

Understanding causes of rollover crashes

Each year in Australia hundreds of trucks rollover causing significant loss of life and injuries, damage to vehicles, property and goods. Truck rollovers occur with all types of trucks but are more common with trucks carrying timber, livestock, and bulk liquids. More recently there has been an increasing number of emergency services vehicles involved in rollover crashes.

There is no single solution to prevent rollover crashes. However, by understanding the causes, and creating a code of behaviour, the freight industry can help significantly reduce the number of rollover crashes.

Rollover crash causes

A major study of 239 truck rollover crashes in the USA revealed that the following factors contributed to the crashes:

- almost half resulted from inappropriate speed when changing direction, that is, on corners, curves, and, on and off ramps
- the type of load being carried
- the condition of the brakes
- driver distraction, i.e. inattention, dozing or falling asleep.

Rollover crashes can involve many factors such as vehicle speed, load, the type of vehicle and its condition, weather, location, and the driver.

To understand how rollover crashes occur, we need to understand the factors involved in rollover crashes, which are speed, centre of gravity, braking and centrifugal force.

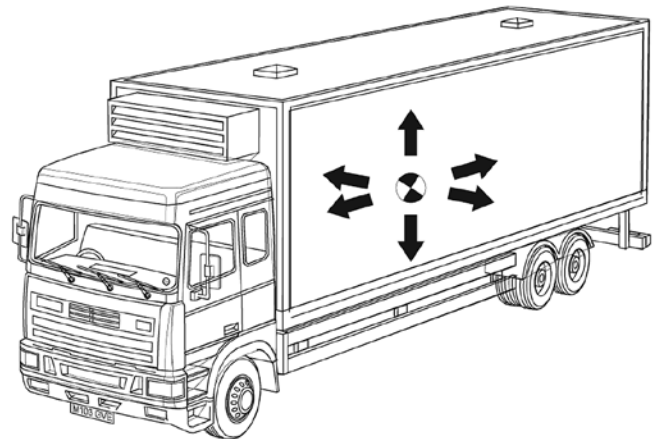
Speed

The effect of speed on cornering stability, braking distance and impact forces are all made worse by increased speed. Cornering forces don't just double when the vehicle speed doubles, they increase by four times.

Centre of gravity

Everything is affected by gravity and therefore has a centre of gravity: the point around which the object is balanced in all directions. Trailers with a high centre of gravity can rollover on an incline of as little as fifteen degrees, while the prime mover which, has a lower centre of gravity, will only rollover if the incline is more than sixty degrees.

The higher the centre of gravity, the more unstable the truck; the lower the centre of gravity, the more stable the truck.



Truck showing all forces balanced at a point called centre of gravity (CoG).

A vehicle also requires the load to be centred. If the weight of the load is not centred across its width, stability will be reduced when cornering. If a load is not properly distributed along the length of the trailer, that is, if there is more weight on some wheels than others, then each wheel will not brake with the same force. This can cause wheel lockup.

Braking

The faster a vehicle travels, the longer it takes to stop. For example, if a truck's speed is doubled, it will take four times longer to stop.

Centrifugal force (overturning or side force)

Centrifugal force is the force that makes objects slide across the seat when a vehicle corners at high speed. It happens when a moving object, such as a vehicle, changes direction.

Changing direction causes a force pushing the vehicle away from the centre of the turn which can lead to a rollover. The tighter the turn, the greater the force will be to push the truck over. The same applies for the speed of travel to negotiate the turn.

Together, both speed and tightness of the turn will increase the risk of rollover. If a truck travels around a corner at 30km/h certain forces will apply. If the truck travels the same corner at 60km/h these forces increase by four times.

UNDERSTANDING CAUSES OF ROLLOVER CRASHES

Centrifugal force also applies in a straight line. At highway speed, a small correction applied to the steering, or a rapid change in direction, such as a swerve, can easily cause a rollover crash.

Every time speed is doubled, the rollover force increases by four times, and every small change in direction can double the rollover force again. This means that at 100km/h in a straight line, a small correction can increase the rollover force by four times, compared to the same manoeuvre at 50km/h.

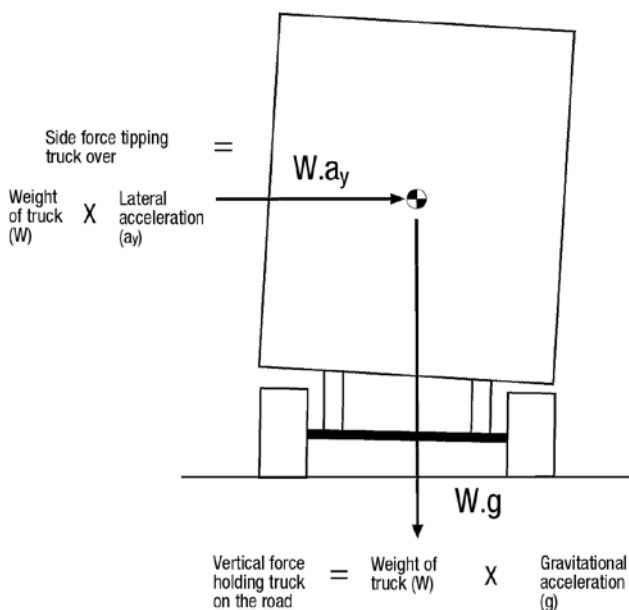
Stability

Of the factors that can influence a vehicle's tendency to roll over, the following are the most important:

- speed
- turning angle
- centre of gravity height
- track width
- suspension
- tyres.

Static roll threshold

The **static roll threshold** (SRT) of a vehicle is a guide to the risk of a vehicle rolling over. A vehicle with a low SRT value is more likely to roll over than one with a higher SRT value. The SRT values are calculated from the position of the centre of gravity.



Static rollover threshold (SRT) forces on a truck being tested.

For further information please phone 13 11 71 or visit vicroads.vic.gov.au

This is a static test and dynamic forces still will affect the vehicle as it travels. There are a number of dynamic systems such as electronic stability control and rollover prevention system that will reduce the risk of a rollover crash.

The challenge for drivers

A driver often has a difficult task in coping with varying sized weights and loads, causing changes in the centre of gravity.

In some cases, such as when carrying containers, a driver can't even see what is being carried in the container, or how it is loaded.

To reduce the risk of a rollover crash, a driver needs to:

- understand vehicle dynamics and what can cause a rollover
- use the correct driving techniques to manage the forces at work
- ensure the vehicle speed is appropriate for driving conditions
- consider the effects of road conditions on different loads
- through this program become familiar with the effects of speed, weight and cornering dynamics.

The challenge for owner drivers, transport operators, consignors and receivers

Transport operators and others should ensure systems are in place to:

- ensure the vehicle is correctly loaded and the load is safely restrained
- use appropriate vehicles and or trailers for the task
- plan trips to reduce the risk by assessing routes
- educate drivers and others about rollover crashes and measures to avoid them.

This information sheet is part of the *Heavy Vehicle Rollover Prevention Program* available at vicroads.vic.gov.au