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Transporter suspension configuration

In this instalment of The Knowledge, MARCO VAN DAAL offers guidelines on how to arrive at a justified suspension configuration

Every transport equipment company goes through a process of configuration selection for each of the projects they are about to be engaged in. This process sounds a lot easier than it can be in practice as the process of configuration involves not only engineering and planning but also field/operational personnel and, in critical cases, the involvement of top management in the company.

Note: it goes without saying that safety is always the highest priority.

There are exceptions but the vast majority of all transports are executed on either a 3 point or a 4 point suspension configuration. We all know about the existence of these possibilities but we may not all know when to choose which one and why.

This article provides a guideline of how to arrive at a justified suspension configuration.

Review Figures 1 and 2, a 3 point and a 4 point suspension configuration. Each of the suspension points represents a group of axles that are all connected to the same hydraulic circuit. If the hydraulic pump is activated (by the operator) oil will flow into each of these axles that are part of that group. The 3 or 4 points create a hydraulic platform that can be controlled and kept level by the operator, hence the name 'hydraulic platform transporter'.

For the transporter to remain stable, the combined centre of gravity (CoG), as shown in Figures 1 and 2, has to remain within the stability area. The stability area is the triangle, in case of a 3 point suspension, or the rectangle, in case of a 4 point suspension, that is formed by connecting the centres of each of the suspension points.

Note: obviously there should be sufficient axle lines in the configuration to support the weight of the load.

During the transport, the CoG will move about as this is a dynamic process. The road conditions, wind, super elevation, cambers and acceleration, all have an impact on this. The key to a successful transport is, as mentioned, to keep the CoG inside the stability area. This is called the hydraulic stability or tipping stability. The lines of the stability area are called the tipping lines.

So, when 3 and when 4 points?

As one can see, the stability area of the 3 point suspension is quite a bit smaller than that of the 4 point suspension. Yet, the 3 point suspension is used most of the time. This may sound counter intuitive but there is a good reason behind this. The 3 point suspension set up is very easy to control. During the transport, any leaning of the load can be corrected by adjusting just one of the suspension groups. If the load leans towards group 2, oil needs to be pumped into group 2.

Compare this to a 3 legged chair, if the chair leans to one side, one leg needs to be shimmed and the chair is level.

A 4 point suspension is a lot more difficult to control. Assuming that the CoG is situated perfectly in the centre of >

FIGURE 1

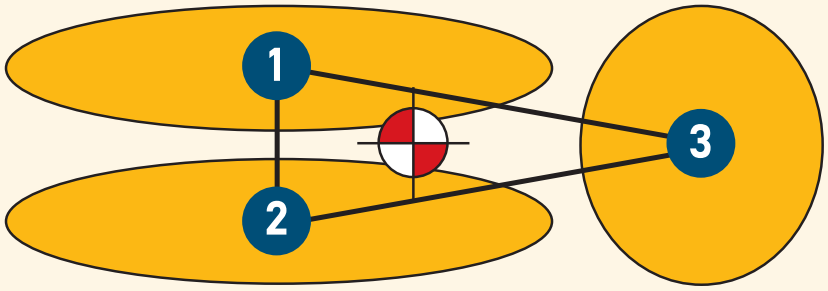
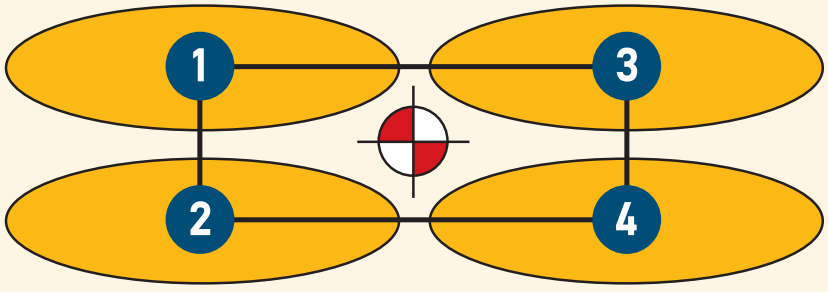


FIGURE 2



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 training seminars around the world.

the stability area, if the load leans towards group 2 and 4, it could be that either one of these groups, or both, need oil pumped into them. To find this out, you would need to look at the pressure indicators; the one with the lowest pressure needs oil until group 2 and 4 show a somewhat equal pressure. If the load still leans, both groups will require oil to correct the lean.

When over-correcting, the load will now lean towards groups 1 and 3. If you take into consideration that the entire transport is a dynamic process, you could be constantly correcting.

This process we can compare with a 4 legged chair. If the chair leans to one side and you shim one of its legs you may end up having to shim an opposite leg as well. It is a lot more cumbersome than levelling the 3 legged chair.

The inexperienced operator could get the load into a side-to-side or transverse rocking motion by over-correcting a number of times. The only way to get out of this situation is to completely stop the transport, level the load and start again.

There is, however, another drawback of using a 4 point suspension set up. Again, the comparison is made with a 4 legged chair. Assume that the chair has a 200 pounds (lbs) capacity, 50 lbs per leg. A 200 lbs person sits on the chair and each leg carries 50 lbs. Now let's assume that the floor is not perfectly level and the chair only sits on three legs. This means that each leg is now carrying 66.6 lbs, an overload of 33 percent on each of the load carrying legs.

And, if this wasn't bad enough, the person sitting on the chair moves about making the chair rock back and forth. During this rocking there is a moment that the chair sits on only two legs. At this moment, each of these two legs carries 100 lbs, an overload of 100 %. Clearly this is not what the chair is made for and there is a real possibility of damage.

The same potential problem applies to a hydraulic transporter with a 4 point suspension set up. There is a distinct possibility that only two of the four hydraulic groups carry the load, and those two groups then carry twice the loads they were intended to carry.

Hence there is a generally accepted recommendation that when using a 4 point suspension, the load should not exceed 50 % of the transporter capacity. When following this recommendation, even in the worst case scenario that the load is carried by only two groups, these groups would not be overloaded when suddenly exposed to twice the load.

Another recommendation is that 4 point suspension configurations should only be handled by experienced operators.

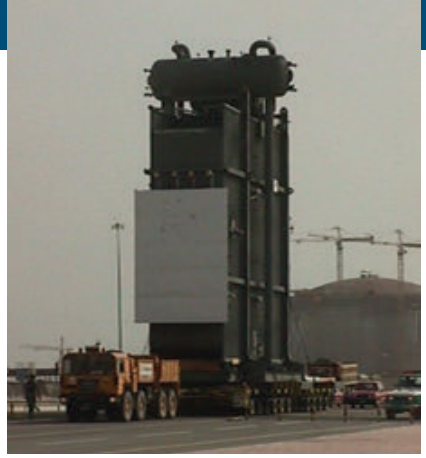


FIGURE 3

Why use 4 points at all?

This is a question that I am being asked quite often during my seminars. If there is such a risk when using a 4 point suspension, why use it at all. To answer this question, we have to go back to Figures 1 and 2 again. As you can see, a 4 point suspension allows for more sideways movement (sideways lean) of the CoG than the 3 point suspension. Loads with a high CoG sometimes require this additional allowance. Note that as the CoG rises, its sideways movement amplifies during the transport. This makes 4 point suspension configurations more suitable for loads with a high CoG.

Figure 3 shows the transport of a 300 tonne boiler with a high CoG carried out on a double 16 axle line transporter in a 4 point configuration. This transporter has a capacity of 16 axle lines x 2 x 25 tonnes = 800 tonnes. The load is less than half of the transporter capacity, making it impossible to overload the transporter due to rocking.

For the sake of convenience, below is a short overview of the pros and cons of each of the suspension configurations.

3 POINT SUSPENSION CONFIGURATION

ADVANTAGES:

- Easy to control and keep level (most commonly used configuration)
- Near equal load distribution and less danger of overload

DISADVANTAGES:

- Relatively small stability area
- Less suitable for high CoG

4 POINT SUSPENSION CONFIGURATION

ADVANTAGES:

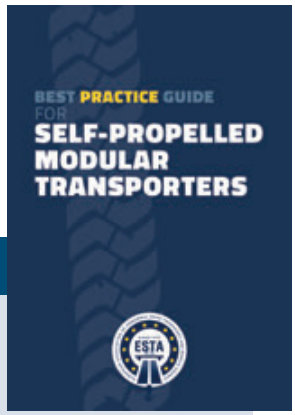
- Larger stability area
- Better suitable for loads with high CoG

DISADVANTAGES:

- More difficult to control, risk of rocking
- Higher risk of axle overload

With this knowledge under our belt, the question may still arise of 'how and where do we start?' when it comes to deciding on a suspension configuration. Below is a guideline that you can follow. Keep in mind that the final configuration is to be checked and verified by a qualified transport engineer. ■

For those who still find this exercise challenging, you can contact me at marco@the-works-int.com. I have a spreadsheet available that produces stability numbers, ground pressure, lashing requirements and a lot more. It is suitable for every transporter combination (single or double, dolly) both for pull type as well as SPMT and for every transporter brand that is currently available: Kamag, Goldhofer, Scheuerle, Faymonville, Cometto and Nicolas.



HOW AND WHERE DO WE START?

STEP 1:
- Always start with a 3 point suspension configuration

STEP 2:
- Check if the stability is adequate – centre of gravity (CoG) is to remain inside the stability area during the transport
- The recently issued *ESTA Best Practice Guide* can assist in establishing the limits. This guide was put together by a number of stake holders in our industry (including Mammoet, Sarens, Fagioli, Goldhofer, Scheuerle, Shell, Dutch Road Authorities, Wagenborg and myself)
- The *ESTA Best Practice Guide* can be downloaded in six languages at: www.estaeurope.eu/ESTABPGSPMT

STEP 3:
- If adequate, this is the preferred configuration
- If not adequate, swap to a 4 point suspension configuration and check the stability again

STEP 4:
- If the weight of the load is more than half the transporter capacity, do not (or with great care) use a 4 point suspension configuration
- In such cases, review a double wide transporter configuration for safe execution.