ISSN 1081-4140

SAFETY BULLETIN

October 1997 Volume 6, No. 1

Triodyne Inc.
Consulting Engineers & Scientists – Safety Philosophy & Technology
5950 West Touhy Avenue Niles, IL 60714-4610 (847) 677-4730
FAX: (847) 647-2047
e-mail: infoserv@triodyne.com

VEHICLE SAFETY

Truck Rollover

by Michael A. Dilich[1] and John M. Goebelbecker [2]

ABSTRACT

The ability of a heavy truck to successfully negotiate a curve depends upon the vehicle's speed, its loaded stability and the geometry of the curve. When a rollover occurs, evaluation of factors related to the driver, the vehicle, and the roadway is required.

THE PHYSICS OF ROLLOVER

When a truck travels in a curved path, it leans to the outside of the curve (See Fig. 1). This leaning is caused by the centrifugal force acting through the truck's center of gravity. The truck will roll over away from the center of the curve if the centrifugal force is sufficiently large. The centrifugal force increases with speed and with the curvature of the road.

The measure of a truck's ability to resist rollover is given by its *rollover threshold*. The rollover threshold is the lowest value of centrifugal acceleration which causes the truck to tip over when driven steadily in a curved path. One survey of test data found the rollover thresholds of heavy trucks in the 0.25 to 0.5 g range. Trucks with lower payloads (lower centers of gravity) and stiffer suspensions have higher rollover thresholds and are more difficult to roll over in a curve.

When the rollover threshold becomes sufficiently large, the vehicle will have a tendency to slide out of a curve rather than roll over. For example, automobiles have this tendency because of their low centers of gravity.

[1] Principal Mechanical Engineer, Triodyne Inc., Niles, IL.

[2] Project Engineer, Triodyne inc., Niles, IL.

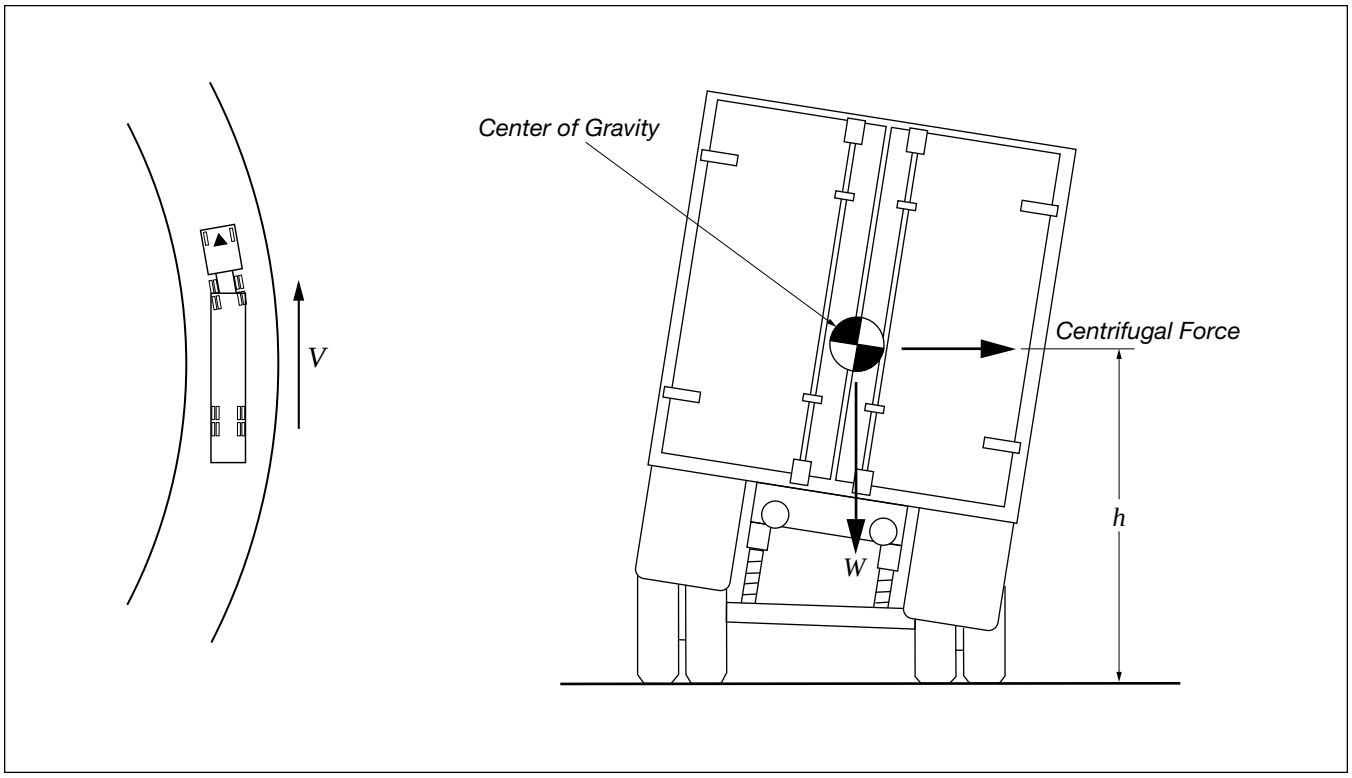

Fig. 1

DISCUSSION

Truck rollovers typically occur at exit and entrance ramps of expressways when a driver misjudges the sharpness of a ramp curve and enters it at an excessive speed. Drivers of semi's who have survived rollover accidents indicate that they did not perceive they were rolling until they looked in their side view mirrors and saw the trailer wheels on the inside of the curve lift off the ground. Then, suddenly, the tractor tipped. The delayed rolling of the tractor is due to the higher center of gravity of the trailer and the flexibility of the trailer structure which allows the trailer to twist and begin rolling while the tractor wheels maintain contact with the road.

Rollover accident victims also often recall sensing that their load shifted and believe the load shift caused their accident. However, the load will always shift due to the extreme tilting of the trailer that occurs during the rollover event itself. Load shifting during a rollover accident is typically a result and not the cause of the accident.

When a rollover accident occurs, a number of factors related to the vehicle, the driver and/or the highway must be investigated before the cause(s) of the accident can be determined.

The following list of possible contributing factors was developed as an aid to the investigation of such accidents.

POSSIBLE CONTRIBUTING FACTORS

Driver Factors to Consider:

- ☐ Entered curve at excessive speed.
- ☐ Not aware of tractor/trailer limitations.
- ☐ Did not anticipate sharpness of curve.
- ☐ Steered truck onto soft shoulder.
- ☐ Drifted off road and abruptly countersteered.
- ☐ Did not comply with speed advisory.
- ☐ Accelerated through curve.
- ☐ Inexperienced transporting high center of gravity loads.
- ☐ Steered abruptly, perhaps during avoidance maneuvers.
- ☐ Was impaired by fatigue, drowsiness, alcohol, drugs, poor eyesight, etc.
- ☐ Was reckless, angry, emotional, or otherwise upset.

Vehicle Factors to Consider:

- ☐ Unusually top heavy load.
- ☐ Collapsed suspension.
- ☐ Under-inflated tires.
- ☐ Poor brake performance prior to entering curve.
- ☐ Cargo distribution.
- ☐ Load shift.

Highway Factors to Consider:

- ☐ Speed advisory for curve.
- ☐ Superelevation (banking).
- ☐ Transition curvature.
- ☐ Shoulder condition.