CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE CHILD SAFETY SEAT VEHICLE CRASH INVESTIGATION

CASE NO: CA06-010

VEHICLE: 1989 CHEVROLET BLAZER

LOCATION: VIRGINIA

CRASH DATE: MAY 2006

Contract No. DTNH22-01-C-17002

Prepared for:

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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 are 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 This investigation focused on the performance of a rear-facing infant Child Safety Seat (CSS) that was placed in the rear right position of a 1989 Chevrolet Blazer. The Blazer was occupied by an unrestrained 47-year-old female driver, an unrestrained 2-year-old male seated in the rear left position, and a 9-month-old female who was restrained in an infant CSS in the rear right seating position of the vehicle. The Blazer was involved in a head-on crash with a 1996 Ford F-350 straight truck after crossing the centerline of the roadway and entering the F-350's travel lane. The Blazer sustained severe front and left side damage as the result of the impact. The infant CSS was used without the detachable base and was placed on the vehicle's seat in a rear-facing configuration. Following the crash, the seat was found wedged between the front right seat back and the rear right seat cushion face-down with the child's head facing the rear of the vehicle. The 9-month-old female sustained a closed head injury, fractures to her left clavicle and left orbit, and multiple soft-tissue injuries. She was transported to a trauma center by helicopter and admitted for treatment for 6 days. The unrestrained female driver of the Blazer sustained massive trauma to the head and chest and she was found post-crash pinned between the intruded roof and seat back and expired at the scene. The unrestrained 2-year-old male child was found lying post-crash with his torso and extremities on the rear left floor and his head wedged between the front left seat back and the B-pillar; he sustained a police-reported skull fracture and expired at the scene. The driver and rear left child passenger were transported to the county morgue. No autopsies were performed. The driver and front right passenger of the F-350 were not injured.			
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BACKGROUND


Figure 1 - Damaged 1989 Chevrolet Blazer

This investigation focused on the performance of a rear-facing infant Child Safety Seat (CSS) that was placed in the rear right position of a 1989 Chevrolet Blazer. The Blazer (**Figure 1**) was occupied by an unrestrained 47-year-old female driver, an unrestrained 2-year-old male seated in the rear left position, and a 9-month-old female who was restrained in an infant CSS in the rear right seating position of the vehicle. The Blazer was involved in a head-on crash with a 1996 Ford F-350 straight truck after crossing the centerline of the roadway and entering the F-350's travel lane. The Blazer sustained severe front and left side damage as the result of the impact. The infant CSS was used without the detachable base and was placed on the vehicle's seat in a rear-facing configuration. Following the crash, the seat was found wedged between the front right seat back and the rear right seat cushion face-down with the child's head facing the rear of the vehicle. The 9-month-old female sustained a closed head injury, fractures to her left clavicle and left orbit, and multiple soft-tissue injuries. She was transported to a trauma center by helicopter and admitted for treatment for 6 days. The unrestrained female driver of the Blazer sustained massive trauma to the head and chest and she was found post-crash pinned between the intruded roof and seat back and expired at the scene. The unrestrained 2-year-old male child was found lying post-crash with his torso and extremities on the rear left floor and his head wedged between the front left seat back and the B-pillar; he sustained a police-reported skull fracture and expired at the scene. The driver and rear left child passenger were transported to the county morgue. No autopsies were performed. The driver and front right passenger of the F-350 were not injured.

The Special Crash Investigations SCI team at Calspan became aware of this crash through an Internet news search for cases of interest to SCI. The notification was forwarded to the Crash Investigation Division of the National Highway Traffic Safety Administration and an on-site investigation was assigned on May 10, 2006. Cooperation with the investigating police agency was established and both vehicles and the CSS were inspected on May 15, 2006.

SUMMARY

Vehicle Data – 1989 Chevrolet Blazer

The 1989 Chevrolet Blazer was identified by the Vehicle Identification Number (VIN): 1GNCT18Z4K0 (production number omitted). The vehicle's odometer read 464,238 km (182,771 miles). The Blazer was a two-door 4x4 sport utility vehicle and was equipped with a 4.3-liter, six-cylinder engine, an automatic transmission, and power assisted front disc/rear drum brakes. The Blazer was configured with 38 cm (15") steel wheels and Winston Winner G/T

P215/65R15 tires. The manufacturers recommended tire pressure was 240 kPa (35 PSI). The specific tire information at the time of the SCI vehicle inspection was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	0 kPa	2 mm (3/32")	No	Tear in sidewall and tread
LR	103 kPa (15 PSI)	3 mm (4/32")	No	None
RF	200 kPa (29 PSI)	2 mm (2/32")	No	None
RR	97 k Pa (14 PSI)	3 mm (4/32")	No	None

The Chevrolet Blazer was configured with front bucket seats with folding backs and integral head restraints. At the time of the SCI inspection, the driver's seat was adjusted to 20 cm (8") rear of full-forward and 11 cm (4.5") forward of full-rear. The second row was configured with a bench seat with folding seat backs and no head restraints.

Vehicle Data – 1996 Ford F-350 Super Duty

The 1996 Ford F-350 Super Duty straight truck was identified by the VIN: 1FDLF47F7TE (production number omitted). The 1½ ton truck was equipped with a large cargo box approximately 540 cm (212") in length and 305 cm (120") in height, mounted to a chassis-cab frame. The 4 x 2 vehicle was equipped with a conventional cab and a 469 cm (184.8") wheelbase. The truck weighed 3,047 kg (6,717 lb) and was configured with a 5-speed manual transmission, ABS brakes, a tilt steering wheel, dual rear wheels, and power steering. The F-350 was equipped with 41 cm (16") steel wheels and varied Firestone brand LT235/85R16 tires. The manufacturers recommended tire pressure was 552 kPa (80 PSI). The specific tire information at the time of the SCI vehicle inspection was as follows:

Position	Tire Make/Model	Measured Pressure	Measured Tread Depth	Damage
LF	Wheel missing	Unknown	Unknown	Unknown
RF	Firestone Steeltex Radial	517 kPa (75 PSI)	3 mm (4/32")	None
LR (outer)	Firestone Transforce H/T	Unknown	9 mm (11/32")	None
LR (inner)	Firestone Transforce H/T	Unknown	9 mm (11/32")	None
RR (outer)	Firestone Transforce H/T	Unknown	10 mm (12/32")	None
RR (inner)	Firestone Transforce H/T	Unknown	9 mm (11/32")	None

The 1996 Ford F-350 was configured with a front split-bench seat for three frontal seating positions. The two outboard seats were equipped with integral head restraints.

Crash Site

This two-vehicle crash occurred in the northbound lane of a two-lane rural roadway during the daylight hours of May 2006. At the time of the crash, there were no adverse weather conditions and the asphalt roadway was dry. The north/south roadway was configured with one lane in each direction separated by a double-yellow painted centerline, with a white fog line outboard of each. The travel lanes were both 3.4 m (8.6') in width and the roadside shoulders were 0.4 m (1.3'). The southbound roadway **(Figure 2)** was straight with a negative 2 percent slope and was leading to a sharp left curve with a super elevation of 3 percent. The northbound roadway

(Figure 3) was straight at the point of impact, but had just diverged from a sharp right curve 8 m (26.2') prior to the point of impact. The roadway was bordered by gravel and natural growth. The west roadside was 2.5 m (6.4') in width before declining steeply down a hillside. A 1 m (3.3') wide ditch was present on the east roadside before ascending up a steep hillside. The posted speed limit was 64 km/h (40 mph). The scene schematic is included as **Figure 15** of this narrative report.

Figure 2 - Northbound approach of 1996 Ford F-350

Figure 3 - Southbound approach of 1989 Chevrolet Blazer.

Crash Sequence

Pre-Crash

The 47-year-old female driver of the 1989 Chevrolet Blazer was southbound approaching a sharp left curve. The 54-year-old male driver of the 1996 Ford F-350 Super Duty was northbound emerging from a right curve. The driver of the Blazer crossed over the double-yellow centerline and partially entered the northbound lane. There was no physical evidence to support pre-crash braking from either vehicle. It does not appear that any crash avoidance measures were taken.

Crash

The front left aspect of the Blazer impacted the front aspect of the F-350 in an offset configuration in the northbound lane. The crush profile was understated due to the corner engagement between the two vehicles. As the two vehicles crushed, their respective front left wheels engaged causing a fracture to the Blazer's front left tie-rod and deforming the wheel rearward 23 cm (9.1"). The front left wheel of the F-350 fractured from the axle and was discarded prior to the SCI inspection. Following the wheel-to-wheel impact, the front and left side of the F-350 climbed the front end of the Blazer and impacted the left A-pillar, roof, and down the left side before the vehicles separated en-route to final rest. This crash falls outside the scope of the WinSMASH program due to the modifications of the F-350 and the side engagement between the two vehicles. However, the barrier routine of the WinSMASH program was computed based on the Blazer's frontal crush profile and the resultant borderline total delta-V was 26 km/h (16.1 mph). The longitudinal and lateral components were -26 km/h (-16.1) and 5 km/h (3.1 mph), respectively. The delta-V results were anecdotal and should not be viewed as representative of this crash.

As the vehicles separated, the Blazer traveled in a southbound direction approximately 5 m (16.4') while rotating counterclockwise 40 degrees and came to rest in the center of the roadway

straddling the double-yellow centerline. At rest, the Blazer was facing a southeasterly direction. The F-350 traveled in a northbound direction and entered the east shoulder before crossing the roadway in a northwesterly direction and exiting the west roadside approximately 20 m (51') from the point of impact. Several gouges were visible on the roadway in the area of the point of impact. Additionally, fluid spills and final rest markers were present indicating the post-impact positions of the vehicles. Yaw marks began at the point of impact, followed a trajectory onto the east shoulder, crossed over the roadway, and diminished at the F-350's marked final rest position.

Post-Crash

The driver and left rear child passenger of the Blazer sustained fatal injuries and expired prior to the arrival of emergency personnel. The 9-month-old female seated in the rear-facing CSS was wedged upside-down between the seats and was heard to be crying by a passing motorist. An off-duty nurse, who stopped for the crash, entered the vehicle through rear right shattered window opening and placed the CSS in an upright position. After administering first aid, she cut the integrated harness straps with scissors and removed the child from the CSS. She placed the child on a wooden board provided by another passerby. She then cut the shoulder portion of the rear right manual lap and shoulder restraint and removed the child on the board from the rear right window opening, with the assistance of other witnesses. The infant was placed on the roadside and comforted until the arrival of emergency personnel. The infant sustained multiple fractures and soft-tissue injuries and was airlifted to a trauma center for treatment.

Vehicle Damage

Exterior Damage – 1989 Chevrolet Blazer

The 1989 Chevrolet Blazer sustained severe frontal and left side damage due to the off-set frontal impact with the front and left side, including the cargo box, of the 1996 Ford F-350 Super-Duty straight truck **(Figure 4)**. The direct contact damage began 27 cm (10.7") left of the vehicle's centerline and extended 48 cm (18.9") to the left front bumper corner. A width of 19 cm (7.5") of the chrome bumper at the left front corner was separated and discarded prior to the SCI investigation. The separation was outboard of the frame rail and the crush profile was not altered due to this separation. The position of the left corner was estimated resulting in a Field L measurement of 144 cm (56.7"). The maximum crush was located at the front left bumper corner and measured 55 cm (20.5) in depth. The direction of force for the Blazer was 12 o'clock. The Collision Deformation Classification (CDC) was 12-FLEW-3. Six equidistant crush measurements were documented along the bumper beam and were as follows: C1 = 55 cm (20.5"), C2 = 18 cm (5.9"), C3 = 10 cm (2.8"), C4 = 5 cm (0.8"), C5 = 1 cm, C6 = 0 cm. The C1 measurement was estimated due to the separated front bumper.

Figure 2 - Damaged frontal plane - 1989 Chevrolet Blazer.

The greatest extent of the crush was located outside the frame rail, which allowed engagement onto the left side structure. The Blazer's front left wheel was damaged due to contact with the front left wheel of the F-350. This engagement fractured the tie-rod, tore the sidewall and tread

of the front left tire, and damaged the wheel rim. The left front wheel was displaced rearward 23 cm (9.1) and compressed the wheelbase to 237 cm (93.3”). No individual CDC was assigned to this event due to it being a continuous engagement from the initial impact.

Figure 3 - Damaged left side of 1989 Chevrolet Blazer.

As the vehicles continued to engage, the Blazer’s left front wheel yielded allowing the F-350 to partially ramp up the front end of the Blazer and contact the left side, left A-pillar, and the roof **(Figure 5)**. The direct contact damage down the left side of the Blazer extended from the front left bumper corner 323 cm (127.2”) rearward, before terminating 112 cm (44.1”) forward of the left rear bumper corner. The front left fender was peeled rearward and laterally 46 cm (18”) outboard of the vehicle’s baseline. The left side sustained crush from the F-350 along the mid-door level. The maximum crush on the left side was located 20 cm (8”) rear of the B-pillar and was 34 cm (13.5”) in depth. The left A-pillar was deformed laterally 42 cm (16.5”) into the passenger compartment and the roof was deformed 44 cm (17.5”) vertically from contacting the front bumper and cargo box of the F-350. The Blazer’s hood protruded through the windshield and into the passenger compartment reaching a maximum encroachment of 11 cm (4.5”) located 21 cm (8.3”) inboard of the lower left aspect of the windshield. The right aspect of the Blazer’s hood shifted from its original position 69 cm (27”) to the left. Direct contact damage was present on the vehicle’s cowl beginning at its left most aspect and extending to the right 20 cm (8”). The front left door of the vehicle was removed by the emergency personnel and was not available for an inspection.

Interior Damage – 1989 Chevrolet Blazer

Figure 6 - Front left seating area of 1989 Chevrolet Blazer.

The 1989 Chevrolet Blazer sustained severe interior damage as a result of passenger compartment intrusion **(Figure 6)**. The static intrusions were altered due to the extrication measures performed by the emergency personnel. All three left side and the right side A- and C- pillars were mechanically cut. The instrument panel was displaced forward and several components were manually detached post-crash, presumably by rescue efforts. The steering column intruded into the passenger compartment 20 cm (8”). The spokes and mounting flange of the wheel assembly were deformed from occupant loading. The column compressed from the shear capsules and the steering assembly collapsed. The fractured lower instrument panel was the result of passenger compartment intrusion and in all probability direct contact of the driver’s lower extremities. The bottom of the left sun visor sustained a fabric tear located 13 cm (5”) inboard of the far left aspect and 20 cm (7.9”), inboard of the far right aspect. It was possible that this component was contacted by the driver; however, considering the level of intrusion, it was more likely due to an intruding component. The roof intruded both longitudinally and vertically into all three frontal sectors and the windshield header

Figure 7 - Left A-pillar in relation to seat back.

Figure 8 - Left A-pillar in relation to seat back.

intruded vertically into the front left and center sectors. The floor pan and toe pan intruded moderately into front left sector and the left A-pillar intruded laterally 25 cm (9.8”). Despite an absence of distinct physical evidence at the vehicle inspection, witnesses recall the driver as being pinned between the intruded roof and the front left seat back. It is likely that the driver contacted the left instrument panel, and the front bumper and potentially the cargo box of the F-350. The post-crash position of the left aspect of the roof was found to be rear of the driver’s seat at the time of the SCI inspection. Due to the height of the seat back in relation to the roof **(Figures 7 and 8)**, emergency personnel probably manually lifted the roof and adjusted the seat back forward after removing the driver to allow access to the rear left occupant.

The back aspect of the front left seat back contained direct contact evidence and body fluid transfers from the 2-year-old child seated in the rear left position. A scuff was present on the lower left aspect of the seat back that measured 5 cm (2”) in length. A linear blood transfer located 3 cm (1.2”) inboard of the right aspect of the seatback was present beginning at the bottom aspect and ascending vertically 18 cm (7.3”) **(Figure 9)**. Pooled blood was present on the second row floor in the center and left seating positions. The plastic panel housing of the left B-pillar sustained two linear cracks 6 cm (2.5”) in length and an underlying scuff mark. The left side B-pillar and side panel intruded laterally into the second row left seating position.

Figure 9 – Loading and body fluids on seat back.

The specific passenger compartment intrusions were documented by their magnitude as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
FL	Roof	66 cm (26”)	Longitudinal
FC	Roof	61 cm (24”)	Longitudinal
FL	Roof	42 cm (16.5”)	Vertical
FL	Windshield header	40 cm (15.5”)	Vertical
FL	Instrument panel	33 cm (13”)	Longitudinal

FC	Roof	28 cm (11”)	Vertical
FC	Windshield header	25 cm (9.8”)	Vertical
FL	A-pillar	25 cm (9.8”)	Lateral
FC	Instrument panel	22 cm (8.7”)	Longitudinal
FL	Steering column	20 cm (7.9”)	Longitudinal
FR	Roof	13 cm (5.1”)	Vertical
FL	Roof side rail	11 cm (4.3”)	Lateral
RL	Side panel	9 cm (3.5”)	Lateral
FL	Floor pan	8 cm (3.1”)	Vertical
FL	Toe pan	8 cm (3.1”)	Longitudinal
RL	B-pillar	6 cm (2.4”)	Lateral

**The roof and header intrusions were slightly altered by emergency personnel.*

Exterior Damage – 1996 Ford F-350 Super Duty Straight Truck

The 1996 Ford F-350 sustained moderate damage as a result of the offset frontal impact with the 1989 Chevrolet Blazer **(Figure 10)**. The direct contact damage across the vehicle’s bumper beam began 16 cm (6.3”) left of the vehicle’s centerline and extended 64 cm (25”) to the left front bumper corner. The direct contact damage across the vehicle’s hood began at the hood’s left corner and extended 62 cm (24.5”) to the right. The direct and induced damage extended the full width of the bumper beam and measured 170 cm (67”). The crush profile was projected slightly due to the altered state of the vehicle. The crush profile stands were set from the rear axle forward 555 cm (218.5”) to include the original wheelbase and front overhang. The maximum crush was located at the front left bumper corner and was 31 cm (12.2”) in depth. The front left wheel was fractured from the axle and was not present during the SCI inspection. Due to the offset manner in which this impact occurred, subsequent direct contact damage extended 153 cm (60.2”) down the left side of the cab aspect of the F-350. Red paint transfers from the Blazer accompanied the direct damage on the left side of the F-350. The direction of force for the F-350 was 12 o’clock. Six equidistant crush measurements were documented along bumper beam and were as follows: C1 = 31 cm (12.2”), C2 = 5 cm (2”), C3 = 2 cm (0.8”), C4 = 0 cm C5 = 0 cm, C6 = 0 cm. The CDC for the impact with the Blazer was 12-FYEW-2.

Figure 10 - Damaged 1996 Ford F-350.

As the engagement between the two vehicles continued, the F-350 partially climbed the front end and contacted the Blazer’s A-pillar, windshield, and roof before separating. The cargo box **(Figure 11)**, which protruded 25 cm (10”) outboard of the vehicle’s bodyline contacted the Blazer’s roof. The ground clearance for the cargo box was 66 cm (26”) in height. The direct contact damage on the cargo box measured 5 cm (2”) in width across the horizontal plane; the direct contact damage on the cargo box began 18 cm (7”) above the bottom aspect and was 46 cm (18”) in height. A wide-body mirror was present outboard the vehicle’s cab and protruded laterally 40 cm (15.5”). A red paint transfer was present along the horizontal mirror brace,

which was located 114 cm (45”) from the ground. The horizontal paint transfer was 14 cm (5.5”) in length.

Figure 11 - Damaged cargo box on Ford F-350.

Induced damage was present along the entire left side of the F-350’s cab due to the translation of energy from the offset frontal impact. The inertia caused the front left door to deform, and once opened following the impact, it could no longer be closed (sprung-mass). Additionally, the energy translation resulted in three linear stress cracks along the left third aspect of the vehicle’s windshield.

Previous damage was present on the right rear corner of the cargo box. The damage emanated at the right corner of the cargo box and extended forward 66 cm (26”).

Manual Restraint Systems – 1989 Chevrolet Blazer

The 1989 Chevrolet Blazer was equipped with 3-point lap and shoulder belts for the front seating positions. The driver’s belt was configured with separate lap and shoulder belts sewn to a common latch plate. Both belts were configured with an Emergency Locking Retractor (ELR). The driver’s safety belt was not used in this crash; however, it was found to have been cut by the emergency personnel. The safety belt was 30 cm (11.8”) in length from the anchor point to the latch plate and 67 cm (26.4”) in length from the latch plate to the severed aspect. The front right safety belt was also configured with separate lap and shoulder belts sewn to common latch plate and routed to separate ELR’s. The belt was intact at the time of the SCI inspection and measured 122 cm (48”) in length from the anchor point to the latch plate and 71 cm (28”) in length from the latch plate to the retractor housing. There was no discernable contact evidence on either belt and they were both in worn condition.

Figure 12 - Rear right lap and shoulder restraint.

The rear seat was equipped with manual 3-point lap and shoulder belts for the outboard positions. Each was configured with continuous loop webbing, a locking latch plate, and an ELR. The rear right belt was found in the engaged position at the time of the SCI inspection. The rear right safety belt was used to improperly install a rear-facing CSS. The belt’s latch plate was still buckled at the time of the SCI inspection **(Figure 12)**; however, the shoulder portion of the belt was cut by witnesses 34 cm (13.5”) below to the retractor housing was cut as the child was removed from the vehicle following the crash. The CSS was found in the cargo bay of the Blazer during the SCI inspection. Rippling and cupping of the lap belt was present and the webbing was twisted one rotation. The belt was stretched in various locations and loading evidence was present on the lap belt portion of the belt system. The loading evidence was located 23 cm (9.1) from the position of the buckled latch plate and again 51 cm (20.1”) forward thereof. The evidence was consistent with the length of the front aspect of the CSS, which is 36 cm (14”) in width. No loading marks were present on the rear right D-ring. Due to glass and fluid

absorption material strewn into the back seating area, it was difficult to isolate corroborative physical evidence on the seat cushion. Considering the upside-down position of the CSS post-crash, it is probable that the restraint was loose. As the CSS engaged the loosely installed belt system, the top aspect of the CSS engaged the belt system allowing the bottom aspect to move in a forward trajectory against the low frictional vinyl surface of the seat cushion and submarine the belt-system. As the CSS was disengaging from the belt system, it tracked forward while the child was suspended in an upside-down position, and became wedged in-between the rear seat cushion and the front right seat back.

The left rear safety belt was not used by the child occupant seated in the position. The full excursion of the safety belt was 127 cm (50”), 41 cm (16.1”) of which was measured from the anchor to the latch plate and 86 cm (34”) from the latch plate to the retractor housing. Body fluid transfers were present on the belt and the sliding latch plate; however, the belt was found submerged in the pooled body transfers fluid and rain water on the floor at the time of the SCI inspection.

Child Safety Seat

Graco - Aspen Travel System/Winnie the Pooh

A rear-facing infant CSS was installed in the rear right seating position of the Chevrolet Blazer. The model number was 7454WNN and the date of manufacture was March 22, 2003. The infant seat was configured with a three-point harness system and a two-piece locking harness retainer clip. The CSS was designed for rear-facing only, and for children weighing 9 kg (20 lb) or less and whose height was 66 cm (26”) or less. The child’s weight was 10 (22 lb) and her height was 74 cm (29”), both of which exceeded the designated parameters of
the CSS. The CSS is illustrated in **Figures 13 and 14.**

Figure 13 - Frontal view of rear-facing CSS.

Figure 14 - Lateral view of rear-facing CSS.

The CSS was removed from the vehicle and found in the cargo area of the vehicle during the SCI inspection. The CSS was installed without the detachable base and the integrated harness straps had been cut by a passerby who removed the child prior to the arrival of emergency personnel. The left strap was routed through the top harness slots and the retainer clip was positioned 27 cm (10.5”) from the top harness slot and 18 cm (7.3) above the cut point. The remainder of the harness was not contained within the vehicle.

At impact, the CSS initiated a forward and slightly lateral trajectory to the left. The CSS loaded the front right seat back and the rear-facing child loaded the shell of the CSS, which distributed the frontal crash forces. As the CSS rebounded, the loosely installed belt system loaded the top aspect of the CSS allowing the bottom aspect to submarine the belt system and travel forward against the low frictional material of the vinyl seat cushion. The CSS rotated 180 degrees about its longitudinal axis suspending the child in an upside-down position with her head facing the rear of the vehicle. The CSS was found wedged between the front right seat back and the rear right seat cushion.

The CSS was also equipped with an inclinometer, a carrying handle, and a locking clip. The locking clip was not used in this crash. The CSS was designed to be installed with or without the detachable base. The topside of the CSS contained belt paths for securing it into a rear facing position without the detachable base unit. The excursion of the rear right lap was 15 cm (5.8”). The latch plate was still engaged into the buckle at the time of the SCI inspection. The belt was stretched in various locations and loading evidence was present on lap belt portion of the safety system. The loading evidence is located 23 cm (9.1”) from the position of the buckled latch plate and again 51 cm (20.1”) forward thereof. The evidence is consistent with the 36 cm (14”) width of the CSS.

Occupant Demographics

Driver

Age/Sex:	47-year-old/Female
Height:	Not reported
Weight:	Not reported
Seat Track Position:	20 cm (8”) rear of full-forward and 11 cm (4.5”) forward of full-rear
Safety Belt Usage:	Unrestrained
Usage Source:	Vehicle inspection
Eyewear:	Not reported
Type of Medical Treatment:	Expired at scene and was not transported to a medical facility

Driver Kinematics

The 47-year-old driver of the Chevrolet Blazer was seated in an upright posture. She was not restrained by the available lap and shoulder belt. At impact with the F-350, the driver responded to the 12 o’clock direction of force with a forward and slightly left trajectory into the steering column, evidenced by the deformed steering wheel rim. The steering column intruded into the passenger compartment 20 cm (8”). The spokes and mounting flange were deformed from occupant abdominal loading. The column compressed from the shear capsules and the steering assembly collapsed. The driver’s lower extremities contacted the lower instrument panel. This is supported by the fractured panel cover and the location of the driver’s legs in relation to the post-crash position of the instrument panel. According to witness statements the driver was found pinned to the seatback by the intruding roof and A-pillar. Despite a masking of distinct physical evidence, the driver contacted the left A-pillar, the roof, and probably the front bumper and cargo box of the F-350. The driver sustained fatal injuries and expired at the scene. Specific injury information is not known as no official autopsy was performed.

Rear Left Passenger

Age/Sex:	2-year-old/Male
Height:	Not reported
Weight:	Not reported
Seat Track Position:	Not adjustable
Safety Belt Usage:	Unrestrained
Usage Source:	Vehicle inspection
Eyewear:	Not reported
Type of Medical Treatment:	Expired at scene and was not transported to a medical facility

Rear Left Passenger Injuries

Injury	Injury Severity	Injury Source
Skull fracture (NFS)	Moderate (150400.2,9)	B-pillar

**Source – Police.*

Rear Left Occupant Kinematics

The 2-year-old male passenger of the Chevrolet was seated in an unknown posture. He was not restrained by the available lap and shoulder belt. At impact with the F-350, he initiated a forward and upward trajectory and loaded the driver's seat back, evidenced by body fluid transfers along the seat back. As the vehicle rotated counterclockwise, the child continued in a forward and left trajectory and his head contacted the intruding B-pillar, sustaining a police-reported skull fracture. The plastic panel housing of the left B-pillar sustained two linear cracks 6 cm (2.5") in length and an underlying scuff mark. He was found post-crash with his torso and extremities in the rear left floor of the second row with his head wedged between the intruded left B-pillar and the driver's seat back. A large body fluid transfer resulting from the child's injuries accumulated on the vehicle's floor in the rear left and center positions. A small blood splatter emanating from the left was found on the back of the front right seat back. The child sustained fatal injuries and expired at the scene. Specific injury information is not known as no official autopsy was performed.

Rear Right Passenger

Age/Sex:	9-month-old /Female
Height:	74 cm (29")
Weight:	10 kg (22 lb)
Seat Track Position:	Not adjustable
Safety Belt Usage:	Rear-facing CSS with a 3-point harness installed with a manual 3-point lap and shoulder belt
Usage Source:	Vehicle inspection, CSS inspection, witness interview
Eyewear:	None
Type of Medical Treatment:	Airlifted to local hospital and admitted for six days

Rear Right Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Cerebral subdural hematoma	Severe (140650.4,9)	Seat cushion
Left eye orbit fracture	Moderate (251202.2,2)	Seat cushion
Left clavicle fracture	Moderate (752200.2,2)	Integrated harness strap
Right scalp contusion	Minor (190402.1,1)	Seat cushion
Right forehead laceration	Minor (190602.1,1)	Glass on seat cushion
Right forehead abrasion	Minor (290202.1,7)	Glass on seat cushion
Scalp laceration (NFS)	Minor (190600.1,9)	Glass on seat cushion
Scalp laceration (NFS)	Minor (190600.1,9)	Glass on seat cushion
Left eyebrow contusion	Minor (290402.1,7)	Seat cushion
Left eye contusion	Minor (290402.1,2)	Seat cushion
Left arm contusion (NFS)	Minor (790402.1,2)	Integrated harness strap
Left thigh contusion	Minor (890402.1,2)	Integrated harness strap
Left calf contusion	Minor (890402.1,2)	Plastic trim of CSS

Source: Medical Records

Rear Right Passenger Kinematics

The 9-month-old female child was seated in a reclined position in a rear-facing CSS. The CSS was installed by the vehicle's manual 3-point lap and shoulder belt in the rear right position of the Blazer. The child was restrained within the CSS by the 3-point integrated harness. At impact with the F-350, the child and the CSS initiated a forward and slightly lateral trajectory to the left. The CSS loaded the front right seat back and the rear-facing child loaded the shell of the CSS, which distributed the frontal crash forces. It was likely that the CSS was not held tightly by the vehicle's belt system which upon rebound, allowed the bottom aspect of the CSS to submarine out from under the belt. The CSS rotated 180 degrees about its longitudinal axis suspending the infant in an upside-down position with her head facing the rear of the vehicle. The CSS was found wedged between the front right seat back and the rear right seat cushion. As the child loaded the integrated harness of the CSS she sustained a left clavicle fracture at mid-shaft and contusions to her left calf and thigh. The child then loaded the seat cushion in an upside-down configuration and sustained a closed head subdural hematoma, a left orbit fracture, and multiple soft tissue injuries to her face, scalp, and upper extremities. Shards of glass were present on the seat cushion resulting in multiple head and facial lacerations. The infant, still internally restrained upside-down in the rear-facing CSS in the right rear position was heard to be crying by a passerby. An off-duty nurse, who stopped for the crash, entered the vehicle through the shattered rear right window opening and placed the CSS in an upright configuration. After administering first aid, she cut the integrated harness straps with scissors and removed the child from the CSS. She placed the child on a wooden board provided by another passerby. She then cut the shoulder portion of the rear right manual lap and shoulder restraint and removed the child on the board from the rear right window opening, with the help of other passing motorists. The infant was placed on the roadside and comforted until the arrival of emergency personnel. She sustained severe injuries and was airlifted to a trauma center and admitted for treatment for six days.

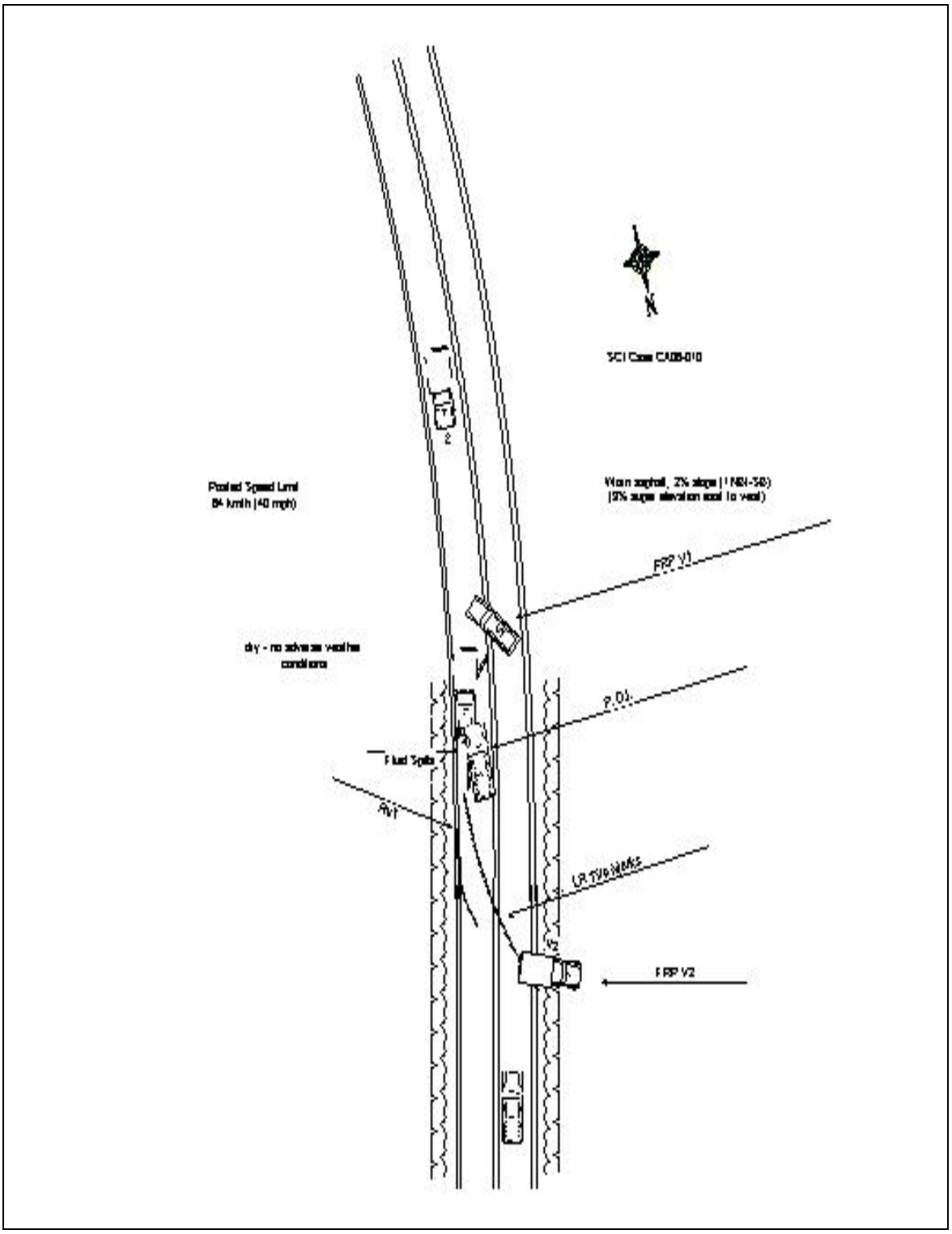

Figure 15 – Scene Schematic