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Unloading dolly loads

This article completes a series of three. We have seen what bolsters or turntables are and the various different types. Last month's article highlighted some transport scenarios where things can go wrong if not assessed properly. MARCO VAN DAAL reports

This article assumes that the decision to use turntables has already been made and that the transport has already taken place to the final destination. The transporters are in their offload locations and the cranes, a main crane and a tailing crane, are in position and hooked up to the vessel. The lift is about to commence.

The word vessel is used for the remainder of this article. A vessel (bullet tanks also fall in this category) is typically installed in the same manner in which it is transported, i.e. horizontally. Lifting lugs are situated symmetrically around the centre of gravity so that two equal size cranes can lift the vessel and place it on its foundation. Many vessels have no lifting lugs and are "belly slung" for final positioning.

If the vessel is installed vertical it is commonly called a column. Cold boxes are also in this category. The main crane carries the full weight of the vessel once upright. If the lifting lugs are located correctly, the tail crane can be quite a bit smaller as it will lift much less than 50 % of the vessel's weight.

The second category, vessels that are installed vertical, are the topic of this article. These could pose a problem if the unloading from the hydraulic transporters is not carefully planned and executed.

Figure 1 shows two 6-axle line transporters carrying a vessel with a weight of 300 US tons or 660,000 pounds (272 tonnes). The dimensions shown in the figure are in millimetres and feet & inches. This figure represents a generic vessel with a single tail lug at the skirt of the vessel and two lift lugs at the head of the column near the tangent line. The transporters have an assumed axle line capacity of 30 ton or 66,000 pounds. The capacity of each 6-axle line transporter is 180 tons or 396,000 pounds. The saddles A and B are situated at equal distances from the centre of gravity.

During transportation each of the saddles carries an equal load:

EQUATION 1

$$Load_A = Load_B = \frac{Dist_{(A-CoG)}}{Dist_{(A-B)}} = \frac{41'\text{-}0.125"}{82'\text{-}0.25"} = 0.5$$

$$Load_A = Load_B =$$
$$0.5*660{,}000\ LBS = 330{,}000\ LBS\ or\ 165\ ton$$

This is well within the capacity of the transporters of 396,000 pounds or 180 tons. Note that for this exercise the hydraulic stability has purposely not been taken into account.

Once the vessel is lifted off the saddles, the main and tail crane carry the following loads:

EQUATION 2

$$Load_{Main} = \frac{Dist_{(TailLug-CoG)}}{Dist_{(TailLug-HeadLug)}} = \frac{90'\text{-}2.625"}{164'\text{-}0.5"} = 0.55$$

$$Load_{Main} = 363{,}000\ LBS\ or\ 165\ ton$$

EQUATION 3

$$Load_{Tail} = \frac{Dist_{(HeadLug-CoG)}}{Dist_{(TailLug-HeadLug)}} = \frac{73'\text{-}10.125"}{164'\text{-}0.5"} = 0.45$$

$$Load_{Tail} = 297{,}000\ LBS\ or\ 135\ ton$$

When it comes to lifting the vessel off the transporters, the sequence is generally as follows:

- The main crane lifts the vessel head in increments until an air gap appears between saddle A and the vessel.
- The tail crane lifts the skirt end of the

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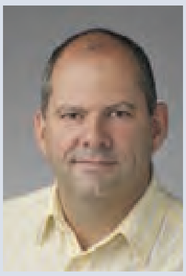
ABOUT THE AUTHOR



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 esteemed companies and leading authorities 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.com/books/the-art-of-heavy-transport/

Van Daal has a real passion for sharing knowledge and experience – the primary reason for the seminars that he frequently holds around the world. He lives in Aruba, in the Dutch Caribbean.

vessel until an air gap appears between saddle B and the vessel.

Figure 2 shows this arrangement after the main crane has lifted the vessel clear from saddle A.

EQUATION 4

$$Load_{Main} = \frac{Dist_{(B-CoG)}}{Dist_{(B-HeadLug)}} = \frac{41'\text{-}0.125"}{114'\text{-}10.25"} = 0.357$$

$$Load_{Main} = 235{,}620 \; LBS \; or \; 107 \; ton$$

EQUATION 5

$$Load_{B} = \frac{Dist_{(HeadLug-CoG)}}{Dist_{(B-HeadLug)}} = \frac{73'\text{-}9.8"}{114'\text{-}10.25"} = 0.643$$

$$Load_{B} = 424{,}380 \; LBS \; or \; 193 \; ton$$

Knowing that transporter B has a capacity of 396,000 pounds (180 tons) it is now known that this transporter is structurally overloaded. What happens to transporter B in this situation? In the best case, somebody keeps an eye on the hydraulic pressure gauges on this transporter and it will be noticed that the pressures are approaching and exceeding the maximum allowable pressure. At this point the lift should be stopped and reassessed.

In addition to the transporter being overloaded, saddle B could be overloaded as well and collapse.

Let's see what happens if the tail crane lifts the skirt end of the vessel first;

EQUATION 6

$$Load_{Tail} = \frac{Dist_{(A-CoG)}}{Dist_{(A-TailLug)}} = \frac{41'\text{-}0.125"}{131'\text{-}2.75"} = 0.313$$

$$Load_{Tail} = 206{,}580 \; LBS \; or \; 94 \; ton$$

EQUATION 7

$$Load_{A} = \frac{Dist_{(TailLug-CoG)}}{Dist_{(A-TailLug)}} = \frac{90'\text{-}2.625"}{131'\text{-}2.75"} = 0.687$$

$$Load_{A} = 453{,}420 \; LBS \; or \; 206 \; ton$$

This makes the situation even worse. When the main crane lifts the vessel clear from the saddle, transporter B carries 193 tons. When the tail crane lifts the vessel clear from the saddle, transporter A carries 206 tons. Both are overload situations.

The question that arises is how can such a vessel be lifted without overloading either transporter A or transporter B. The answer lies in the simultaneous lifting of the head lug and the tail lug. Most commonly this is done in increments where both the main crane and the tail crane take increasing portions of the load until an overload situation can no longer occur.

To carry out such a lift in a controlled way, crane operators use their on board computer as an aid and the transporter operators use their hydraulic gauges in the same way. The lift superintendent, in charge of the entire lift, stays in contact with all four people to receive feedback on the increasing loads on the cranes and the decreasing loads on the transporters.

Head lug location

As previously stated, lifting lugs are sometimes situated on the vessel in a location that allows for a much smaller tail crane. The closer the head lugs are located to the centre of gravity, the smaller the tail crane can be. Note that this typically results in longer rigging on the main crane.

Figure 3 shows such a vessel. All dimensions of this vessel have remained the same, just the head lugs have been moved from the tangent line to about 10 metres (almost 33 feet) above the centre of gravity.

As the saddles have not changed position, nothing has changed from a transportation point of view, the results of equation 1 are still valid. Both transporters carry 330,000 pounds or 150 tons.

Once the vessel is lifted off the saddles, the main and tail crane carry the following loads;

EQUATION 8

$$Load_{Main} = \frac{Dist_{(TailLug-CoG)}}{Dist_{(TailLug-HeadLug)}} = \frac{90'\text{-}2.625"}{123'\text{-}0.325"} = 0.733$$

$$Load_{Main} = 483{,}780 \; LBS \; or \; 220 \; ton$$

EQUATION 9

$$Load_{Tail} = \frac{Dist_{(HeadLug-CoG)}}{Dist_{(TailLug-HeadLug)}} = \frac{32'\text{-}9.7"}{123'\text{-}0.325"} = 0.267$$

$$Load_{Tail} = 176{,}220 \; LBS \; or \; 80 \; ton$$

It is clear that this shift in the head lug location still requires a main crane that is capable of lifting the entire weight of the vessel but that the tail crane capacity has been reduced from 135 tons to a mere 80 tons. A substantial decrease that results in a much smaller class tail crane to perform this lift.

Let's have a look at the different sequences while lifting this vessel. First, the main crane lifts the head of the vessel out of the saddle while the skirt remains.

EQUATION 10

$$Load_{Main} = \frac{Dist_{(B-CoG)}}{Dist_{(B-HeadLug)}} = \frac{41'\text{-}0.125"}{73'\text{-}9.825"} = 0.556$$

$$Load_{Main} = 366{,}960 \; LBS \; or \; 167 \; ton$$

EQUATION 11

$$Load_{B} = \frac{Dist_{(HeadLug-CoG)}}{Dist_{(B-HeadLug)}} = \frac{32'\text{-}9.7"}{73'\text{-}9.825"} = 0.444$$

$$Load_{B} = 293{,}040 \; LBS \; or \; 133 \; ton$$

As it turns out this is a perfectly acceptable lift situation as there is no overload on any of the components.

For the sake of completeness, let's look at the scenario where the skirt is lifted out of the saddle first while the main crane stands by. These loads are identical to equations 6 and 7.

$$Load_{Tail} = 206{,}580 \; LBS \; or \; 94 \; ton$$
$$Load_{A} = 453{,}420 \; LBS \; or \; 206 \; ton$$

As we have seen before, this is an overload situation on transporter A. But is goes further than just this. The tail crane is expecting a load of 80 tons (see equation 9), instead it is carrying 94 tons, an increase of 17.5 %. Any decent crane operator will make this increase over the expected load known to the lift superintendent and the lift will have to be reassessed.

Let's assume this vessel is not lifted off the transporters but lowered onto the transporters from ship cranes or from the fabrication shop cranes. While the vessel is suspended the main and tail crane carry loads as per equations 8 and 9.

$$Load_{Main} = 483{,}780 \; LBS \; or \; 220 \; ton$$
$$Load_{Tail} = 176{,}220 \; LBS \; or \; 80 \; ton$$

While lowering the vessel onto the transporters, the main crane sets down the vessel before the tail crane and the tail crane experiences an instant increase in load from 80 to 94 tons. This may result in a serious overload.

On many occasions transport and lifting is under different contracts with different operating companies. The transport contractor may not know the set-up of the cranes and the lift contractor may not know the configuration of the transporters. This increases the risk of one of the above structural overload scenarios. Where two contractors are involved, it is recommended that transport and lift plans are shared and discussed prior to the lift.

Pictures 1 and 2 show the transport and lift of a 700 ton vessel in Qatar. At the time I was employed by Mammoet and responsible for the transport. The client hired Van Seumeren for the lifting of the vessel. As you can see on picture 1, the transport saddles are situated fairly central around the centre of gravity. The head lugs (trunnions in this case), however, are located much further forward from the head saddle. When it was time to commence with the lift, the head of the vessel was lifted first, resulting in an almost overload situation on the rear transporter. Luckily this was caught on time and the lift was reassessed and carried out without further issue. We all learned a valuable lesson that day. ■

NOTE: Every effort is made to ensure the accuracy of the contents of these articles. If you find any mistakes, a brief notification and explanation would be appreciated.