CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE CHILD AIR BAG RELATED SERIOUS INJURY CRASH INVESTIGATION

CASE NO: CA06-025

VEHICLE: 1995 FORD CONTOUR

LOCATION: OHIO

CRASH DATE: OCTOBER 2006

Contract No. DTNH22-01-C-17002

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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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VEHICLE: 1995 FORD CONTOUR
LOCATION: OHIO
CRASH DATE: OCTOBER 2006

BACKGROUND

This on-site investigation focused on the severity of the crash and the source and severity of injury for a 6-year old male front right passenger of a 1995 Ford Contour **(Figure 1)**. The Contour was equipped with first generation frontal air bags for the driver and front right passenger positions that deployed as a result of a minor severity rear-end crash with a 1998 Jeep Cherokee. The 20-year old male driver of the Contour was apparently distracted and failed to detect the Cherokee as it stopped for traffic. The driver of the Contour applied a rapid braking force immediately prior to impact. The unrestrained front right child passenger was displaced forward by the braking force. The front bumper fascia of the Contour contacted and underrode the rear bumper of the Jeep as the hood face and upper radiator support engaged the bumper of the Jeep. This impact deployed the frontal air bag system in the Contour. The expanding front right air bag contacted the child passenger as he responded forward to the 12 o'clock direction of force. The child loaded into and displaced the air bag forward against the windshield. As a result of air bag expansion, the child passenger sustained a severe subdural hemorrhage, a severe cerebral edema, bilateral intracerebral hemorrhages, a subarachnoid hemorrhage, four metacarpus fractures to his right hand, and multiple soft-tissue injuries. He was transported by ambulance to a local hospital where he was stabilized for helicopter transfer to a regional trauma center. He was admitted in critical condition with a minimal chance of survival. He spent 41 days in the trauma center before being transferred to a care facility for victims of severe brain injuries. Since the crash, he has been unable to respond to stimulus or communicate in any manner. The drivers of the Jeep and the Contour were not injured. The Contour was towed from the scene of the crash and impounded. The Jeep was driven from the scene.

Figure 1 - Damaged 1995 Ford Contour.

Notification of this crash was provided to NHTSA by the Calspan Special Crash Investigations (SCI) team on October 10th and was assigned for on-site investigation on October 11, 2006. The investigating officer was contacted and cooperation was established for this on-site investigation. The involved vehicles and the crash site were inspected on October 19, 2006.

SUMMARY

Crash Site

This crash occurred on a five lane U.S. Route in an urban area during nighttime hours. The roadway consisted of two travel lanes in each direction and a dual center left turn lane. The asphalt road surface was straight and level and bordered by 15 cm (6") barrier curbs. The weather conditions were overcast with light rain and the road surface was wet. Illumination was provided by artificial lighting from light poles and area businesses. The crash site was located several hundred meters north of a signalized four-leg intersection. Traffic had backed up from the intersection to the location of the crash. The posted speed limit was 40 km/h (25 mph). The Crash Schematic is attached as **Figure 12** at the end of this narrative report.

Vehicle Data

1995 Ford Contour

The subject vehicle in this crash was a 1995 Ford Contour GL, four-door sedan. The vehicle was manufactured on 9/95 and was identified by Vehicle Identification Number (VIN) 3FALP65L7SM (production number deleted). At the time of the crash, the vehicle odometer reading was 185,261 km (115,119 miles). The Contour was powered by a transverse mounted 2.5 liter V-6 gasoline engine linked to a 3-speed automatic transmission with a console mounted transmission selector lever. The service brakes were four-wheel power-assisted disc without anti-lock brakes (ABS). The vehicle manufacturer recommended tire size was P205/60R15 at 214 kPa (31 PSI). All tires were properly sized with the exception of the right rear. A space-saver spare tire was mounted at this position at the time of the crash. The vehicle manufacturer recommended front and rear cold tire pressure was 241 kPa (31 PS) and 234 kPa (34 PSI). The specific tire data at the time of the SCI inspection was as follows:

Position	Tire Manufacturer/Model	Measured Pressure	Measure Tread Depth	Damage
Left Front	Lemans HR	255 kPa (37 PSI)	2 mm (2/32")	None
Left Rear	BF Goodrich Advantage GT	134 kPa (19.5 PSI)	3 mm (4/32")	None
Right Front	Radial GT SR5000	124 kPa (18 PSI)	2 mm (2/32")	None
Right Rear	General Temporary Use Only	321 kPa (46.5 PSI)	2 mm (2/32")	None

The interior of the Contour was equipped with cloth surfaced front bucket seats and a fixed three-passenger rear bench seat. The front seats were manually adjustable for fore and aft positioning and recline. The front seat backs were configured with adjustable head restraints that were in the full-down positions. There were no rear seat head restraints. At the time of the crash, the rear seat area was filled with clothing and miscellaneous items piled to the top of the front seat backs.

1998 Jeep Cherokee

The struck vehicle in this crash was a 1998 Jeep Cherokee, 5-door sport utility vehicle. Permission to conduct a complete inspection was not obtained from the owner; therefore

limited data was obtained for this investigation. The Cherokee was equipped with OEM steel wheels and Uniroyal Laredo all-season tires. The service brakes were power-assisted front disc/rear drum (ABS unknown).

Crash Sequence

Pre-Crash

The driver of the Jeep Cherokee was traveling in a southerly direction on the outboard travel lane of the five-lane roadway, approaching a line of traffic. Traffic had backed-up from the four-leg signalized intersection that was located several hundred meters south of the impending crash site. The driver of the Cherokee stopped for traffic in the outboard lane.

The 20-year old male driver of the Ford Contour was traveling in a southerly direction on the outboard lane at approximately the posted speed limit of 40 km/h (25 mph). As he approached the Jeep Cherokee, the driver of the Contour was momentarily distracted from the driving task. He redirected his attention forward and observed the stopped Cherokee directly forward of his path of travel. The Contour driver applied a rapid braking force in an attempt to avoid the crash. This braking force compressed the front suspension as the vehicle continued forward to impact. **Figures 2** and **3** illustrate the pre-crash direction and point of impact of both vehicles.

Figure 2 - Southbound approach of both vehicles.

Figure 3 - Area of impact.

Crash

The full-frontal area of the Contour impacted the rear bumper of the stopped Jeep Cherokee. Resultant directions of force were within the 12 o'clock sector for the Ford and 6 o'clock for the struck Cherokee. The initial contact involved the top surface of the Contour's front bumper fascia against the rear bumper of the Jeep. As the Contour engaged the Jeep, its front bumper underrode the rear bumper of the Cherokee. The hood face subsequently engaged the rear bumper of the Jeep, crushing the hood face and the upper radiator support panel. The damage algorithm of the WINSMASH program computed total velocity changes of 16 km/h (9.9 mph) for the Ford and 16 km/h (9.9 mph) for the struck Jeep. The specific longitudinal and lateral components were -16 km/h (-9.9 mph) and 0 km/h (0 mph) for the Ford and 16 km/h (9.9 mph) and 0 km/h

(0 mph) for the Cherokee. As a result of the crash, the frontal air bag system in the Contour deployed.

The impact displaced the Jeep a minimal distanced forward as it came to rest on the outboard travel lane near the point of impact. The Contour came to rest at or near the point of impact.

Post-Crash

Police and emergency personnel were dispatched to the scene of the crash. The injured front right child passenger of the Contour was removed from the vehicle by rescue personnel and transported by ambulance to a local hospital where he was stabilized and transferred by helicopter to a regional trauma center. The drivers of the vehicles were not injured. Following the on-scene police investigation, the Jeep was driven from the scene. The Ford was towed to a local facility and impounded by the investigating officer. He authorized the inspection of the vehicle at this facility.

Vehicle Damage – Exterior

1995 Ford Contour

The frontal area of the Ford Contour sustained minor severity damage that involved the front bumper fascia, hood, grille, both headlight and turn signal assemblies, the leading edges of the front fenders, and the upper radiator support panel **(Figures 4 and 5)**. The top surface of the Contour's front bumper initially engaged and underrode the rear bumper. The grille, hood face, and upper radiator support subsequently engaged the rear bumper as the Contour continued forward. The direct contact damage on the bumper fascia began 66 cm (26") right of center and extended 136 cm (53.5") to the left corner. There was no crush at the level of the bumper. The hood face crushed rearward against the upper radiator support and the hood latch released. The full-width of the support was deformed resulting in a "Field L" measurement width of 130 cm (51"). Maximum crush was 8 cm (3") located at the left corner of the radiator support. The crush profile at the level of the support was as follows: C1 = 8 cm (3"), C2 = 2 cm (0.8"), C3 = 3 cm (1.1"), C4 = 1 cm (0.4"), C5 = 3 cm (1.2"), C6 = 2 cm (0.8"). The Collision Deformation Classification (CDC) for this impact was 12-FDEW-1.

Figure 4 - Frontal perspective of damage.

Figure 5 - Overhead perspective of frontal damage.

Interior – 1995 Ford Contour

The interior of the Ford Contour was not damaged by the crash or reduced in size by intrusion of frontal components. There were no interior contact points from driver or passenger interaction. Subtle expansion striations were noted to the face of the front right air bag that is addressed in further detail in the *Frontal Air Bag* section of this report.

Exterior - 1998 Jeep Cherokee

The back plane of the Jeep Cherokee sustained minor severity damage as a result of the impact with the Ford Contour **(Figures 6 and 7)**. The damage was limited to the rear bumper which was crushed forward, indicative of the 6 o'clock direction of force. The direct contact damage began 43 cm (17") right of center and extended 119 cm (47") to the left corner. Maximum crush was 8 cm (3") located on the bumper face, 33 cm (13") inboard of the left corner. The crush profile was along the total damage width of 163 cm (64") and was as follows: C1 = 0 cm, C2 = 8 cm (3"), C3 = 4 cm (1.5"), C4 = 3 cm (1"), C5 = 1 cm (0.25"), C6 = 0 cm. The CDC for this impact was 06-BDLW-1.

Figure 6 - Damaged 1998 Jeep Cherokee.

Figure 7 - Damaged 1998 Jeep Cherokee.

Frontal Air Bag System – 1995 Ford Contour

The Ford Contour was equipped with a first generation frontal air bag system for the driver and front right passenger positions. The system consisted of a conventionally mounted driver air bag module within the four-spoke steering wheel rim, a mid-mount front right air bag module, two ball-in-tube electro-mechanical sensors that were mounted to the forward face of the upper radiator support panel **(Figure 8)**, a right kick-panel mounted safing sensor, and a right lower instrument panel air bag control module. The frontal air bags deployed as a result of the frontal engagement against the rear of the Jeep. The front mounted crash sensors were not damaged as a result of the underride crash.

Figure 8 - Air bag sensor.

The driver's air bag deployed from an H-configuration module **(Figure 9)**. The cover flaps were 19 cm (7.5") in width at the horizontal tear seam. The upper flap flared to a

width of 12 cm (10.1”) and was 9 cm (3.6”) in height. The lower flap was 7 cm (2.75”) in height. The air bag was vented by two 2 cm (0.75”) diameter ports located on the back side of the bag at the 12 o’clock sector. The ports were centered 6 cm (2.5”) forward of the peripheral seam. The air bag was also tethered by four internal straps at the 12/6 and 3/9 o’clock positions. The maximum excursion of the air bag at the tether location was 23 cm (9”).


Figure 9 - Deployed driver's air bag.

The front right air bag deployed from a mid mount module that was incorporated into the apex of the top and mid right instrument panel **(Figure 10)**. The single cover flap was formed to the contour of the instrument panel and was reinforced with a sheet metal backer that acted as a hinge. The flap’s overall dimensions were 36 cm (14.25”) in width and 17 cm (6.75”) fore and aft. The acronym SRS (Supplemental Restraint System) was embossed into the lower right aspect of the flap. As the air bag deployed, the cover flap opened in an upward and forward direction and contacted and fractured the windshield.

The deployed front passenger air bag was tethered by a single wide band tether that was sewn to the face of the bag 23 cm (9”) below the top surface of the bag face. The face of the air bag measured 61 cm (24”) in width and 51 cm (20”) in height. The top and bottom seams of the bag protruded 30 cm (12”) outboard of the leading edge of the module. The maximum excursion of the bag was 61 cm (24”) at the mid point.

Subtle vertically oriented striations were present on the left lower third of the face of the bag which measured 25 cm (10”) in height and 17 cm (6.75”) in width **(Figure 11)**. These striations resulted from expansion of the air bag within the module as its expansion was restricted by the out-of-position front right passenger. There was no occupant contact evidence (tissue and/or body fluid) on the air bag.


Figure10 - Deployed front right air bag.

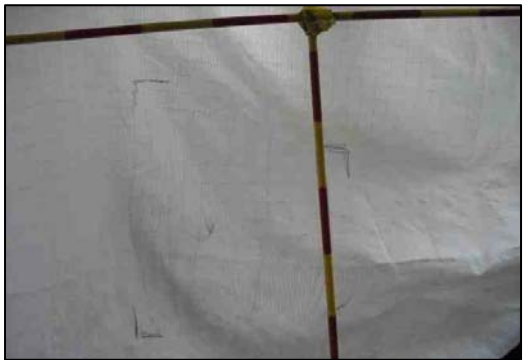
Figure 11 - Linear vinyl striations on air bag membrane.

The out-of-position child passenger loaded the air bag in response to the frontal crash forces as it expanded against his right hand, head, and face. His forward motion displaced the bag forward and right against the windshield. A large air bag fabric transfer was noted to the windshield at the upper right corner area adjacent to the right A-pillar. The air bag did not contribute to the fracturing of the windshield.

Manual Safety Belt Systems – 1995 Ford Contour

The Ford Contour was equipped with continuous loop three-point lap and shoulder belt systems for the four outboard seated positions. The front belt systems were configured with sliding latch plates and adjustable D-rings. The driver's D-ring was adjusted to the full-up position while the right D-ring was 3 cm (1") below the full-up position. The driver's belt retracted onto an Emergency Locking Retractor (ELR). The front right retractor was switchable from the ELR to an Automatic Locking Retractor (ALR) mode.

The driver's latch plate and webbing exhibited historical usage indicators consisting of fraying on the edges of the webbing. The safety belt system did not; however, yield loading evidence associated with this crash. Based on the lack of belt loading evidence, it was determined that the driver was not restrained.

The front right belt system yielded subtle routine usage indicators for the mileage on the vehicle consisting of fraying on the edges of the webbing. Again, there was no loading evidence on the belt system. Based on the trajectory of the child passenger and the lack of loading evidence, this passenger was not restrained during the crash. It should be noted that the Police Accident Report listed both occupants of the Contour as restrained.

The rear seat of the vehicle was stacked with clothing and miscellaneous items at the time of the crash. There was no space for a rear seat passenger. The outboard safety belt system were equipped with switchable ELR/ALR retractors and fixed D-rings. The center rear position was lap belt equipped. The latch plate was cinching.

Driver Demographics/Data – 1995 Ford Contour

Age/Sex:	20-year old/Male
Height:	Unknown
Weight:	Unknown
Manual Safety Belt Use:	None
Usage Source:	Vehicle inspection
Eyewear:	None
Seat Track Position:	Rear
Egress from Vehicle:	Exited unassisted through the left front door
Mode of Transport from Scene:	Not reported
Type of medical treatment:	None

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98	Injury Source
Not injured	N/A	N/A

Source – Investigating police officer

Driver Kinematics

The driver of the Ford Contour was seated in a rear track position [3 cm (1.25") forward of full-rear] with the seat back reclined to an angle of 30 degrees and the head restraint adjusted to the full down position. He was not restrained by the manual safety belt system.

At impact, the driver initiated a forward trajectory in response to the frontal impact force. He loaded the deployed air bag which provided sufficient restraint in this low-severity crash. The driver rebounded into the front left seat back and was not injured.

Front Right Child Passenger Demographics/Data

Age/Sex:	6-year old/Male
Height:	122 cm (48")
Weight:	19 kg (40 lb)
Manual Safety Belt Use:	None
Usage Source:	Vehicle inspection
Eyewear:	None
Seat Track Position:	Rear
Egress from Vehicle:	Removed from vehicle by rescue personnel;
Mode of Transport from Scene:	Transported by ambulance to a local hospital where he was stabilized and transferred by helicopter to a regional trauma center
Type of medical treatment:	Admitted in critical condition for 41 days before being transferred to a full-time care center

Front Right Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Severe subdural hemorrhage to right side of head	Critical (140656.5,1)	Expanding front right air bag
Severe cerebral edema	Critical (140666.5,1)	Expanding front right air bag
Bilateral intra-cerebral brain hemorrhages (both temporal lobes and right frontal lobe)	Critical (140646.5,3)	Expanding front right air bag
Subarachnoid hemorrhage in interpeduncular cistern	Serious (140684.3,9)	Expanding front right air bag

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Multiple right hand fractures (metacarpus 2 – 5)	Moderate (752002.2,1)	Expanding front right air bag
Epistaxis	Minor (251090.1,4)	Expanding front right air bag
Left eyelid contusion	Minor (297402.1,2)	Expanding front right air bag

Source – Medical Reports

Front Right Passenger Kinematics

The front right child passenger was seated in a rear track position with the seat back reclined. At the time of the SCI inspection, the seat back was reclined to a measured angle of 34 degrees from veritcal. It could not be determined whether this was the position of the seat back at the time of the crash, or if it was placed in an altered position by rescue personnel. He was not restrained by the manual safety belt system. The lack of loading evidence and his subsequent trajectory supported his unrestrained status.

Immediately prior to impact, the driver applied a rapid braking force in an attempt to avoid the impending crash. As a result of this braking action, the unrestrained child passenger initiated a forward trajectory. The frictional interaction between his buttocks and lower extremities against the cloth seat cushion allowed his upper body to move forward and downward in an arcing trajectory. This positioned his face in close proximity to the mid mount front right air bag module.

At impact, the first generation frontal air bag system deployed. It appears the child attempted to brace for the impact by extending his right arm toward the instrument panel evidenced by the head fractures. The early stage of the expanding air bag struck the child passenger on the right hand, face, and head regions as he initiated a forward trajectory in response to the front crash forces. The continued expansion of the air bag lifted the child vertically as he loaded the bag, displacing the air bag up and right with respect to the vehicle. Fabric transfers from the air bag were visible at the upper right quadrant of the windshield. The forward, out-of-position child passenger momentarily restricted the deployment of the front right air bag. This was evidenced by vertically oriented striations on the lower face of the bag from expansion against the module assembly. There was no damage or occupant contact evidence to the bag membrane.

The child was displaced rearward into the front right seat back where he came to rest. The child sustained four metacarpus fractures to his right hand, a severe subdural hematoma, a sever cerebral edema, bilateral hemorrhages to both temporal lobes, a subarachnoid hemorrhage, and soft-tissue injuries to his nose and left eyelid This was associated with the initial contact from the expanding air bag and/or the acceleration applied to the child's head by the expanding air bag.

Medical Treatment

The child was removed from the vehicle by rescue personnel and transported by ambulance to a local hospital where he was stabilized and prepared for helicopter transfer to a regional trauma center. He was admitted to the trauma center in extremely critical condition with minimal chance of survival. During hospitalization, the child developed an infection and was placed on a ventilator. A shunt was internalized in the child's head to allow for drainage and a gastric tube was inserted for feeding purposes. The child remained at the trauma center for 41 days before being transferred to a full-time care center for permanent residency.

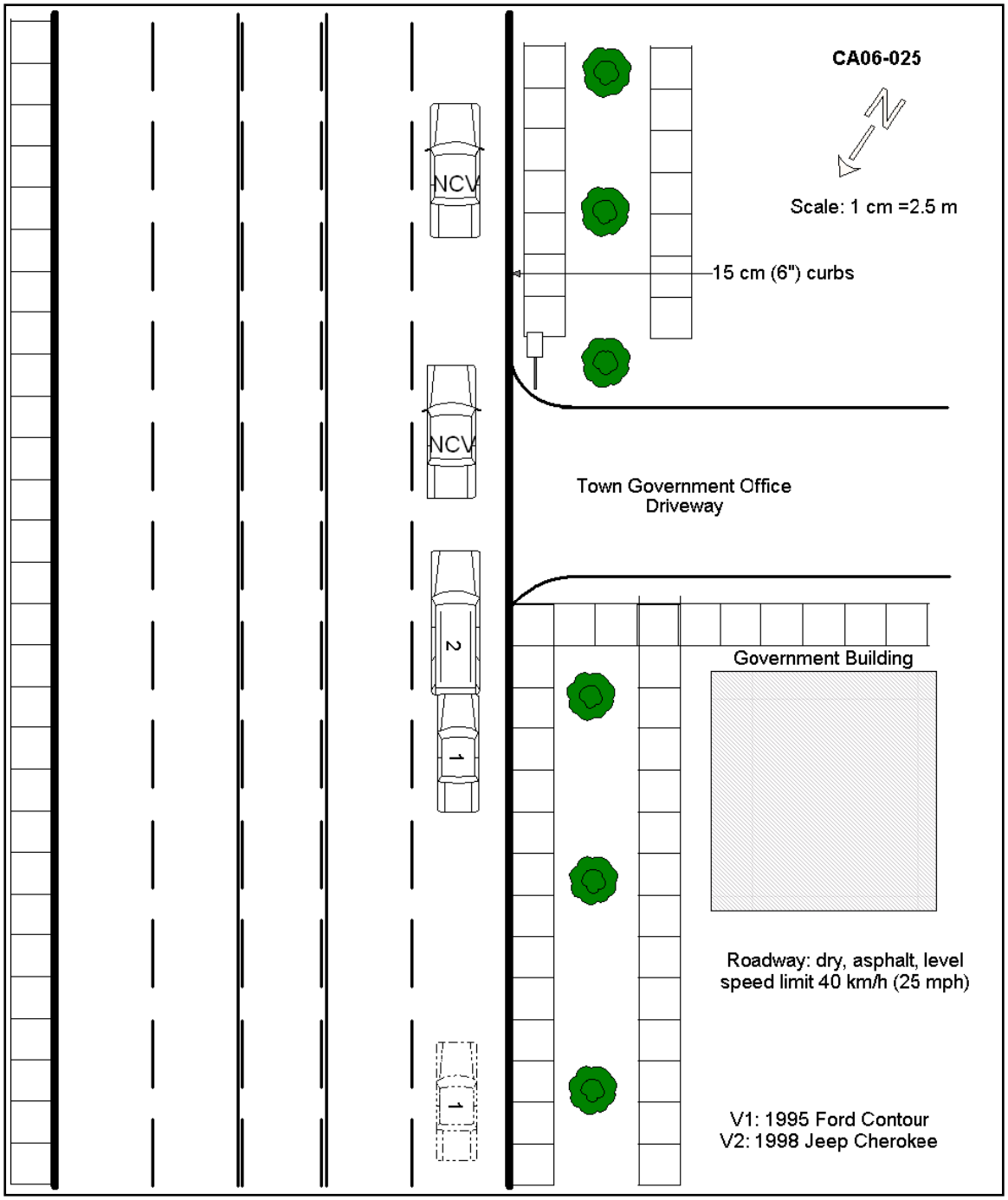

Figure 12 – Crash Schematic