A Breakthrough in Large Truck Driver Performance Assessment

Garth R Lawrence
Managing Director
RoadAware Safety Systems
glawrence@road-aware.com

Brian L Bullock
Principal
RoadAware Safety Systems
bbullock@road-aware.com

"Preventative technology may be more valuable than reactive technology"

Prevention – the crash that never happened!

Introduction

Most trucking companies do not have the time or resources to conduct in service ride checks with drivers. Instead, they rely on the more common 'reactive' events like hard braking, sharp turns, speeding and traffic tickets to provide an insight into driver's behavior. These events usually lead to disciplinary action to a greater (termination) or lesser (slap on wrist) extent. Monitoring driver behavior in difficult road geometries (called red spots) will lead to better coaching to prevent risky behaviors.

Trucking companies need a rapid and low-cost assessment of driver risk for many reasons.

- to assess and rank each driver by risk,
- to compare and rank driver risk across all drivers,
- to assess drivers more often,
- to determine success of training/coaching events with drivers,
- to aid, assess and improve driver assessment and training programs,
- to help manage high driver turnover,
- for companies doing acquisitions and need to review driver behaviors and risks during new driver onboarding process.

Identifying driver risk behavior over an entire workday then devising a corrective action specific to those risks is a daunting task. Assessing speed based on posted speed limits is problematic as truck tip over limits on curves or stopping limits on slopes may be much lower than the posted or advisory speed limits. However, the ability to collect high resolution GPS data in the cab of a semi-truck and calculate a recommended safe speed based on truck configuration, vehicle dynamics, road configuration and engineering calculations opens a new, detailed look at driver risk behavior at critical points in a driver's day. Safety Manager coaching can be specific to road geometry and include actual driver speed charts through calculated 'Red Spot' road segments. The driver not only sees their profile through the road segment, but they can also directly compare it the calculated tip over speed on curves or stopping speed on a slope. This Virtual Ride Along approach and the improved driver coaching it provides can reduce risky behavior in

both new drivers (or new to the company) and with experienced drivers who become complacent allowing speeds to creep up which then become risky habits.

Background

National data confirms that truck driver behavior is a huge factor in crash risk. Driver behaviors that contribute to crash risk based on national data include:

We Know that:

1. 45% of truck crashes involve excessive speed (NHTSA)
2. 30% of truck crashes occur on curves
3. 20% of total fatalities occur involve rollovers
4. 47% of truck driver deaths occurred in crashes in which their vehicles rolled over

Note on Item 3 : In collisions, the drivers and occupants of passenger vehicles are most likely to die. The truck driver will survive 80% of the time.
Note on Item 4: If the truck rolls over the driver has a 50/50 chance of surviving.

These statistics confirm that slopes and curves are a significant hazard to truck drivers who do not approach these road segments with due care and consideration. Monitoring driver performance in these road segments allows company safety managers to flag risky drivers and provide directed coaching to prevent crashes.

The Virtual Ride Along Background

A 6-month study was conducted to measure and assess driver risk levels based on driver performance through hazardous geometries known as 'Red Spots'. RoadAware Safety Systems extracted curvature and percent slope geometries that met or exceeded RoadAware's geometry criteria. The extracted curvatures and slopes are used to calculate tip over speeds on curves and safe speeds on slopes. Using vehicle dynamics and engineering calculations, power unit and trailer specifications (including trailer and load type, load weight and segment curvature and % slope) tip over speeds on curves, ramps and interchanges and safe descent speeds on slopes were calculated. Safety factors were also applied to the calculations to provide a Recommended Safe Speed (RSS) or a Recommended Safe Descent Speed (RSDS) for each Red Spot. GPS data was recorded once a second on a tablet computer to provide a dense speed profile.

The study involved 12 drivers driving bulk haul semi-trucks. The loads were ore concentrate except for one driver hauling a tanker trailer loaded with acid. The power units coupled with an empty trailer

generally weighed in at about 35,000 pounds. Fully loaded trailers ran with 45,000 pound loads for 80,000 pound total tractor/trailer Gross Vehicle Weight (GVW). All units had 10 brake sets.

A GPS enabled tablet was installed in each truck for a period of 5 to 10 days. GPS point data were uploaded to the cloud via cell phone link. A driver's complete day, from 8 to 14 hours (28.8k to 50.4k GPS points) was usually recorded including both loaded and empty segments. Each driver ran the same fixed route a minimum of 3 times. The selected routes offered a variety of curves including roundabouts, interchanges, ramps and road segment curves and slopes ranging from 3% to nearly 8% covering 3 to 8 mi in length. Road types included Interstate, US Highway, State roads and tertiary roads.

The data was uploaded to the ***Road-Aware*** application dashboard where date, time, location, altitude, speed, and several additional parameters were calculated. The processed data were then downloaded and imported into the dashboard display application before being sorted by Red Spot location. The data in each Red Spot was then sorted by date and time and plotted speed vs time through the Red Spot.

1. The drivers were ranked by comparing speeds through Red Spots vs Recommended Safe Speeds, frequency of braking events, cornering events and number of times posted speed was exceeded.
2. RoadAware was contracted to measure and assess driver risk level based on driver performance in hazardous geometries.

Findings

The key findings from the study are:

1. Detailed measurements of driver performance in the most difficult road segments is an effective method of grading driver risk.
2. Top drivers display consistent driving habits that enable the truck to negotiate difficult geometries with near zero risk of a driver at fault crash.

3. Many drivers are careless in their approach to difficult geometries and are unprepared for unexpected events.
4. Some drivers are much too aggressive which results in a high risk of a driver at fault crash.

Over the study, it was found that many different risky behaviors could be identified and documented. These behaviors could be compared between the runs of a specific driver to look at the driving consistency and between drivers to look at risk differences between drivers. Driver behaviors that can be detected and reported included:

a. Excess speed on descents.
b. Use of service brakes on descents.
c. Excess speed in curves of all types.
d. Speeding in assigned sensitive areas.
e. Failure to slow down for connector ramps.
f. Failure to slow down for exits.

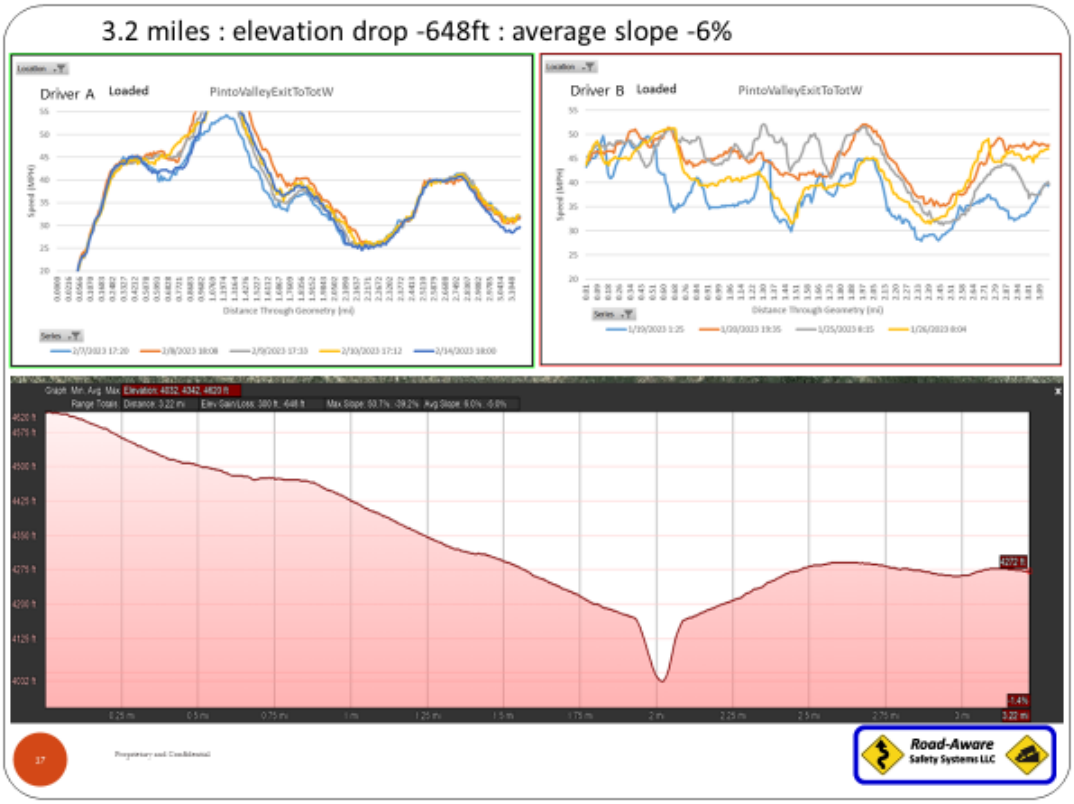
The data showed that the top driver in each terminal matched all the speed criteria for zero risk of loss of control of the truck. In general, drivers accepted the reports and changed their driving behavior to reduce risk.

Some drivers were identified as high risk because the speeds they used in difficult geometries were near the limits of dynamic stability. Some drivers in the high risk category achieved top driver status after they were measured and coached using the Virtual Ride Along approach.

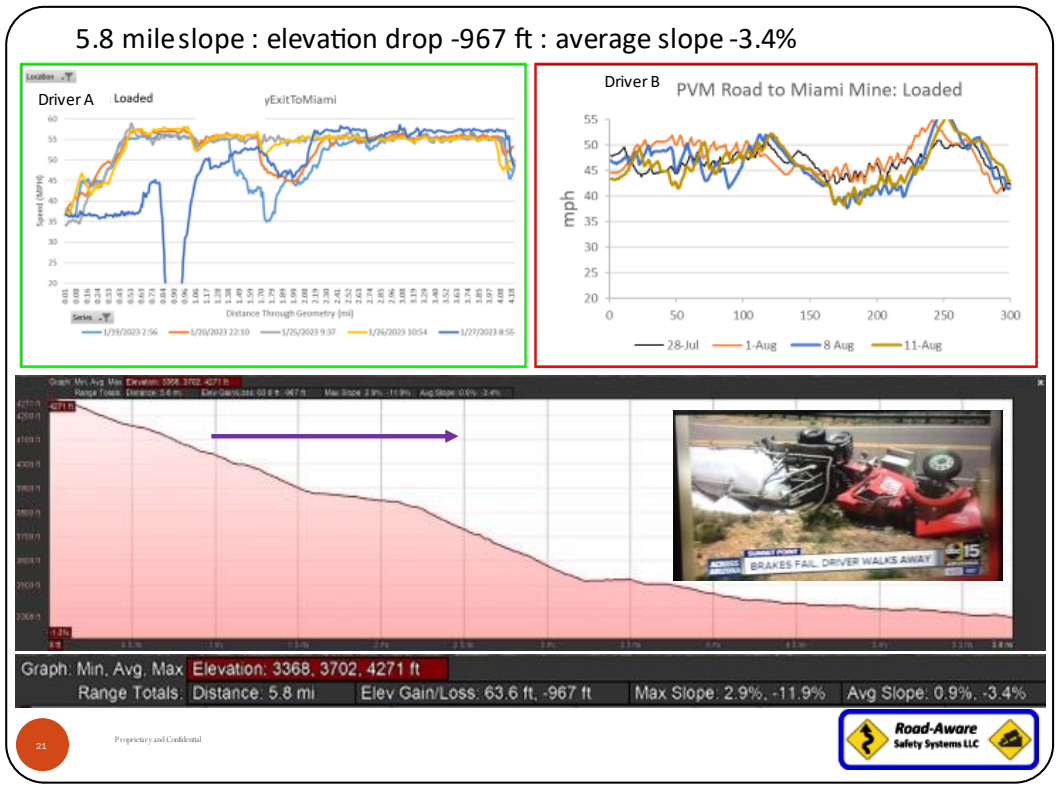
The following examples show a variety of Red Spots traversed by drivers in the study. Driver A is a top ('less risky') driver while Driver B exhibits a 'riskier' behavior through the road segment. Events such as brake snubbing on a downhill, use of automatic transmission and cruise control by the driver and transmission upshifting can be seen in the charts presented.

Excess Speed: on Descents

A 3.5 mile downslope averaging -6% slope. Driver A shows the use of engine braking with an automated transmission to manage this steep descent smoothly and safely. Driver B is seen "freewheeling" down the slope using service brakes to control the descent risking brakes overheating.

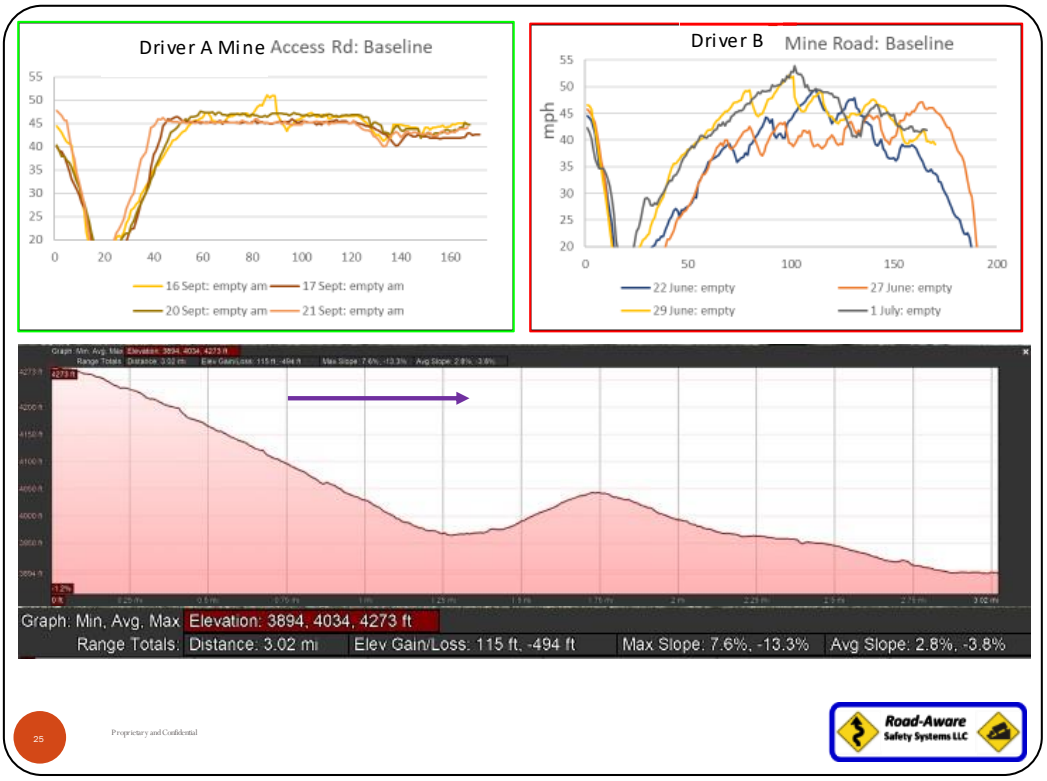


Overuse of Service Brakes on Descents: Loaded



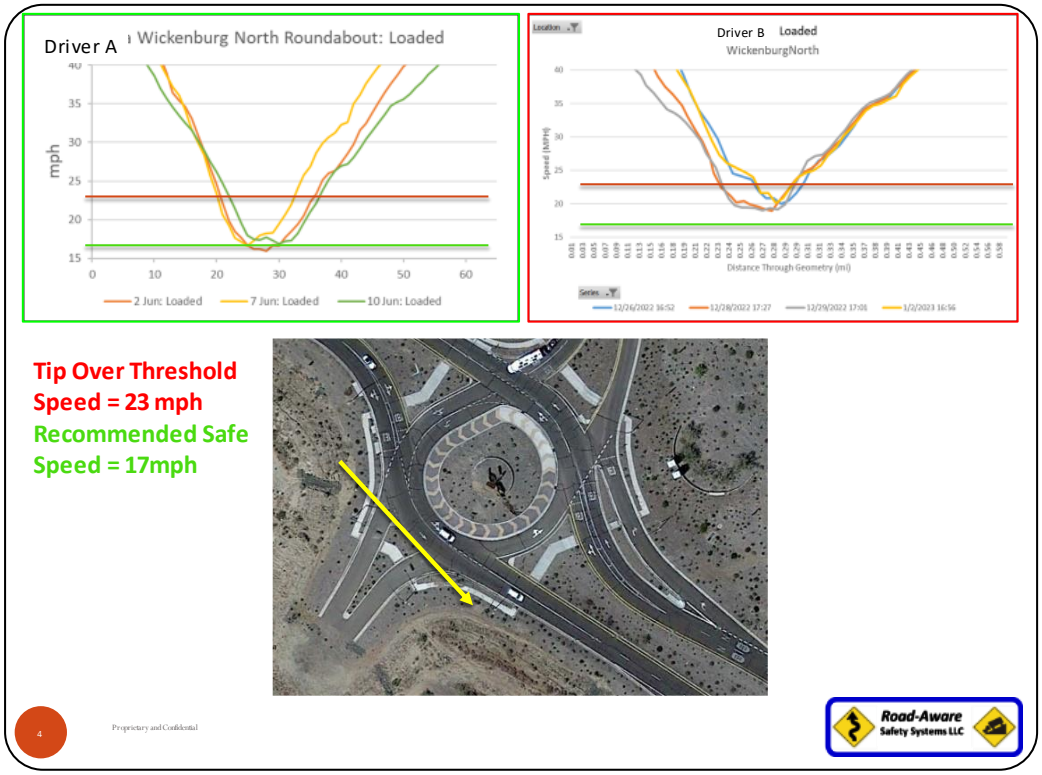
A 5.8 mile downslope averaging -3.4%. Driver A makes a descent using engine braking at 55 mph for a controlled descent. Driver B is seen continually pumping service brakes to control descent speed as seen in the 'saw tooth' pattern. He shows difficult speed control between runs with up to 10 mph difference.

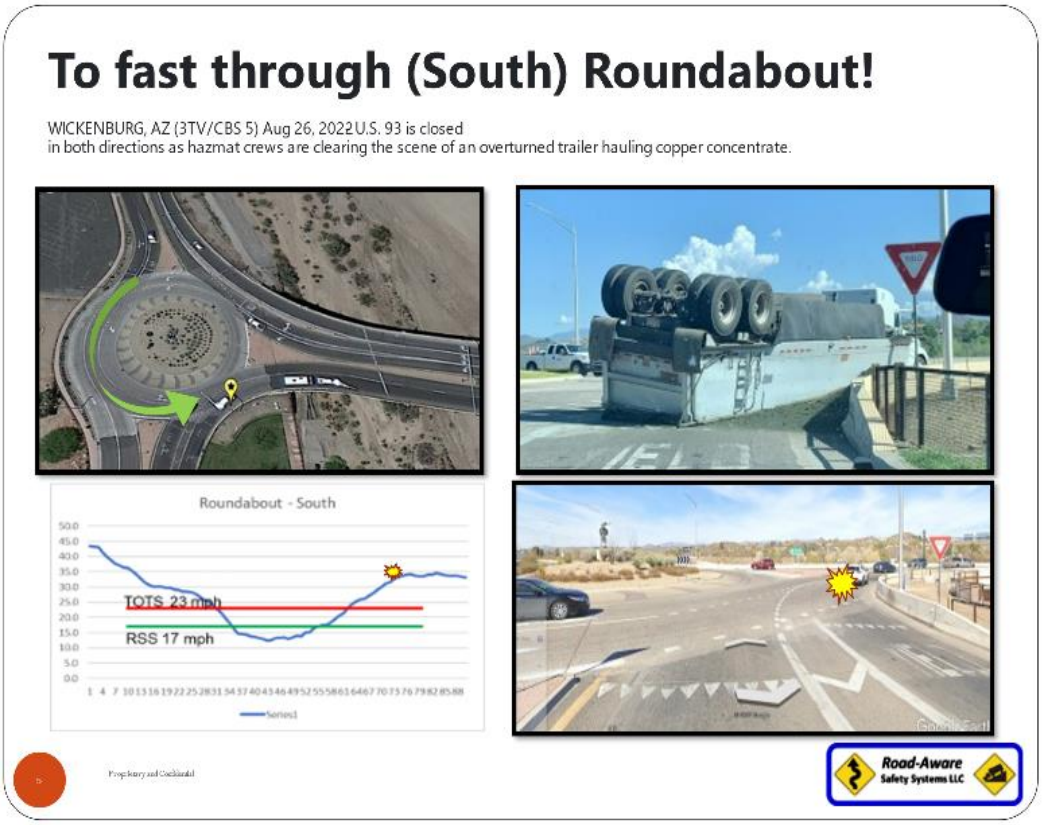
Overuse of Service Brakes on Descents: **Empty**



A 3 mile descent averaging -3.8% slope, empty load. Driver B shows lack of speed control downhill with continuous use of service brakes seen in sawtooth braking pattern. Driver A shows a consistent speed pattern resulting in less risky descent.

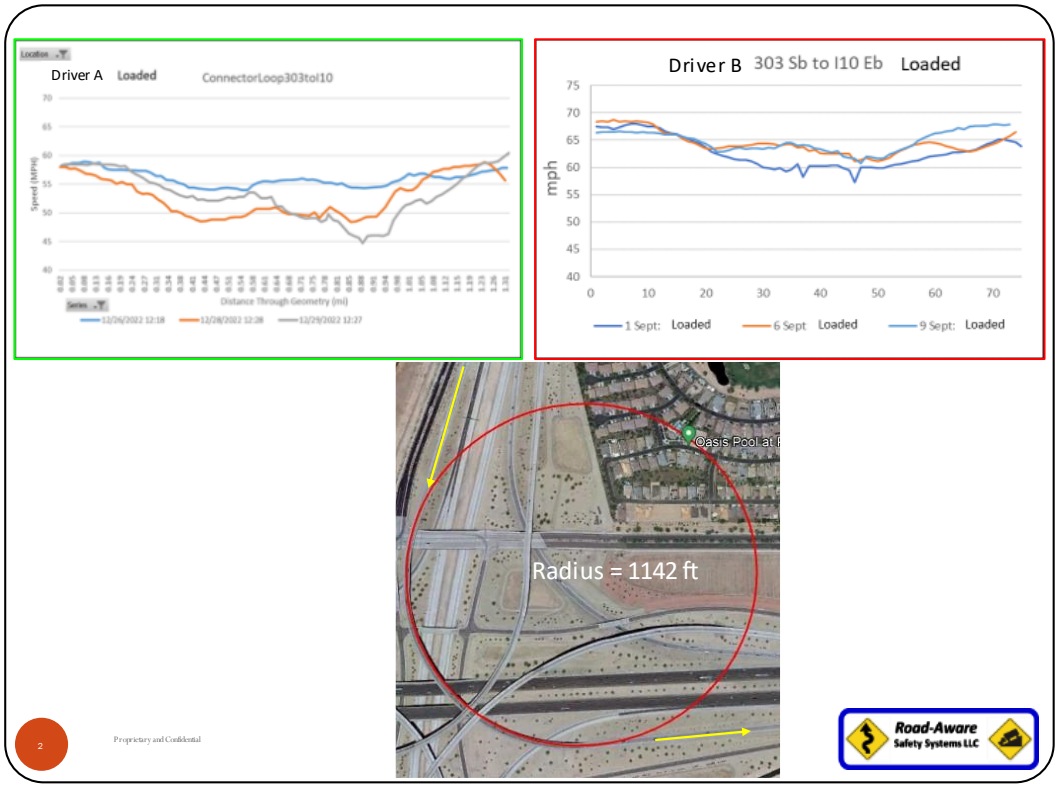
Excess Speed in Curves: at Roundabouts





Drivers often underestimate the tip over forces acting on their trailers as they travers a roundabout. The calculated tip over speed for a dry bulk load through this roundabout is 23 mph with a recommended safe speed of 17 mph. Driver A has a repeatable speed profile through the roundabout, at or below the recommended speed. Driver B has more variable speed profiles showing a faster speed entering the roundabout. On the right or exit side of the speed track the power unit can be seen accelerating with steps in the profile as the transmission shifts gears.

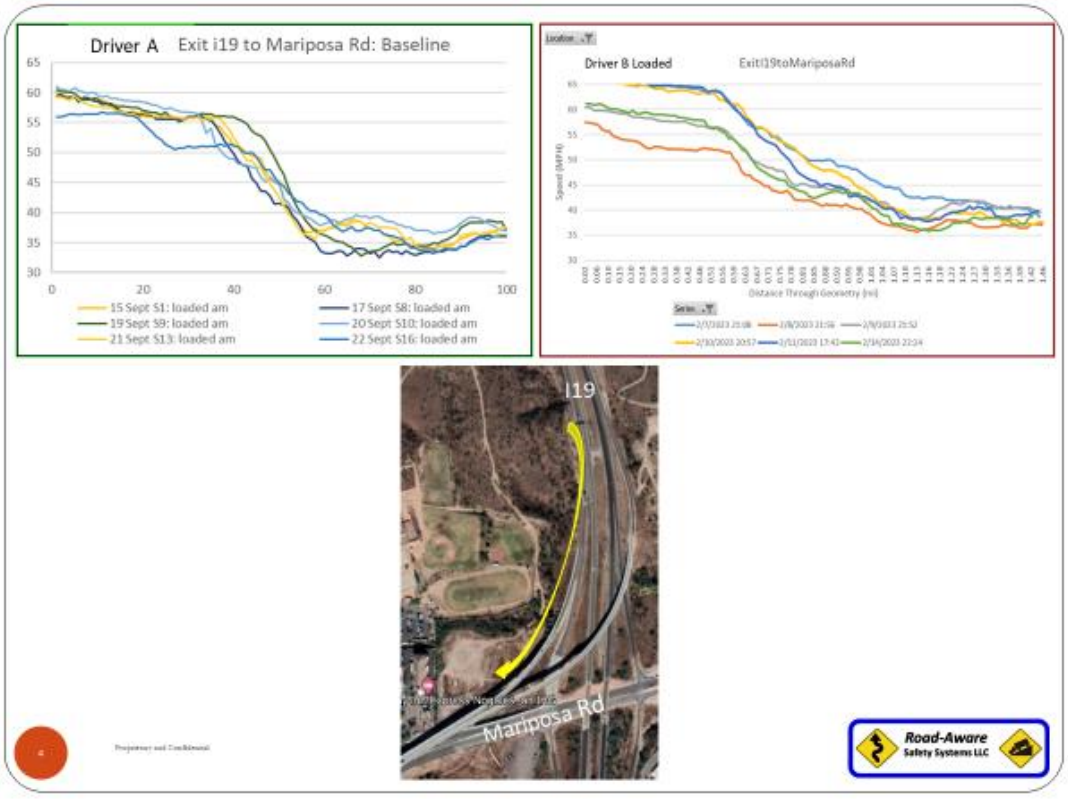
Excess Speed in Curves: At Interchanges



Driver A enters the interchange at under 60 mph and traverses the long curve between 50 and 55 mph. Driver B takes a riskier approach entering the interchange at over 65 mph and staying above 60 mph through the full interchange.

Excess Speed in Curves: at Exit Ramps - Failure to Slow Down Exiting

Exit ramp from Interstate to local road. Driver A exits at 60 mph then controlled braking to merge with local road under 40 mph. Driver B tends to exit at a higher speed then merges with local road at speeds above 40 mph



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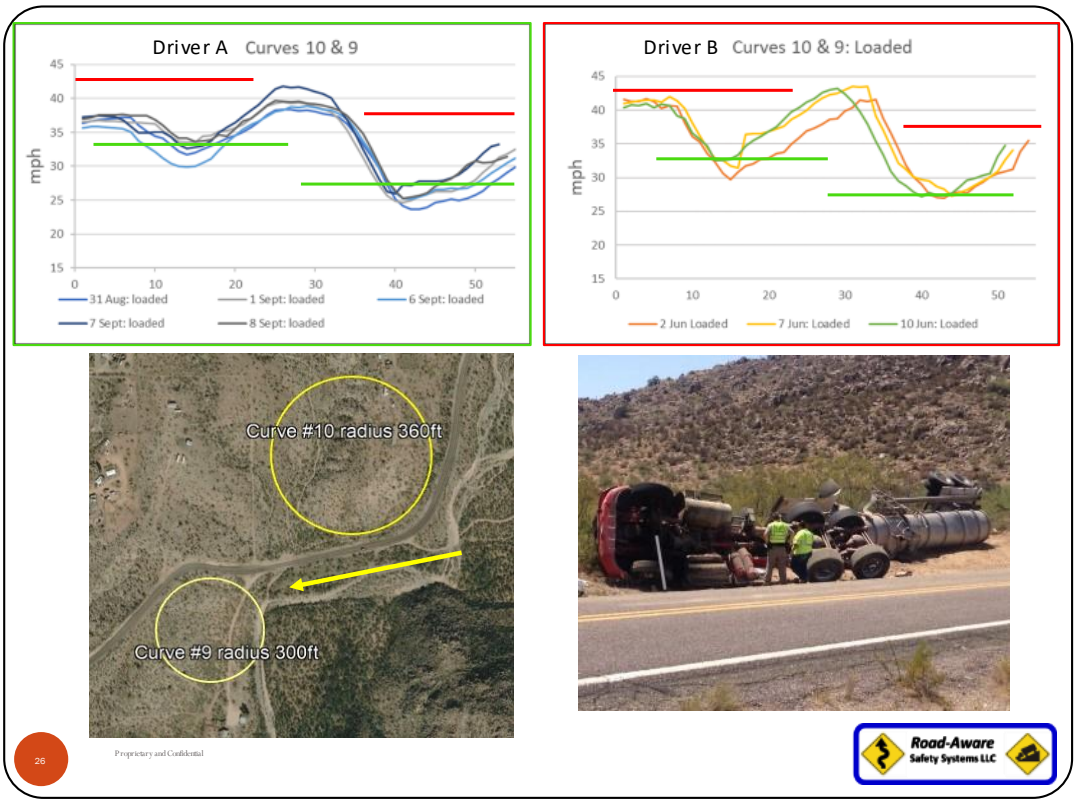
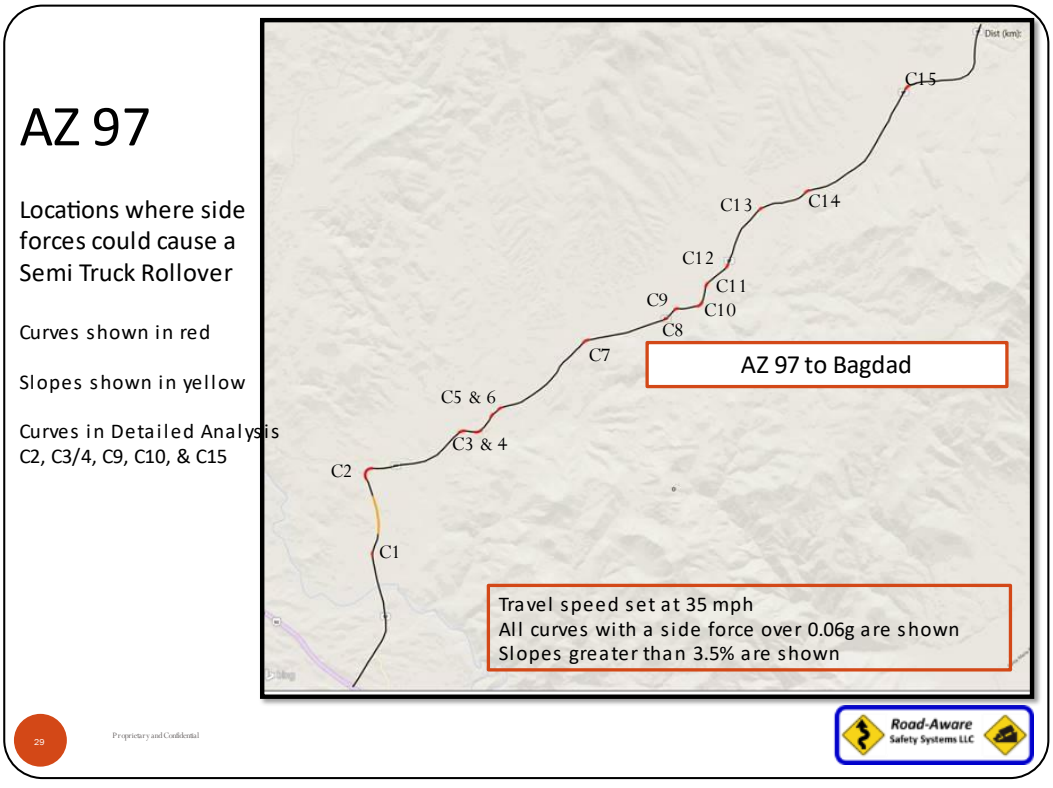
Excess Speed in Curves: at Road Curves

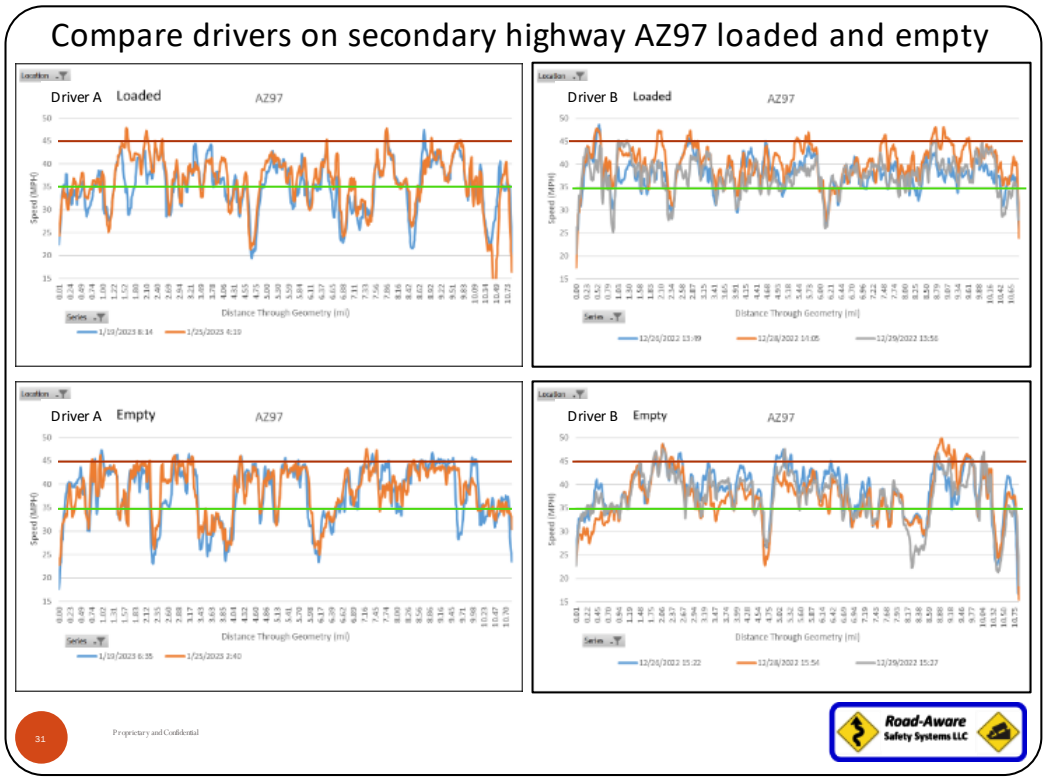


Driver A enters the curve sequence at just over 35 mph, transitions the curves in a smooth controlled fashion staying at or below the recommended safe speed. Driver B takes a riskier approach and enters the curves at over 40 mph then brakes firmly to reach recommended safe speed before acceleration back to above 40 mph. The driver then brakes firmly again to reach the RSS of the next curve then accelerates quickly again.

Driver to Driver Comparison: On 10.9 mile segment of Old, Curvy, Secondary Highway

We can see a different profile between two drivers along this 10.9 mile segment of tertiary highway. Driver A generally takes the curvy road at recommended safe speeds, marginally touching over 45 mph top speed, and taking the many curves at low risk speeds. Driver B is generally driving at higher, riskier speeds, seldom getting below the 35 mph speed line. In addition Drive B has a more 'ragged' profile indicative of accelerating then braking more often that Driver A.





Conclusions

Trucking companies need a rapid and low-cost assessment of driver risk for many reasons. Monitoring driver behavior in all segments of driving, not just certain events, will lead to better coaching to prevent these risky behaviors in the first place. The Virtual Ride Along provides safety managers, company drivers and contracted owner/operator units, a unique view into driver behaviors on difficult road segments. Better data, directed coaching, improved driver response leads to less risky driver behaviors and better management of insurance and maintenance costs.