



C15 Accident Reconstruction of 14-Passenger Catastrophic Rollover and Analysis of How Occupant Restraints Could Have Prevented Five Fatalities and Four Serious/Severe Traumas Including Analysis of Pediatric Restraint Usage

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The purpose of this study was to: 1) demonstrate the accident reconstruction and tire integrity analysis involved in determining the cause of this high speed solo rollover accident, 2) analyze seatbelt use, 3) assess the fatalities and serious/severe traumas that could have been prevented with proper occupant restraint use, and 4) demonstrate a unique approach to visual communication.

This presentation will impact the forensic community and/or humanity by demonstrating how: 1) evidence can be utilized to support findings that differed from other authority, 2) occupant trauma databases were supplemented manually with the effect of proximity to crush, 3) kinematic analysis of 14 occupants was simplified by utilizing a roofless exemplar vehicle and 4) interactive presentation programs maximized flexibility (individual occupants could be illustrated in any sequence or in any level of detail).

History: Fourteen church volunteers, ages 5 – 70, were traveling in a 15-seat passenger van. They were proceeding north on a rural highway, a few minutes before 11 PM, when the rollover occurred. The van was traveling at approximately 78 mph, and, due to some driver impetus, it swerved to the right, initiating a right-side leading skid. This led to a clockwise rollover.

Methods: First, the cause of the accident is determined using the physical evidence revealed during the vehicle and scene inspections. Second, the physical evidence in the vehicle and the trauma sustained by the occupants is utilized to determine which of the 14 passengers were restrained. The interior contents and the trajectories of those objects were considered. Lastly, this information, in conjunction with: 1) crush damage, 2) analysis of trajectories/ejection paths and 3) comparison to databases^{1,2,3,4,5,6,7,8,9,10,11} of occupant exposure, is collectively utilized to assess the trade-off injuries of those nine occupants that were determined to be unrestrained.

Cause of the Accident: Initially, in the case in question, there was consideration that the front left tire was underinflated, causing steering problems. Testing showed that the rollover could explain a loss of pressure in the tire. Measurement of the roll angle versus lateral acceleration on an equally loaded exemplar van followed the equation: roll angle = $91.6(g)^{1.4}$. However, the rollover occurred on a relatively straight section of a four-lane divided freeway that required little or no steering input and had a maximum lateral acceleration of 0.07g for a roll angle of 2.2 degrees. In fact, the driver caused the rollover by making an unsafe turning movement while exceeding the speed limit and being inattentive.

Restraint Usage and BioMedical Engineering Analysis: The van is configured for 15 total persons with 15 occupant restraints. There are driver and passenger captain's chairs, three bench seats, each of which with a three-person restrained capacity, and a last row bench seat with four-person restrained capacity. In this case, the entire last row was being utilized for storage and the front two seats were occupied, thereby leaving four people in each of the three middle rows with only three seatbelts available in each row. The child was positioned sleeping over her grandfather's lap.

The subject vehicle was inspected to determine the amount of crush sustained for each individual's seating position and seatbelt use evidence. The seatbelt evidence reviewed in detail is the occupant's restraint use that differs from the MAIT report and the bases for the differences in opinion.

This analysis revealed that there were three properly belted and at most two improperly belted passengers. Nine of the total fourteen occupants were ejected. Seven people died. Three occupants sustained serious injury.

Next, resultant occupant clearances were determined for each occupant's position. The most severe crush was focused towards the left front side of the vehicle.

The trade-off injury analysis utilized a database of collisions to determine the most likely AIS levels, given the change in velocity of the vehicle. The crush intrusion was greatest on the driver's compartment (who was seat belted properly). Given the severity of the intrusion, the occupant would have perished regardless of seatbelt use. The four people in the row behind the driver were unbelted and also perished, most likely from their ejections from the vehicle. If properly belted and seated correctly, only one of the passengers on that row at most would have likely sustained life threatening injuries from the crush. Two ejected passengers resulting in two fatalities from the middle row of seats would likely have been avoided if the occupants had been properly belted. The rest of the passengers would have sustained minor to moderate injuries if belted properly and seated correctly (i.e., using the last row of seats) because there was little evidence of intrusion and force sustained to the rear occupants. Lastly, the pediatric out-of-position occupant was analyzed.



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Findings:

- the probable causes of the accident are: inattentive driver and exceeding the 65 mph speed limit. There was no evidence of mechanical failure, maintenance or road condition causal factors for the rollover.
- Five fatalities and four serious/severe traumas may have been prevented by choosing to use the seatbelts properly.

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Rollover, Seatbelt Analysis, Ejection