

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

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**CALSPAN ON-SITE DRIVER AIR BAG FATALITY INVESTIGATION
CASE NO. CA98-063
VEHICLE: 1993 TOYOTA COROLLA
LOCATION: NEW JERSEY
CRASH DATE: OCTOBER 1998**

Contract No.
DTNH22-94-D-07058

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

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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.

TECHNICAL REPORT STANDARD TITLE PAGE

1. <i>Report No.</i> CA98-063	2. <i>Government Accession No.</i>	3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> Calspan On-Site Driver Air Bag Fatality Investigation Vehicle: 1993 Toyota Corolla Location: New Jersey		5. <i>Report Date:</i> August, 1999	
		6. <i>Performing Organization Code</i>	
7. <i>Author(s)</i> Crash Research Section		8. <i>Performing Organization Report No.</i>	
9. <i>Performing Organization Name and Address</i> Transportation Sciences Crash Research Section Veridian Engineering (Calspan Operations) P.O. Box 400 Buffalo, New York 14225		10. <i>Work Unit No.</i> CO1115.0202. (9100-9109)	
		11. <i>Contract or Grant No.</i> DTNH22-94-D-07058	
12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		13. <i>Type of Report and Period Covered</i> Technical Report Crash Date: October, 1998	
		14. <i>Sponsoring Agency Code</i>	
15. <i>Supplementary Notes</i> On-site investigation of an air bag deployment crash that resulted in fatal cervical injuries to the belted female driver of the 1993 Toyota Corolla.			
16. <i>Abstract</i> <p>This on-site investigation focused on the death and injuries mechanisms of a 52 year old female driver of a 1993 Toyota Corolla. The Toyota was equipped with a supplemental frontal air bag for the driver position which deployed during the crash. The driver relinquished control of the vehicle as she exited a left curve onto a straight segment of a two lane road in an 80 km/h (50 mph) speed zone. The vehicle entered a drainage ditch and subsequently impacted a driveway culvert with the front undercarriage area of the vehicle. The impact deployed the front driver air bag system.</p> <p>The driver was 157.4 cm (62.0") in height with a weight of 51.8 kg (115.0 lb). She was properly restrained by the manual 3-point lap and shoulder belt system. At impact, she was slumped forward with her face within a close proximity to the steering assembly and the air bag module. At deployment, the expanding air bag contacted her face which resulted in multiple soft tissue injuries of the face and lateral neck. The continued expansion of the air bag hyperextended her head which resulted in a fracture with dislocation at C2/C3 with complete cord transection.</p> <p>The driver was removed from the vehicle and transported by ambulance to a local hospital where she expired within 4 hours of the crash. A complete autopsy was performed on the body.</p>			
17. <i>Key Words</i> Deployment of the front driver air bag Driver's head slumped forward Proper use of the manual belt system Fracture and dislocation at C2/C3 with cord transection		18. <i>Distribution Statement</i> General Public	
19. <i>Security Classif. (of this report)</i> Unclassified	20. <i>Security Classif. (of this page)</i> Unclassified	21. <i>No. of Pages</i> 12	22. <i>Price</i>

TABLE OF CONTENTS

BACKGROUND	1
SUMMARY	
Crash Site	1
Pre-Crash	2
Crash	2
Post-Crash	3
VEHICLE DATA	3
VEHICLE DAMAGE	
Exterior	4
Interior	5
MANUAL RESTRAINT SYSTEMS	5
AUTOMATIC RESTRAINT SYSTEM	6
DRIVER DEMOGRAPHICS	7
DRIVER INJURIES	8
DRIVER KINEMATICS	9
MEDICAL TREATMENT	11
CRASH SCHEMATIC	12

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BACKGROUND

This on-site investigation focused on the injury mechanisms and cause of death of a 52 year old female driver of a 1993 Toyota Corolla. The Toyota was equipped with a frontal driver air bag system that deployed as a result of an undercarriage impact with a driveway culvert (**Figure 1**). The short stature driver was seated in a forward track position and properly restrained by the manual 3-point lap and shoulder belt system. Her head was slumped forward at impact within the deployment path of the driver air bag. Air bag expansion resulted in abrasions (AIS-1) of the face and lateral surfaces of the neck, a cervical spine fracture with dislocation at (C2/C3) with cord transection (AIS-6), and subarachnoid hemorrhage (AIS-3). She was transported by ambulance to a local hospital where she expired within 4 hours of the crash.



Figure 1. Final rest of the Toyota Corolla.

The crash occurred during the early morning hours of October in a rural area of New Jersey. The medical examiner identified the air bag as the mechanism of injury and death to the driver. The investigating police officer subsequently notified NHTSA's Special Crash Investigation Section on November 10, 1998. The crash was assigned to Calspan's SCI team on the afternoon of the 10th and an on-site investigation was scheduled and conducted on November 16th.

SUMMARY

Crash Site

The crash occurred on a rural two lane county road during nighttime hours. In the vicinity of the crash site, a left curve terminated into a straight segment of roadway that was level (**Figure 2**). The asphalt travel lanes were bordered by 1.3 m (4.3') asphalt shoulders with drainage ditches paralleling the shoulders. Residential driveways intersected the shoulders with culverts channeling the ditches under the driveways. Delineators were positioned approximately 0.5 m (1.6') outboard of the shoulder at the edge of the drainage ditch. The asphalt travel lanes were dry with a posted speed limit of 80 km/h (50 mph). Conditions were clear with a police reported temperature of 18 degrees C (65 degrees F).



Figure 2. Overall view of the crash site and pre-crash trajectory of the Toyota.

Pre-Crash

The 52 year old female driver of the Toyota Corolla was en route to her residence following a visit to a friend's residence. The driver consumed an alcoholic beverage(s) at the friend's house and had a recorded blood alcohol content (BAC) of .161. She apparently became lost on the drive as she had traveled only eight miles from the friend's residence in a one hour time frame. A nurse, who had completed her assigned shift at a local hospital, was following the Toyota Corolla as it was traveling in a northerly direction on the county road. The nurse observed the operator of the Toyota driving in an erratic manner, weaving from side-to-side. In addition, the nurse noted the speed of the Toyota to vary between 40-64 km/h (25-40 mph). She suspected the driver was intoxicated and used her cellular telephone to notify the local police. The nurse reported the vehicle type and the license plate number in addition to the heading and location of the Toyota.

As the driver of the Toyota exited a moderate left curve, she allowed her vehicle to drift to the right, off the outboard edge of the northbound travel lane at a shallow departure angle of approximately 4-6 degrees. The point of departure was approximately 120 m (400') north of the termination point of the curve.

Crash

The right front tire dropped off the outboard edge of the paved shoulder which allowed the undercarriage of the Toyota to superficially gouge the edge of the asphalt shoulder. As the Toyota continued forward, the right side tires entered the drainage ditch as the vehicle continued in a northerly direction. The front right area of the bumper fascia impacted a delineator (**Figure 3**) which resulted in minor vehicle damage. The Toyota continued forward and impacted a second delineator which involved the front left area of the bumper fascia. The delineators were positioned 12.8 m (42.0') apart.



Figure 3. Departure and struck delineators.

The left side tires departed the shoulder and entered the drainage ditch at a point 15.0 m (49.2') north of the right side departure point. The Toyota subsequently impacted a third delineator with the left outside rear view mirror. This delineator was located 14.8 m (48.6') north of the previously struck reflective marker.

The Toyota arced back toward the shoulder as it approached a driveway culvert. The center and right aspect of the lower front bumper fascia was abraded as the fascia engaged against the edge of the asphalt driveway. The lower aspect of the radiator support panel impacted the asphalt edge of the driveway at the culvert (**Figure 4**). The impact crushed the radiator support panel to a maximum depth of 16.6 cm (5.75") and displaced the front right structure of the vehicle vertically upward. The undercarriage impact was assigned a non-horizontal impact force of 00 with a Collision Deformation Classification (CDC) of 00-UFZW-1. The



Figure 4. Struck culvert.

WinSMASH program computed a barrier equivalent speed of 18.1 km/h (11.2 mph) for the culvert impact with a longitudinal component of -18.1 km/h (-11.2 mph). As a result of the culvert impact, the Toyota's supplemental frontal driver air bag system deployed. The Crash Schematic is included as **Figure 11, Page 12** of this report.

Post-Crash

The Toyota Corolla came to rest with the front undercarriage area of the vehicle resting against the edge of the asphalt driveway at the struck culvert location, facing in a northerly direction. The right side tires were resting on the downslope to the drainage ditch as the left side tires were positioned on the outboard edge of the asphalt shoulder. At rest, the engine remained running (**Figure 1**).

The witness who was following the Toyota, notified the local police department of the crash, however, she did not approach the vehicle. As the first officer arrived on-scene, the officer opened the door of the Toyota and noted that the driver was slumped forward against the steering assembly and the deployed air bag. He checked the driver and noted that she was in respiratory arrest. The officer unbuckled the manual restraint system and was assisted by the witness in removing the driver from the vehicle. They initiated rescue breathing activities and waited for rescue personnel who arrived on-scene within 12 minutes of the officer.

The driver was transported by ambulance to a local hospital where she was evaluated and placed on life-support. Following a consultation with family members, support was withdrawn and the driver expired approximately 3 hours and 45 minutes following the crash.

VEHICLE DATA

The involved vehicle in this single vehicle run-off-road crash was a 1993 Toyota Corolla DX, 4-door sedan. The Corolla was manufactured in April 1993, and was identified by vehicle identification number (VIN) 2T1AE09E2PC (production number deleted). The Toyota was manufactured in Canada and had a maximum gross vehicle weight rating (GVWR) of 1,588 kg (3,500 lb). At the time of the crash, the odometer had recorded 10,335 km (64,222 miles).

The Toyota Corolla was powered by a 1.8 liter transverse mounted engine linked to a 3-speed automatic transmission with a console mounted transmission selector lever. Additional mechanical features included power-assisted rack-and-pinion steering and power-assisted front disc/rear drum brakes without anti-lock (ABS). The tires were Goodyear WeatherHandler P185/65R14 all-season radials mounted on OEM steel wheels. The tires were properly inflated and in new condition with tread depths ranging from 10-11/32nds. The front wheel covers were missing from the vehicle and were not located at the crash scene.

The Toyota Corolla DX was configured with front bucket seats with reclining seat back supports and manual track adjusters, manually operated side windows and door locks, tilt steering wheel, and 3-point manual lap and shoulder belts for the four outboard seated positions.

VEHICLE DAMAGE

Exterior

The Toyota Corolla sustained moderate damage as a result of the multiple event run-off-road crash sequence. The primary damage that resulted in air bag deployment occurred from the culvert impact to the undercarriage of the vehicle at the lower radiator support. The direct contact damage consisted of abrasions to the lower bumper fascia with mud and debris embedded into the frontal undercarriage components (**Figure 5**). The direct contact damage began 10.2 cm (4.0") right of center and extended 45.7 cm (18.0") to the right. Although the front lower bumper fascia was involved, there was no residual crash at bumper level. The culvert impact displaced the lower radiator support panel to a maximum depth of 14.6 cm (5.75") located 35.6 cm (14.0") right of center (**Figure 6**). The crush profile at the lower radiator support panel was as follows: C1 = 0.6 cm (0.25"), C2 = 4.8 cm (1.9"), C3 = 9.5 cm (3.75"), C4 = 13.7 cm (5.4"), C5 = 14.6 cm (5.75"), C6 = 9.5 cm (3.75").



Figure 5. Overall view of the frontal undercarriage damage to the Corolla.



Figure 6. Undercarriage damage to the Corolla.

The secondary damage to the vehicle involved minor damage from impact with three delineators (**Figure 7**). The initial delineator impact damage was located on the upper surface of the bumper fascia 60.3-68.6 cm (23.75-27.0") right of center, above the parking light lens. The damage consisted of vertically oriented abrasions and a separated turn signal assembly. The fascia was split at this location, however, the tear probably resulted from frontal deformation as a result of the culvert impact.



Figure 7. Delineator impact to the bumper fascia.

A second delineator impact occurred at the front left bumper fascia.

Four vertically oriented abrasion patterns were located 23.5-51.4 cm (9.25-20.25") left of center. Each pattern was approximately 1.9-2.5 cm (0.75-1.0") in width. The third delineator impact involved the left outside rear view mirror. The mirror sideswiped the delineator as the vehicle traveled in the drainage ditch. This impact produced abrasions to the mirror and fractured the mirror from its mounting bracket.

It should be noted that the hood damage at the front left corner resulted from the firemen attempting to cut

the battery cables during their post-crash rescue activities. The left front door was inadvertently closed and locked following the removal of the driver, therefore preventing access to the interior mounted hood release lever.

Interior

The interior of the Toyota Corolla sustained minor damage that was associated with driver contact. There was no intrusion of the passenger compartment or damage related to exterior deformation.

The driver loaded the manual belt system as she responded to the frontal undercarriage impact force by moving in a forward direction. Her loading of the belt system produced a faint D-ring abrasion to the shoulder belt webbing, an abrasion to the webbing at the latchplate position, and an abrasion to the lap belt webbing from interaction against the lateral outboard surface of the seat cushion. The belt system is further discussed in the Manual Restraint System heading of this summary report.

The Toyota was equipped with a manually adjusted seat that was adjusted to a mid track position. The seat track was positioned 8.9 cm (3.5") rearward of the full forward position and 15.2 cm (6.0") forward of the full rear position. The seat back support was reclined to a measured angle of 25 degrees which resulted in a horizontal distance of 48.3 cm (19.0") between the center of the driver air bag module and the seat back support. The adjustable driver's head restraint was positioned 2.5 cm (1.0") above the seat back support.

The upper steering wheel rim was displaced approximately 1.2 cm (0.5") forward as a result of air bag expansion and possible driver head contact. The Toyota Corolla was equipped with an energy absorbing steering column with shear brackets. The knee bolster was removed from the vehicle to access the steering column assembly. There was no compression of the energy absorbing column or compression of the shear modules. The four spoke steering wheel was not deformed.

MANUAL RESTRAINT SYSTEMS

The Corolla was equipped with manual 3-point lap and shoulder belt systems for the four outboard seated positions. The front belt systems consisted of a continuous loop webbing that retracted onto a dual mode locking retractor that was located in the lower B-pillar. The webbing was equipped with a sliding latchplate. The webbing was routed through an adjustable upper anchorage (D-ring). The left D-ring was adjusted to the full-down position while the right D-ring was adjusted to the full up-position. The vertical travel adjustment of the D-rings was 8.9 cm (3.5"). In addition, the front belt systems were equipped with energy management loops incorporated into the lap belt webbings above the sill anchorage point. The loops were concealed within a vinyl sleeve.

The driver was properly restrained by the manual belt system at the time of the crash. Belt usage was confirmed by observations of the first arriving officer who unbuckled the belt system to remove the driver from the vehicle and from witness marks visible at three distinct points on the webbing. Driver loading of the belt system was not sufficient to deploy the energy management loop.

The vinyl sleeve which concealed the driver's side energy management loop was abraded from interaction against the lateral (outboard) aspect of the seat cushion as the driver loaded the belt system. The abrasion extended 15.9-19.1 cm (6.25-7.5") above the sill anchorage point. A diagonally oriented abrasion was noted to the webbing at the position of the latchplate. The abrasion resulted from belt movement through the plastic covered latchplate as the driver loaded the webbing. The abrasion was located 89.5-90.1 cm (35.25-35.75") above the floor anchorage. A diagonally oriented D-ring transfer was observed on the outboard aspect of the shoulder belt webbing 175.3-177.8 cm (69.0-70.0") above the referenced floor anchorage.

AUTOMATIC RESTRAINT SYSTEM

The 1993 Toyota Corolla was equipped with a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver's position. The SRS deployed as a result of a front undercarriage impact sequence with the driveway culvert. The air bag system consisted of two front mounted crash sensors, an interior mounted safeing sensor and diagnostic module, a spiral cable (clockspring-type assembly) mounted within the steering assembly, an instrument panel mounted air bag indicator lamp, and the steering wheel mounted driver air bag module.

The driver air bag module was concealed within the four-spoke steering wheel rim with the spokes positioned at the 3 and 9 and 4 and 8 o'clock positions. The H-configuration module cover flaps were nearly symmetrical with a horizontal tear seam width of 14.6 cm (5.75"). The vertical height of the upper cover flap was 7.0 cm (2.75") while the lower flap was 6.4 cm (2.5"). The upper flap had the Toyota logo embossed into the center area of the flap above the tear seam while the lower flap was identified with SRS AIRBAG centered below the horn symbol.

There was no occupant contact evidence or damage noted to the upper cover flap. A diagonally oriented abrasion pattern was noted to the upper left corner of the lower cover flap (**Figure 8**). The abrasion pattern extended 4.4 cm (1.75") inboard of the left upper corner and extended vertically 2.9 cm (1.125"). Although unconfirmed by clothing damage or specific injury patterns, the abrasions probably resulted from contact against the driver's upper abdominal/chest area.



Figure 8. Abrasion to the lower cover flap.

The air bag was approximately 61.0 cm (24.0") in diameter and was not tethered by internal straps. The bag was vented by two 2.9 cm (1.125") diameter vent ports located on the back side of the bag at the 11 and 1 o'clock sectors. The vent ports were centered 7.0 cm (2.75") inboard of the peripheral seam and 18.9 cm (7.4") apart. An identification number of 930219G 1678 was stamped on the bottom, forward aspect of the bag.

The air bag membrane expanded from the module against the forward positioned driver during the vehicle's engagement against the driveway culvert. Contact evidence on the air bag membrane consisted of flesh tone make-up and lipstick transfers to the face and back side of the bag and bloody tissue transfers to the

center face of the bag. The make-up transfers resulted from both the initial expansion of the bag against the face of the driver and her subsequent final rest position as she slumped into the deflating air bag.

Two faint lipstick transfers was noted to the center area of the air bag (**Figure 9**). The upper lip transfer was located 6.4-7.0 cm (2.5-2.75") above the horizontal centerline and 1.9-4.4 cm (0.75-1.75") left of the vertical centerline of the bag. The lower lip transfer was located 4.4-5.1 cm (1.75-2.0") above the horizontal reference line and 1.9-4.4 cm (0.75-1.75") left of center. A make-up transfer was noted surrounding the left peripheral seam of the bag 7.0-12.1 cm (2.75-4.75") above the centerline which extended 2.5 cm (1.0") fore and aft of the internally stitched seam. A second area of flesh-tone make-up was centered at the right of the bag, extending 5.7 cm (2.25") above the reference line to 6.4 cm (2.5") below the horizontal centerline. The transfer was located 10.2-17.8 cm (4.0-7.0") right of center.



Figure 9. Tissue and make-up transfers on the air bag.

A diagonally oriented bloody transfer with tissue fragments extended across the upper centerline of the face of the bag (**Figure 9**). The transfer extended 2.5 cm (1.0") left of center to 4.4 cm (1.75") right of center and 7.6-19.1 cm (3.0-7.5") above the horizontal centerline. Several blood related spatters were noted to the bag at the 2:30 o'clock sector adjacent to the peripheral seam.

An additional large area of make-up was noted to the forward panel of the air bag. The transfer extended 30.4 cm (12.0") along the peripheral seam between the vent ports and extended 15.2 cm (6.0") toward the inflator. At the termination point, the transfer approximately 5.7 cm (2.25") in width. Although these transfers evidenced the driver's involvement with the air bag, there were no tears, cuts, or snag points to the woven fabric of the bag membrane.

DRIVER DEMOGRAPHICS

Age/Sex:	52 year old female
Height:	157.4 cm (62.0")
Weight:	51.8 kg (115.0 lb)
Manual Restraint Usage:	3-point lap and shoulder belt
Usage Source:	Vehicle inspection, officer's observation at scene
Eyewear:	None reported
Mode of Transport From Scene:	Ambulance to a local hospital
Type of Medical Treatment:	Expired within 4 hours of the crash
BAC:	Blood .161

DRIVER INJURIES

Injury	Injury Severity (AIS 90)	Injury Mechanism
Fracture dislocation of the spinal column at C2/C3 with cord transection and hemorrhage into the soft tissue	Maximum (640236.6,6)	Hyper extension due to expansion of the driver air bag membrane against the face of the driver
Multiple abrasions of the chin, cheeks and nose	Minor (290202.1,0)	Expansion of the driver air bag membrane
Abrasions of the lateral aspects of the neck	Minor (390202.1,1; 390202.1,2)	Expansion of the driver air bag membrane
Bilateral eyelid abrasions	Minor (297202.1,1; 297202.1,2)	Expansion of the driver air bag membrane
Bilateral orbital ecchymoses	Minor (297402.1,1; 297402.1,2)	Expansion of the driver air bag membrane
Conjunctivae congested with petechial hemorrhages bilaterally	Minor (240416.1,1; 240416.1,2)	Expansion of the driver air bag membrane
Small linear fracture of the right orbital roof	Minor (251202.2,1)	Steering wheel rim (possible)
1.5" linear contusion to the midline of the upper lip	Minor (290402.1,8)	Expansion of the driver air bag membrane
1" laceration of the lower lip and a 1.5" laceration of the inner surface of the lower lip	Minor (290602.1,8)	Expansion of the driver air bag membrane
3 x 3" contusion of the right upper chest over the breast	Minor (490402.1,1)	Expansion of the driver air bag membrane

Injury	Injury Severity (AIS 90)	Injury Mechanism
4 x 3" contusion of the left upper chest over the breast with hemorrhage into the subcutaneous tissue	Minor (490402.1,2)	Expansion of the driver air bag membrane and shoulder belt loading
3 x 2" scalp contusion over the right temporal region with hemorrhage into the right temporalis muscle	Minor (190402.1,1)	Steering wheel rim (possible)
2 x 1" scalp contusion to the vertex with subgaleal hemorrhage	Minor (190402.1,5)	Rebound contact into the left B-pillar (possible)
Diffuse subarachnoid hemorrhage involving the lateral convexities of the cerebrum, bilaterally	Serious (140466.3,6)	Hyper extension due to expansion of the driver air bag membrane against the face of the driver
Contusions to the dorsal aspects of both hands in the thenar region	Minor (790402.1,1; 790402.1,1)	Expansion of the driver air bag membrane

All injuries were identified in the autopsy report that was provided by the Medical Examiner's office.

DRIVER KINEMATICS

The driver of the 1993 Toyota Corolla was seated in a normal driving posture with the manual seat track adjusted to a mid track position. The seat track was adjusted 9.5 cm (3.75") rearward of the full forward position and 15.2 cm (6.0") forward of the full rear track position. The seat back support was reclined to a measured angle of 25 degrees. In this position, the horizontal distance between the center of the driver air bag module cover flap and the seat back support (**Figure 10**) was 48.3 cm (19.0"). The tilt steering wheel was adjusted to a mid position with a column angle of 31 degrees.



Figure 10. Driver seat track position with respect to the deployed air bag.

The driver was properly restrained by the manual 3-point lap and shoulder belt system. Belt usage was determined from loading evidence visible on the belt webbing. The loading evidence consisted a diagonally oriented D-ring transfer that was located 175.3-177.8 cm (69.0-70.0") above the floor anchorage for the lap belt webbing. A faint webbing abrasion was noted on the webbing at the position of the latchplate, located 89.5-90.8 cm (35.25-35.75") above the floor anchorage. The energy management loop of the belt

webbing was not deployed, however, the vinyl sleeve that concealed the webbing was abraded from loading against the outboard aspect of the fabric seat cushion. The latchplate was abraded in the typical pattern associated with frequent belt usage.

The driver was heavily intoxicated with a toxicology test result of .161. Due to her intoxicated state, the driver either fell asleep or passed out as she exited the left curve of the county road. As a result, she relinquished control of the vehicle and the Toyota subsequently departed the right road edge and entered a drainage ditch. The frontal area of the Toyota impacted several delineators which resulted in minimal damage to the vehicle. The front undercarriage area of the vehicle subsequently impacted the driveway culvert which resulted in deployment of the driver air bag system. Prior to impact, the driver probably slumped forward with her head slumped down with her chin resting on the upper chest area which protected the anterior neck from contact by the expanding driver air bag membrane.

At impact, the driver responded to the non-horizontal impact force by moving forward and loading the manual restraint system. Her head possibly contacted the upper steering wheel rim due to the forward position of the head prior to air bag deployment. In addition, her head was probably turned to the left which exposed the right aspect to the forward components. As a result of the suspected head contact, the driver sustained a small linear fracture of the right orbital roof, a 3 x 2" scalp contusion over the right temporal region with hemorrhage into the right temporalis muscle, and diffuse subarachnoid hemorrhage.

It was possible that the driver air bag system deployed late in the crash sequence. The left upper corner of the lower air bag module cover flap probably contacted the left chest/abdominal area of the driver. A diagonally oriented abrasion pattern was noted to the cover flap. She sustained a contusion over the left breast, however, it was possible that the contusion resulted from air bag deployment and/or loading of the manual restraint system as the driver responded in a forward direction to the crash pulse.

The expanding air bag membrane impacted the face of the driver and wrapped onto the lateral aspects of the neck which resulted in multiple abrasions, lacerations, and contusions of the chin, cheeks, lips, nostrils of the nose, lateral neck, and eyelids. The anterior neck was void of abrasions which indicated that the head was slumped forward, thus protecting the anterior neck from bag expansion. The medical examiner identified the soft tissue facial and neck injuries as follows:

- < Diffuse patterned abrasions on the lateral aspects of the face of the face and neck bilaterally
- < 4.25 x 4" patterned abrasions on the anterior right cheek and lateral right cheek which extends upward to involve the lateral aspect of the right eye and lateral aspect of the right neck
- < 2.5 x 2" abrasion on the lateral right neck, square shaped
- < 1.5" linear contusion to the midline of the upper lip, diffuse contusions of the lips
- < .25-1.5" abrasions of the midline of the chin
- < 1.5-1.0" abrasion on the inferior aspect of the midline chin
- < Multiple linear abrasions on the underside of the nose extending to the upper lip

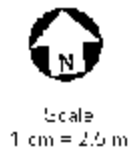
- < 3 x 2.5" patterned abrasion on the lateral and anterior aspect of the left cheek, which extends onto the lateral aspect of the right left neck
- < Lateral left neck abrasion 3.5 x 1.25", appears square shaped
- < 4 x 2" area of no injury to the underside of the chin and anterior neck
- < 1.0" laceration of the lower lip and a 1.5" laceration of the inner surface of lower lip

The expanding air bag accelerated the head in an upward and rearward direction which resulted in a Hyper extension-type fracture/dislocation of C2/C3 with cord transection. The continued expansion of the air bag displaced the driver in a rearward direction in combination with her rebound trajectory from the frontal impact force. The vertex aspect of her scalp probably impacted the left B-pillar which resulted in a 2 x 1" scalp contusion to the vertex scalp with subgaleal hemorrhage. There was no contact evidence to the pillar. The driver subsequently slumped forward into the deployed air bag where she came to rest within the vehicle. She also sustained contusions of the dorsal aspects of both hands at the thenar regions which probably resulted from the early deployment phase of the air bag as her hands remained on the steering wheel rim.

MEDICAL TREATMENT

The driver was initially assessed at the scene by the first arriving officer and the witness (nurse). Paramedics arrived on-scene and detected faint vital signs. The driver was transported by ambulance to a local hospital where she was evaluated with attempts to stabilize her condition. The driver was maintained on life support for approximately 3.5 hours. Medical consultation with family members resulted in termination of life support and the immediate death of the driver. The body was transferred to the medical examiner's facility that was located at another hospital within the county where a complete autopsy was performed.

CALSPAN CASE NO. CA98-63



Speed limit:
80 km/h (50 mph)

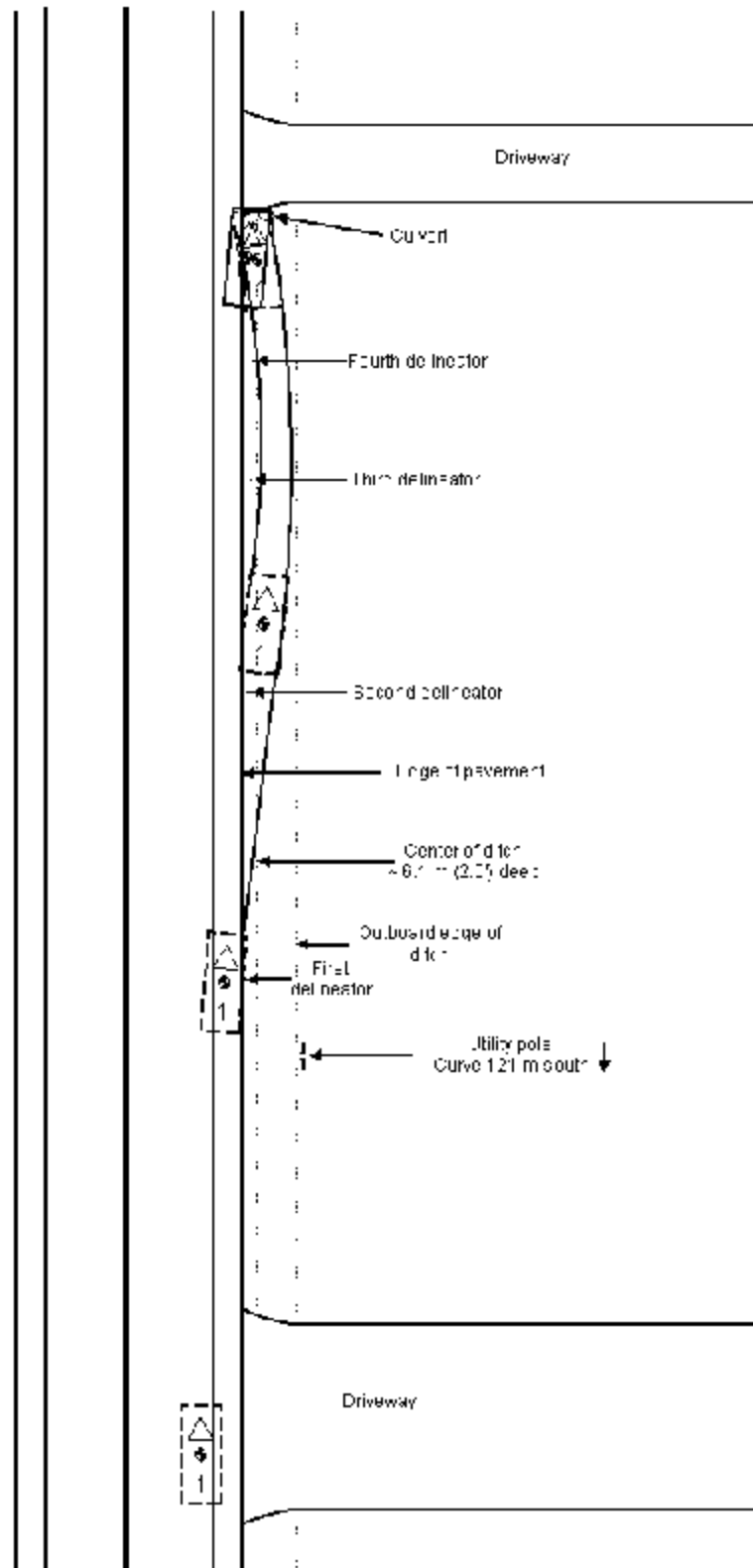


Figure 11. Crash Schematic