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Scientific Issues in Motor Vehicle Cases

Reconstruction and Crashworthiness

The attorneys who call on accident reconstruction experts range from having absolutely no idea what is going on to ones who can reconstruct the accident themselves. They are not necessarily trained engineers or accident reconstructionists, but they have been dealing with the field long enough to know the critical issues.

—Renfroe et al, *The Role of Expert Witnesses in Accident Reconstruction Cases*

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BASIC CONCEPTS THAT MUST BE UNDERSTOOD

- Delta V
- Acceleration/Deceleration
- Momentum
- Force
- Kinetic Energy
- Induced Damage
- Crush Energy
- Coefficient of Friction
- Skid Marks
- Yaw
- Principal Direction of Force
- Reference Point
- Critical Speed
- Perception/Reaction
- Drag Factor
- Newton Three Laws:
 1. Inertia
 2. Bodies subject to a constant force
 3. Equal and opposite reactions

SCIENTIFIC PROBLEM SOLVING

Herman Gordon

1. Understand the problem
 - What are the data?
 - What are the unknowns?
 - What are the scientific principles that apply?
 - Can the problem be solved?
2. Assumptions
 - What can you or need you assume?
 - What shouldn't you assume?
 - Have you made subconscious assumptions?
3. Devise a plan of attack
 - Have you seen this or a related problem before?
 - Have you seen a similar unknown before?
 - If you can't solve this problem, can you solve a simpler problem or part of the problem?
4. Review
 - Are you sure of the solution? Can you see it at a glance?
 - Did you use all of the data?
 - Can you get the same solution another way?
 - Are there other valid solutions?



CRASH INVESTIGATION DATA POINTS

1. Human factors information

- a. Perception time
- b. Detection
- c. Identification
- d. Decision
- e. Response
- f. Reaction time
- g. Driver experience
- h. Driver general health condition including disabilities
- i. Driver alertness
- j. Driver distractions
- k. Visual acuity
- l. Field of vision
- m. Depth perception
- n. Contrast sensitivity
- o. Visual adaptation
- a. Alcohol or drugs

2. Vehicle

- a. Type—passenger car, straight truck, tractor trailer, motorcycle, towing
- b. Number of axles
- c. Load
- d. Type of cargo
- e. Vehicles defects
- f. Headlights
- g. Steering
- h. Brakes
- i. Tires
- j. Suspension
- k. Windshield wipers
- l. Undercarriage

3. Visual obstructions

- a. Weather—fog etc.
- b. Lighting conditions
- c. Ambient light
- d. Artificial illumination
- e. Headlights
- f. Alignment
- g. How clean
- h. Physical obstructions
- i. Dirt on windshield
- j. Background “noise”
- k. Visual distractions
- l. Glare

4. Scene

- a. Type of road surface
- b. Condition of roadway surface
 1. Smooth, bumps, potholes etc.
 2. dry, wet , snow, ice
- c. Alignment of roadway
- d. Pitch of roadway
- e. Markings on roadway , lines etc.
- f. Traffic control devices
 1. traffic signal sequence
 2. traffic detectors
- g. Gouge marks, scrapes, scratches
- h. Holes and grooves
- i. Tire marks
- j. Skid
- k. Yaw
- l. Sideslip
- m. Striation
- n. Scuff
- o. Bloodstain pattern

(continued on next page)



5. Vehicle inspection

- a. Paint chips and paint transfers
- b. Marking on vehicles
- c. Impact damage
- d. Glass damage
- e. Hairs and fibers
- f. Blood stains
- g. Airbags deployed?
- h. Seat belt use
- i. Bulbs
- j. Reflectors
- k. Steering
- l. Tires
 - 1. condition
 - 2. inflation
- m. Wheel alignment
- n. Mirrors
- o. ECM
- p. Horn

6. Investigation

- a. Field sketches
- b. Scale plan drawings
- c. Total Station or other mapping
- d. Photos
- e. Aerial photos (including Google Maps and other images available on the internet)
- f. Video cameras
- g. Statements of drivers, passengers and witnesses
- h. Physical evidence
- i. Vehicle damage and appraisal reports
- j. Vehicle examination reports
- k. Weather reports
- l. Information from injuries
- m. Location of injured person (driver, passenger, front seat, back seat, ejected, pedestrian etc.)

7. Injuries

- a. Size, shape, number and location
- b. Presence of foreign material such as oil or paint
- c. Nature and extent of internal injuries
- d. Interior contact points
- e. Safety restraint injuries

8. Pedestrians

- a. Clothing
- b. Primary point of impact
- c. Secondary point of impact

9. Conspicuity

10. Accuracy, Errors, Tolerances

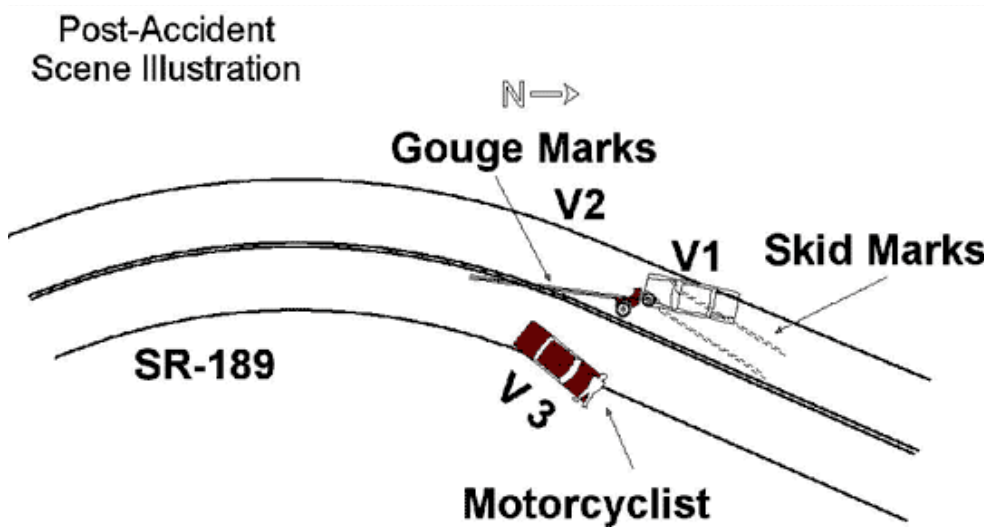
11. Other areas with their own additional subsets

- a. Trucks
- b. Motorcycles
- c. Fires



IDENTIFYING THE PROBLEM

Problem 1



Problem 2

Police report says all tire marks on road and median relate to bus except on mark on the extreme right of diagram at edge of center lane





Police Report

North Bound on I-95. Bus was on center lane,
began driving erratic, changed to the left lane
almost driving a red car off the road. Then
the bus was right next to the truck (center lane)
and proceeded to go back towards the truck.
The truck slammed on the breaks, the bus kept
turning in front of the truck but then flipped
on its side and skidded towards the right shoulder.

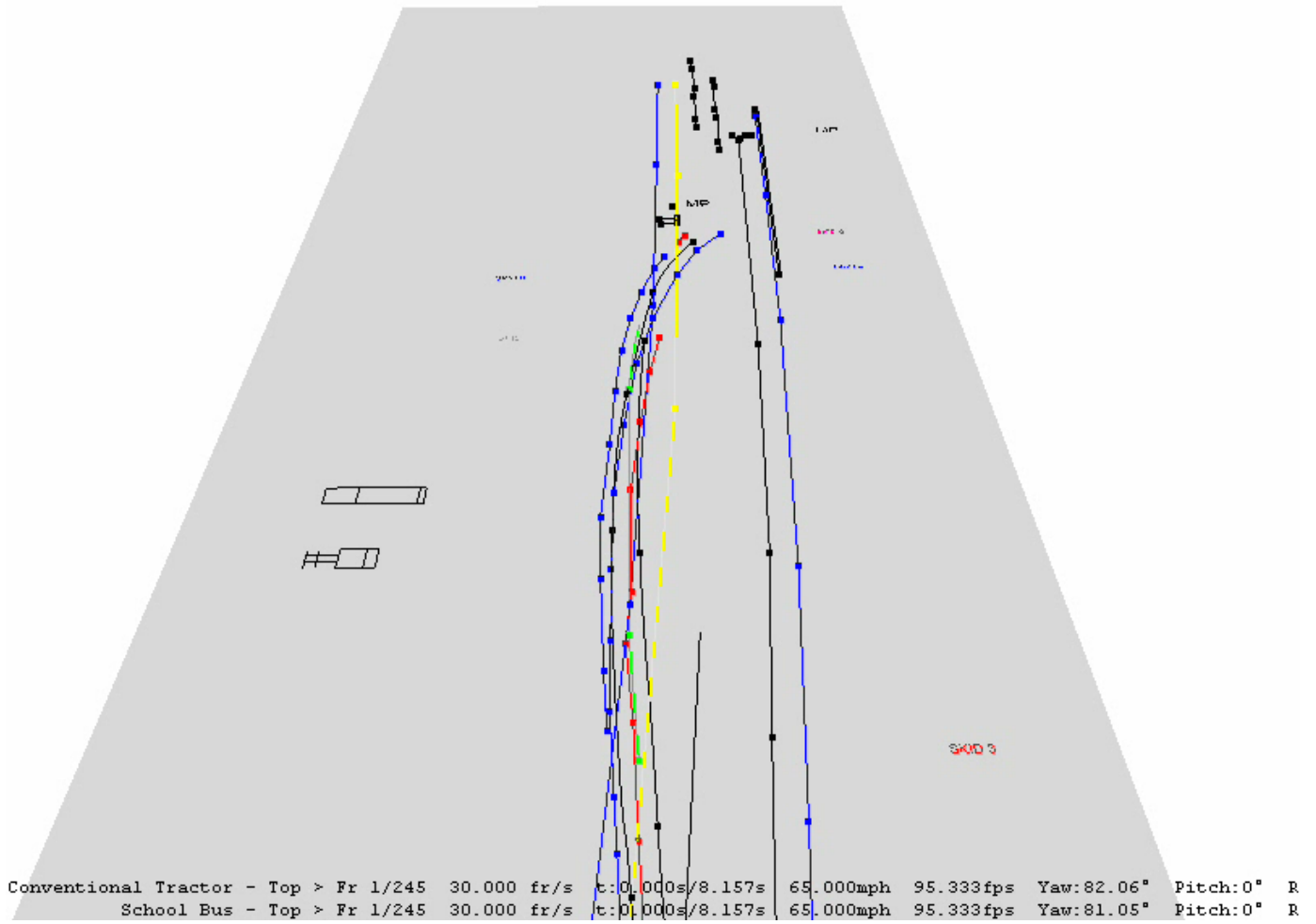
Statement

At that point, I'm slowing down cause I know this isn't going to be good. The truck was pretty solid. Right there in the center lane and his brakes came on so he was slowing down, stepping on the brake and then what happened next is really hard for me to understand why, but I saw the bus turn towards the right.

Deposition

Lawyer: "The truck never moved towards his lane, the truck stayed in his lane?"

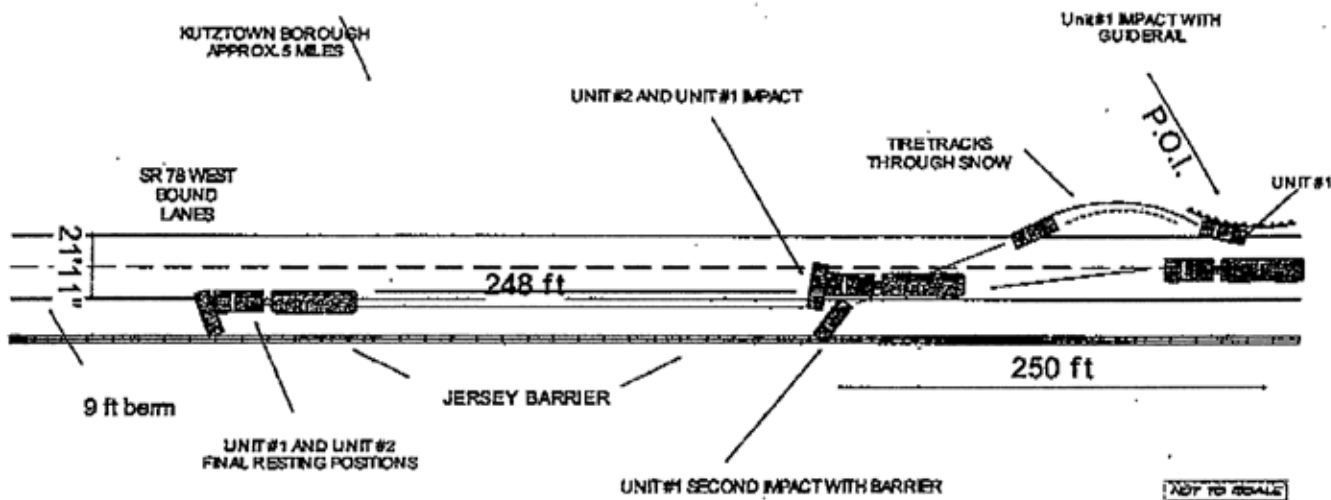
Witness: "The truck was solid, you know, on the center lane, slowed down."



Problem 3

"A crash is a series of events."

—Evidence in Traffic Crash Investigation and Reconstruction, R. W. Rivers 2009

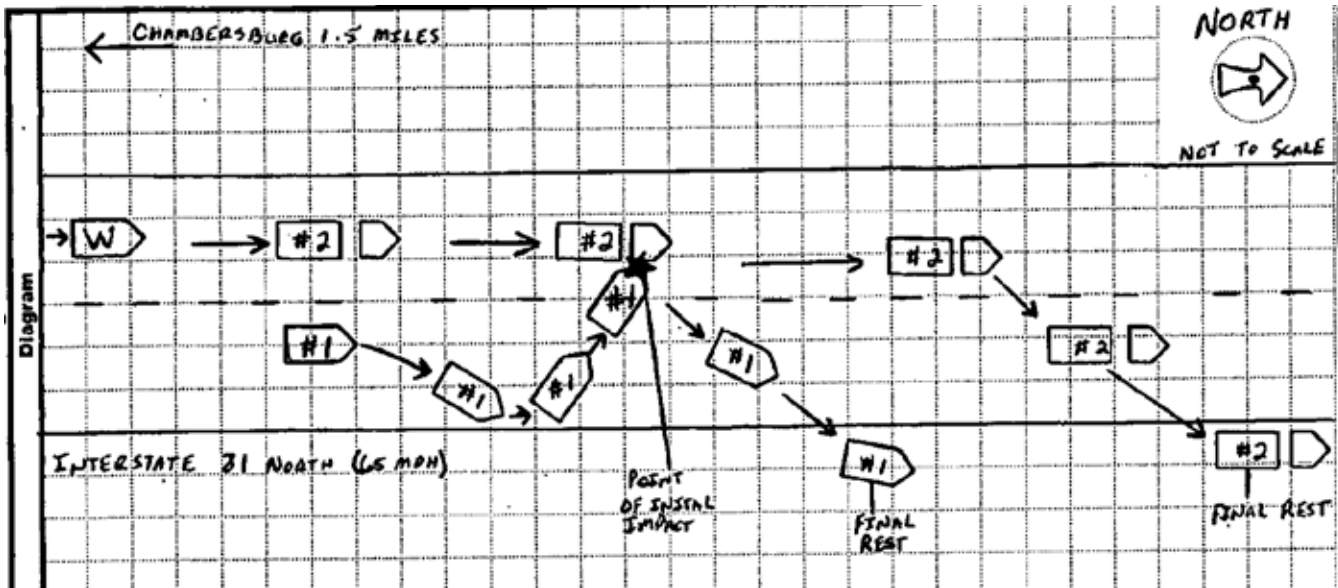


Crash Synopsis
PRIOR TO THE CRASH UNIT#1 WAS TRAVELING IN FRONT OF UNIT#2 WITHIN THE RIGHT LANE WESTBOUND ON INTERSTATE 0078, ON A WET ROADWAY.
THIS CRASH OCCURRED AS OPER#1 LOST CONTROL OF UNIT#1 AS IT TRAVELED ONTO THE NORTH BERM IN A WESTERLY DIRECTION. UNIT#1 RIGHT REAR IMPACTED WITH A GUIDE RAIL. FOLLOWING INITIAL IMPACT, UNIT#1 CONTINUED TRAVELING WEST ON THE NORTH BERM ONTO AN EMBANKMENT. UNIT#1 THEN TRAVELED BACK ACROSS BOTH LANES IN A SOUTHERLY DIRECTION, ONTO THE CENTER MEDIAN, INTO A RAISED CONCRETE BARRIER HEAD-ON.
UNIT#2 TRAVELED INTO THE LEFT LANE AS OPER#2 ATTEMPTED TO AVOID UNIT#1. UNIT#2 FRONT IMPACTED WITH THE LEFT SIDE OF UNIT#1 AS IT CAME TO A FINAL REST AGAINST SAME FACING WEST.

OPERATOR#2 WAS BRIEFLY INTERVIEWED AT SCENE IMMEDIATELY UPON MY ARRIVAL AT SCENE AT APPROXIMATELY 1018 HOURS. HE SUBSTANTIALLY STATED HE WAS IN THE RIGHT LANE BEHIND UNIT#1. HE SAW UNIT#1 TRAVEL OFF THE ROADWAY, ONTO THE NORTH BERM, UP AN EMBANKMENT, BACK ACROSS BOTH LANES. HE ESTIMATED UNIT#1 SPEED AT APPROXIMATELY 60 TO 65 MILES PER HOUR. UNIT#1 ESTIMATED SPEED WAS APPROX. 53 MILES PER HOUR. HIS ESTIMATED DISTANCE BEHIND UNIT#2 WAS APPROX. 150 FEET PRIOR TO OPERATOR#1 LOSING CONTROL OF UNIT#1. OPERATOR#2 SUBSEQUENTLY PROVIDED A WRITTEN STATEMENT BACK AT THE BUREAU.

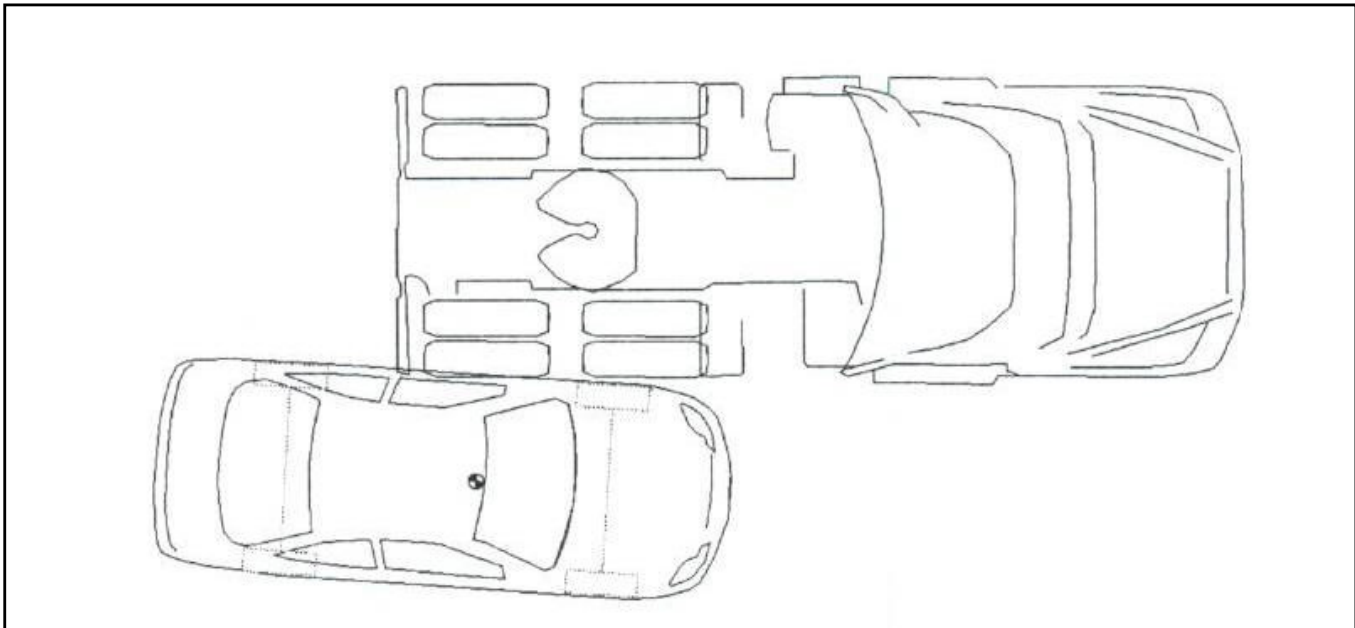
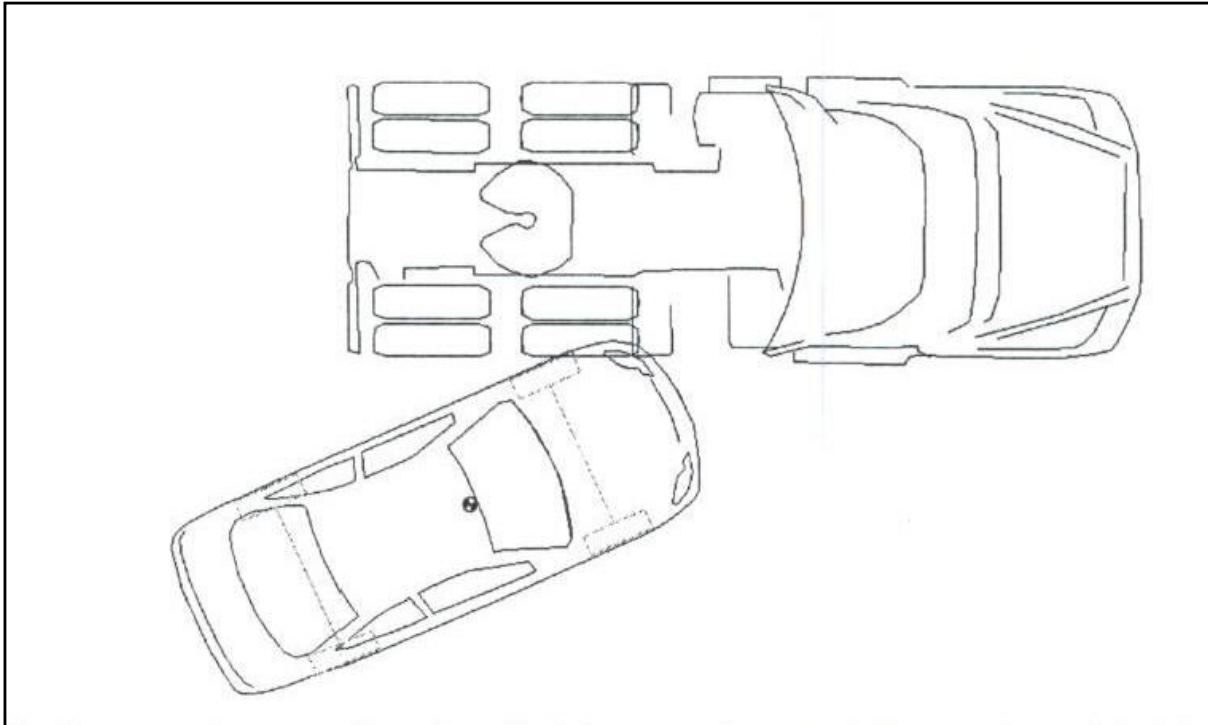
Problem 4

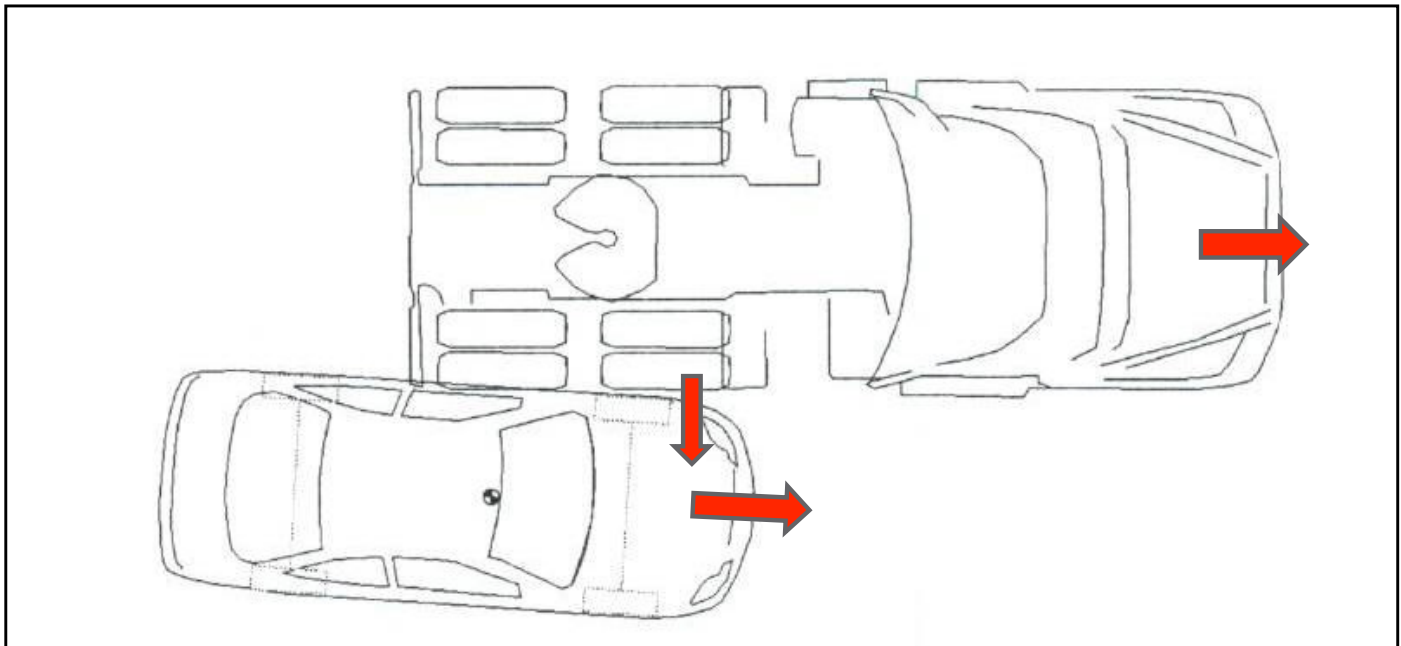
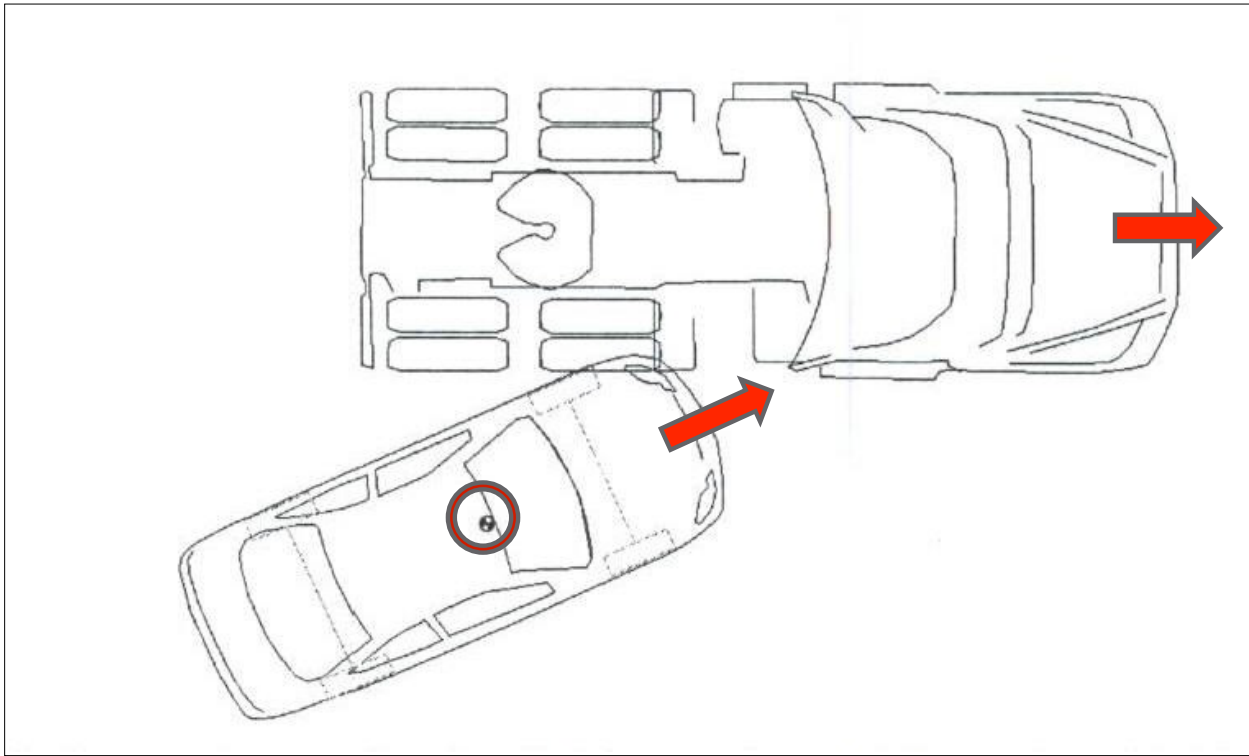
Driver unit #1's story cannot be confirmed by accident reconstruction!

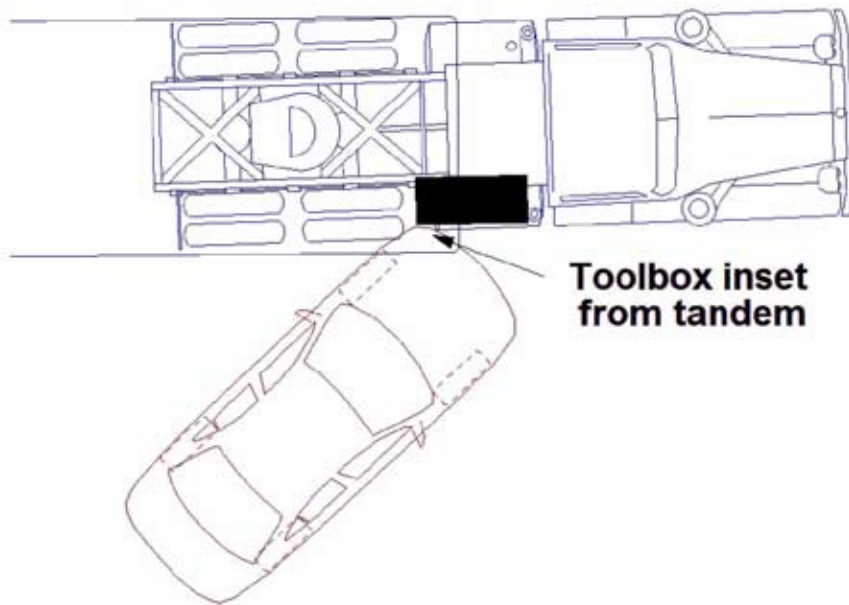
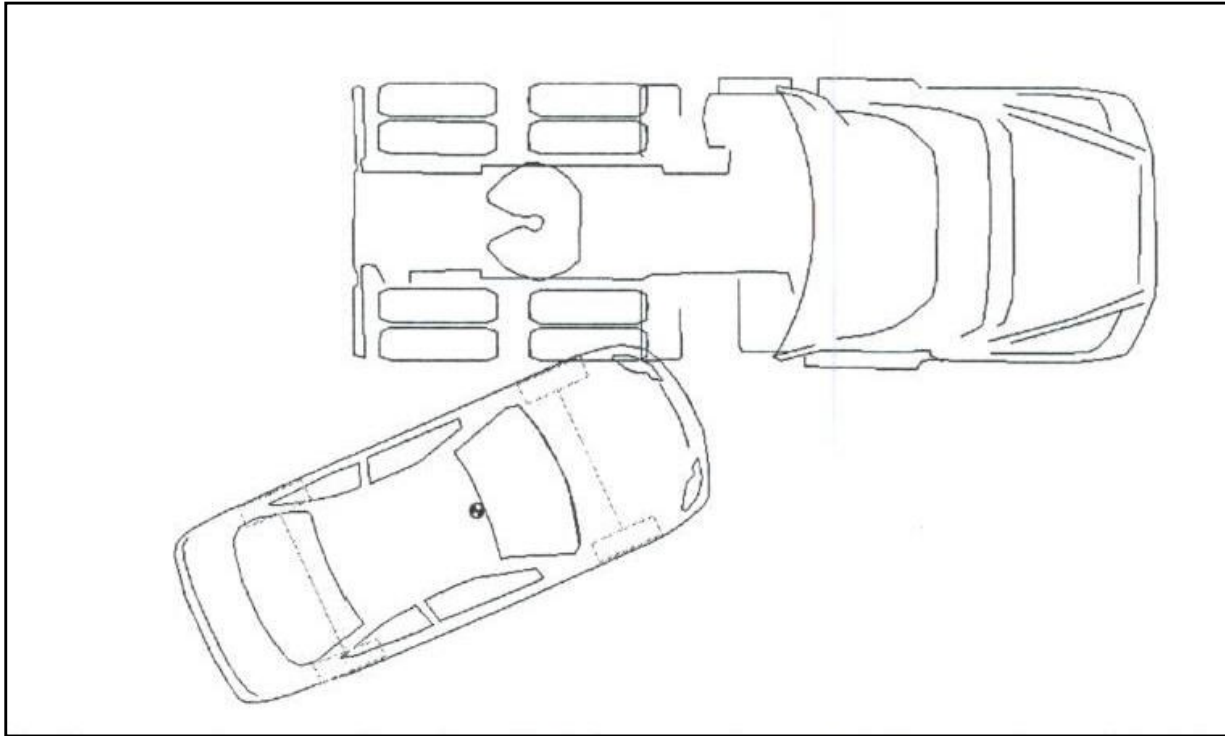












**Toolbox inset
from tandem**

