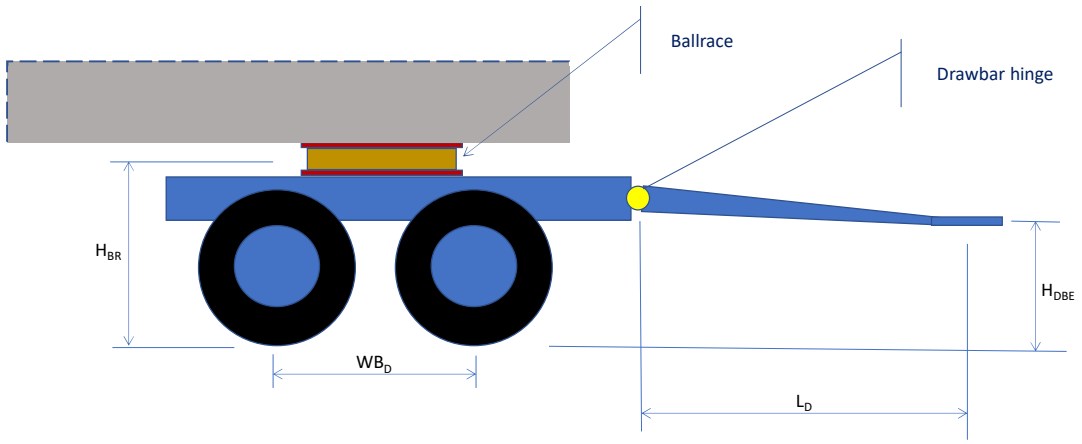
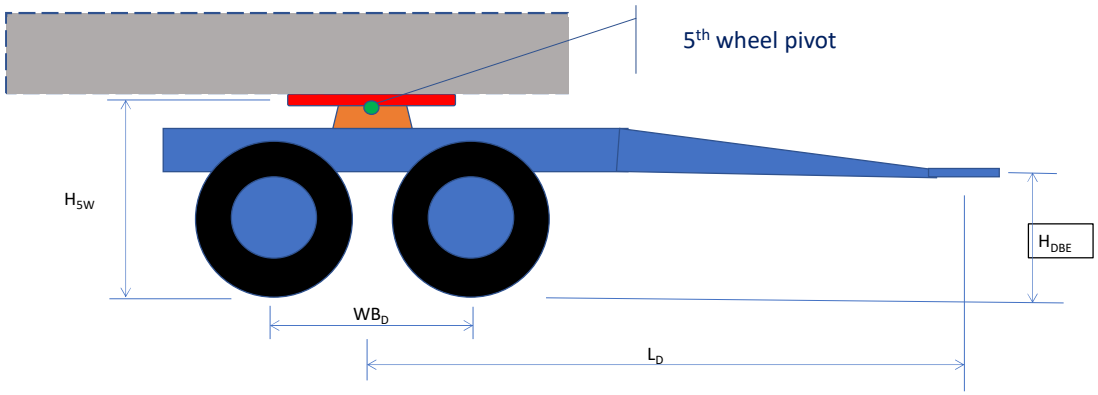
Forward axle group of full trailer



This forward axle group is fully pitching constrained to the trailer frame through the ball race

A full trailer has a ball race that attaches the forward axle group to the trailer frame. This constrains the forward axle group from pitching without bending the trailer frame.

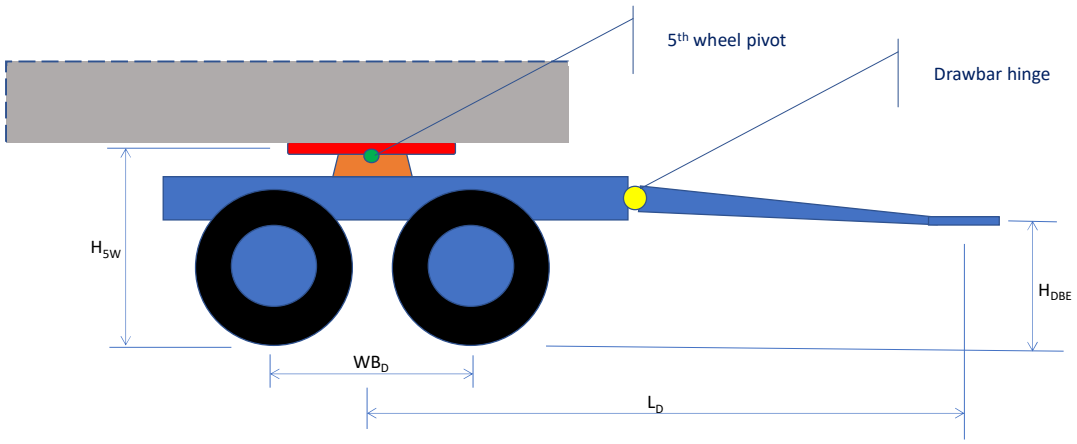
Rigid drawbar dolly with semi-trailer



This dolly is partially pitching constrained through the rigid drawbar

A 5th wheel has a pivoting axle. This enables the forward axle group i.e. the dolly, to pitch with respect to the trailer frame. However the rigid drawbar is supported in the clevis coupling of the towing vehicle. Thus the pitching mowement of the dolly is to some extent constrained.

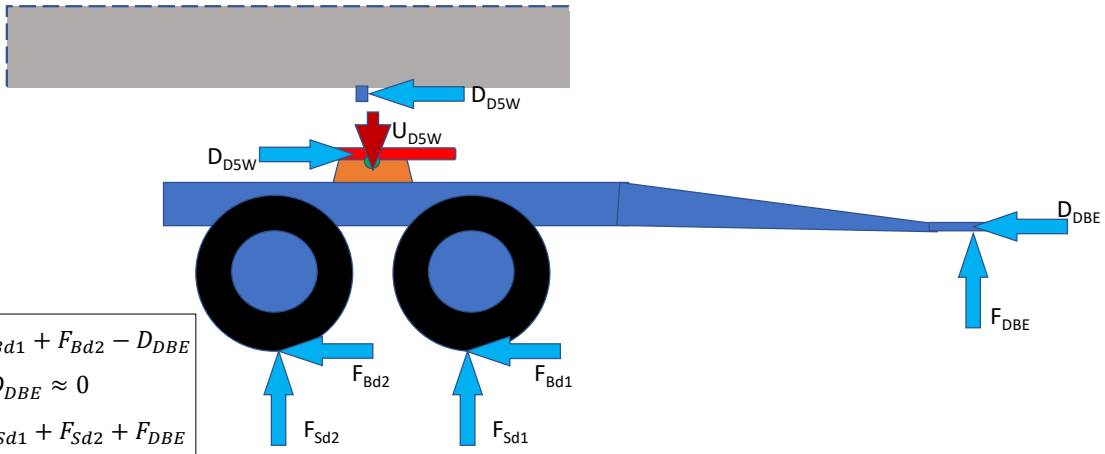
Hinged drawbar dolly with semi-trailer



This dolly is with limited pitching constraint thanks to 5th wheel pivot axle, drawbar hinge and a short wheelbase, WB_D.

With a hinged drawbar the dolly gets free to pitch.

Rigid drawbar dolly with semi-trailer



$$D_{D5W} = F_{Bd1} + F_{Bd2} - D_{DBE}$$

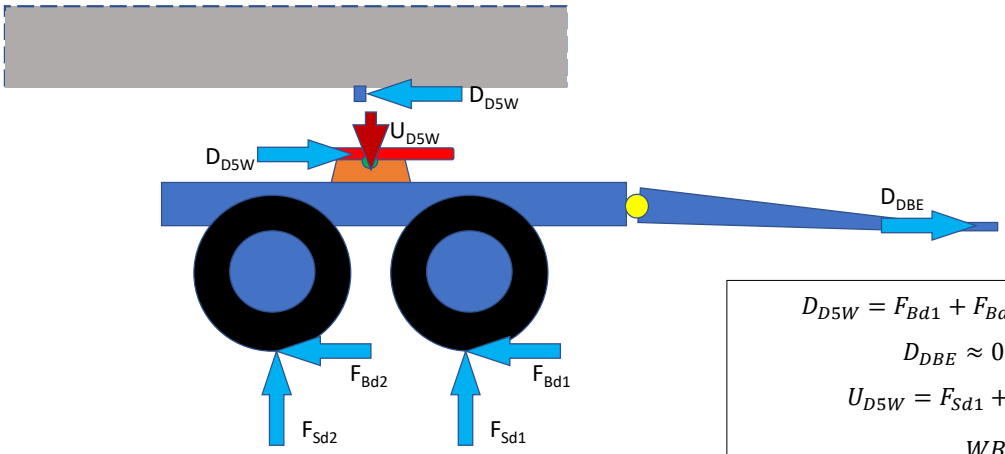
$$D_{DBE} \approx 0$$

$$U_{D5W} = F_{Sd1} + F_{Sd2} + F_{DBE}$$

$$F_{DBE} \approx \frac{D_{D5W} * H_{5W}}{H_{DBE}}$$

Splittng up the geometry the acting forces can be visualized. Through a moment equation around an axle in the ground surface right between the dolly axles the vertical support force of the drawbar eye can be calculated. It is assumed that the trailer is braking itself i.e. D_{DBE} becomes zero.

Hinged drawbar dolly with semi-trailer



$$D_{D5W} = F_{Bd1} + F_{Bd2} - D_{DBE}$$

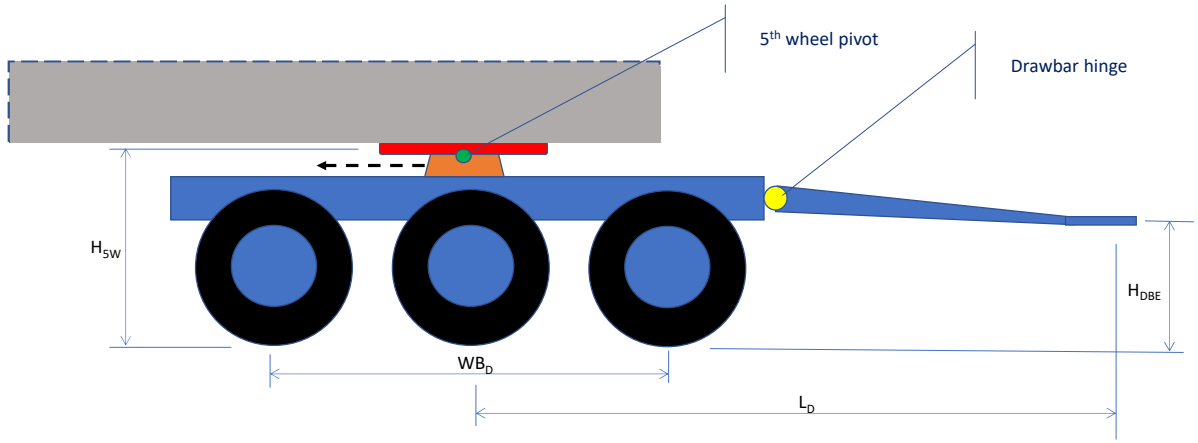
$$D_{DBE} \approx 0$$

$$U_{D5W} = F_{Sd1} + F_{Sd2}$$

$$D_{D5W} * H_{5W} \approx F_{Sd1} * \frac{WB_D}{2} - F_{Sd2} * \frac{WB_D}{2}$$

Considering the hinged drawbar the moment equation from the previous page shows the load transfer between dolly axles.

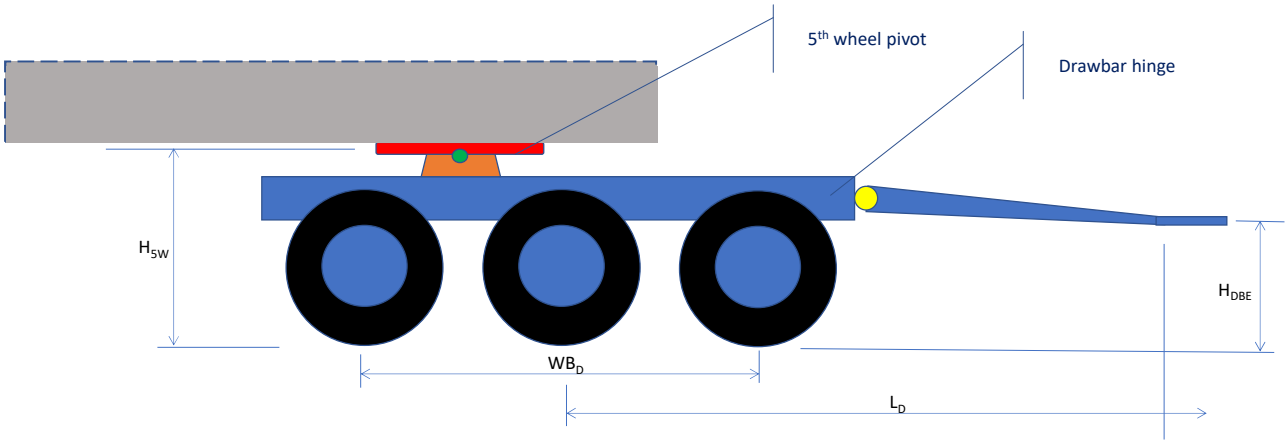
Hinged three axle drawbar dolly with semi-trailer



This dolly is with some pitching constraint due to long wheelbase, WB_D.
Moving the 5th some distance aft could balance a braking pitching moment.

Apart from allowing more vertical load (U) from the semitrailer a three axle semitrailer results in a wheelbase that is two times so long as compared with a twoaxle dolly. An unsymmetric position of the 5th wheel gives aneven load distribution of the axles loads for the dolly. In addition it can give a counter balance to the pitching moment from braking.

Hinged three axle drawbar dolly with semi-trailer

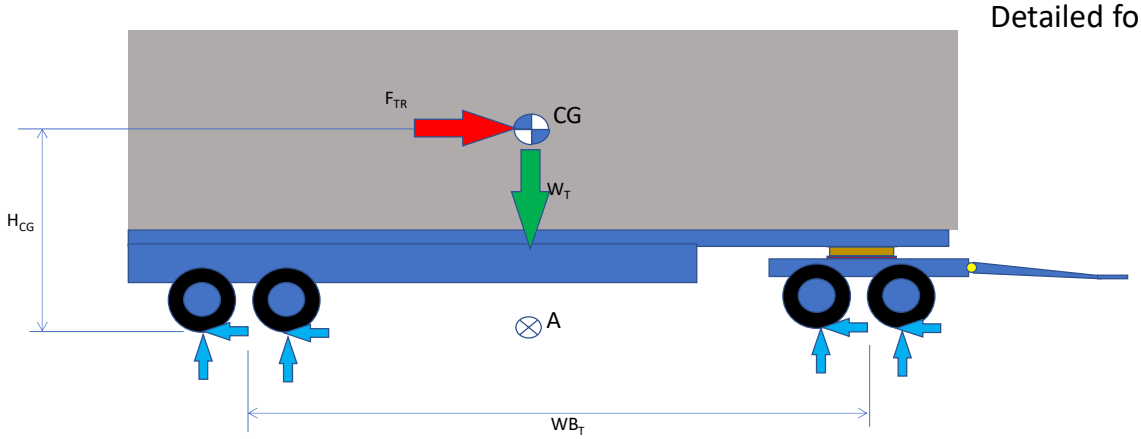


This dolly is with some pitching constraint due to long wheelbase, WB_D.
Moving the 5th some distance aft could balance a braking pitching moment.

An off center position also reduces the load carrying capacity benefit.

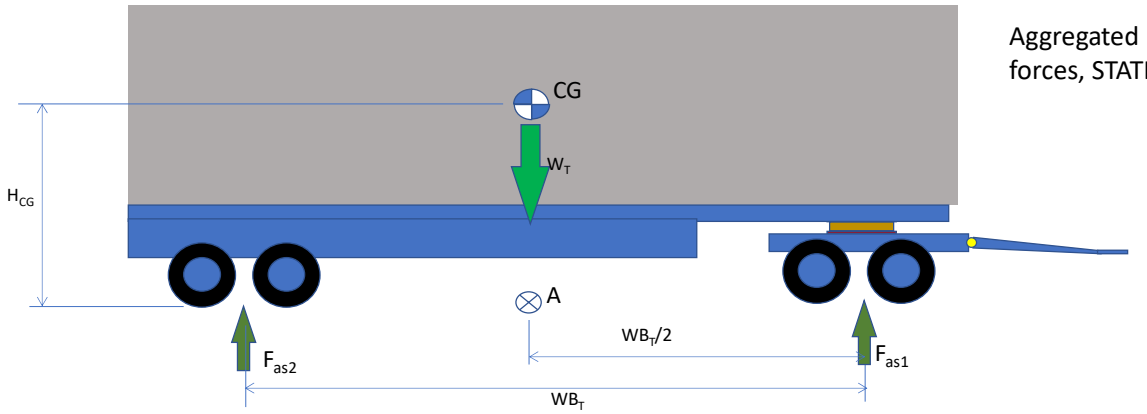
Load transfer with a braking full trailer

Detailed forces



An overall detailing of the forces of a full trailer.

Load transfer with a braking full trailer

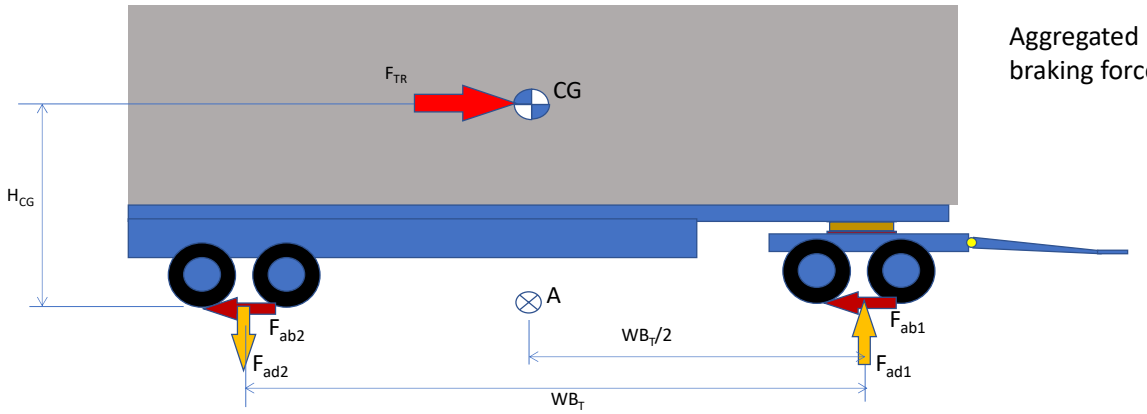


Aggregated forces, STATIC

$F_{as1} = F_{as2} = W_T/2$

This is just an illustration of the static load distribution.

Load transfer with a braking full trailer



Moment equation around point A:

$W_T = g*M_T$; $F_{TR}=r*M_T=F_{ab1}+F_{ab2}$; $F_{TR}*H_{CG}=F_{ad1}*WB_T/2+ F_{ad2}*WB_T/2$ $F_{ad}= F_{ad1}= F_{ad2}$

$F_{ad}= F_{TR}*H_{CG}/ WB_T$ With retardation r= 0,6*g; M_T=20 tonnes; WB_T= 8 m; H_{CG}= 2 m

F_{ad}= 30kN This represents a load transfer of 30kN

This slide just reflects the load transfer forces in a braking.