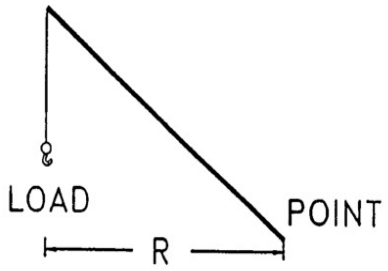
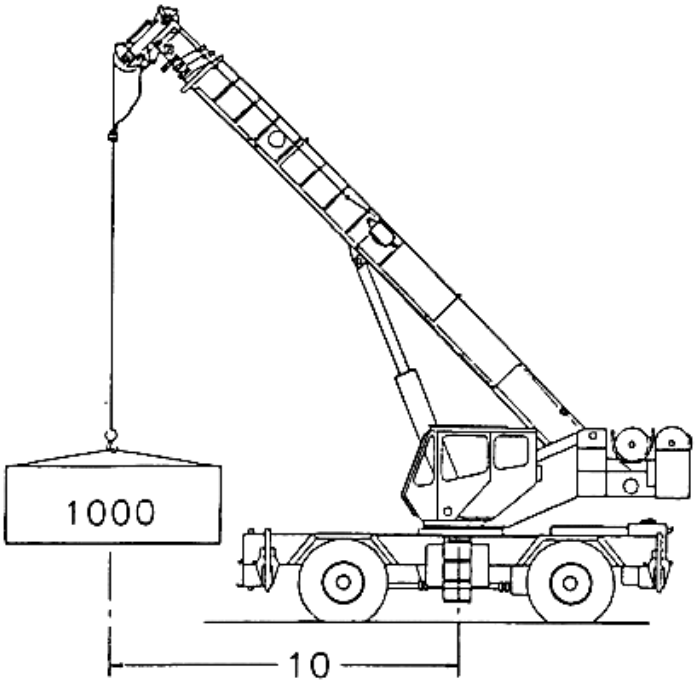
LOAD MOMENT

Safe Load Indicating Systems for mobile cranes have been in existence for over 50 years. Over the past 20 years as technology has progressed, devices capable of measuring load moment have become very widely used on many types of cranes on a worldwide basis. Despite this prevalence there exists a number of misconceptions about what load moment is and its importance for monitoring the capacity of cranes.

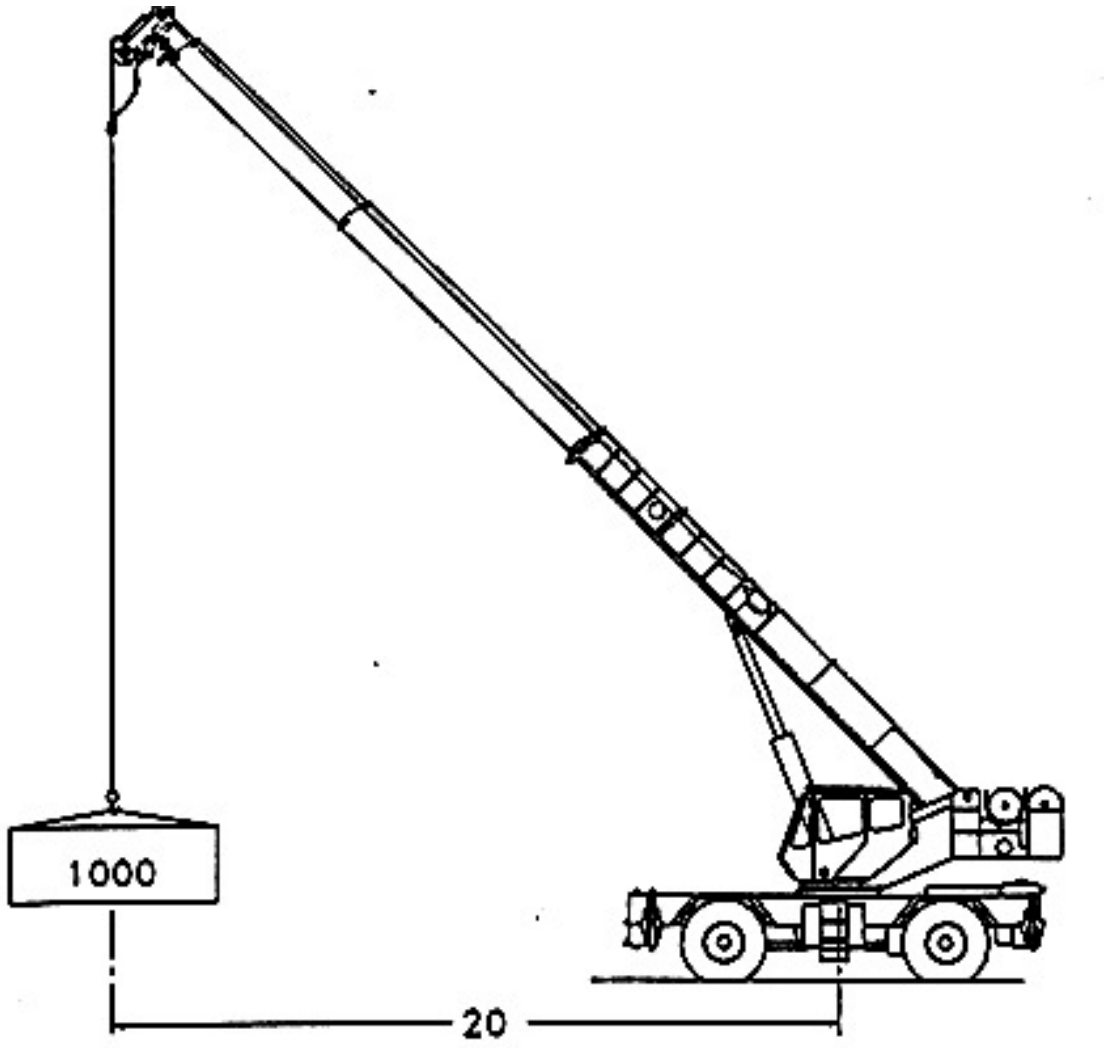
The term load moment is an engineering term which refers to the product of a force and its moment arm. The moment arm is defined as a perpendicular distance between the force vector and a reference point as shown below.



In the case of cranes, the force acts vertically through the center of gravity of the load and the moment arm becomes the horizontal distance from this center of gravity of the load and the center of rotation of the crane. Therefore, with a one thousand unit force acting at a ten unit radius the load moment is the product of these two factors or ten thousand units as shown below.



If we increase the radius such that this load acts upon a twenty unit radius, the load moment has increased to twenty thousand units



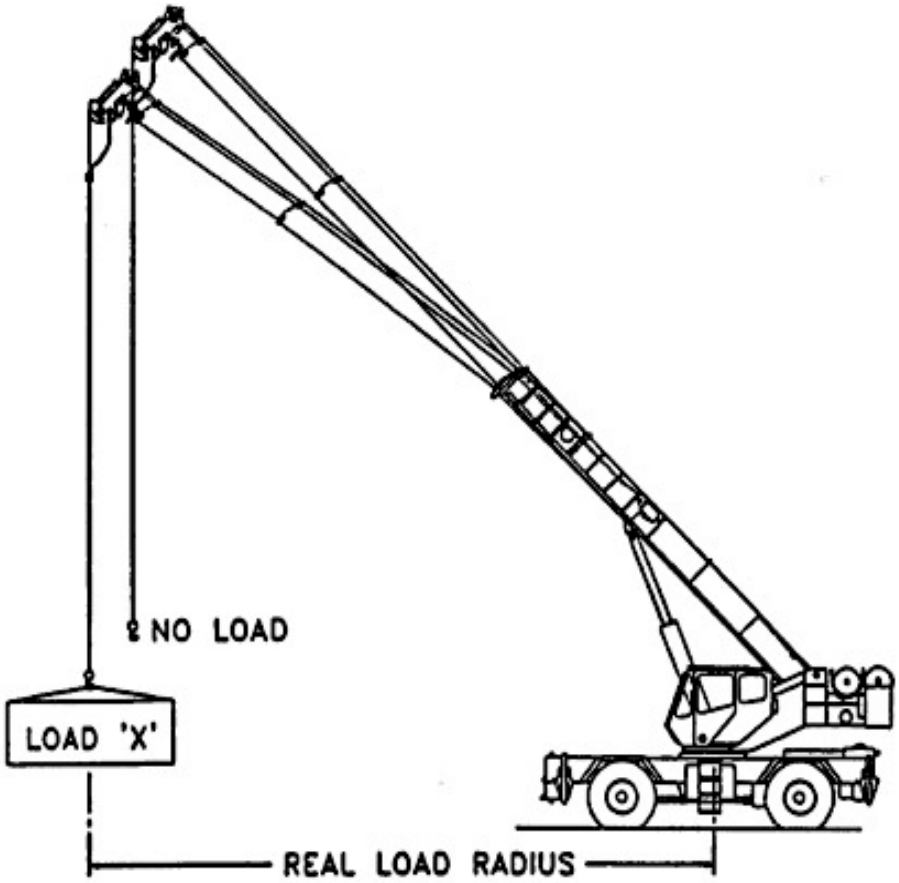
In this example the load on the load line has remained the same but the load on the crane, the load moment, has actually increased by a factor of two. Because load moment is used to determine the capacity of a crane, crane load charts require the operator to determine not only the magnitude of the load but the radius that the load is acting upon. Since load moment is a product of these two each value becomes equally important.

In the past crane operators often relied on "feel" to determine when the crane was reaching capacity. By working from "the seat of his pants" the operator felt the load on the outriggers lighten and knew he was reaching the stability limits of his machine. He was in effect using the stability of the machine to indicate load moment. In the past the cranes were very heavily constructed with the

consequence that the structural capacity far exceeded the stability limits of the machine. Now the emphasis is on reach and roadability and the manufacturers have utilized higher yield steels to create the stronger and lighter cranes. This has had two effects.

1. The structurally limited portion of the loadcharts has increased. This is the first portion of the loadchart where a structural failure can occur before the stability limits are , '- ' reached. In some cases this can encompass the entire chart for the main boom. A failure in this area can be sudden and with little or no warning.

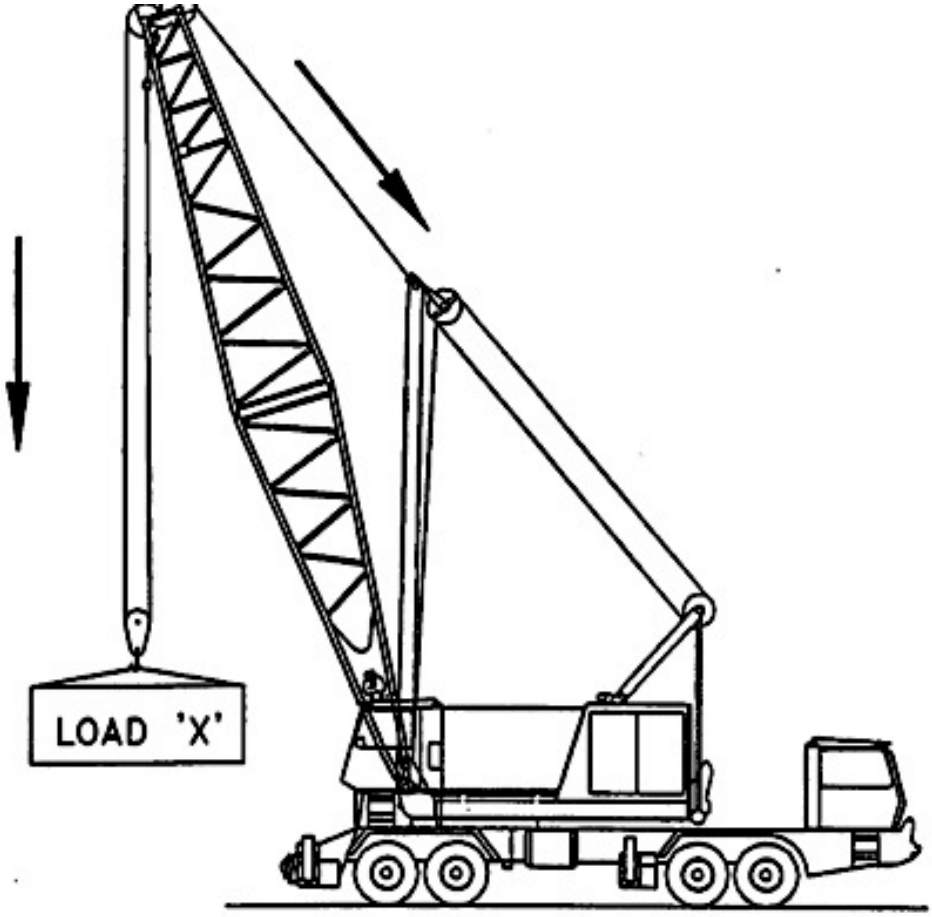
2. The second effect is that by utilizing lighter booms with more elastic steels boom deflection has increased dramatically. This is extremely important because as the boom deflects under an actual load it increases the load radius.



This increases the load moment proportionately. An increase in radius of 15% has increased the load on the crane by 15%. It is extremely important that the operator be aware of these dynamic changes effecting the crane.

In a job site situation the operator may not know the true magnitude of the load. It may have been frozen to the ground or may have taken on water. Once determined this is only half the equation. Just as importantly, he does know the

final load radius. It is impractical to physically measure this new load radius because the true load radius is not achieved until the pick is already made. Therefore, it is imperative that the operator not only be aware of the load on hook but also of his true load radius, dynamically, as he increases the load on the boom. This is the distinct advantage of a load moment system. A load moment system, by monitoring load moment and by compensating for the true deflection under load can give an operator an indication of exactly where he is on the loadchart of the machine. If only the hook block load is monitored the true load on the boom and its effects on radius are not considered. Conventional Lattice Boom Cranes work under a different principle which results in reducing the impact of deflection.



As shown above the pendant ropes supporting the boom tip create an offsetting force with the resulting load aligned in the plans of the boom. The boom in a conventional cane therefore is in compression behaving more as a column. Generally, total deflection has much less impact upon radius than it does with telescopic cranes. There are still however, great advantages to a load moment system on a conventional crane. By monitoring the forces in the boom hoist structure, the system can monitor the load on hook, the boom weight, and any

dynamic forces on the boom. In the case of large conventional machines additional forces such as icing, wind, load dynamics, etc. can have a significant impact on capacity.

Load moment systems, as with most crane indicating systems, are considered operators aids. The intent is always to provide the operator with as much relevant information as possible to enable hirn/her to perform their duties in the most safe and efficient manner possible. Ultimately, however, it is the operator that makes the difference. A well trained and experienced operator utilizing well maintained equipment with state of the art operator aids is the best assurance that the lift operations will be conducted safely and efficiently.