

On-scene Investigation / Vehicle to Vehicle  
Dynamic Science, Inc. / Case Number: DS98018  
1995 Hyundai Accent L 3-door Hatchback  
Arizona  
May 1998

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*The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.*

*Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.*

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| 16. Abstract<br><p>The collision occurred in May 1998 around 1215 hours in Arizona. This was a two-vehicle rear end type collision. The weather was clear, and the roadway was dry and free of defects. Vehicle 1, a 1995 Hyundai Accent L 3-door hatchback, was driven westbound by a restrained 27-year-old female (158 cm-62 in/64 kgs-140 lbs) at a minimum travel speed of 39.3 km/h (24.4 mph). The front right seat was occupied by a 5-year-old female (122 cm-48 in/23.6 kgs-52 lbs)-the driver's daughter, who was improperly restrained with the shoulder belt behind her back. Vehicle 2, a 1985 Ford LTD Crown Victoria 4-door, was being driven westbound by a 46-year-old male (191 cm-75 in/109 kgs-240 lbs). Vehicle 2 was directly in front of Vehicle 1, stopped and attempting a left turn into a private parking lot. The front right seat of Vehicle 2 was occupied by a restrained 36-year-old male (168 cm-66 in/73 kgs-160 lbs).</p> <p>The driver of Vehicle 1 stated that she was looking at and talking to her daughter who had a coloring book on her lap and was coloring in it. The driver further stated that her daughter was wearing the available lap and shoulder restraints, but that she was wearing the shoulder belt behind her back; this was indicated in the medical records. When the driver of Vehicle 1 looked forward, she saw Vehicle 2 was stopped directly in front of her. The driver applied her brakes and deposited 8.7 meters (28.4 ft) of locked wheel skidmarks. Vehicle 1 was unable to stop and its front (12FDEW1, 0E PDOF) struck the back of Vehicle 2 (06BDLW1, 180E PDOF). At impact, Vehicle 1 sustained a total Delta-V of 16.9 km/h (10.5 mph), and a longitudinal Delta-V of -16.9 km/h (-10.5 mph) and both front air bags deployed. Vehicle 2 sustained a total Delta-V of 9.3 km/h (5.8 mph), and a longitudinal Delta-V of 9.3 km/h (5.8 mph).</p> <p>Prior to the collision with Vehicle 2, the driver of Vehicle 1 was presumed to have been seated in an upright position with both of her hands on the steering wheel. She was restrained by the available lap and shoulder belts. Due to the pre-impact braking she was projected forward and loaded the lap and shoulder belts. At impact with Vehicle 2, the driver's air bag deployed and came into contact with the driver's left forearm causing contusions and abrasions (AIS-1). The driver of Vehicle 1 was transported via ground ambulance to a local medical center. It is not clear if she received treatment for her injuries.</p> <p>The front right occupant of Vehicle 1 sustained fatal injuries in this collision. Prior to the collision with Vehicle 2, she was seated in an upright position, and was preoccupied with her coloring book. She was wearing the lap belt, but the shoulder belt was behind her. The pre-impact braking and subsequent impact caused her to pitch forward and into close proximity of the now-deploying air bag. The air bag struck her directly in the face, the anterior part of the neck, chest, and both arms. As the air bag continued its unfolding pattern "it snapped" and accelerated her head rearward causing the fatal injury of a complete dislocation of the occipital bone (AIS-2) and the first cervical vertebra with a laceration an almost a complete transection of the pons and medulla (AIS-6). She also sustained a subarachnoid hemorrhage (AIS-3) around the base to the cerebellum and brain stem; moderate to severe cerebral edema (AIS-4), and mild to moderate edema and congestion to her lungs (AIS-3). She sustained numerous contusions (AIS-1) and abrasions (AIS-1) about her face, neck, chest, abdomen, both of her upper arms, and her right fingers as a result of contact with the air bag. She sustained a contusion (AIS-1) to her right lateral leg that may have been caused by contact with the instrument panel, and an abrasion (AIS-1) to her lateral thigh.</p> <p>Immediately after the collision, bystanders came out of local businesses. They saw the driver of Vehicle 1 screaming for help for her child, and saw smoke emanating from Vehicle 1, which was perceived as a fire. The front right occupant was removed from Vehicle 1 and carried into one of the businesses. Medical records indicate that she was unconscious, unresponsive with agonal respirations and no pulse. A deputy was on scene almost immediately and he initiated cardiopulmonary resuscitation, and the investigating police officer noted that she was completely blue when he first saw her. Initially she was transported via ground ambulance to a site where she was airlifted to a medical center. Her Glasgow Coma Scale was noted as a 3. She arrived at the medical center where she received 50 minutes of preoperative resuscitation. A lateral C-spine x-ray showed the occipital dislocation and she was declared brain dead at 1420 hours of the same day.</p> |                                      |   |                            |                                       |  |
| 17. Key Words<br><b>Air bag, deployment, injury, accident, fatality, passenger, child</b>  |                                      |   | 18. Distribution Statement |                                       |  |
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**Dynamic Science, Inc.**  
**Accident Investigation**  
**Case Number: DS98018**

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**BACKGROUND:**

**Description:** This case was initiated in response to a report of fatal injuries to the front right occupant, a 5-year-old female, as a result of the deployment of the front right passenger's air bag. The case was conducted as an on scene investigation. The National Transportation Safety Board, as a result of a newspaper article, notified the National Highway Traffic Safety Administration. The driver of Vehicle 1 was present during the vehicle inspection.

**Investigation Type:** On-scene

**Crash Location:** Arizona

**Crash Date:** May, 1998

**Notification Date:** May, 1998

**Field Work Completed:** May, 1998

**SUMMARY:**

The collision occurred in May, 1998 around 1215 hours in Arizona. This was a two-vehicle rear end type collision. At the point of impact, the roadway is a two way, two lane, undivided asphalt roadway with a positive 3.3% slope (see Figure 1). The weather was clear, and the roadway was dry and free of defects. There were no traffic controls and the posted speed limit is 56 km/h (35 mph).



**Figure 1.** Roadway and impact area.

Vehicle 1, a 1995 Hyundai Accent L 3-door hatchback, was driven westbound by a restrained 27-year-old female (158 cm-62 in/64 kgs-140 lbs) at a minimum travel speed of 39.3 km/h (24.4 mph)<sup>1</sup>. The front right seat was occupied by a 5-year-old female (122 cm-48 in/23.6 kgs-52 lbs)<sup>2</sup>—the driver's daughter, who was improperly restrained with the shoulder belt behind her back.

Vehicle 2, a 1985 Ford LTD Crown Victoria 4-door, was being driven westbound by a 46-year-old male (191 cm-75 in/109 kgs-240 lbs). Vehicle 2 was directly in front of Vehicle 1, stopped and

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<sup>1</sup> See Attachment A for calculations of minimum travel speed

<sup>2</sup> The height and weight were obtained from the autopsy report and they differed from what was indicated on the police report

attempting a left turn into a private parking lot. The front right seat of Vehicle 2 was occupied by a restrained 36-year-old male (168 cm-66 in/73 kgs-160 lbs).

The driver of Vehicle 1 stated that she was looking at and talking to her daughter who had a coloring book on her lap and was coloring in it. The driver further stated that her daughter was wearing the available lap and shoulder restraints, but that she was wearing the shoulder belt behind her back; this was indicated in the medical records. When the driver of Vehicle 1 looked forward, she saw Vehicle 2 was stopped directly in front of her. The driver applied her brakes and deposited 8.7 meters (28.4 ft) of locked wheel skidmarks.

Vehicle 1 was unable to stop and its front (12FDEW1, 0E PDOF) struck the back of Vehicle 2 (06BDLW1, 180E PDOF). At impact, Vehicle 1 sustained a total Delta-V of 16.9 km/h (10.5 mph)<sup>3</sup>, and a longitudinal Delta-V of -16.9 km/h (-10.5 mph) and both front air bags deployed. Vehicle 2 sustained a total Delta-V of 9.3 km/h (5.8 mph), and a longitudinal Delta-V of 9.3 km/h (5.8 mph). These results fit the collision model and appear reasonable.

The front seat lap and shoulder restraints of Vehicle 1 are equipped with emergency locking retractors, and load limiters (energy management loops) that did not separate in either seat position. There are indications of previous seat belt usage on both sides (the vehicle has 79,926 km/-49,665 miles). There was evidence of loading on the driver's seat belts, but very little evidence of loading front passenger's seat belts.

Prior to the collision with Vehicle 2, the driver of Vehicle 1 was seated in a fabric covered bucket seat with a folding back. The seat was slightly reclined at a 14E angle and adjusted to between forward most and middle track position. She is presumed to have been seated in an upright position with both of her hands on the steering wheel. She was restrained by the available lap and shoulder belts. At impact with Vehicle 2, her right foot was depressing the brake pedal and her left foot was depressing the clutch pedal. Due to the pre-impact braking she was projected forward and loaded the lap and shoulder belts. At impact with Vehicle 2, the driver's air bag deployed and came into contact with the driver's left forearm causing contusions and abrasions (AIS-1). The driver of Vehicle 1 was transported via ground ambulance to a local medical center. It is not clear if she received treatment for her injuries.

The front right occupant of Vehicle 1 sustained fatal injuries in this collision. Prior to the collision with Vehicle 2, the front right occupant in Vehicle 1 was seated in a fabric-covered bucket seat with a folding back. The seat was reclined at a 23E angle and was adjusted to between the middle and rear-most track position. She was seated in an upright position, and was preoccupied with her coloring book. She was wearing the lap belt with the shoulder belt behind her. The pre-impact braking and subsequent impact caused her to pitch forward and into close proximity of the now-deploying air bag. The air bag struck her directly in the face, the anterior part of the neck, chest, and both arms. As the air bag continued its unfolding pattern it accelerated her head rearward causing the fatal injury of a complete dislocation of the occipital bone (AIS-2) and the first cervical vertebra with a laceration an almost a complete transection of the pons and medulla (AIS-6). She also sustained a subarachnoid hemorrhage

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<sup>3</sup> Computed using WinSmash with the Damage Only Option

(AIS-3) around the base to the cerebellum and brain stem; moderate to severe cerebral edema (AIS-4), and mild to moderate edema and congestion to her lungs (AIS-3). She sustained numerous contusions (AIS-1) and abrasions (AIS-1) about her face, neck, chest, abdomen, both of her upper arms, and her right fingers as a result of contact with the air bag. She sustained a contusion (AIS-1) to her right lateral leg that may have been caused by contact with the instrument panel, and an abrasion (AIS-1) to her lateral thigh.

Immediately after the collision, bystanders came out of local businesses. They saw the driver of Vehicle 1 screaming for help for her child, and saw smoke emanating from Vehicle 1, which was perceived as a fire. The front right occupant was removed from Vehicle 1 and carried into one of the businesses. Medical records indicate that she was unconscious, unresponsive with agonal<sup>4</sup> respirations and no pulse. A deputy was on scene almost immediately and he initiated cardiopulmonary resuscitation, and the investigating police officer noted that she was completely blue when he first saw her. Initially she was transported via ground ambulance to a site where she was airlifted to a medical center. Her Glasgow Coma Scale was noted as a 3. She arrived at the medical center where she received 50 minutes of preoperative resuscitation. A lateral C-spine x-ray showed the occipital dislocation and she was declared brain dead at 1420 hours of the same day. Her eyes and heart were harvested for organ donation.

#### Rescue Activities time line:

| <u>Event</u>                       | <u>Event Time</u> |
|------------------------------------|-------------------|
| Ambulance called                   | 1213              |
| Collision Reported to police       | 1215              |
| Police arrived at scene            | 1223              |
| Ambulance departed scene           | 1247              |
| Helicopter alerted                 | 1225              |
| Helicopter arrived at scene        | 1250              |
| Helicopter left scene              | 1303              |
| Helicopter arrived at hospital     | 1319              |
| Hospital records indicate admitted | 1311              |
| Time of Death                      | 1420 hours        |

Both occupants in Vehicle 2 reported that they had not been injured.

Vehicle 1 was towed from the scene, but was driveable. Vehicle 2 was not damaged, there was only paint transfer only to the back bumper. Vehicle 2 was driven from the scene by its driver.

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<sup>4</sup> When the heart stops beating in cardiac arrest the breathing center in the brain is still alive for a couple of minutes and will cause the victim to take a few abnormal breaths. These abnormal breaths associated in dying are called agonal respirations. They may appear like snoring, gasping, or snorting and will disappear in a couple of minutes.

**DETAILED INFORMATION****Vehicles**Vehicle 1

|                     |   |                                   |
|---------------------|---|-----------------------------------|
| Description:        | 1995 Hyundai Accent L 3-door Hatchback  |                                   |
| VIN:                | KMHVD14NXSUXXXXXXX  |                                   |
| Odometer:           | 79,926 km (49,665 miles)  |                                   |
| Engine:             | 1.5 L OHC L4  |                                   |
| Vehicle History:    | The vehicle's front end had a different shade of paint indicating previous damage and repairs. The vehicle was reportedly purchased from rental car agency. It is not known if the air bags had previously deployed.  |                                   |
| Cargo:              | None  |                                   |
| Damage Description: | Moderate damage to the front bumper, hood, grille area, front left fender and windshield. The hood was displaced rearward and buckled upward at the left corner. There was contact damage and white paint transfers beginning at the front left bumper corner and extending laterally towards the front right bumper corner. The windshield was cracked by the front right passenger's air bag module cover. The vehicle was towed from the scene but not due to damage since the vehicle was driveable; it was driven to where it was inspected. |                                   |
| CDC:                | 12FDEW1   |                                   |
| Impact Speed:       |   | 17.2 km/h (10.7 mph) <sup>5</sup> |
| Delta V:            | Total   | 16.9 km/h (10.5 mph)              |
|                     | Longitudinal  | -16.9 km/h (-10.5 mph)            |
|                     | Latitudinal   | 0 km/h (0 mph)                    |
|                     | Energy  | 8, 509 joules<br>( 6,276 ft-lbs)  |

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<sup>5</sup> Calculated combining total delta v and post impact skidmark, see Attachment A





**Figure 2.** Damage to Vehicle 1.

**Air bag System:**

Vehicle 1 was equipped with a driver's air bag and mid-mounted front right passenger's air bag. The steering wheel hub mounted driver's air bag is circular and is 54.5 cm (21.5 in) in diameter; it has two vent holes, two tethers, and ten horizontal folds. There were black smudges on the upper right quadrant of the face of the air bag from either contact with the interior module covers or possibly make-up transfer from the driver. The module cover has an "H" configuration; there were no indications of any damage or occupant contact. The passenger side air bag is rectangular in shape and measures 54 cm (21.3 in) high by 42.5 cm (16.7 in) wide; it has two tethers and two vent holes. There is 58 cm (22.8 in) of air bag excursion. The distance from mid-instrument panel to the back of the front right seat is 76 cm (29.9 in). There were no occupant contacts found on the air bag, but there were crayon smearing about the entire face of the air bag (see Figure 3). The module cover is rectangular in shape and there were no indications of damage or occupant contact.



**Figure 3.** Crayon smearing to front right air bag.

The windshield on the right side was cracked by the front right passenger's air bag module cover. There was an air bag imprint on the windshield directly above the steering wheel. There was also an air bag imprint on the right side, on the upper front right quadrant of the windshield. There was also powder residue from the front right passenger's air bag on the front right side window.

Vehicle 2

|                     |   |                     |
|---------------------|---|---------------------|
| Description:        | 1985 Ford LTD Crown Victoria 4-door                           |                     |
| VIN:                | 2FABP43G7FXXXXXXX   |                     |
| Odometer:           | 118,596 km (73,694 miles)                                     |                     |
| Engine:             | 5.8 L V8  |                     |
| Reported Defects:   | None reported   |                     |
| Cargo:              | None  |                     |
| Damage Description: | Minor damage to the rear bumper consisting of paint transfer. |                     |
| CDC:                | 06BDLW1   |                     |
| Impact Speed:       | 0 km/h  | (0 mph)             |
| Delta V:            | Total   | 9.3 km/h ( 5.8 mph) |
|                     | Longitudinal  | 9.3 km/h ( 5.8 mph) |
|                     | Latitudinal   | 0 km/h (0 mph)      |
|                     | Energy  | 9,425 Joules        |



**Figure 4.** Damage to Vehicle 2.

( 6,958 ft-lbs)

**Occupants**

| <u>Vehicle 1</u>                | Occupant 1   | Occupant 2  |
|---------------------------------|--|---|
| Age/Sex:                        | 27/Female  | 5/Female  |
| Seated Position:                | Front left   | Front right   |
| Seat Type:                      | Fabric-covered bucket seats with folding backs                           | Fabric-covered bucket seats with folding backs                                  |
| Height:                         | 158 cm (62 in)   | 122 cm (48 in)  |
| Weight:                         | 64 kg (140 lbs)  | 23.6 kg (52 lbs)  |
| Occupation:                     | Unknown  | NA  |
| Pre-existing Medical Condition: | None noted   | None noted on medical records   |
| Alcohol/Drug Involvement:       | None   | NA  |
| Driving Experience:             | Presumed to be > 10 years  | NA  |
| Body Posture:                   | Normal, upright  | Sitting upright coloring with crayons   |
| Hand Position:                  | Presumed both on steering wheel  | Holding crayons and coloring book   |
| Foot Position:                  | Right foot depressing brake pedal, and left foot depressing clutch pedal | Dangling over the leading edge of the seat cushion                              |
| Restraint Usage:                | Lap and shoulder restraint used properly                                 | Lap and shoulder restraints used improperly. Shoulder restraint behind her back |
| Air bag:                        | Deployed as a result of impact   | Deployed as a result of impact  |

| <u>Vehicle 2</u>                | Occupant 1  | Occupant 2   |
|---------------------------------|---|--|
| Age/Sex:                        | 46/Male   | 36/Male  |
| Seated Position:                | Front left  | Front right  |
| Seat Type:                      | Split bench with separate back cushion                | Split bench with separate back cushion             |
| Height:                         | 191 cm (75 in.)                                       | 168 cm (66 in.)                                    |
| Weight:                         | 109 kg (240 lbs.)                                     | 68 kg (150 lbs.)                                   |
| Occupation:                     | Unknown   | Unknown  |
| Pre-existing Medical Condition: | Unknown   | Unknown  |
| Alcohol/Drug Involvement:       | None  | None   |
| Driving Experience:             | Presumed > 30 years                                   | Presumed > 20 years                                |
| Body Posture:                   | Unknown   | Unknown  |
| Hand Position:                  | On steering wheel                                     | Unknown  |
| Foot Position:                  | Right foot depressing brake pedal, left foot on floor | Unknown  |
| Restraint Usage:                | Lap and shoulder restraints used—per police report    | Lap and shoulder restraints used—per police report |
| Air bag:                        | NA  | NA   |

**Injuries and Injury Mechanisms**Vehicle 1

|                       | <u>INJURY</u>   | <u>OIC CODE</u> | <u>ICD-9</u> | <u>SOURCE</u>       |
|-----------------------|---|-----------------|--------------|---------------------|
| Driver:               | Contusions to left forearm  | 790402.1, 2     | 923.10       | Driver's air bag    |
|                       | Abrasions to left forearm   | 790202.1, 2     | 913.0        | Driver's air bag    |
| Front right occupant: | Complete dislocation of occipital bone and the first cervical vertebra with almost complete transection of the pons and medulla. Declared brain dead. | 650208.2, 6     | 847.0        | Front right air bag |
|                       | Subarachnoid hemorrhage around the base of the cerebellum and brain stem  | 140212.6, 8     | 851.65       | Front right air bag |
|                       | Moderate to severe cerebral edema   | 140684.3, 3     | 852.2        | Front right air bag |
|                       | Mild to moderate edema and congestion to lungs  | 140664.4, 3     | 348.5        | Front right air bag |
|                       | Contusion to right cheek covering an area measuring overall 9x7 cm  | 441402.3, 9     | 518.4        | Front right air bag |
|                       | Contusion to right cheek covering an area measuring overall 9x7 cm  | 290402.1, 1     | 920          | Front right air bag |
|                       | Abrasion to right cheek covering an area measuring overall 9x7 cm   | 290202.1, 1     | 910.0        | Front right air bag |

|  |                            |                |                     |
|--|----------------------------|----------------|---------------------|
| Circular contusion to upper lip  | 290402.1, 8                | 920            | Front right air bag |
| Abrasion to upper lip  | 290202.1, 8                | 910.0          | Front right air bag |
| Extensive contusion to lower lip   | 290402.1, 8                | 920            | Front right air bag |
| Abrasion to lower lip  | 290202.1, 8                | 910.0          | Front right air bag |
| Laceration of the frenulum   | 290600.1, 8                | 873.49         | Front right air bag |
| Abrasion to inferior portion of the chin measuring 17x5 cm   | 290202.1, 8                | 910.0          | Front right air bag |
| Triangular shaped abrasion covering the anterior neck and anterior chest measuring overall 15x9 cm | 390202.1, 5<br>490202.1, 0 | 910.0<br>910.0 | Front right air bag |
| Abrasion to right anterior arm, midway between elbow and shoulder measuring 5.5x2.5 cm             | 790202.1, 1                | 912.0          | Front right air bag |
| Contusion to right posterior thumb measuring 1.5x1 cm  | 790402.1, 1                | 923.3          | Front right air bag |
| Contusion of right posterior index finger involving middle knuckle measuring 2.7x1.6 cm            | 790402.1, 1                | 923.3          | Front right air bag |
| Abrasion to the left anterior and lateral forearm and arm measuring 21x9 cm                        | 790202.1, 2                | 912.0          | Front right air bag |

|  |                            |                |                                 |
|--|----------------------------|----------------|---------------------------------|
| Four abrasions covering lower chest and upper abdomen both on the right and left sides measuring 10x9 cm | 590202.1, 1<br>590202.1, 2 | 911.0<br>911.0 | Front right air bag             |
| Contusion right lateral leg below the knee measuring 3x3 cm  | 890402.1, 1                | 924.10         | Possibly right instrument panel |
| Linear abrasions to right lateral thigh measuring 14x3 cm  | 890202.1, 1                | 916.0          | Source unknown                  |

Vehicle 2

INJURY

|                      |             |
|----------------------|-------------|
| Driver               | Not injured |
| Front right occupant | Not injured |

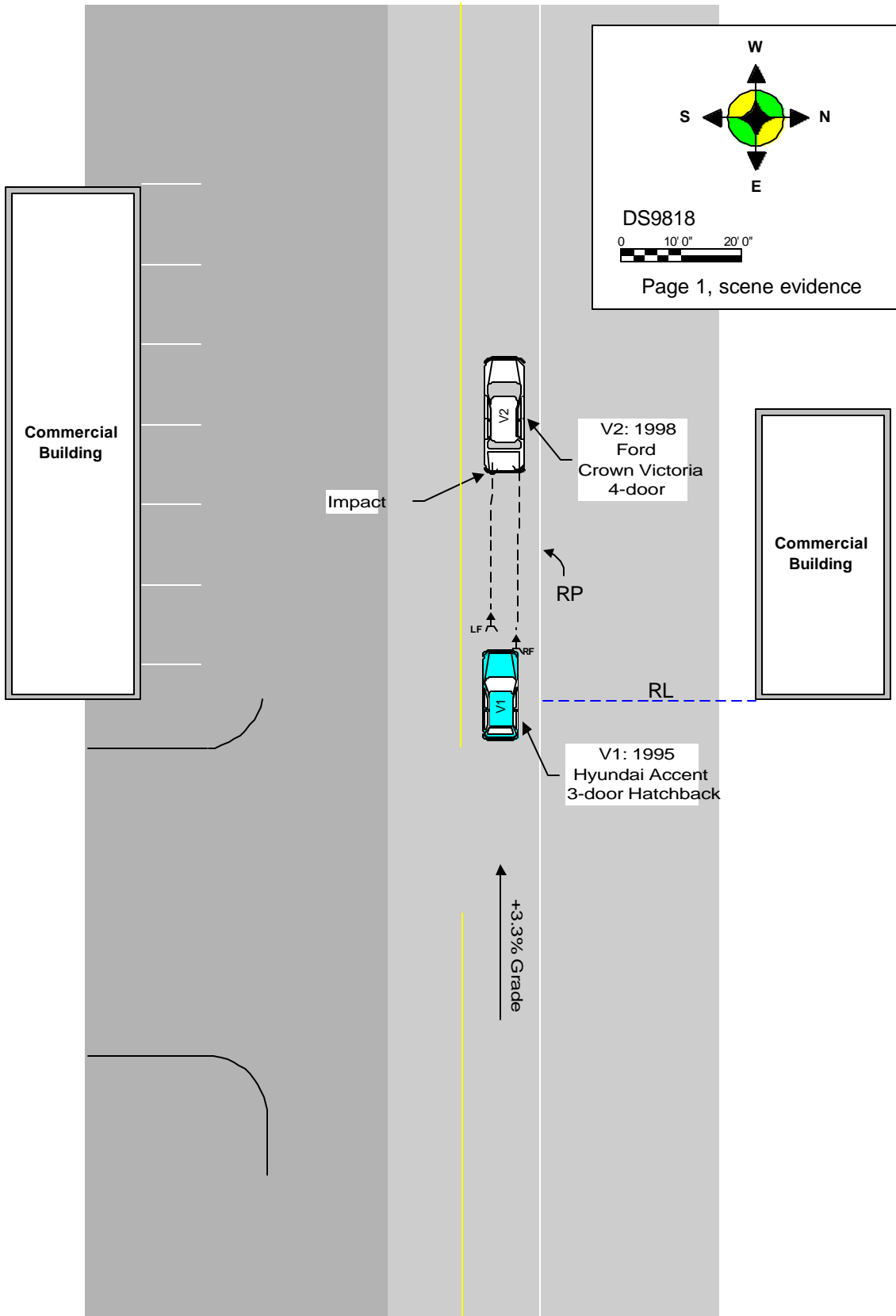
## Occupant Kinematics

Vehicle 1 was traveling westbound at a calculated speed of 39.3 km/h (24.4 mph). Prior to the collision with Vehicle 2, the driver of Vehicle 1 was seated in a fabric covered bucket seat with a folding back. The seat was slightly reclined at a 14E angle and adjusted to between forward most and middle track position. She is presumed to have been seated in an upright position with both of her hands on the steering wheel. She was restrained by the available lap and shoulder belts. At impact with Vehicle 2, her right foot was depressing the brake pedal and her left foot was depressing the clutch pedal. Due to the pre-impact braking she was projected forward and loaded the lap and shoulder belts. At impact with Vehicle 2, the driver's air bag deployed and came into contact with the driver's left forearm. The driver came to rest in an upright seating position.

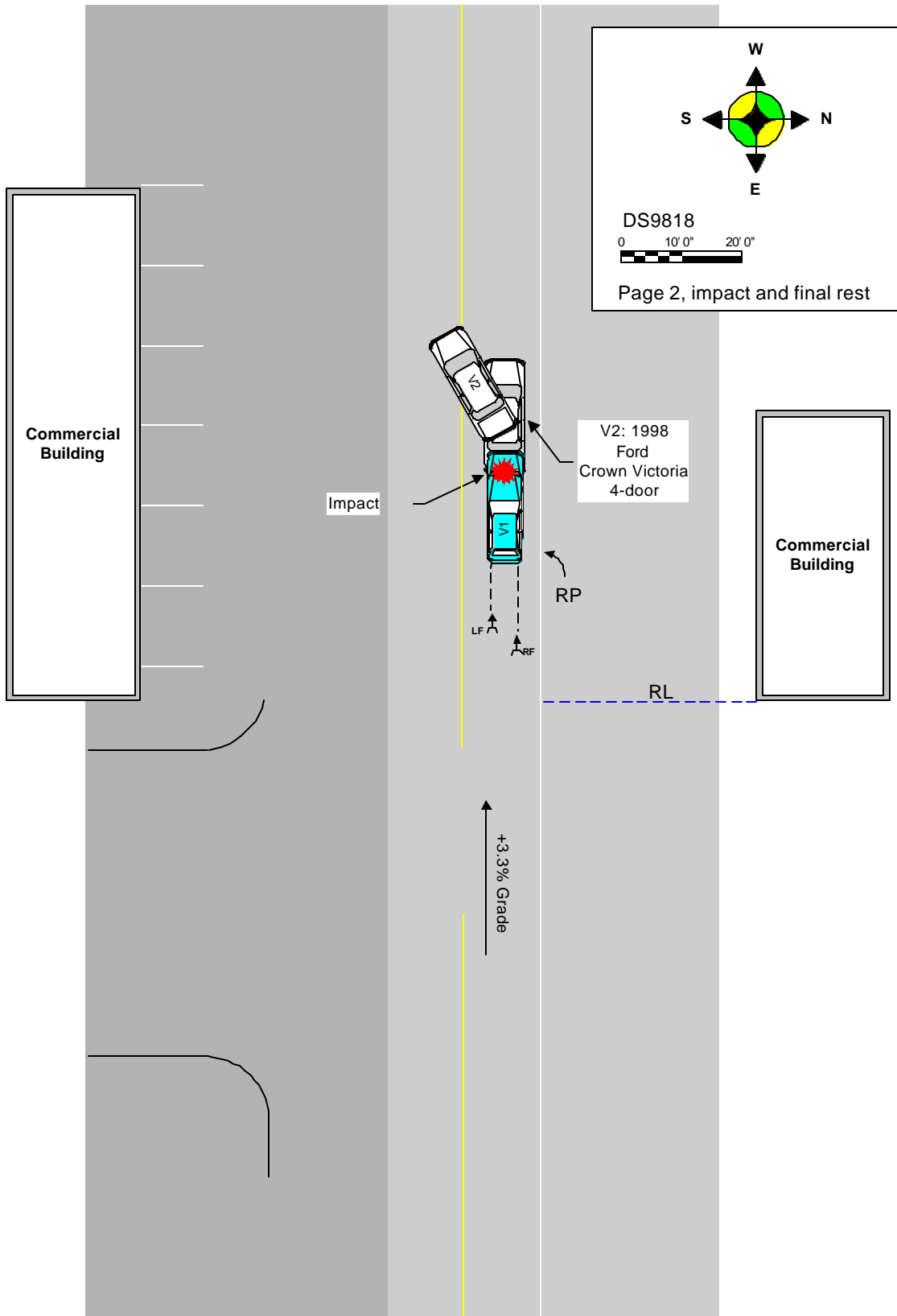
Prior to the collision with Vehicle 2, the front right occupant in Vehicle 1 was seated in a fabric-covered bucket seat with folding a back. The seat was reclined at a 23E angle and was adjusted to between the middle and rear-most track position. She was seated in an upright position, and was preoccupied with her coloring book. The pre-impact braking and subsequent impact caused her to pitch forward and into close proximity of the now-deploying air bag. The air bag struck her directly in the face, the anterior part of the neck, chest, and both arms. As the air bag continued its unfolding pattern "it snapped" and accelerated her head rearward causing the fatal injury of a complete dislocation of the occipital bone and the first cervical vertebra with a laceration an almost a complete transection of the pons and medulla.



Scene Diagram - page 1



Scene Diagram - page 2



**COLLISION MEASUREMENTS**

**Reference point:** North Edge fog line of East-West Roadway

**Reference line:** East End of Commercial Building on North Side of Roadway Edge

| <b>Data Point</b>            | <b>Distance and Direction from Reference Point</b> | <b>Distance and Direction from Reference Line</b> |
|------------------------------|--|---|
| Begin RF skidmark            | 3' 8" S  | 11' 7" W  |
| Impact                       | 3' 6" S  | 38' 3" W  |
| End RF skidmark (final rest) | 3' 5" S  | 40' 6" W  |
|                              |  |   |
| Begin LF skidmark            | 8' 3" S  | 15' 10" W   |
| Impact                       | 8' 2" S  | 38' 3" W  |
| End LF skidmark (final rest) | 8' 1" S  | 39' 3" W  |
|                              |  |   |
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|                              |  |   |

**ATTACHMENT A**

**CASE NUMBER: None**

Comments: DS9818 Minimum travel speed from RF skidmark

**\* \* MINIMUM SPEED W/ KNOWN DRAG FACTOR \* \***

$$S = \sqrt{30 \times D \times f}$$

$$S = \sqrt{30 \times 28.42 \times 0.70}$$

$$S = \sqrt{596.82}$$

$$S = 24.42$$

S = The Speed in MPH.

30 = A Constant.

D = The Distance in Feet.

f = The Adjusted Accel/Drag Factor.

| INPUTS:                          |       |
|----------------------------------|-------|
| The Acceleration/Drag Factor is: | 0.70  |
| The Distance in Feet is:         | 28.42 |

| RESULTS:                |       |
|-------------------------|-------|
| The Speed in MPH is:    | 24.42 |
| The Velocity in FPS is: | 35.79 |

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**CASE NUMBER: None**

Comments: DS9818 Impact speed calculated using post impact skidmark and total delta v

**\* \* COMBINED MINIMUM SPEEDS W/ KNOWN SPEEDS \* \***

$$S = \sqrt{S^2(1) + S^2(2) + \dots S^2(n)}$$

$$S = \sqrt{(2.30)^2+(10.50)^2+(0.00)^2+(0.00)^2+(0.00)^2+(0.00)^2+(0.00)^2+(0.00)^2}$$

$$S = \sqrt{5.29+110.25+0.00+0.00+0.00+0.00+0.00+0.00}$$

$$S = \sqrt{115.54}$$

$$S = 10.74$$

S = The Speed in MPH.  
 S<sup>2</sup> = The Individual Min. Speed.  
 (1), (2), (n) = The # of the individual speed.

| INPUTS:             |       |
|---------------------|-------|
| Speed #1 in MPH is: | 2.30  |
| Speed #2 in MPH is: | 10.50 |

| RESULTS:                |       |
|-------------------------|-------|
| The Speed in MPH is:    | 10.74 |
| The Velocity in FPS is: | 15.74 |

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