



RULES on Trailer Stability are needed!!

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AND TRANSPORT
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OVERVIEW

- Introduction
- Why are Stability Rules Needed?
- Accidents
- How it can be done correctly
- Accident Analysis
- Stability of Trailer
- Recommendations





JUMBO SHIPPING
The Heavy Lift Shipping Company



JUMBO LOGISTICS
Total Transport



JUMBO OFFSHORE
Lift - Ship - Install, All in one go



Loading & Unloading of Heavy Cargo



■ Introduction

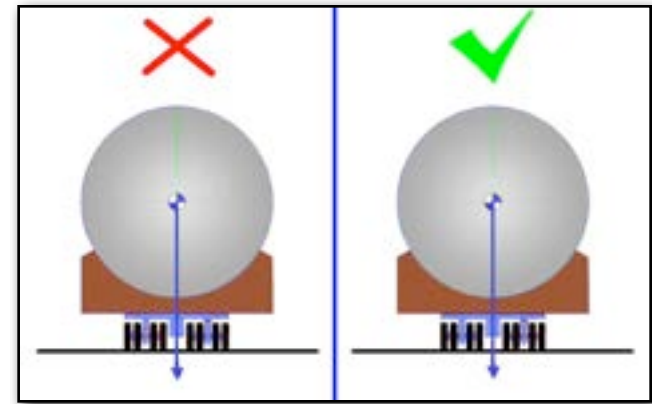
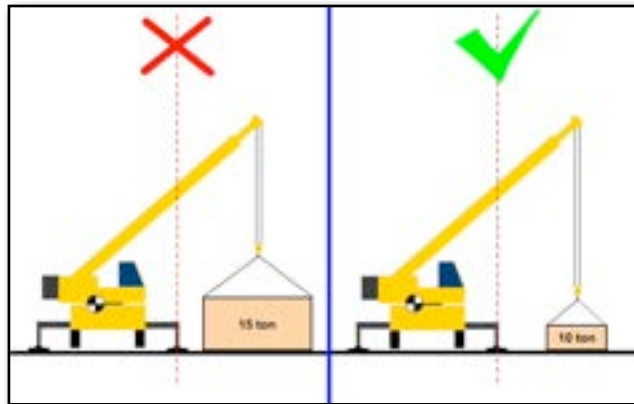
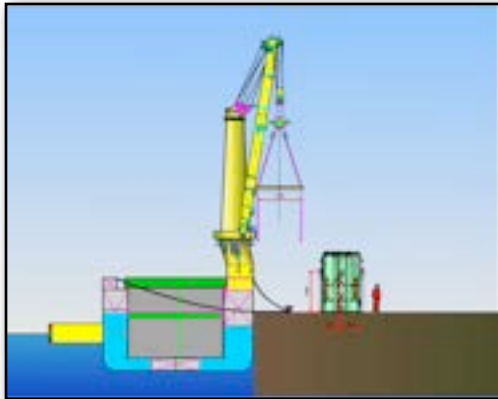
- **Leaders** in Heavy Lift Shipping want to lead in **Safety as well**
- Jumbo **pays a lot of attention to safety** and **detailed Project Preparation & Planning**
- **Training & Education of Staff and Crew members**
- **Innovation is Key to the Game**
- All **lifting gear is Certified** and replaced in planned intervals

Why are Stability Rules for Trailers needed?

- There are still too **many accidents** and we want:
- No **Injury** to people
- No **Damage** to the environment
- No **Damage** to equipment and cargo
- No **Project delays**
- **IMPROVE SAFETY IN THE HEAVY TRANSPORT INDUSTRY**



- There are stability rules for Ships (IMO)
- There are stability rules for Cranes (75% of Tipping)
- There are **NO** stability Rules for **Trailers**



Can that be changed?

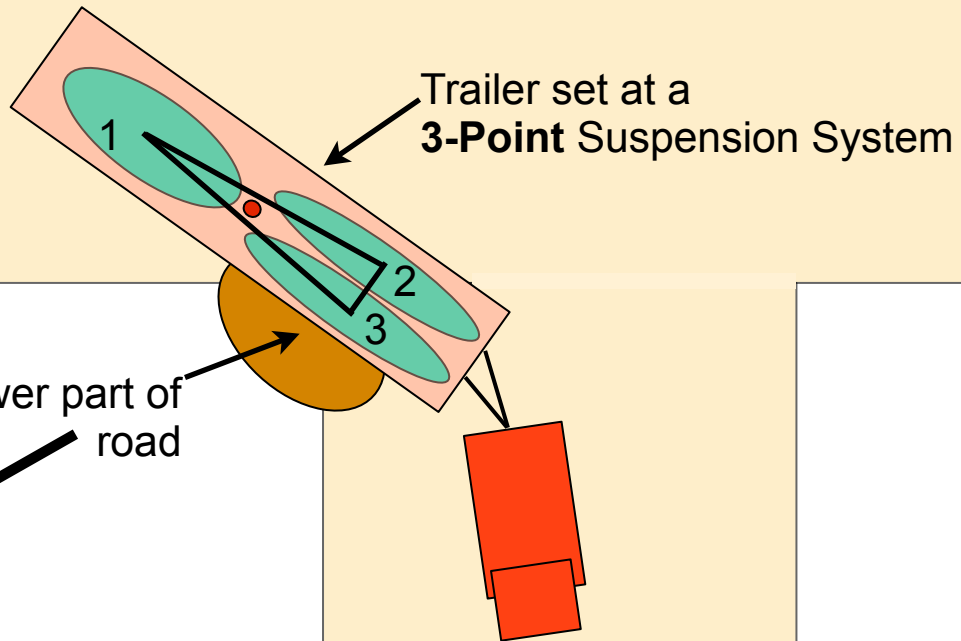
- It is **not the intention** to embarrass **any individual or Company** by showing the following accidents
- I am trying to **improve Safety** in the **Heavy Transport Industry**
- What you see in the next slides **can happen to all of us at anytime!**
- **LET US STOP THESE ACCIDENTS as all of these can be prevented!!**

Accidents



Accidents





- Trailer was about to **enter the corner**
- 3-point suspension with the **single point (1) at the rear (Wrong? or Correct?)**
- When entering the corner, suspension point 3 will **tilt the trailer immediately** without warning
- With the tractor unit **pulling it around the corner** this will help tilting the transport combination
- If the **single point suspension** was at the front we would have noticed that the front axle went down due to the **lower part of the road** and the trailer **could have been leveled in time**

A Transformer Tipped Over



Mechanical Failure?..

or Operators error?

A Transformer Tipped Over

Mechanical Failure?

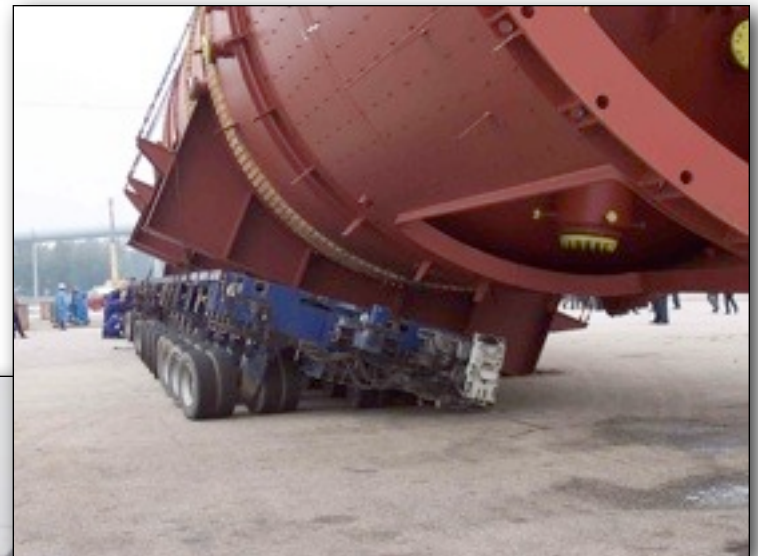
or

Operators error?



A Transformer Tipped Over







- Almost **all accidents** are caused by **human error**
- Sometimes a **mechanical, hydraulic or electronic failure** causes tipping of the trailer



- It can be done correctly if you know how
- The **Human error** can be avoided by:
 - **Training**
 - **Detailed engineering**
 - **Correct operating instructions**
 - **Follow procedures and instructions**

How it can be done right



- Equipment Failure can be avoided by:
 - Proper Maintenance & Inspection
 - Make equipment Failsafe



Transport of fully rigged Platform Ringer Crane



Transport of a Pressure vessel



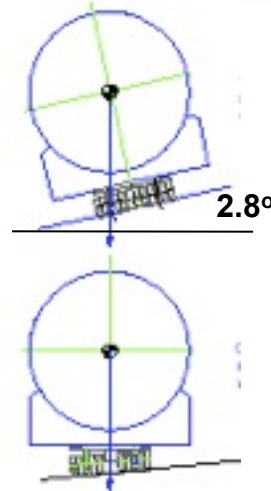
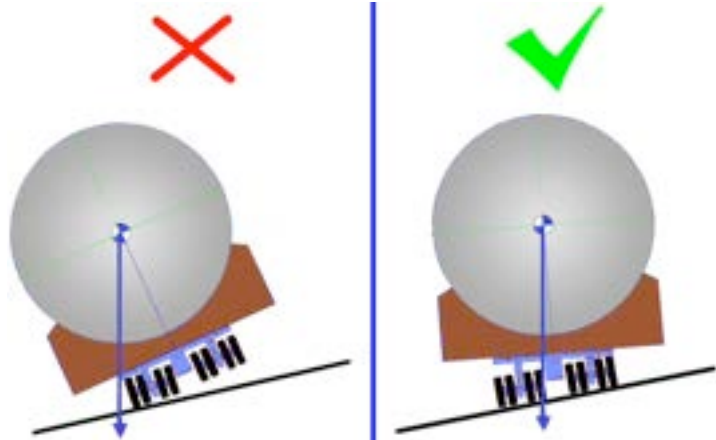


STARTING POINTS:

1. Platform trailer: **12 axlelines**
2. Diam. reactor approx. **5,8 m; Weight.203 Ton**
3. Cap. Trailer: **300 ton**
4. A **4 point suspension** was selected
5. **At first site** nothing to worry about
6. Center axles **were closed-off**, due to loads at end of trailer
7. **Instruction:** Use spirit level due to critical stability and **keep trailer leveled** at all times and use a 4 point suspension system!!

WHY DID IT TIP OVER?

1. **Camber of road: 2.8°**
2. **No spirit level was used**
3. **Trailer was not leveled**
4. **Too high pressure at one side, so they could not level the trailer anymore**
5. **Trailer tips over gradually and the lashings break off**
6. **Trailer falls back on the road**
7. **The reactor ends in the ditch next to the road**



SYMMETRICAL (2x5+2x5) 4 POINT SUSPENSION SYSTEM

LOAD ON FRONT 10 AXLES = $3895/10500 \times 203 = 75.30$ Ts

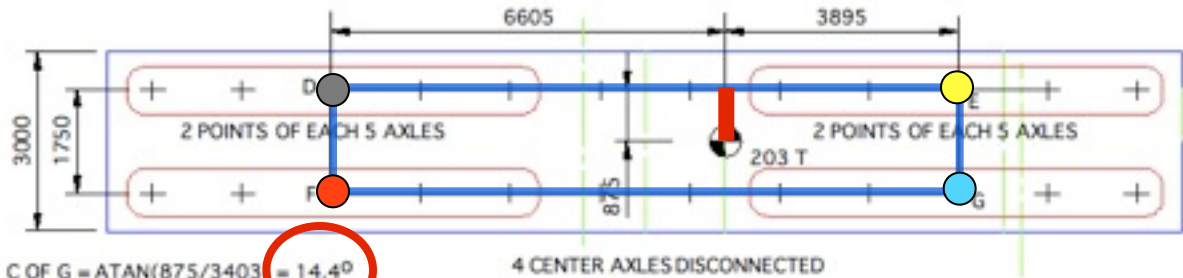
LOAD PER AXLE AT FRONT = 7.53 TS

LOAD AT REAR AXLES = $6605/10500 \times 203 = 127.69$ Ts

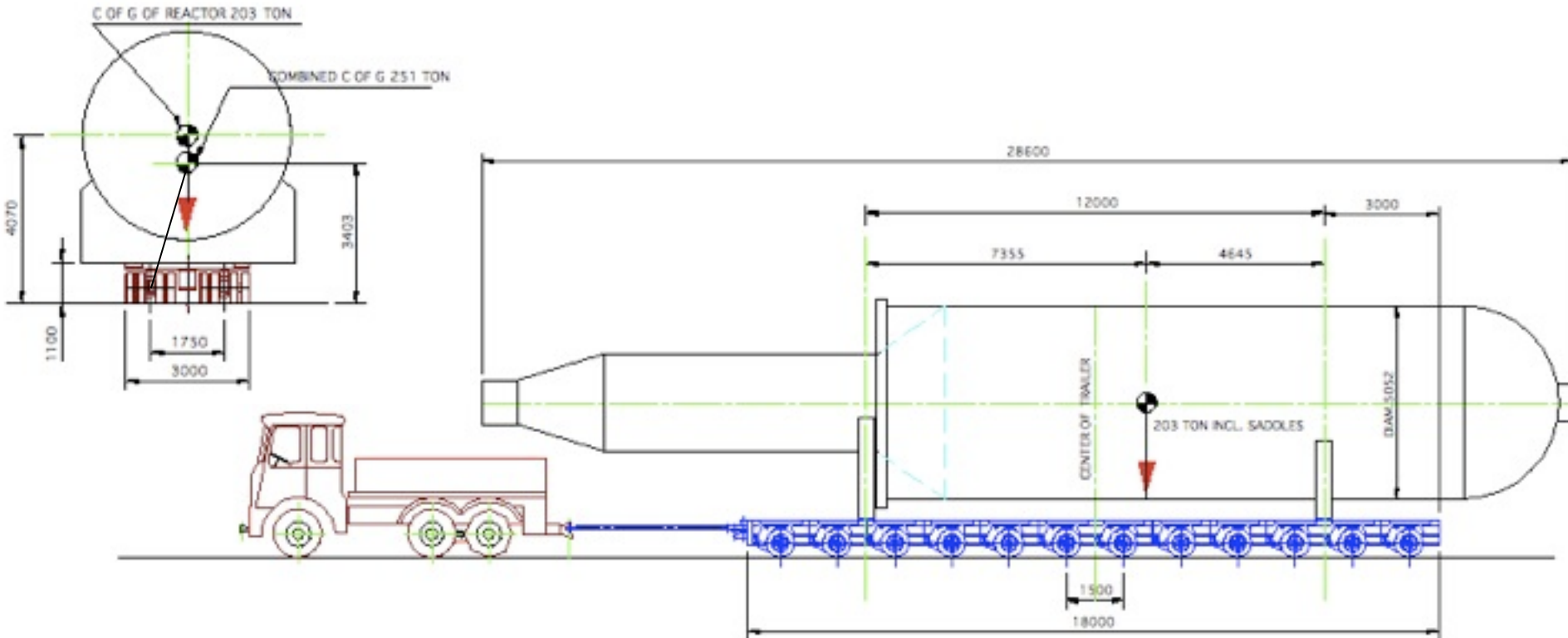
LOAD PER REAR AXLE = $127.7/10 = 12.77$ TS

HIGHER RISK FOR OVERLOAD OF AXLES

THEORETICAL TIPPING ANGLE INDEPENDANT ON LOCATION OF C OF G = $ATAN(875/3403) = 14.4^\circ$



NOTE: it was assumed that the CoG was on the center line of the reactor

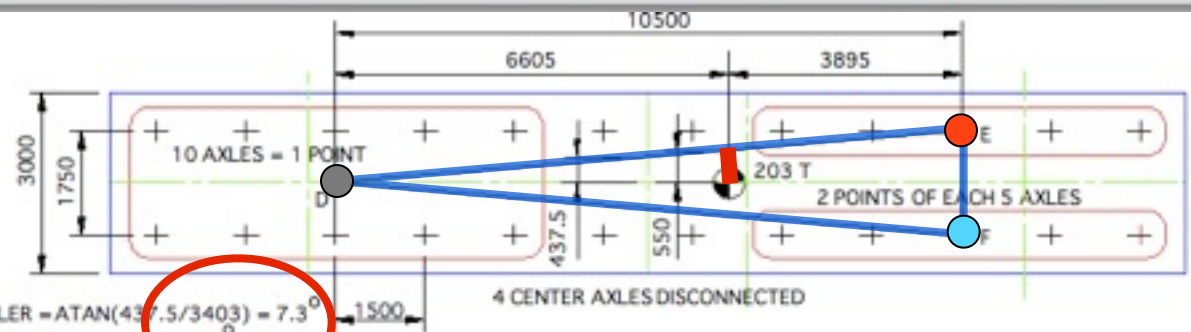


SYMMETRICAL (10+2x5) 3 POINT SUSPENSION SYSTEM

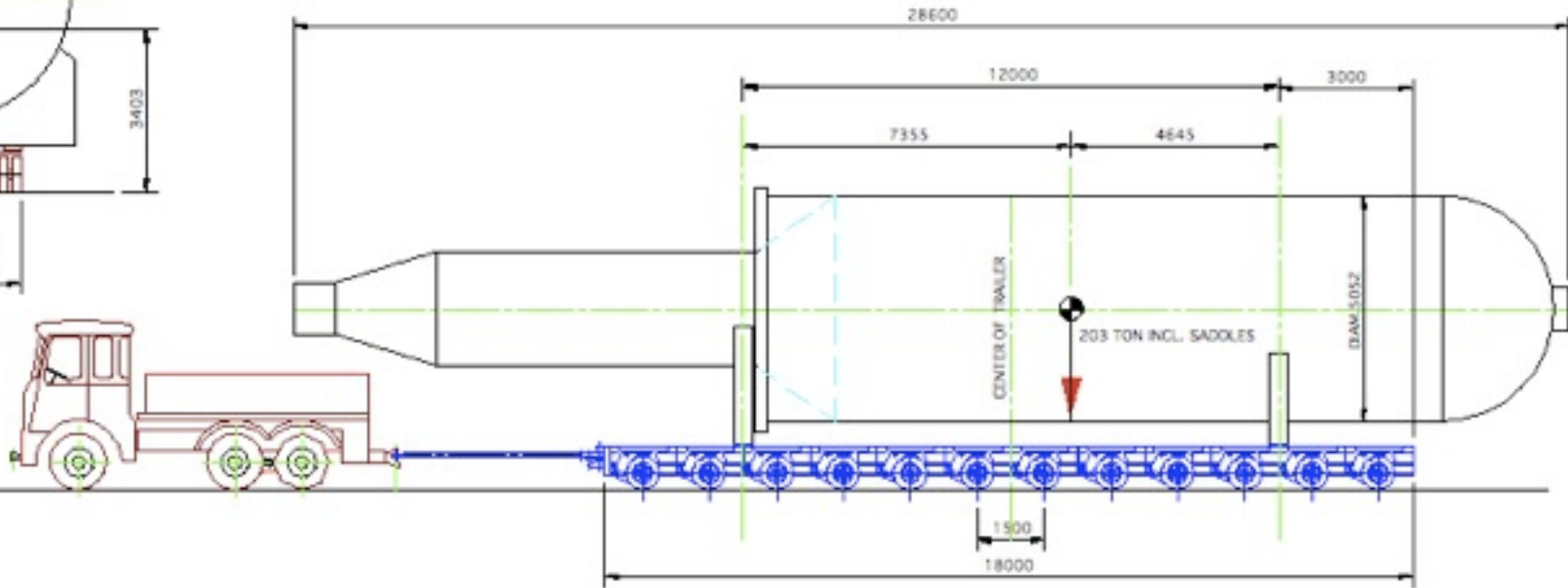
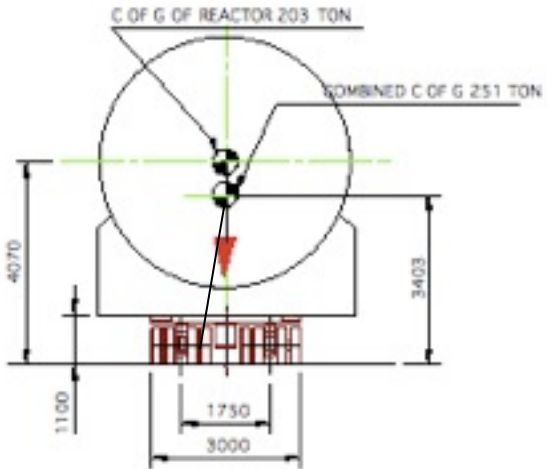
LOAD ON FRONT 10 AXLES = $3895/10500 \times 203 = 75.30$ Ts
 LOAD PER AXLE AT FRONT = $75.3/10 = 7.53$ TS
 LOAD AT 10 REAR AXLES = $6605/10500 \times 203 = 127.69$ Ts
 LOAD PER REAR AXLE = $127.7/10 = 12.77$ TS

HIGHER RISK FOR TIPPING OVER

THEORETICAL TIPPING ANGLE IF C OF G WAS IN CENTER OF TRAILER = $ATAN(437.5/3403) = 7.3^\circ$
 THEORETICAL TIPPING ANGLE DUE TO OFF CENTER OF C OF G = $ATAN(550/3403) = 9.1^\circ$



NOTE: it was assumed that the CoG was on the center line of the reactor



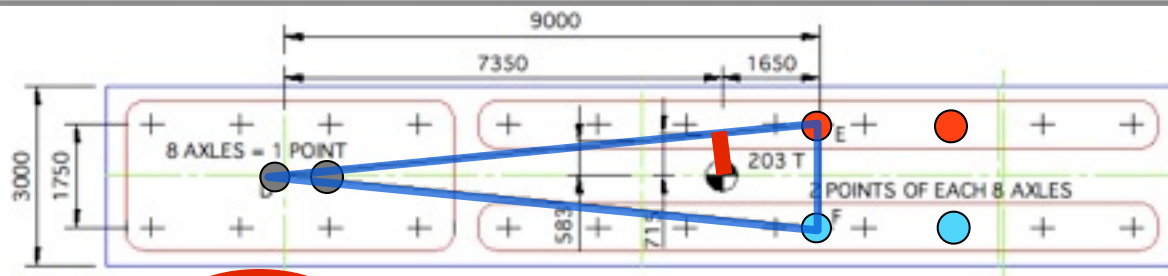
A-SYMMETRICAL (8+2x8) 3 POINT SUSPENSION SYSTEM

LOAD ON FRONT 8 AXLES = $1650/9000 \times 203 = 37.22$ Ts
 LOAD PER AXLE AT FRONT = $37.2/8 = 4.65$ TS
 LOAD AT 16 REAR AXLES = $7350/9000 \times 203 = 165.78$ Ts
 LOAD PER REAR AXLE = $165.8/16 = 10.36$ TS

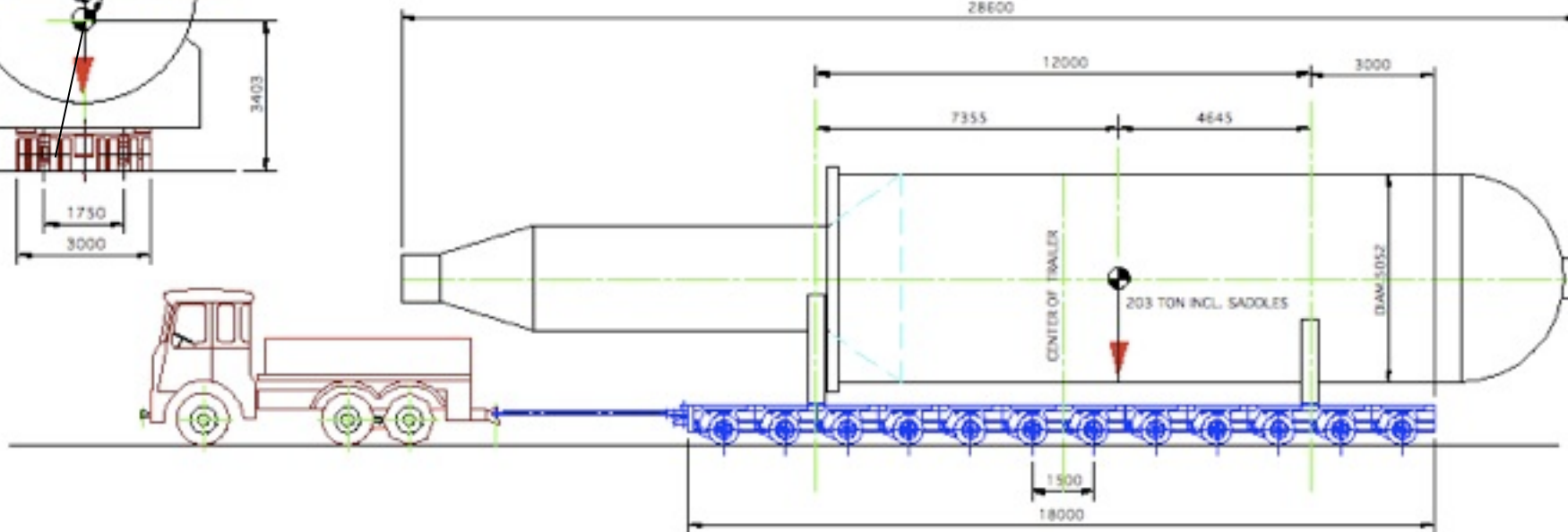
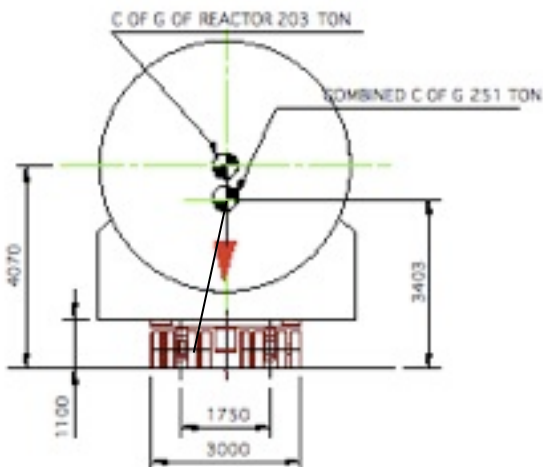
HIGHER RISK FOR BENDING TRAILER

THEORETICAL TIPPING ANGLE IF C OF G WAS IN CENTER OF TRAILER = $ATAN(583/3403) = 9.7^\circ$

THEORETICAL TIPPING ANGLE DUE TO OFFCENTER OF C OF G = $ATAN(715/3403) = 11.8^\circ$



NOTE: it was assumed that the CoG was on the center line of the reactor

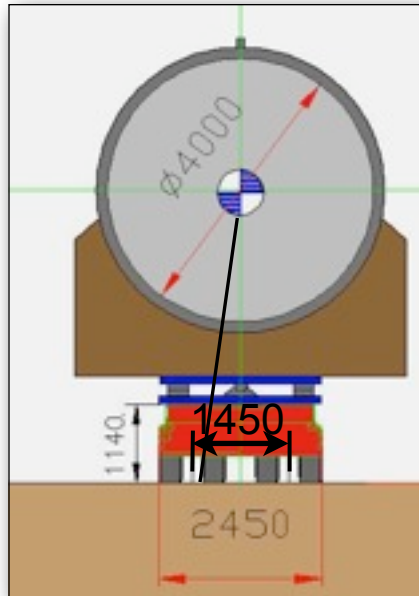


1. It was **indicated** that both **saddles were equally loaded**
2. This appeared **not to be the case**. The CoG was a lot more to **the aft** of the trailer
3. Aft axlelines of the trailer were loaded up to their maximum (**25 Ton/axleline**).
4. Due to **tilting of the trailer** the axles at the lower side will be loaded even more and tilt the trailer more
5. With a **3-point suspension**, the trailer would have tipped over even earlier, due to the **smaller theoretical tipping angle**.

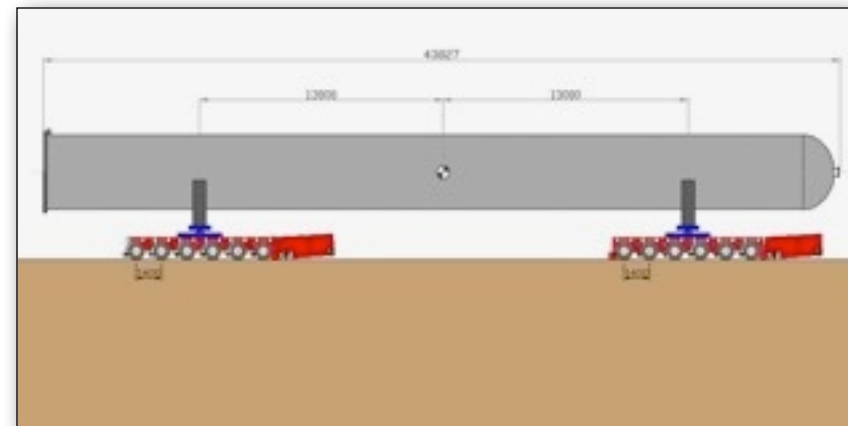
Which mistakes were made:

1. The **spirit level was not used** (it was stowed in the tractors cabin)
2. The **operators did not** pay attention to **the level of the transport combination**
3. As the **the trailer** was not leveled in time, the whole **transport combination** tipped over.





1. Establish **Stability Rules**
 - Theoretical Tipping angle
 - Hydraulic pressure
2. Issue Operating Guide Lines
3. Involve Trade Organisations
4. Make them Universally applicable
5. Training and Education of Personnel
6. Use of the **right** equipment



1. Transport of Sphere of 260 Ton diam. 16 m, on 12 lines of SPMT's coupled side by side
2. The SPMT's demonstrate the Carroussel Mode (turning on the spot)
3. Stability is critical, so use a spirit level and keep the trailer leveled at all times!!

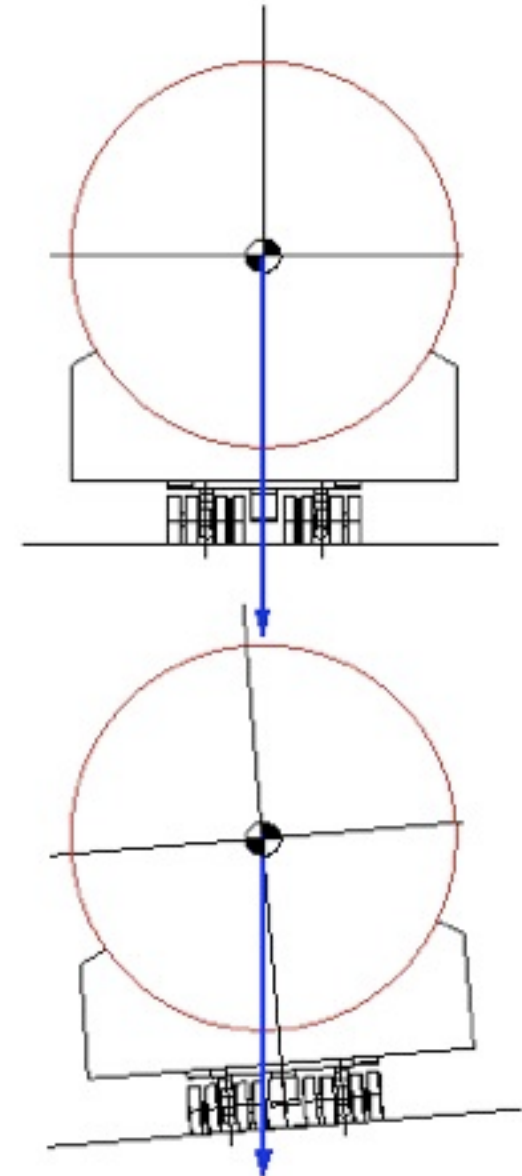


This is the **same** turn as where the reactor tipped over, but now the trailer **was leveled**

1. **Monitor trailer level** at all times during transport (**Spirit level, Electronic device etc.**)
2. **My rule of thumb is:** A load which is **2 x as high as the width of the trailer** on which it will be transported: **WATCH OUT FOR STABILITY OF THE TRANSPORT COMBINATION!**
3. **Preference for a 3 point suspension system** due to equal axle loads
4. At **high loads a 4 point suspension system gives a better stability**
5. **Watch the pressure** in each hydraulic suspension point, and adjust if necessary
6. **Always avoid sudden movement** (braking, fast change of direction, bumps etc.)



1. A Joint Industry Project or Forum involving **ESTA** and **SC&RA** to be founded to **develop Stability Rules for Trailers** and make them **Universally applicable**
2. **Support from Industry Leaders** is needed (ALE, Fagioli, Mammoet, Sarens, Scheuerle, Goldhofer, Nicolas etc.)
3. **TRAIN & EDUCATE MANAGEMENT STAFF AND OPERATIONAL PERSONNEL**





Thank you for your attention
ANY QUESTIONS?



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