and shows the compartment walls in blue. On the right side of the drawing there are two additional compartment walls and therefore the CoG of the silo is slightly towards the right.

As it is important to lift the silo level, to be able to set it down on its legs, shackles were added to one side and after two or three attempts the silo lifted level.

To ensure that the lift and subsequent installation would go smoothly, the entire facility was measured and mapped in a three-dimensional drawing.

Abandoning the lift (at any stage) would set back the schedule and that was to be avoided. Figure 3 (initial position) and Figure 4 (final position) show the result of this exercise.

For both cranes the initial and final radii were determined and documented:

Crane 1 initial radius: 14.99 m

FIGURE 5

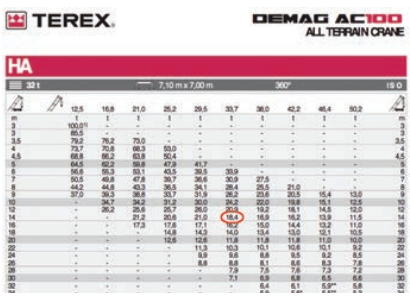
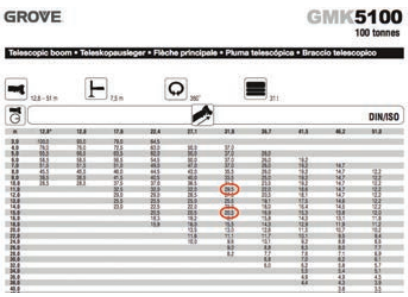


FIGURE 6



OVERVIEW OF RATED CAPACITY

		CAPACITY	REDUCED CAPACITY (85 %)
Crane 1, Grove, initial radius:	14.99 m	20.5 tonne	17.4 tonne
Crane 1, Grove, final radius:	11.06 m	29.5 tonne	25.1 tonne
Crane 2, Terex, initial radius:	13.32 m	18.4 tonne	15.6 tonne
Crane 2, Terex, final radius:	14.01 m	18.4 tonne	15.6 tonne

Crane 1 final radius: 11.06 m

Crane 2 initial radius: 13.32 m

Crane 2 final radius: 14.01 m

The following two cranes with sufficient capacity were selected:

Crane 1: A 100 tonne capacity Grove GMK5100 with 31.9 m of main boom

Crane 2: A 100 tonne capacity Terex AC 100 with 33.7 m of main boom

From manufacturers load charts, as shown in Figure 5 and Figure 6 and the reduction of the rated capacity, the below overview can be made. In this scenario neither crane exceeds 85 % of its rated capacity. Refer to table above.

Pre-lift meeting

To ensure a smooth execution, all parties involved in the lift were called to a meeting where the lift plan was discussed. A separate meeting with both crane operators, the lift supervisor, both spotters, two tag line men and the safety officer was also conducted.

For a successful lift it was important that the crane operators understood the criticality of the lift and that they were in agreement with the arrangement and crane set-up.

Communication was agreed to be by radio only between these eight individuals. As the operators cannot see each other and from a certain point onwards cannot see the silo either, they asked for additional and continuous feedback from the lift supervisor during the execution of the lift. This request was obviously granted.

Execution

On the day of the lift, early in the morning the lift site was cordoned off with caution tape indicating the "fall area" of the cranes. Nobody outside the immediately involved individuals was allowed in this area.

At around 08.00 the lift commenced. Figure 7 shows the lift in process, the silo lifted to about half the height of the building. In Figure 8 the silo is being slewed over the earlier installed silo legs. Figure 9 shows the silo almost lining up with its support structure.

During the slewing operation the lift supervisor received feedback from the spotters about the plumbness of the lifting wire of each of the cranes. In each of these figures you can see the man lift that was used by the lift supervisor to ensure that all obstacles and obstructions were cleared.

Not visible in the figures are the two tag line men. They started off by having a relatively easy task. This task became quite a bit harder when the silo was elevated above the roof, as at that time the wind had an influence on it. They managed to keep the silo from spinning.

At 11.00 the lift was completed and the slings could be unhooked. All the preparation work, engineering, meetings, site visits, measurements, drawings, etc paid off. A critical lift executed smoothly without delay or damage. ■

FIGURE 7

FIGURE 8

FIGURE 9