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Inverting a hydraulic jack allows it to be used as a climbing jack when lifts of more than one stroke length are required

Last month's article covered a number of alternative moving techniques, including rolling, skidding, airbags and air pallets. This month attention turns to some alternative lifting methods. MARCO VAN DAAL reports

Alternative lifting

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, with his wife and daughters.

The simplest of lifting methods is the use of a hydraulic jack. A hydraulic jack consists of a cylindrical housing in which a ram can move up and down. The ram moves up under the influence of oil that is pumped into the cavity underneath the piston in the cylinder. As it moves upwards the ram protrudes from the top of the jack and raises the load.

Hydraulic jacks, like every other piece of equipment, follow certain laws of nature:

A jack's capacity can be determined by the F = P * A equation, where;

- F is the Force (or capacity) expressed in Newton (N)
- A is the area under the ram expressed in square centimetres (cm^2)
- P is the pressure applied expressed in newtons per square centimetre (N/cm^2)

An example;
P = 5,000 N/cm^2
A = 150 cm^2

The capacity of the jack is therefore;
F = P * A = 5,000 * 150 = 750,000 N (or roughly 75 tonnes)

NOTE: *This example created the impression that a higher capacity can be achieved by applying additional pressure to the jack. In principle this is correct, although the internal seals of the jack are designed for a maximum pressure that determines the capacity of the jack. Exceeding this maximum pressure could result in seal damage.*

If the load is to be lifted by more than one stroke of the jack, a cribbing (a pile of neatly stacked hard wood or steel beams) is to be placed next to the jack. The ram of the jack is then retracted and the load now rests on the cribbing. The elevation of the jack is raised by placing it on yet another cribbing and the load can be lifted another stroke. It goes without saying that this is a very labour intensive way of lifting a load, especially if this load is to be raised to a significant height.

New ideas

Thanks to the guys in our industry who do this work on a daily basis, an innovative yet simple solution to make this type of work a lot less labour intensive was created. A regular hydraulic jack >

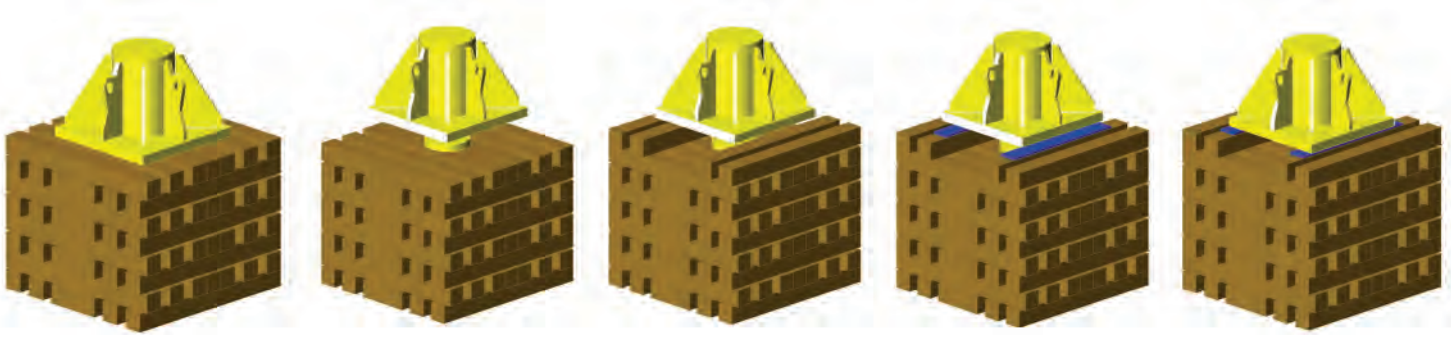


FIGURE 1 Using hydraulic jacks to raise a load to a significant height is a laborious process

was turned upside down (now the ram protrudes from the bottom), a load bearing platform was constructed around the bottom of the jack and the climbing jack was born.

There are seven basic steps in the cycle of a climbing jack, see Figure 1.

Step 1: jack is set up
Step 2: ram is extended
Step 3: hardwood timbers are placed parallel underneath the jack (criss-cross)
Step 4: steel strips are placed onto the hardwood
Step 5: the jack is lowered on the steel strips and the ram is retracted
Step 6: the void underneath the jack is now filled up with hardwood
Step 7: the ram is extended continue from step 2

NOTE: *The steel strips that are used are there to create sufficient space between the jack and the previous layer of timbers, so that the timbers of step 6 can be easily inserted underneath the jack.*

The hardwood that is used as jacking timber is mostly called ekki or azobe. They are both of the same Ochnaceae botanic family. It is found in West Africa (among others in Cameroon, Ivory Coast, Nigeria and Sierra Leone). Once the wood is dried and the moisture content has fallen below 12 % this wood is extremely durable and hard. Besides jacking timber, this wood is also used for rail road crossties and harbour work. Machining with hand tools (drill or saw) is almost impossible, the final dimensions are commonly achieved on a lathe.

According to the Center of Wood Anatomy Research, azobe has a maximum compression, or crushing, strength of 914 to 1,050 kg/cm^2) (13,000 to 15,000 PSI). This makes it very suitable for jacking operations. One thing to keep in mind, though, is its specific gravity of 1,120 kg/m^3 (70 lbs/ft^3), it is heavier than water and it will sink.

Strand jacks

While on the subject of jacks, it is a small jump to strand jacks. Strand jacks have been around for quite a while but not in a heavy lift application. They were originally

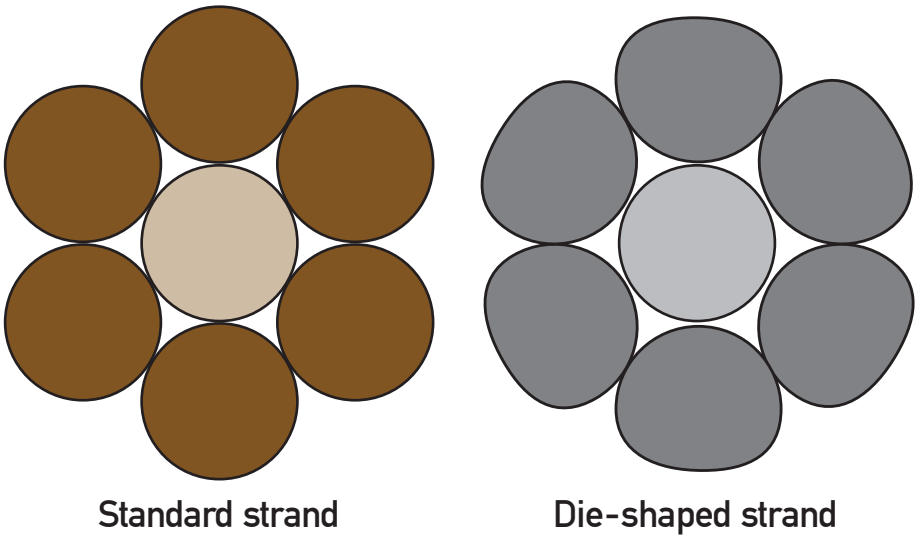


FIGURE 2 Standard strand on the left and a die-formed strand for strand jacking

used for post-tensioning of concrete beams when used for large spans such as bridges. Nowadays, strand jacks are found in horizontal applications as pulling tools, for example, for large load outs, or in vertical applications as lifting tools on cranes, lifting towers or gantries. They can even be used upside down.

A strand jack is a hollow jack that is fed with die-formed 18 mm strands of 15 tonne capacity wire rope. The strands are held in place by wedges. There is a set in the top of the jack and a set in the bottom. The strands are die-formed (see Figure 2) to allow the wedges to have a tight grip on the strand. Higher capacity strand jacks use more strands, the strand pattern is always symmetrical to avoid eccentric loads on the jack.

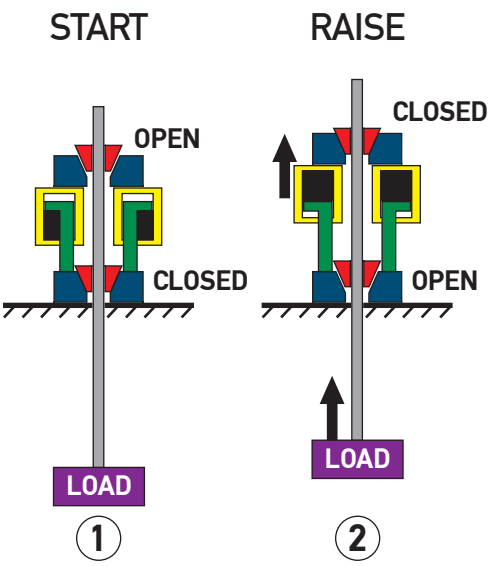
To lift a load, the strand jack follows a sequence of activities, see Figure 3.

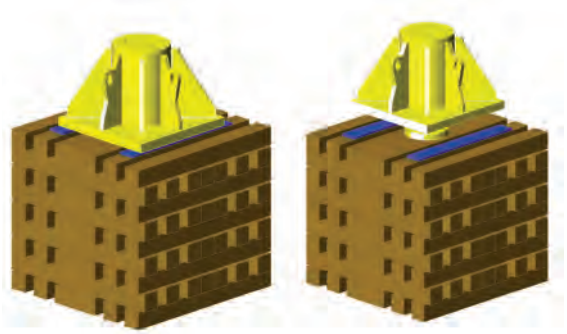
Step 1: the load is suspended by the lower wedges, the upper wedges are open
Step 2: the upper wedges close and the ram extends. The load is now suspended by the upper wedges and is raised. This motion allows the lower wedges to open and stay open
Step 3: at the end of the stroke the lower wedges close again and the downward motion (ram retract) transfers the load to the lower wedges, this motion allows the upper wedges to open and stay open
Step 4: once fully retracted, the upper wedges close and the ram extends, the load is now suspended by the upper wedges and is raised, this motion allows the lower wedges to open and stay open.

The above sequence repeats itself until the load has reached its required height.

An advantage of strand jacks is that one can achieve a high lifting capacity (750 tonnes or more per strand jack is not

FIGURE 3 Operating sequence for strand jacks





Strand jacks in operation being used for horizontal movement rather than vertical lifting

uncommon) on a small footprint. The small footprint causes less site disturbance than a crane of equal capacity. The cost of shipping strand jacks around the world is small compared to a crane.

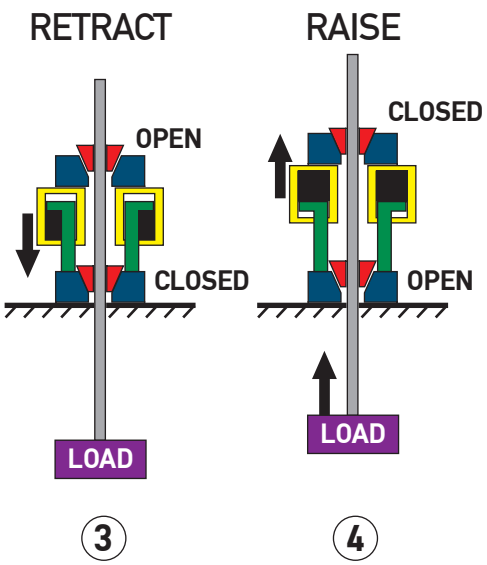
Another advantage of strand jacks is that they are mechanically failsafe, at any point during the lift the weight of the loads can be transferred to the lower wedges and is no longer suspended by hydraulics.

To reach a capacity needed for a strand jack lift, multiple units can be combined. There is almost no limit to how many strand jacks can be used on a lift. Computerised monitoring systems have unprecedented control over a lift and the load can be positioned very precisely.

Strand jacks, however, also have some disadvantages. The strands are generally pre-cut to suit a particular job or project. The likelihood that they can be used on another project is small. Strands exiting the top of a strand jack generally dangle hanging down from the strand guide, they don't coil up neatly on a winch drum.

There is the risk of bird nesting or bird caging in the lifting strands. Bird caging happens when one or multiple strands do not 'flow' right and buckle inside the jack between the top and bottom jaw. With the newest types of strand jack this phenomenon is less likely to happen due to telescopic tubes that do not allow the strands to divert from their path.

They are generally slower than a crane and they work at the same speed regardless of the weight that they lift. Cranes often increase their lifting or hoisting speed with lighter loads, strand jacks cannot do that. ■



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.