ODI Potential Air Bag Failure Investigation / Vehicle to Object
Dynamic Science, Inc. / Case Number: DS03022
2002 Honda Civic
Texas
April, 2003

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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

This case was initiated in response to a reported air bag failure in a 2002 Honda Civic. This single vehicle crash occurred at 0231 hours during the month of March, 2003. The crash occurred off-road within the confines of a multilevel freeway interchange in the state of Texas. The approaching roadway is comprised of two northbound travel lanes that serves as an freeway access road. There is a right hand curve at the area of departure. The speed limit is 72 km/h (45 mph). Adjacent to the roadway is a concrete drainage culvert . At the end of the culvert is a concrete support structure for the crossing roadway. There were two occupants in the vehicle. The driver was an unrestrained 26-year-old male. The front right seat was occupied by a restrained 30-year-old male. The case vehicle was traveling in the curve at approximately 80 km/h (50 mph). The vehicle departed the roadway on the left side and drove into the drainage culvert. The vehicle then struck the support structure with its front end. There were no air bag deployments and neither pretensioner actuated. Both front seat occupants were fatally injured

17. Key Words	18. Distribution Statement
Air bag, non deployment, injury, crash, fatality, passenger.	

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Dynamic Science, Inc.
Crash Investigation
Case Number: DS03022

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BACKGROUND:

Description:	This ODI Potential Air Bag Failure case was identified by the local police agency. NHTSA was notified on April 30, 2003. DSI was assigned the case on June 3, 2003. All field work was completed on June 6, 2003. A local police investigator was present during the vehicle inspection.
Investigation Type:	ODI potential air bag failure
Crash Location:	Texas
Crash Date:	April, 2003
Notification Date:	April 30, 2003
Field Work Completed:	June 6, 2003

SUMMARY

Crash Site

This single vehicle crash occurred at 0231 hours during the month of April, 2003. The crash occurred off-road within the confines of a multilevel freeway interchange in the state of Texas. The approaching roadway is comprised of two northbound travel lanes and serves as an freeway access road. There is a right hand curve at the area of departure. The curb on the west side of the roadway is 18 cm (7 in) high. The weather was clear and the asphalt roadway was dry. Street lights were present in the area and were working properly. The speed limit is 72 km/h (45 mph).

Figure 1. Area of road departure. Impact is marked with red arrow.

Adjacent to the roadway is a concrete drainage culvert that is 8.5 m (28.0 ft) wide, including the sloped walls. The walls are 2.1 m (7.0 ft) wide and are set at a 26 degree angle (44% slope). At the end of the culvert is a concrete support structure for the crossing roadway.

Figure 2. Area of impact

Pre-Crash

The case vehicle is a 2002 Honda Civic two-door coupe (VIN: 1HGEM2195ZLxxxxxx). There were two occupants in the vehicle. The driver was an unrestrained 26-year-old male (180 cm/71 in, 71 kg/157 lbs). The front right seat was occupied by a restrained 30-year-old male (170 cm/67 in, 74 kg/164 lbs). The case vehicle was equipped a driver's front air bag, a front right passenger air bag, driver and front passenger seat-mounted side air bags, and seat belt pretensioners for both front seats. The safety system control module was located under the front of the center console. The seat belt pretensioners were located in the driver and passenger side lower B-pillars and the front seat inner seat belt buckles.

Figure 3. Case vehicle at final rest

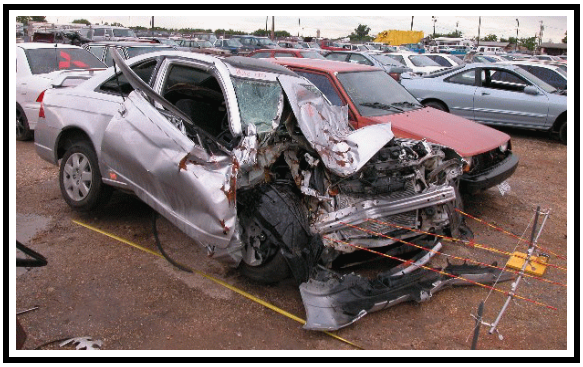

Figure 4. Front right, case vehicle

Crash

The case vehicle was traveling in the curve at approximately 80-97 km/h (50-60 mph). The vehicle departed the roadway on the left side and drove into the drainage culvert. Prior to the impact, the vehicle had a pitch angle of 5.1 degrees and a roll angle of 25 degrees.

The vehicle struck the support structure with its front end (12FZEW6). The rear of the vehicle pitched upward and top of the hood engaged the top of support structure. The vehicle had a maximum crush of 111.0 cm (43.7 in) at C4. The total velocity change as calculated by the WinSmash collision model was 84 km/h (52 mph). The longitudinal and lateral delta V components were -84 km/h (-52 mph) and 0 km/h (0 mph), respectively.

The above threshold impact did not deploy the air bags or actuate the front seat belt pretensioners.

Post-Crash

The case vehicle rotated clockwise after impact and came to rest in the culvert facing northeast. Both occupants were fatally injured. They were extricated from the vehicle by paramedics and firefighters while at the scene.

The case vehicle was towed from the scene due to heavy damage and was placed on a police hold for an indeterminate amount of time.

VEHICLE DATA -2002 Honda Civic

The 2002 Honda Civic was a four-door sedan equipped with a five speed manual transmission, front wheel drive, air conditioning, a tilt steering column, AM/FM stereo with cassette player, illuminated driver's switch, and a driver's armrest. The vehicle was manufactured in June, 2002.

VIN:	1HGEM2195ZLxxxxx
Odometer:	Unknown. Digital display. No power.
Engine:	1.67 L, 4 cylinder
Reported Defects:	None noted
Cargo:	None at time of inspection

The 2002 Honda Civic was equipped with Firestone FR690 P185/65R15 tires. The specific tire data is as follows:

Tire	Tread	Pressure	Recommended pressure
LF	6 mm (8/32 in)	Flat	207 kPa (30 psi)
LR	6 mm (8/32 in)	193 kPa (28 psi)	207 kPa (30 psi)
RF	6 mm (8/32 in)	Flat	207 kPa (30 psi)
RR	6 mm (8/32 in)	Flat	207 kPa (30 psi)

The front seating positions in the 2002 Honda Civic were equipped with bucket seats with adjustable head restraints and folding backs. Both front seats were slightly reclined at the time of inspection. The rear seating positions were configured with a bench seat with folding backs and integral head restraints for the outboard positions.

VEHICLE DAMAGE

Exterior Damage - 2002 Honda Civic

Damage Description:	Major front end damage. Vehicle towed from the scene.	
CDC:	12FZEW6	
Delta V:	Total	84.0 km/h (52.2 mph)
	Longitudinal	-84.0 km/h (-52.2 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	338,575 joules (249,720 ft-lbs)

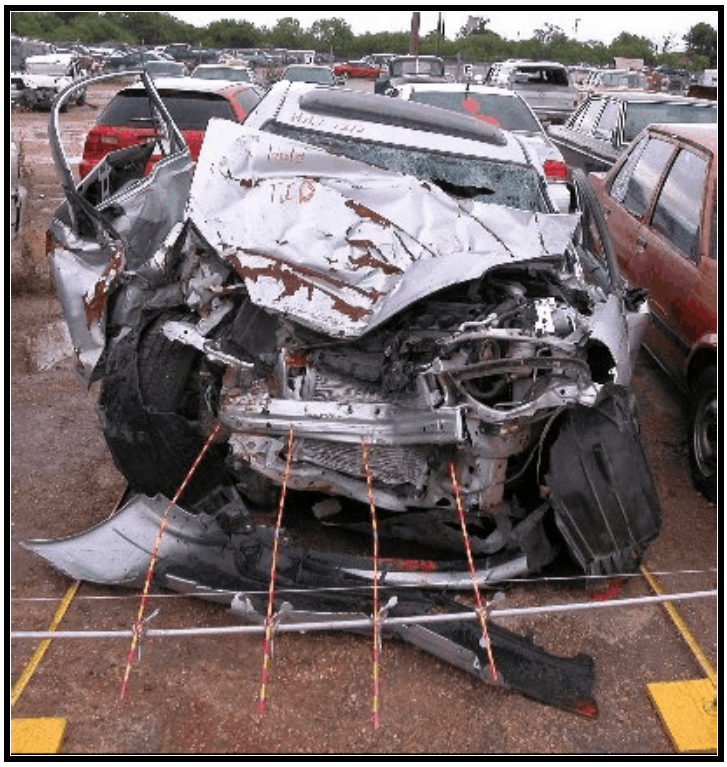

Figure 5. Front view, 2002 Honda Civic

The frontal impact with concrete support structure resulted in severe front end damage to the 2002 Honda Civic. The damaged components for this impact included the bumper fascia and reinforcement bar, upper and lower radiator supports, and hood. There was vertically displaced crease that began at the front right of the hood and extended diagonally to the rear left of the hood that was a result of the vehicle pitching into the top of the open concrete structure. The direct damage to the end plane began at the front right bumper corner and extended 59.0 cm (23.2 in) laterally. The residual crush measured along the bumper reinforcement bar was as follows: C1=3.0 cm (14.2 in), C2=100.0 cm (39.3 in), C3=108.0 cm (42.5 in), C4=111.0 cm (43.7 in). The maximum crush was located at C4. The principle direction of force was within the 12 o'clock sector and was an estimated 000 degrees. Both front wheels sustained rim damage and were flattened by the impact. Both front tires were physically restricted. The wheelbase was shortened by 58.0 cm (22.8 in) on the right side and by 2.0 cm (0.8 in) on the left. The right front door was likely jammed shut and later pried open by rescue personnel.

Vehicle History - 2002 Honda Civic

The 2002 Honda Civic was purchased as a new vehicle in June 2002, nine months before the crash. The driver of the Civic was listed as the co-owner of the vehicle. The vehicle was purchased in the state of Texas and registered in that state in August, 2002. The vehicle had 19 km (12 miles) on the odometer at the time of purchase.

This vehicle had not been in any reported crashes according to the police and a vehicle history report. The vehicle is not on the NHTSA list of vehicles with de-activated air bags.

Interior Damage - 2002 Honda Civic

Interior damage to the Civic was severe and attributed to occupant contact and passenger compartment intrusion. The entire windshield was fractured from impact forces. The glazing at the left front and right front doors was disintegrated. There was steering wheel, instrument panel, and toe pan longitudinal intrusion to the front left seating area. The maximum intrusion came from the steering wheel. The steering wheel rim was not deformed, but steering column had broken loose so the steering column could be moved up and down 7.6-12.7 cm (3.0-5.0 in). It was shifted to the left at the time of the inspection. There was deformation to the knee bolsters on both sides of the steering wheel. The front right passenger, although restrained by the manual belt system, loaded the lower instrument panel with both knees. There was instrument panel, toe pan, and A-pillar longitudinal intrusion to the front right seating area. The maximum intrusion was to the toe pan and measured 40.0 cm (15.7 in). There was also vertical intrusion through the bottom right side floor due to vehicle body buckling. There were significant contacts to the right instrument panel. The rear view mirror was knocked off.

Figure 6. Overview of interior damage, left to right

MANUAL RESTRAINT SYSTEMS - 2002 Honda Civic

The Civic was configured with manual continuous loop 3-point lap and shoulder belts for both front positions and all three rear seat positions. All the seat belts were equipped with sliding latch plates. The driver's seat belt was equipped with an emergency locking retractor. The front right passenger's seat belt and all three rear seat belts were equipped with switchable retractors (retractors that can be changed from an emergency locking retractor to an automatic locking retractor to assist in securing child seats). The driver's seat belt was not in use at the time of the crash. The front right passenger was properly restrained by the manual belt system. At impact, this occupant loaded the seat belt and caused heavy abrasions to the webbing near the latch. Additionally, rescue personnel cut the belt at both the lap and shoulder levels. The seat belt pretensioners were located in the driver and passenger side lower B-pillars and the front seat inner seat belt buckles. The pretensioners did not actuate.

Figure 7. Front right seat belt with no pretensioner compression

Figure 8. Loading to front right seat belt at latch

FRONTAL AIR BAG SYSTEM - 2002 Honda Civic

The case vehicle was equipped a driver's front air bag, a front right passenger air bag, and seat belt pretensioners for both front seats. Side air bags were an option for this vehicle in 2002. The driver's air bag module was mounted in a typical mode within the four-spoke steering wheel rim. The front right passenger's air bag module was a top mount configuration within the upper right instrument panel. The safety system control module was located under the front of the center console. Thevehicle was equipped with two front impact sensors that were attached to the outboard side of the vehicle near the backing bar.

Figure 9. Non-deployment of driver's air bag

For the front air bags to operate: (1) a front impact sensor must activate, and send electric signals to the control module microprocessor, and (2) the control module microprocessor must compute the signals and send the appropriate signals to the air bag inflators.

There were no air bag deployments and neither front seat belt pretensioner actuated. The reason for this is not known. There was some discussion that the pitch/roll angle of the vehicle at impact may have influenced the sensor, but Honda indicated to NHTSA that this should not be a factor. As indicated earlier, the vehicle was purchased new and has been in the possession of its original owners since that time. There were no indications of any prior crashes or repairs.

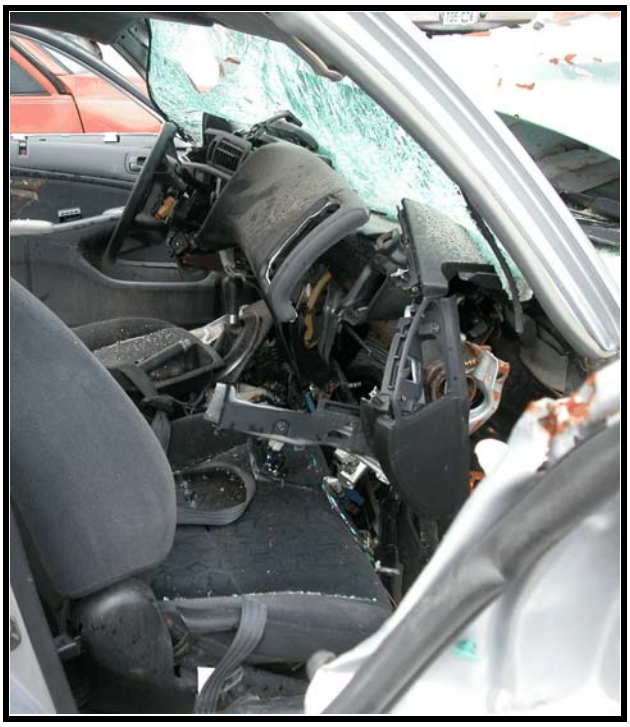

Figure 10. Non-deployment of front right passenger's air bag.

The most likely reason would appear to be related to the sudden loss of battery power at impact. The initial point of impact was on the right corner and involved the right front impact sensor. The battery was located on the right side, just above the sensor area. Both were damaged during the crash.

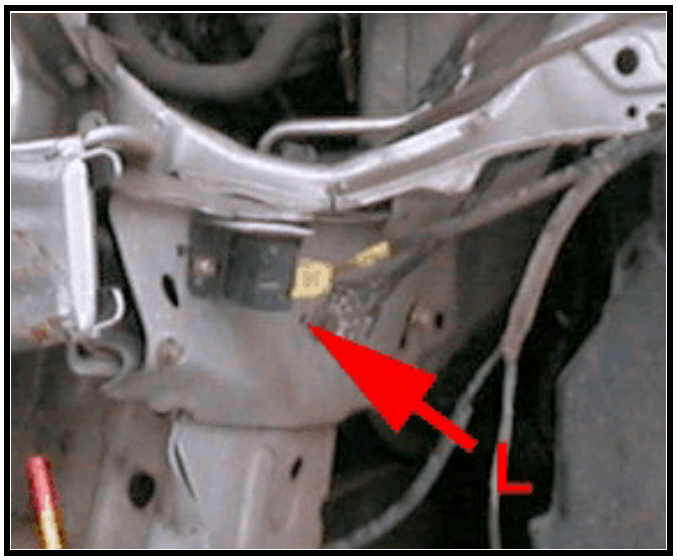

Figure 11. Left front impact sensor

Figure 12. Right front impact sensor

OCCUPANT DEMOGRAPHICS - 2002 Honda Civic

	Occupant 1	Occupant 2
Age/Sex:	26/Male	30/Male
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat. Seat adjusted between forward most and middle track position. Seat back was slightly reclined.	Fabric covered bucket seat. Seat adjusted between forward most and middle track position. Seat back was slightly reclined.
Height:	175 cm (69 in)	170 cm (67 in)
Weight:	71 kg (157 lbs)	74 kg (164 lbs)
Occupation:	Student, per police report	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:		NA
Body Posture:	Presumed to be normal, upright	Presumed to be normal, upright
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, not used	Lap and shoulder belt available, used
Air bag:	Steering wheel mounted air bag available, did not deploy. Pretensioner available, did not actuate.	Top instrument panel mounted air bag, did not deploy Pretensioner available, did not actuate.

OCCUPANT INJURIES -2002 Honda Civic

Driver: Injuries obtained from autopsy report.

INJURY	OIC CODE	Source	Confidence
Bilateral fracture of maxilla	250800.2,3	Steering wheel rim	Probable
Mid line fracture of mandible	250600.1,9	Steering wheel rim	Probable
Fractures of frontal and parietal bones, as well as anterior and middle fossae	150400.2,5 (frontal) 150202.3,8 (basilar)	A pillar	Probable
Massive Subarachnoid hemorrhage (coded to posterior)	140466.3,6	A pillar	Probable
Fracture, left radius and ulna, two-thirds of way down from elbow (distal third)	752800.2,2 radius 753200.2,2 ulna	Instrument panel	Probable
Fracture, distal right femur	851814.3,1	Lower instrument panel	Probable
Laceration, right eyebrow, 5.0 cm (1.9 in) horizontal	290602.1,7	Windshield	Probable
Abrasion, forehead, runs downward from left to right an approximate 45 degree angle	290202.1,7	A pillar	Probable
Laceration, right edge of forehead, 2.0 cm (0.8 in)	290602.1,7	Windshield	Probable
Abrasions, left side of nose	290202.1,4	A pillar	Possible
Abrasions, left cheek	290202.1,2	A pillar	Possible
Laceration, outside corner of right eye, 3.0 cm (1.1 in)	297602.1,1	Windshield	Possible
Lacerations, chin, 1.5 cm (0.6 in) to right of midline, 3.0 cm (1.1 in to left of midline)	290602.1,8	Windshield	Possible
Laceration, anterior aspect of left shoulder, 2.0 cm (0.8 in)	790602.1,2	A pillar	Possible

Minor abrasions, left chest and abdomen	490202.1,2 590202.1,2	Steering wheel	Possible
Dicing injuries to left hand	790602.1,2	Windshield	Possible
Laceration, back of right hand	790600.1,1	Unknown	Unknown
Abrasions/laceration, right patella	890202.1,1 890602.1,1	Lower instrument panel	Probable
Abrasions, left calf	890202.1,2	Lower A pillar	Possible

Front right occupant: Injuries obtained from autopsy report.

Fracture-dislocation of neck at atlanto-occipital junction. Crushed spinal cord.	640250.5,6	Impact forces	Probable
Partial avulsion of brainstem at pontomedullary junction	140212.6,8[1]	Impact forces	Probable
Fracture, right radius and ulna	752800.2,1 radius 753200.2,1 ulna	Upper instrument panel	Probable
Fracture, right tibia and fibula	853404.2,1 tibia 851605.2,1 fibula	Lower instrument panel	Probable
Superficial laceration to spleen	544222.2.2	Shoulder belt	Probable
Right eyebrow, 2.0 cm (0.8 in) avulsion	290802.1,7	Unknown	Unknown
Laceration, right hand, between index and middle finger, 3.0 cm (1.2 in) long	790602.1,1	Windshield	Possible
Lacerations, back of left hand	790602.1,2	Windshield	Possible
Abdominal abrasion, left side, 7.0 x 5.0 cm (2.8 x 1.9 in)	590202.1,2	Lap belt	Certain

[1]Coded as laceration

Knee lacerations (2), left, 2.0 cm (0.8 in) and 1.5 cm (0.6 in) long	890602.1,2	Lower instrument panel	Certain
Abrasions, medial aspect of right ankle	890202.1,1	Toe pan	Probable
Abrasion, right calf	890202.1,1	Unknown	Unknown
Right shoulder/right upper chest abrasion, 10.0 cm (3.9 in) long x 1.0 cm (0.4 in) wide	490202.1,1	Shoulder harness	Probable
Abrasion, right forearm, flexor surface	790202.1,1	Instrument panel	Probable

OCCUPANT KINEMATICS - 2002 Honda Civic

The 26-year-old male driver was sitting in a forward facing position on the fabric covered bucket seat. The seat had been adjusted to between the forward most and middle track position. The seat back was slightly reclined. He was not restrained. He was likely leaning somewhat to the left due to the roll position of the Civic prior to impact. He was wearing a white shirt, blue jeans, and brown shoes. A wrist watch was present on the left wrist. At impact, he pitched forward in response to the 0 degree direction of force. His chest and abdomen engaged the steering wheel/rim causing minor abrasions. Both knees engaged the lower instrument panel/knee bolster. Abrasions were found on the right knee from this contact and the right femur was fractured. The driver's head and torso were already leaning slightly to the left prior to the impact, but pitched sharply in the 11 o'clock direction as the vehicle fully engaged the concrete wall on the right side and began a sharp clockwise rotation. The driver's face (lower) engaged the top of the steering wheel. His face and head continued past this point and engaged the left A pillar and left side of the windshield. The A pillar contacts likely caused the head and upper facial bone fractures while the steering wheel rim contact likely caused the lower facial bones. The driver's left hand came off the steering wheel. The forearm area engaged the left side of the instrument panel causing a radius/ulna fracture.

Figure 13. Driver's seated position

Figure 14. Scuffs to top of steering wheel

The 30-year-old male front right passenger was sitting in a forward facing position on the fabric covered bucket seat. The seat had been adjusted to between the forward most and middle track position. The seat back was slightly reclined. He was wearing the available lap and shoulder belt. He was likely leaning somewhat to the left due to the roll position of the Civic prior to impact. He was wearing a short sleeve grey sweat top, a white T shirt, blue jeans, and brown shoes. At impact, he pitched forward and engaged the lap and shoulder belt. He sustained abdominal abrasions at the umbilicus level from contact with the lap belt and right upper chest/shoulder abrasions from contact with the torso belt. The loading to the abdomen from the lap belt also caused a superficial splenar laceration. Both of this occupant's lower legs engaged the intruding right lower instrument panel, resulting in a tibia/fibula fracture to the right leg, right leg abrasions, and

Figure 15. Front right occupant seated position

bilateral knee lacerations. His right forearm engaged the upper portion of the instrument panel, resulting in a radius/ulna fracture. While his torso was being held in place by the restraint system, this occupant's head pitched sharply forward. This movement caused a fracture-dislocation of the neck at the atlanto-occipital junction. This same movement resulted in a crushed spinal cord, a partial avulsion of the brainstem, and subarachnoid hemorrhages over the brainstem and cerebellum.

Figure 16. Loading to front right seat belt at latch

Attachment 1. Scene Diagram

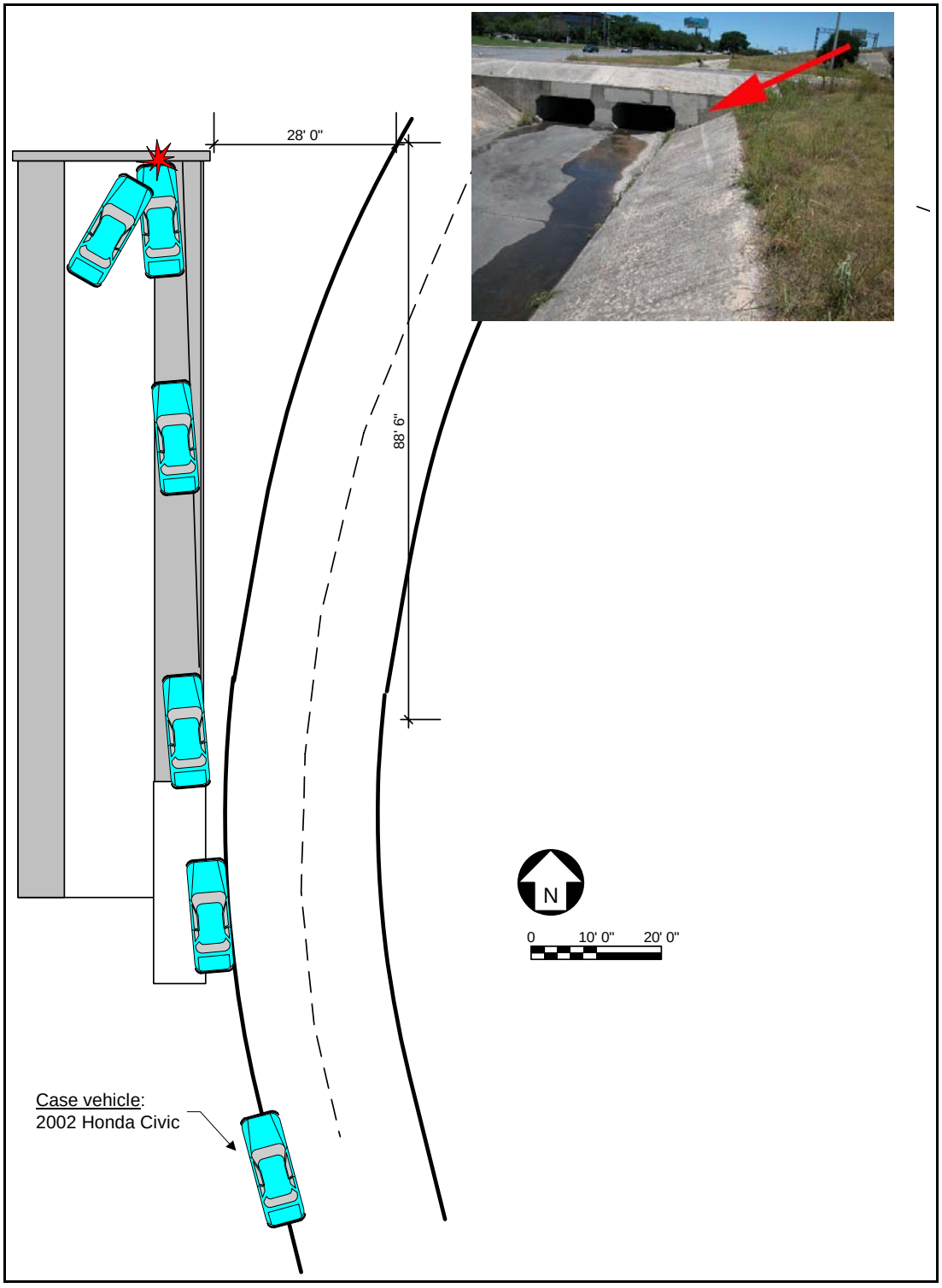

Figure 17. Scene diagram