

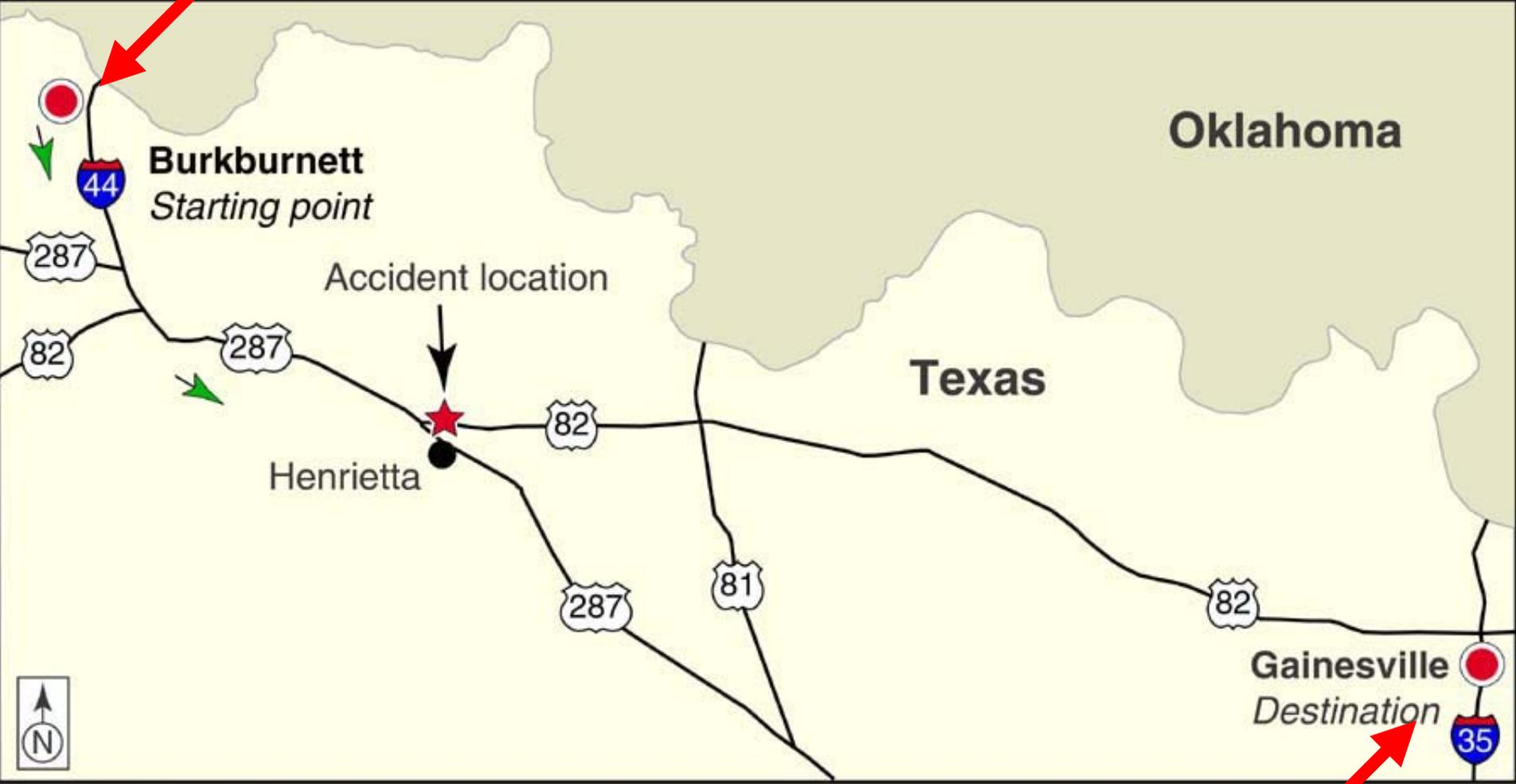


Henrietta, Texas, May 8, 2001

Randleman, North Carolina,
July 1, 2001

15-Passenger Van Rollover Accidents





Henrietta, Texas





Randleman, North Carolina



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15-Passenger Van Issues

- Rollover
- Occupant protection
- Tire condition
- Inspection and maintenance
- Vehicle handling
- Vehicle classification



Henrietta Vehicle Simulations



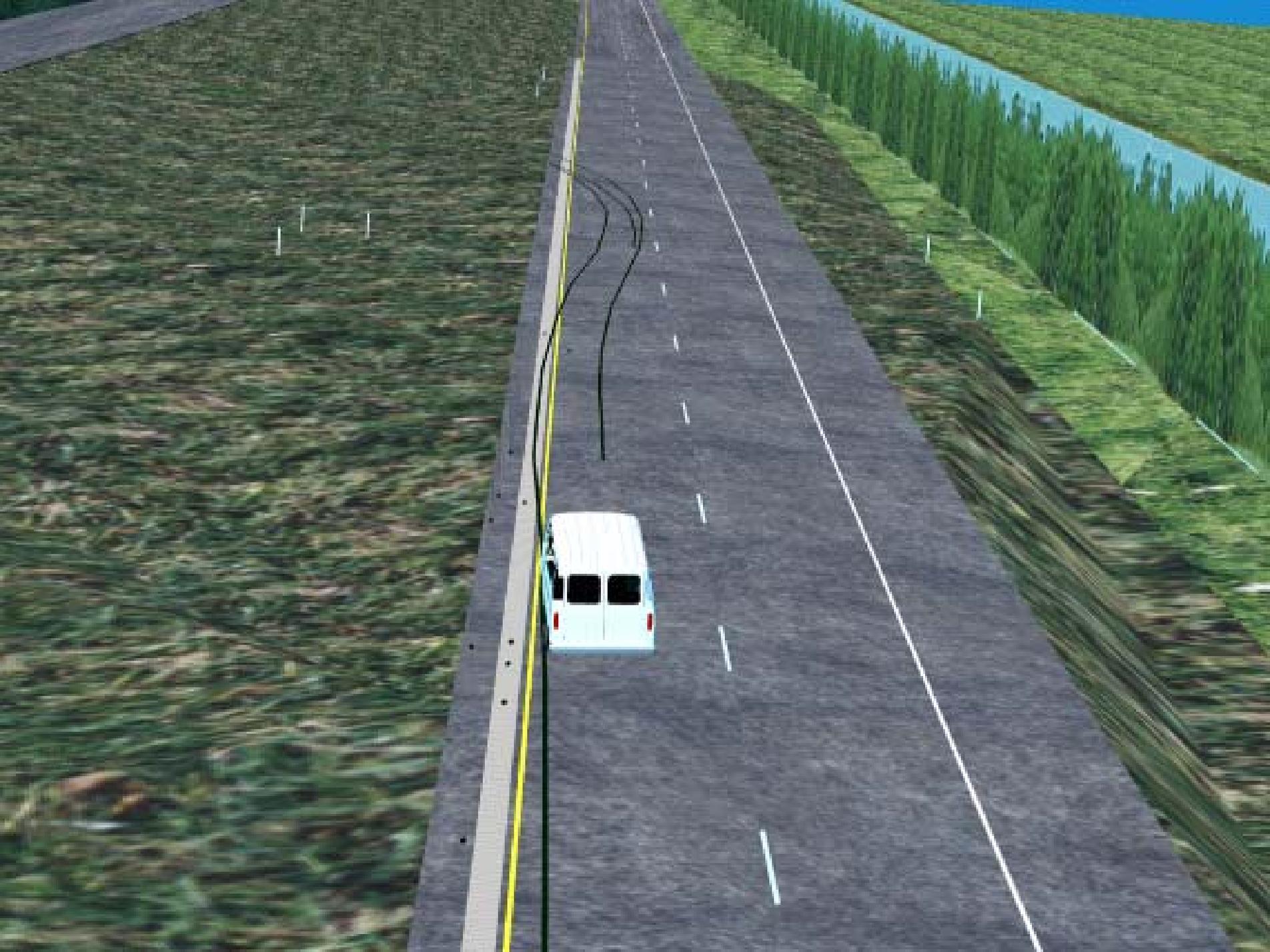
Purpose of Simulations

- To gain better understanding of driver's actions prior to leaving road
- To obtain crash pulse estimates for use in occupant kinematics study





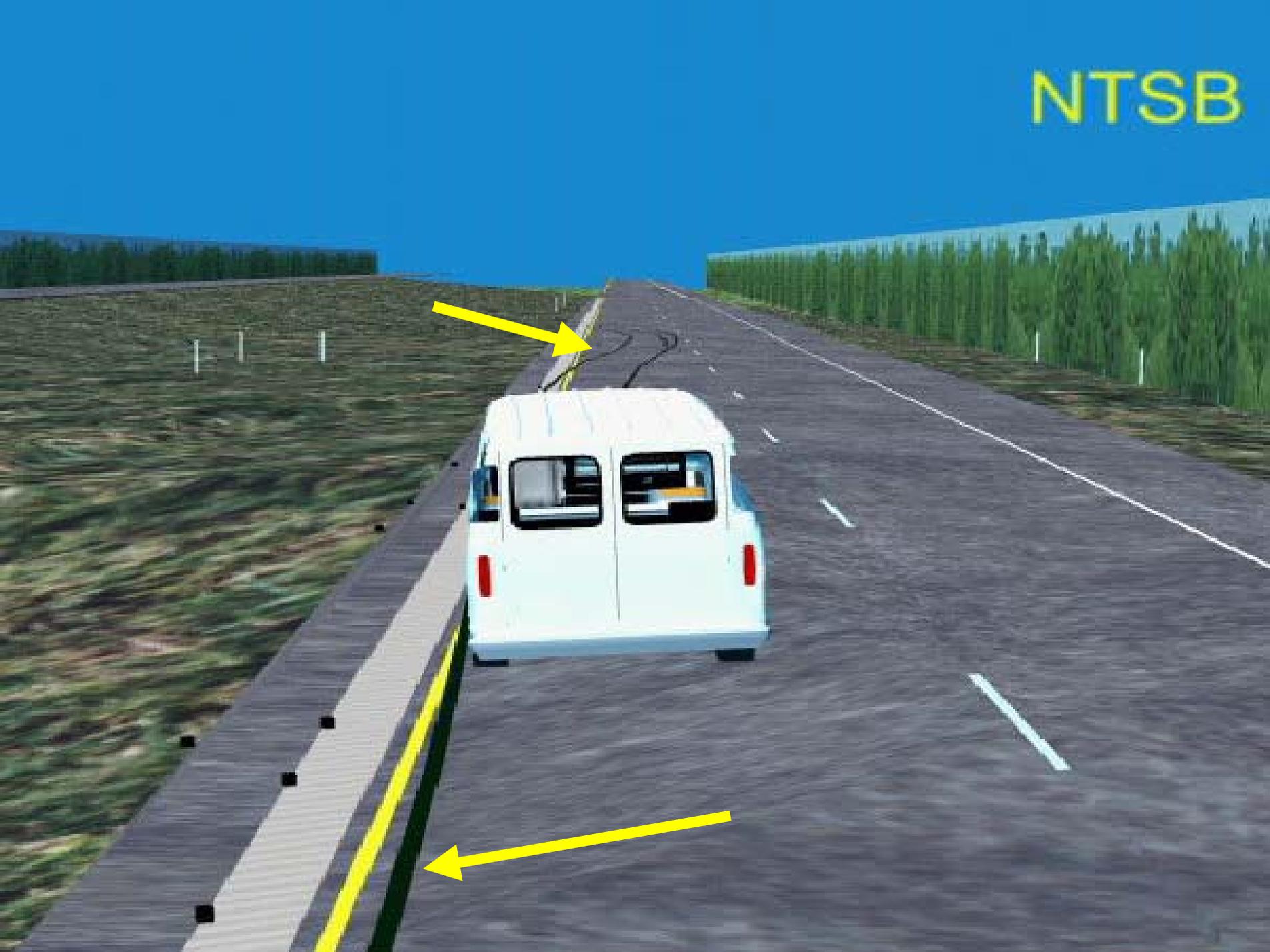








NTSB



Summary

- The van was initially traveling about 67 mph
- The driver steered right and then left before leaving the roadway
- The van rolled two or more times before coming to rest



Handling

- Rear tire failure changes vehicle handling
- Short time to adjust to these handling changes



15-Passenger Van Issues

- Pupil transportation
- Propensity to rollover
- Occupant protection
- Tire condition
- Inspection and maintenance
- Vehicle handling
- Vehicle classification



Pupil Transportation

- *Use of Nonconforming Vehicles for Pupil Transportation*
- 15-passenger vans not built to same occupant protection standards as school buses
- Pupils should be transported in vehicles built to school bus standards
- NHTSA prohibits sale of new vans to schools



15-Passenger Van Rollovers

- Accidents continue to occur
- More likely to roll over when loaded
- Rollover rating system
- Electronic stability control
- Congressional action



Ford 15-Passenger Van Warnings

- Safety advice card
- Rollover warning label



Issues

- Occupant protection
- Tire condition and vehicle inspection and maintenance
- Driver training
- Vehicle classification



Occupant Protection



Survival Factors Issue Areas

- Occupant protection for 15-passenger vans
- Center position seat belt requirements and belt accessibility
- Occupant simulations
 - Ejections
 - Restraint usage
- 4th row lap belt assemblies design
- Roof crush and loss of survivable space



15-Passenger Van Damage



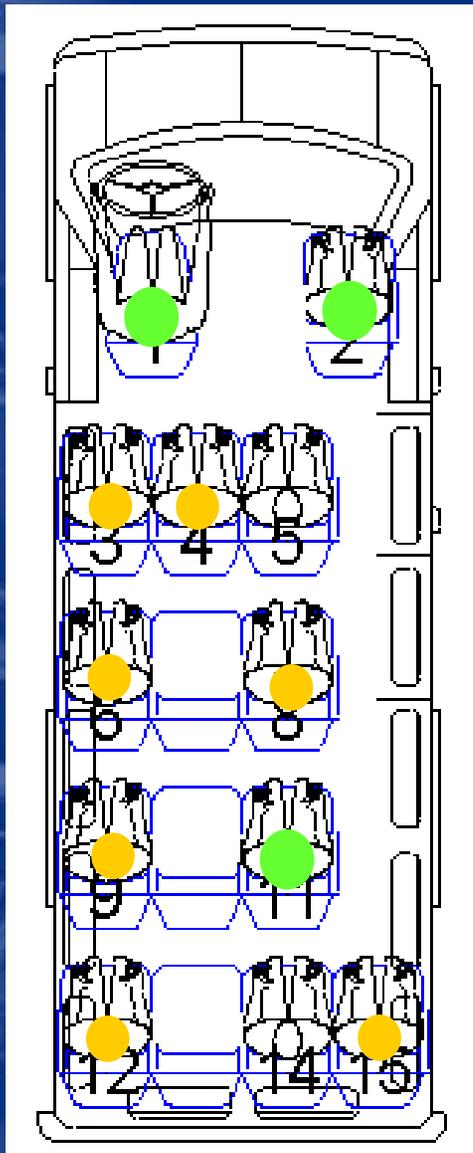
Henrietta, Texas



Randleman, North Carolina



Henrietta – Passenger Seating and Restraints



- Driver lap/shoulder belted
- Front seat passenger lap/shoulder belted
- 10 passengers in rear
 - 1 lap belted
 - All others unrestrained

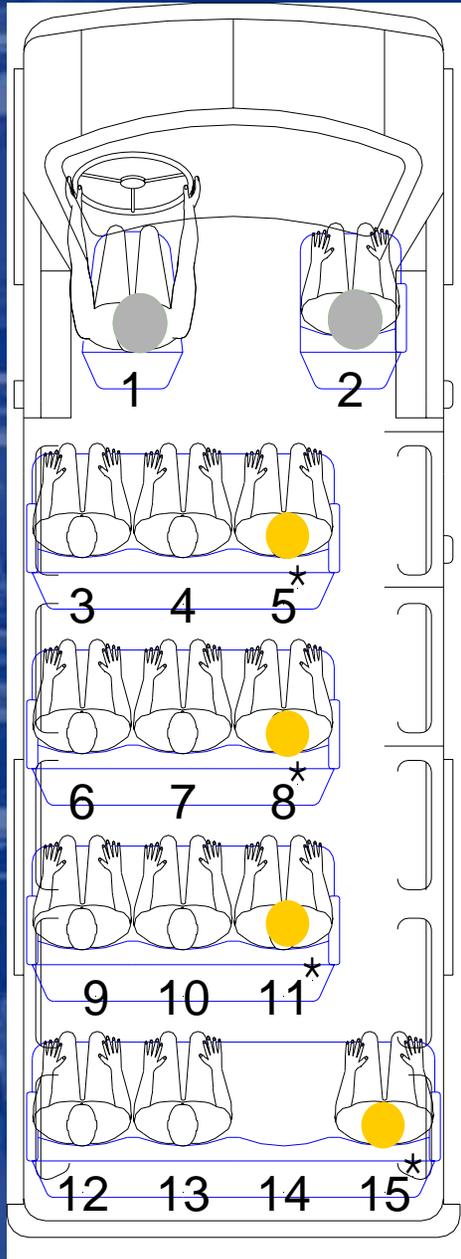


Henrietta - Passenger Injuries

- Driver sustained fatal injuries
- Three ejected passengers - fatal injuries
- Unrestrained passengers - serious injuries
- Lap-belted passenger - right arm fracture



Randleman – Passenger Seating and Restraints



- Driver lap/shoulder belted
- Front seat passenger lap/shoulder belted; shoulder belt behind back
- 12 unrestrained passengers in rear



Randleman - Passenger Injuries

- Driver - serious injuries
- Front passenger - minor injuries
- Four passengers ejected - one fatally injured
- Eight passengers not ejected - minor injuries



Serious and Fatal Injury Causation

- Impact forces from rollover
- Lack of restraint use
- Impact with nonprotected interior surfaces
- Ejection
- Intrusion into the passenger compartment



Occupant Protection

- Most frequent contact point in rollover is roof, pillars, rails, and headers
- Current FMVSS 201 requires occupant protection of these areas in passenger cars, trucks, and multi-purpose vehicles
- 15-passenger vans exempt from FMVSS 201, Part 6



Center Position Seat Belts and Belt Accessibility

Center seat positions only equipped with lap belts

- Lap belts can increase the risk of abdominal, spinal, and head injury
- Center seat occupants should receive same level of protection as other occupants with lap/shoulder belts



Center Position Seat Belts and Belt Accessibility

Seat belt accessibility was limited in Randleman accident van

- Five seats without accessible belts
- Four occupied by children under 16 years of age
 - Required by North Carolina law to be belted
 - Three of these children were ejected
 - One ejected child was fatally injured



T=5.0 seconds
640 degrees Roll

T=3.0 seconds
420 degrees Roll

T=2.0 seconds
380 degrees Roll

T=0.8 seconds
110 degrees Roll

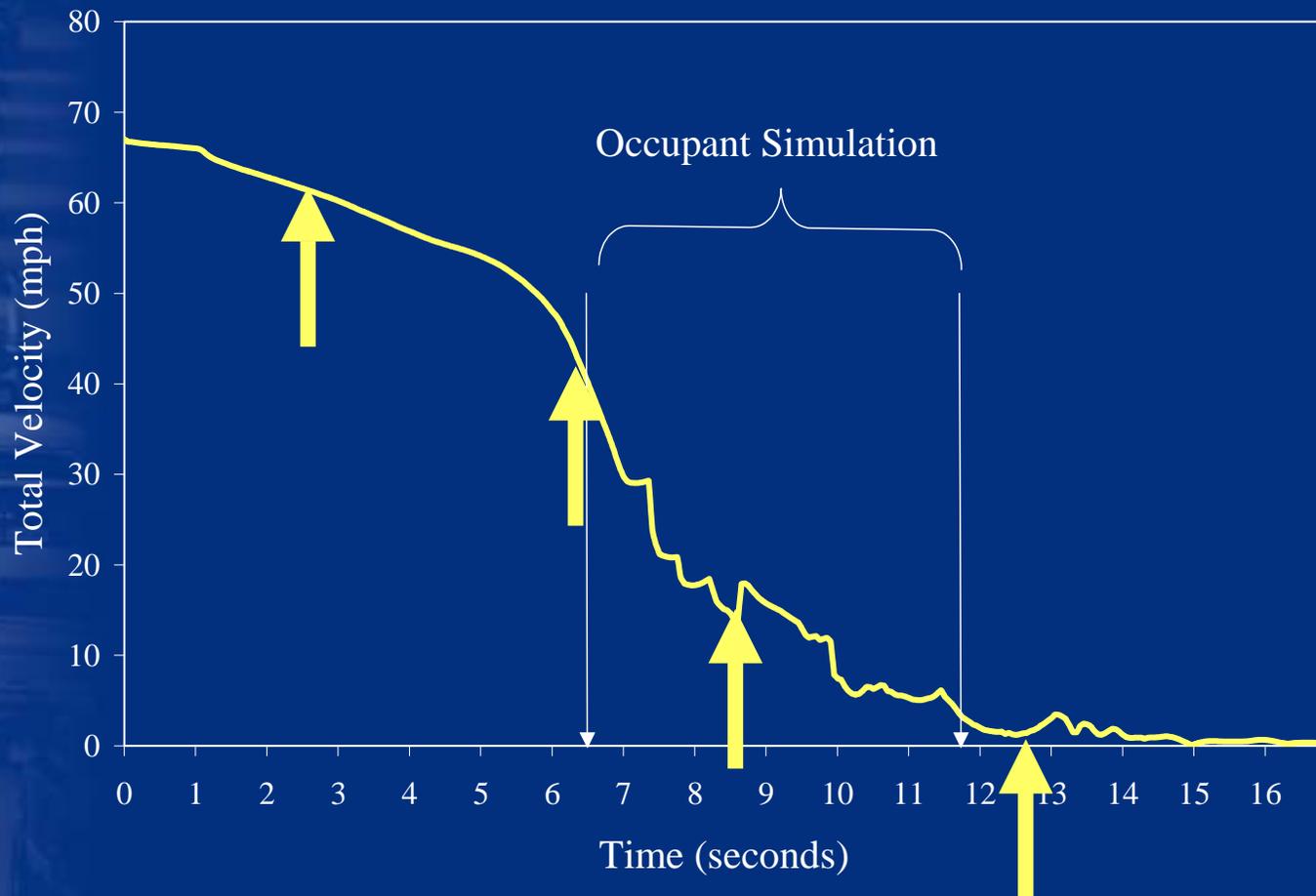
T=0.0 seconds
13 degrees Roll

Occupant Simulations



Occupant Simulations – Set-up

Developed based on the crash pulse from the vehicle dynamics simulation



Occupant Simulations – Set-up

- Assumed upright initial seating position



- Intrusion not modeled



Occupant Simulations – Set-up

- Baseline condition:
 - All occupants unrestrained except occupant in seat 11 who was simulated with a lap belt
 - Driver and front seat passenger not simulated
- Representative of the occupant dynamics but does not show the actual accident; valid for comparisons



Simulations

- Baseline condition: simulation of full overturn sequence
- Lap-belted condition: simulation of first overturn only
- Lap/shoulder-belted condition: simulation of first overturn only



Direction of Travel

T=0.0 seconds
13-degree roll

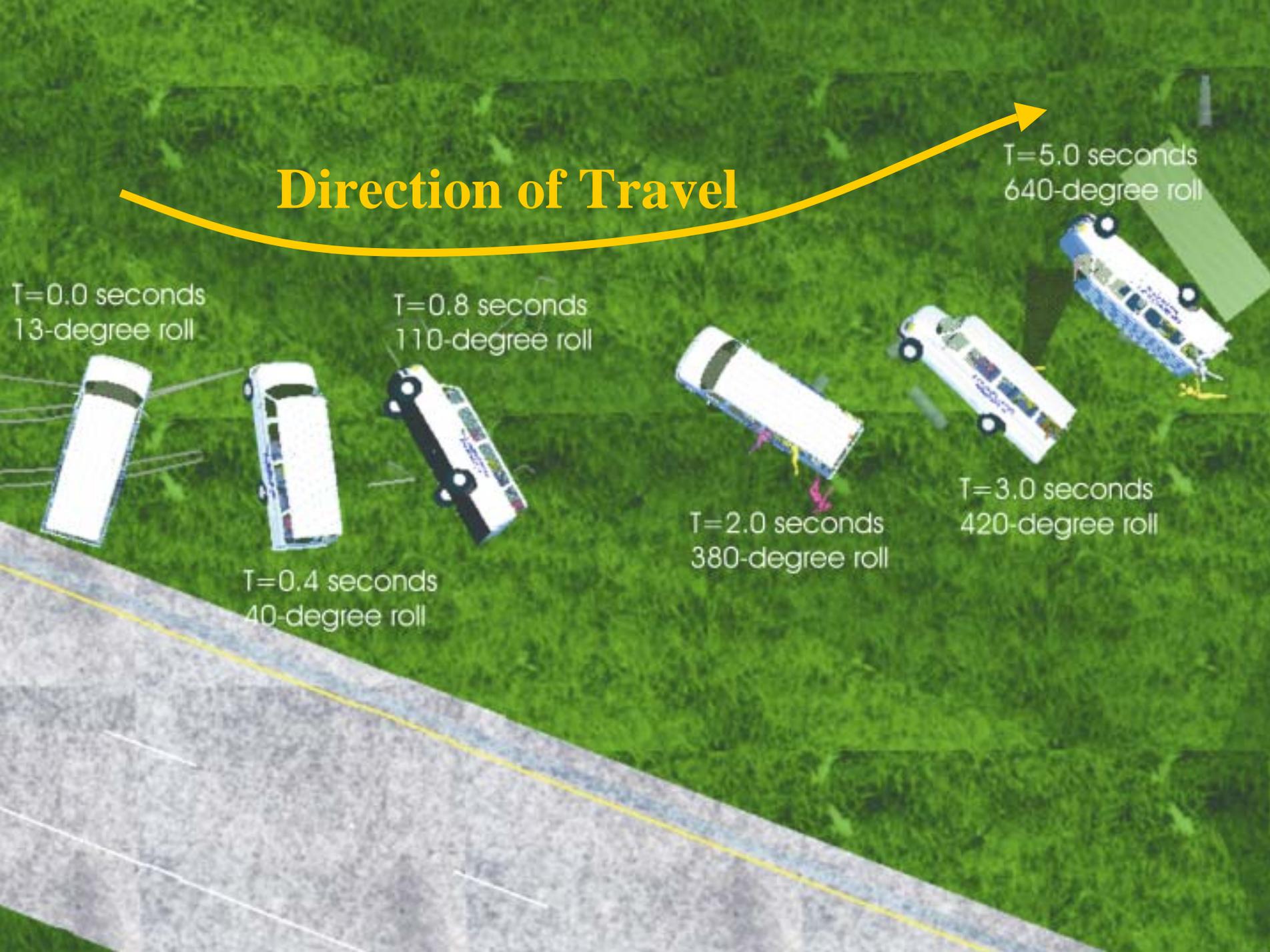
T=0.4 seconds
40-degree roll

T=0.8 seconds
110-degree roll

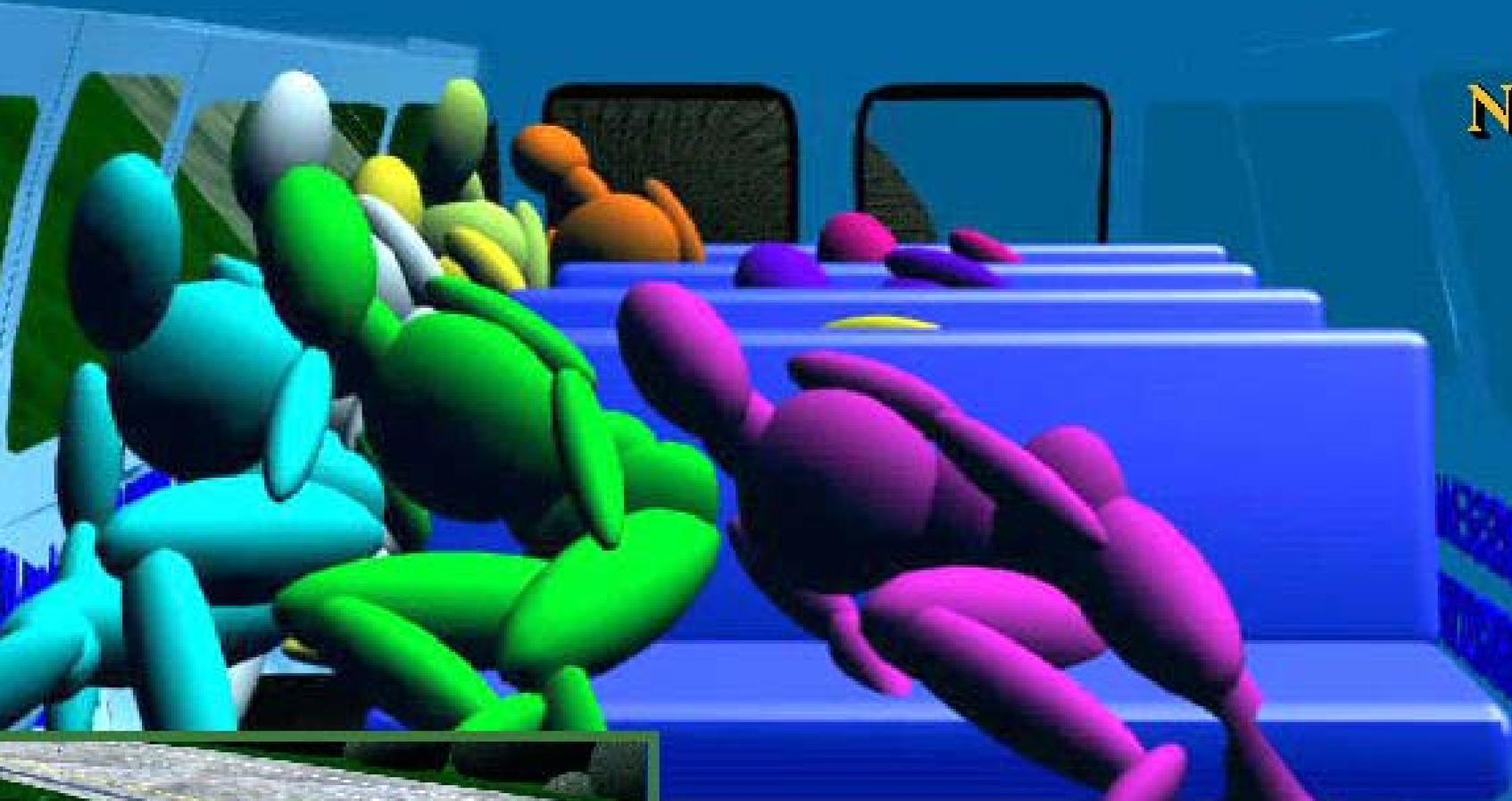
T=2.0 seconds
380-degree roll

T=3.0 seconds
420-degree roll

T=5.0 seconds
640-degree roll



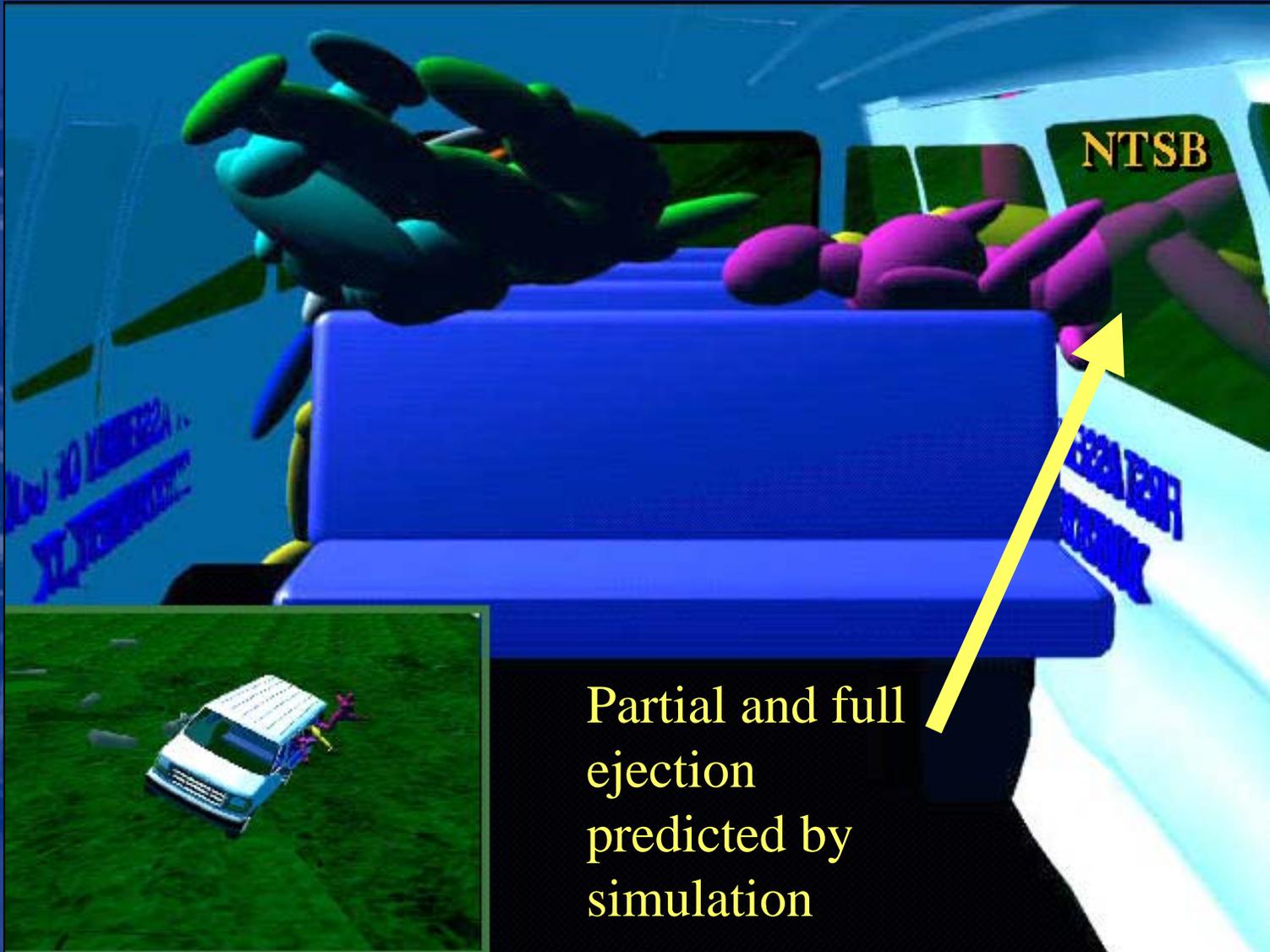
NTSB



Occupant Simulations

- Inset of vehicle dynamics
- Shown at 1/3 speed

Simulation Results



Partial and full
ejection
predicted by
simulation





Lap/Shoulder Belted Simulation

- Reduced lateral motion
- No ejection
- No injuries to head, neck, and chest



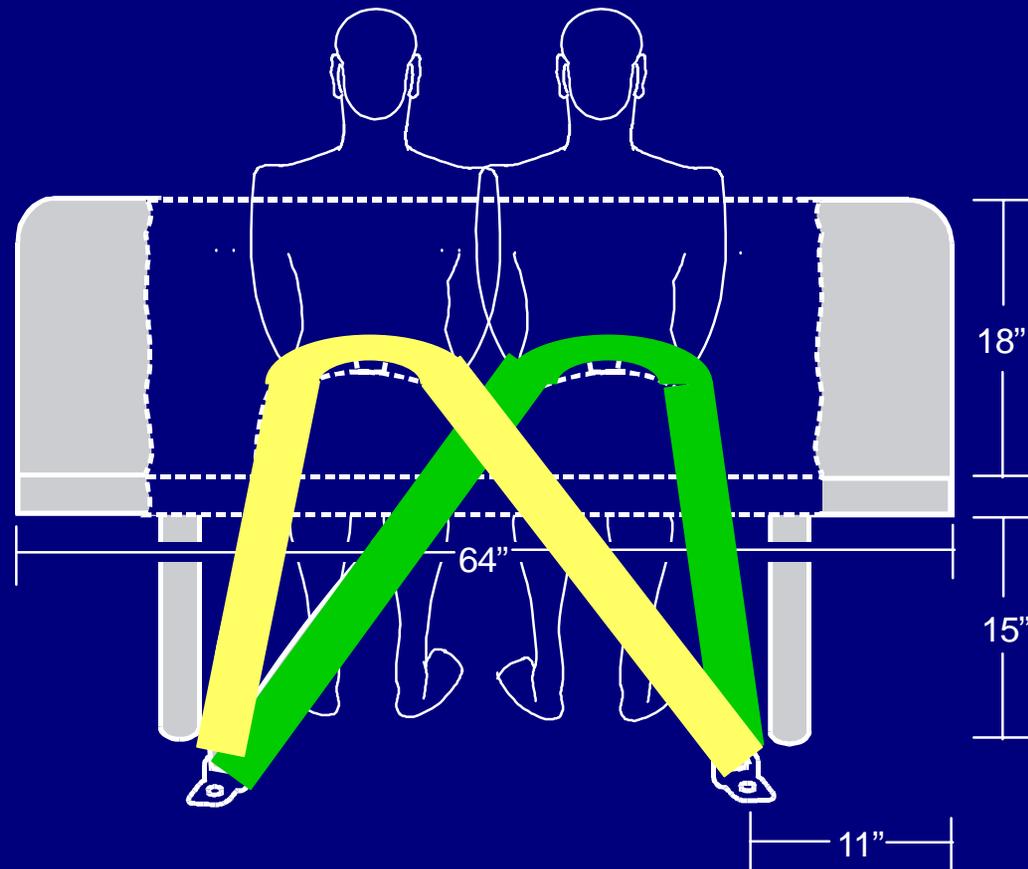
Occupant Simulation Summary

- Injuries resulted from interior contacts
- Ejection seen in accident restraint condition
- Ejection not seen during restrained conditions
- No resulting injuries during first overturn sequence in the lap/shoulder-belted condition



Design of the 4th Row Lap Belt Assemblies

- Lap belt assemblies could be used in a manner not conforming to FMVSS 209
- Design could increase the risk of injury to passengers



Roof Crush and Loss of Survivable Space

- Roof crush contributed to severity of the driver's injuries
- Roof crushed to top of driver's seatback
- In other areas: 4-6 inches above seatback
- Significant loss of survivable space



Roof Crush and Loss of Survivable Space

- FMVSS 216 requirements for roof crush resistance
- Standard applies to passenger cars and multi-purpose vehicles
- 15-passenger vans in higher percentage of rollover accidents



Occupant Protection Summary

- Occupant protection needs improvement in 15-passenger vans
- 15-passenger vans are used in a manner similar to passenger cars but with lower requirements for safety
- Systems approach to occupant protection: lap/shoulder belts, seats, interior structures, and roof strength



Tire Condition and Vehicle Inspection and Maintenance







Tire Degradation

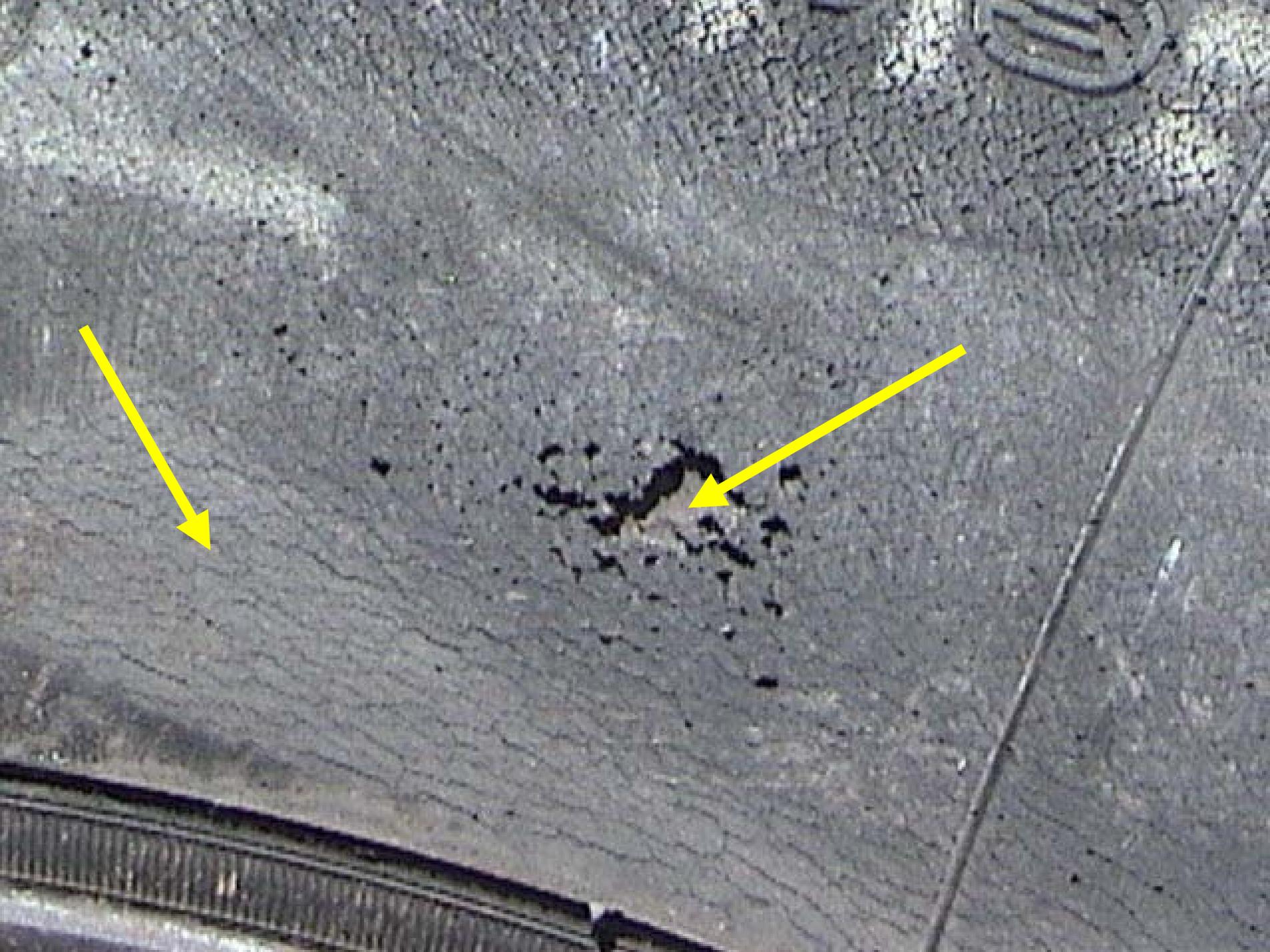
- 5 of 8 tires degraded
 - Weather checking
 - Underinflated operation
 - Use of improper load rating
- Cause of degradation
 - Age
 - Infrequent use
 - Poor maintenance



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Church Vehicle Maintenance and Inspection

- Exempt from FMCSR
- No pretrip inspection required
- No routine maintenance or inspection programs
- Annual State inspections



State Vehicle Inspections

- Both vehicles recently inspected
- Texas, Virginia, and AAMVA do not address:
 - Excessive tire cracking
 - Weather checking – dry rot
 - Deterioration
 - Use of improper load rated tires
- Texas and Virginia: no tire inflation pressure inspection



Tire Inflation Pressures

- Rear tires underinflated
- Causes of underinflation
 - Pressure differential
 - High pressures
 - Tire gauge limitations
 - Lack of inspection
 - Sedentary vehicles



Effects of Underinflation

- Shorter life
- Elevated operating temperatures
- Load capacity reduced
- Handling characteristics



Tire Inflation Monitoring Systems

- Current detection threshold requirement of 25 or 30 percent below recommended pressure
- Warning range below 56 – 60 psi
- Accident tire pressures 58 – 60 psi
- Accident tire pressures would be undetected



Driver Training



Henrietta Driver

- Valid Texas driver's license
- Familiar with van
- No evidence of specialized training
- No evidence of an emergency situation while driving the van



Randleman Driver

- Valid Virginia driver's license
- Familiar with van
- No specialized training



Driver Actions

- Both drivers tried to correct vehicle rotation by steering and possibly braking
- Natural reactions when driver begins to lose control of vehicle



Driver Actions, continued

- Vehicle dynamics of loaded 15-passenger van differ from passenger vehicle
- Guidance
 - Remove foot from accelerator
 - Gently brake
 - Avoid abrupt steering
- Driver input magnified, leading to further instability
- In testing, trained driver could not maintain lane





RUN NO. 2





RUN NO. 2



Training

- NHTSA advisory
- Van owners not aware of NHTSA's advisory
- “Coaching the Van Driver”
- Advantages of training



Driver's Licenses

- Driver's license classes and/or endorsements
- Specialized training and testing



Vehicle Classification



Variations in Classifications

- Issues
 - Occupant protection
 - Vehicle inspection and pretrip
 - Driver training and licensing
- U.S. DOT classifications



Federal Motor Vehicle Safety Standards

- NHTSA
- Defines a 12 – 15 passenger van as a bus
- Excludes 12 –15 passenger vans from FMVSS for passenger cars



Federal Motor Carrier Safety Regulations (FMCSR)

- FMCSA
- Passenger vehicles are commercial vehicles when
 - Transport more than 8 passengers for compensation
 - Carry more than 15 passengers



Federal Motor Carrier Safety Regulations

- 12- and 15-passenger van used as commercial vehicle must:
 - File Motor Carrier Identification Report
 - Mark the vehicle with U.S. DOT number
 - Maintain accident register
- Commercial driver's license only required if designed to carry 16 or more passengers



12- and 15-Passenger Vans

- Do not meet safety standards of passenger cars
- Sometimes considered buses
- ??? Passenger vehicle or commercial vehicle
- Consumer knowledge



Variations in Classifications

- Lesser occupant protection standards
- No pretrip inspections
- No special driver licensing requirements
- Adversely affects safety and operation



