CICA – Vic / Tas Branch
Crane Safety Bulletin
241
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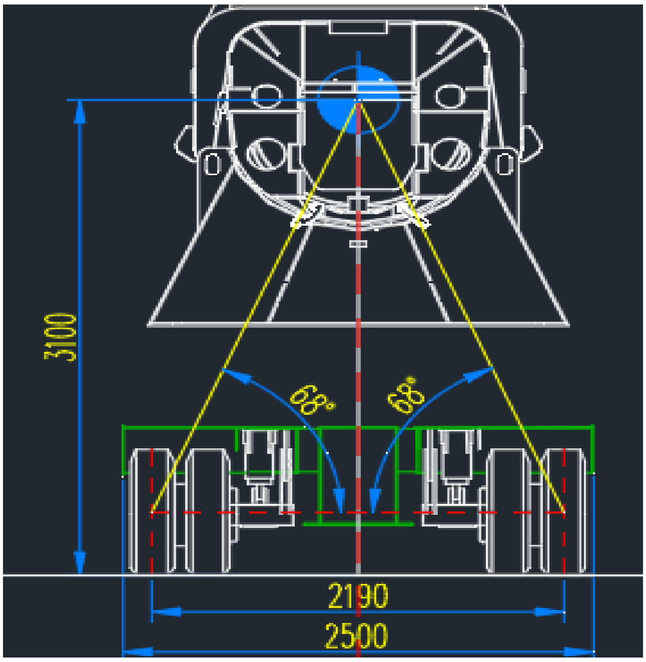
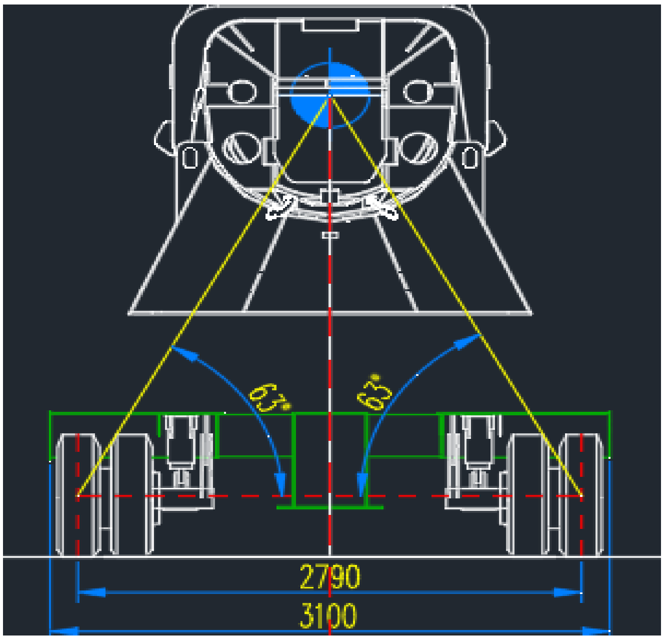
Greetings all. Today's topic continues the discussion about Load Stability.

Referring to a boom mounted on a float we see from the following rear elevation, the height of the COG in relation to the 2.5m legal float width configuration.



Crane booms can weigh up to 20t and the COG is 3.1 meters above the road. The triangle of stability is drawn off the centreline of the outside tyre in this case and I'm ignoring tyre deflection. In theory the stationary float will tip at around 19deg of tilt. If the float is widened to 3.1m then the stationary angle required to tip the float is much larger at 27deg. (I'm ignoring the float mass for simplicity)



The other main factor at play here is the lateral force acting on the 20t boom as the float travels around a corner. This Centrifugal force is defined by the equation:

$F_{centrifugal}$ = mass x velocity^2 / radius

If we take a 300m radius turn and a speed of 80kph (22.2ms^{-1}) we get

$F_{centrifugal}$ = 20,000 x 22.2^2 / 300 = 32.86kN

Lowering the speed to 60kph (16.67ms^{-1})

$F_{centrifugal}$ = 20,000 x 16.67^2 / 300 = 18.53kN

As velocity is squared in the equation, reducing the speed by only 25% has resulted in a 44% reduction in centrifugal force acting on our boom.

Looking back at our float, the 80kph 32.86kN tipping force must act perpendicular to the 68degree line of our narrow trailer. So the real tipping force is actually

$F_{tipping}$ = Cos(90-68) x 32.86 = **30.46kN.**

BUT if we have used the wider float and 63 degree triangle then we have a lower tipping force again.

$F_{tipping}$ = Cos(90-63) x 32.86 = **29.28kN.**

The wider base float not only reduces the effective tipping force but also increases the stabilising moment of the boom mass itself.

Looking at the initial width of 1885mm, the Stabilising moment is boom_mass x gravity x radius.

Stabilising moment = 20,000 x 9.81 x (2.190/2) = 214.8kNm

With our 27% wider trailer the Stabilising moment also increases proportionately to

20,000 x 9.81 x (2.790/2) = 273.7kNm.

Note the Float Mass and it's COG are ignored here as it is constant between the two configurations and not the focus. The key takeaway here is that while widening your float makes a big difference to stability, speed reduction does a lot more when you take lateral forces into account. It is crucial for all road users including heavy vehicles, to pay attention to advisory speed signs and slow down even more if the road is uneven or the visibility is bad. This bulletin aims to explain the physics behind the points made above but does suggest any changes to our heavy haulage laws, regulations or road access.

Stay Safe -CICA