CICA – Vic / Tas Branch
Crane Safety Bulletin
#288 June 2021

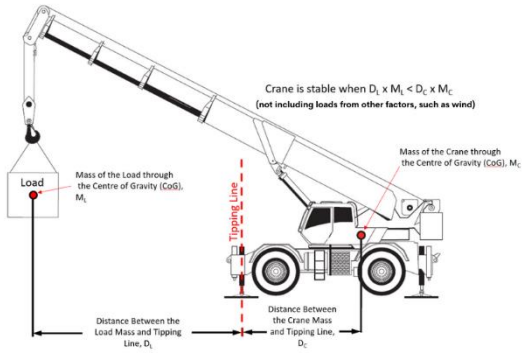
Greetings all. Today's Bulletin is about tipping lines.

Most cranes are built based on the design principle of balance beam. The beam, balanced on a fulcrum, remains in balance when the leverage on one side of the fulcrum is equal to the leverage on the other side of the fulcrum. Crane operators are not required to calculate the leverage for a lift, however, the theory that formed the basis of crane operation needs to be understood.

Two recent crane incidents around the country were due to stability limitations.

A seesaw model is similar to a basic crane model, the counterweight is like the child on one side of the seesaw, and the load is like the child on the other side of the seesaw. Balance will be achieved when the heavier child sits close to the fulcrum point and the lighter child sits far away from the fulcrum point. If the lighter child keeps moving further away from the fulcrum point, the heavier child will be in trouble. Similarly, this same principle is why cranes overturn.

In crane terms, the fulcrum is also called the tipping line.



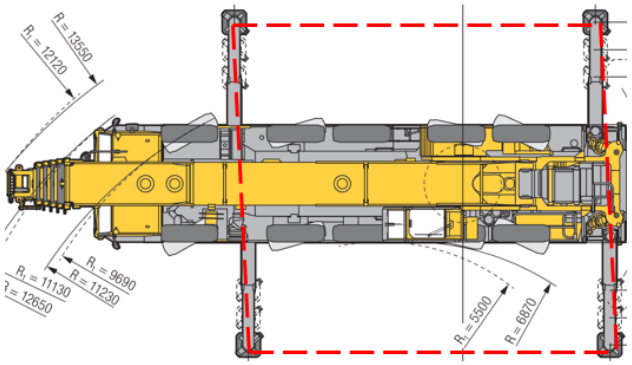
At point of balance:

ML (Load) x DL = Mc (Crane Weight) x Dc

The crane is likely to tip when:

ML (Load) x DL ≥ Mc (Crane Weight) x Dc

On mobile cranes, outriggers provide additional stability by extending the tipping lines from the tyres. The weight of structural and mechanical parts within the tipping line boundary act as a counterweight. The tipping line of a crane with outriggers is determined by the nearest outrigger or outriggers to the load / counterweight.



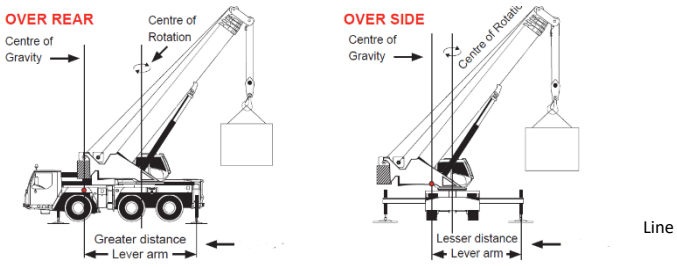
Tipping Lines

The picture below, shows the changing of distances between the centre of gravity and the tipping line as a crane is slewed from over rear to over side.

The stability factor often changes as a crane is slewed.

Structural strength factors are also affected because of greater leverage on outrigger beams etc.

These are the reasons why many crane manufacturers show different operating area capacities on rating charts, for example, over rear, over side, or 360° (full circle).



Line

For crawler cranes or mobile cranes operating on rubber, the tipping line is the crawler tracks or tyres nearest to the load.

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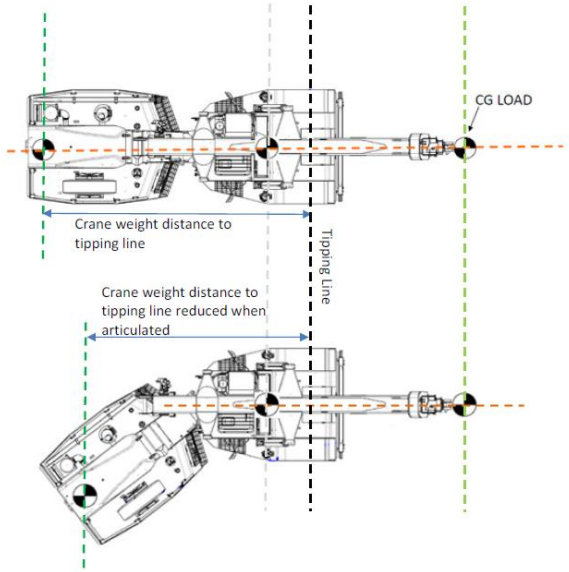

Accidents can happen if one lifts beyond the rated capacity of the crane - as this either forces the crane to go outside its ability to resist tipping or places the crane in a potential structure failure.

People often make the mistake of thinking the crane can lift more than stated on the rated capacity chart because of the safety margins required in the design standards.

This is absolutely incorrect, it would be unsafe to operate a crane where the load's leverage was equal to the crane's leverage, because any slight change on the load side can make the crane unstable. The safety margins are in place to allow for the variables of operation, they are not a reserve saved for recklessness.

Unless in a designed lift (*means extraordinary and temporary lifting operations requiring an assessment of the design of the crane, which may require a temporary re-classification or re-rating or a change in the intended use of the crane*), **DO NOT OPERATE THE CRANE BEYOND THE RATED CAPACITY CHART.**

Stay Safe - CICA