

**TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER**

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ON-SITE DRIVER AIR BAG RELATED FATALITY INVESTIGATION

CASE NO: CA03-066

VEHICLE: 1996 FORD TAURUS

LOCATION: FLORIDA

CRASH DATE: MARCH 2000

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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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<i>16. Abstract</i> This on-site investigation focused on the crash severity and mechanisms of injury that resulted in the death of a 27 year old female driver of a 1996 Ford Taurus. The subject Ford Taurus was equipped with a Supplemental Restraint System (SRS) that consisted of frontal air bags for the driver and front right passenger. The frontal air bag system deployed as a result of a minor severity, angular frontal crash with a concrete retaining wall. The female driver sustained multiple blunt thoracic injuries including: bilateral rib fractures with hemothorax (AIS 5), and a laceration of the superior vena cava (AIS 3), as a result of the deploying driver air bag. She was unresponsive at the crash site, and transported to a Level II trauma center located within 16 km (10 miles) of the crash site. She was pronounced deceased 57 minutes post-crash.			
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ON-SITE DRIVER AIR BAG RELATED FATALITY INVESTIGATION
GENERAL DYNAMICS CASE NO: CA03-066
VEHICLE: 1996 FORD TAURUS
LOCATION: FLORIDA
CRASH DATE: MARCH, 2000

BACKGROUND

This on-site investigation focused on the crash severity and mechanisms of injury that resulted in the death of a 27 year old female driver of a 1996 Ford Taurus, **Figure 1**. The subject Ford Taurus was equipped with a Supplemental Restraint System (SRS) that consisted of frontal air bags for the driver and front right passenger. The frontal air bag system deployed as a result of a minor severity, angular frontal crash with a concrete retaining wall. The female driver sustained multiple blunt thoracic injuries including: bilateral rib fractures with hemothorax (AIS 5), and a laceration of the superior vena cava (AIS 3), as a result of the deploying driver air bag. She was unresponsive at the crash site, and transported to a Level II trauma center located within 16 km (10 miles) of the crash site. She was pronounced deceased 57 minutes post-crash.



Figure 1: Front right view of the Ford Taurus.

This crash was identified through a media search for potential cases of interest for the Special Crash Investigations Program of the National Highway Traffic Safety Administration. The Crash Investigation Division of the NHTSA assigned an on-site investigation to the SCI team at General Dynamics on 11/18/03 following a jury verdict against the vehicle manufacturer in the crash. The plaintiff attorney handling the claim against the vehicle manufacturer was contacted and cooperation was established by the GD SCI team. Although the crash occurred in March, 2000, the Ford Taurus had been held in storage and was available for inspection. The on-site portion of the investigation took place December 3 and 4, 2003.

SUMMARY

Crash Site

This single vehicle crash occurred during the afternoon hours in March 2000. At the time of the crash, it was daylight and there were intermittent rain showers. The road surface was wet. The crash occurred on an elevated, concrete bridge structure that served as the entrance ramp to a state highway. The ramp curved left from a westerly direction to a southerly direction with a measured radius of 191 m (626 ft). The road was configured with two one-way traffic lanes and was bordered by shoulders and Jersey-style concrete retaining walls. The retaining wall measured 0.8 m (2.7 ft) high. The ramp was level in the area of the crash. The super-elevation of the curve measured four degrees. There were chevron alignment signs affixed to the outboard retaining wall spaced 13 m (44 ft) apart throughout the curve. The recommended safe speed

limit for the ramp curve was 56 km/h (35 mph). This sign was posted 0.16 km (0.1 mile) east of the crash site. Due to the passage of time between the date of the crash and the SCI inspection, there was no evidence identified at the scene related to this crash. The concrete barrier had been repainted prior to the SCI inspection. **Figure 2** is a westerly view approaching the entrance ramp. **Figure 3** is a southwesterly view on the bridge near the point of impact.

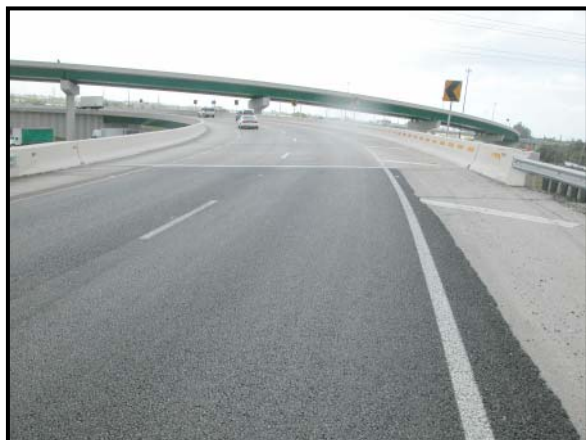


Figure 3: Westerly approach view to the ramp.



Figure 2: Southwesterly view at the point of impact.

CRASH SEQUENCE

Pre-Crash

The 1996 Ford Taurus was traveling westbound to southbound on the entrance ramp to the state highway. The vehicle was driven by a 27 year old female with a reported height and weight of 175 cm (69 in) and 68 kg (150 lbs). She was the vehicle's sole occupant. The minor severity of the crash, lack of seat belt related injuries, and conflicting evidence regarding usage precluded a determination regarding use of the manual restraint system. Manual restraint use could not be conclusively determined. For unknown reasons, the driver lost directional control of the Ford, and departed her travel lane to the right. The on-scene police investigation did not find any pre-crash tire marks that defined the vehicle's pre-crash trajectory or loss of control.

Crash

The crash occurred when the front right aspect of the Ford impacted the bridge retaining wall. The relative heading angle of the vehicle was an estimated 40 degrees to the right of the direction of the roadway at the point of impact. The principle direction of the impact force was in the 11 o'clock sector. A tire scuff on the retaining wall attributed to the right front tire of the Taurus identified the point of impact. This mark was identified during the on-scene investigation by the Florida Highway Patrol. The scuff was located 87.0 m (285.3 ft) from the beginning of the bridge. The Taurus slid along and remained in contact with the retaining wall for a distance of 3.3 m (10.7 ft). During its engagement with the wall the right front tire contacted and then disengaged from the wall. This dynamic was evidenced by the tire scuff documented during the police investigation. Due to its interaction with the wall, the Taurus was redirected in a

counterclockwise direction. The Taurus came to rest in contact with the wall at a relative heading angle of approximately 35 degrees. **Figures 4 through 6** are on-scene photographs taken during the police investigation of the final rest position of the vehicle and the right front tire scuff, respectively. A schematic of the crash is included at the end of this report, **Figure 11**. The force of the impact induced deceleration was sufficient to cause the deployment of the Ford's Supplemental Restraint System. The crash severity (total delta V) calculated by the Barrier Algorithm of the WINSMASH model was 13.3 km/h (8.3 mph).

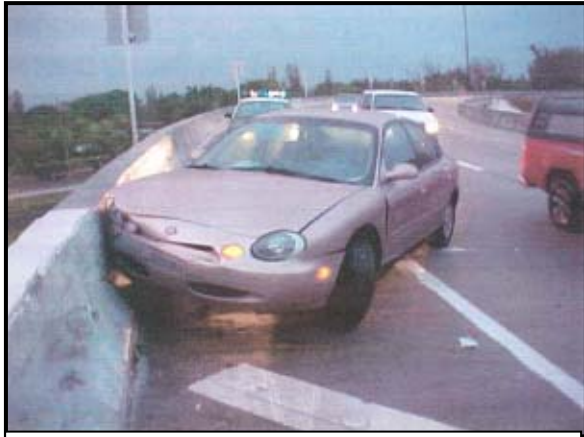


Figure 5: Look back view of the Taurus at final rest.



Figure 4: Final rest of the Taurus against the retaining wall.

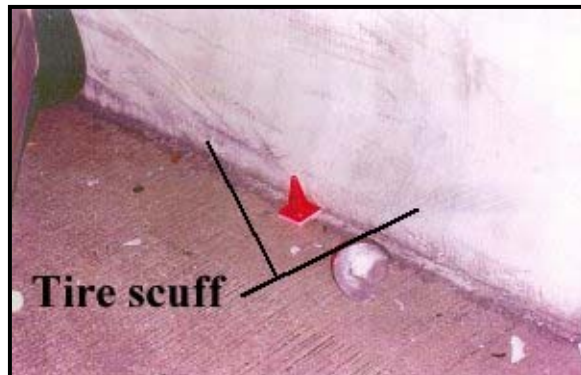


Figure 6: Right front tire scuff identified at the scene.

Post-crash

The crash was discovered by passers-by and reported via the 911 system. The police and ambulance personnel arrived at the scene, and began to render first aid. The driver was unresponsive and without respirations. Her pupils were fixed and dilated. She was transported via ground ambulance to a Level II trauma center located with 16 km (10 miles) of the crash site.

Resuscitative measures at the hospital were unsuccessful and she was pronounced deceased 57 minutes post-crash.

VEHICLE DATA

1996 Ford Taurus GL

The 1996 Ford Taurus was identified by the Vehicle Identification Number (VIN): 1FALP52UXTG (production sequence deleted). The vehicle’s date of manufacture was 02/96. The odometer reading at the time of the SCI inspection was 88,463 km (54,970 miles). The four-door, front-wheel drive sedan was equipped with the GL trim package to include: power steering, power assist front disc/rear drum brakes without ABS, power windows and door locks and a power driver seat. The power train consisted of a 3.0 liter/V6 engine linked to a four speed automatic transmission. The manual restraint system consisted of three-point lap and shoulder belts for the four outboard positions. The Supplemental Restraint System consisted of air bags for the driver and front right passenger. The Taurus was equipped with Michelin Rain Force MX4 P205/65R15 tires on OEM aluminum rims. The manufacturer’s recommended tire pressure was 227 kpa (33 psi). The specific measured tire data at inspection was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	130.8 kpa (19.0 psi)	5.6 mm (7/32)	No	None
LR	151.5 kpa (22.0 psi)	7.1 mm (9/32)	No	None
RF	10.3 kpa (1.5 psi)	5.6 mm (7/32)	No	None
RR	199.7 kpa (29.0 psi)	7.1 mm (9/32)	No	None

Exterior Damage

Figures 7 and 8 are the front and right lateral views of the Ford. The front plane of the Ford sustained 132.0 cm (52.0 in) of direct and induced damage that extended across the vehicle’s front end width. The direct damage measured 99.0 cm (39.0 in). The direct contact began 33.0 cm (13.0 in) left of center and extended to the right corner. The direct damage wrapped around the front right corner and extended 30.5 cm (12.0 in) onto the forward aspect of the right side. The damage profile was biased to the right indicative of an angular contact with the retaining wall. The abrasions on the bumper fascia were directed from the upper left to the lower right (with respect to the vehicle). The vehicle’s residual crush measured along the front bumper was as follows: C1 = 0 cm (0 in), C2 = 0 cm (0 in), C3 = 6.0 cm (2.4 in), C4 = 11.0 cm (4.3 in), C5 = 17.0 cm (6.7 in), C6 = 16.0 cm (6.3 in). There was no measurable change in the wheelbase dimensions. The right front wheel rim was abraded due to contact with the retaining wall. Both front fenders shifted rearward and restricted the operation of the front doors. The right aspect of the windshield was fractured by the deploying front right passenger air bag cover flap.

The Collision Deformation Classification was 11-FZEW-1. The Barrier Algorithm of the WINSMASH model was used to assess the crash severity (delta V) based the above referenced

crush profile. The Ford's calculated total delta V was 13.3 km/h (8.3 mph). The longitudinal and lateral components were -10.2 km/h (-6.3 mph) and 8.5 km/h (5.3 mph), respectively.



Figure 7: Front view of the Ford.

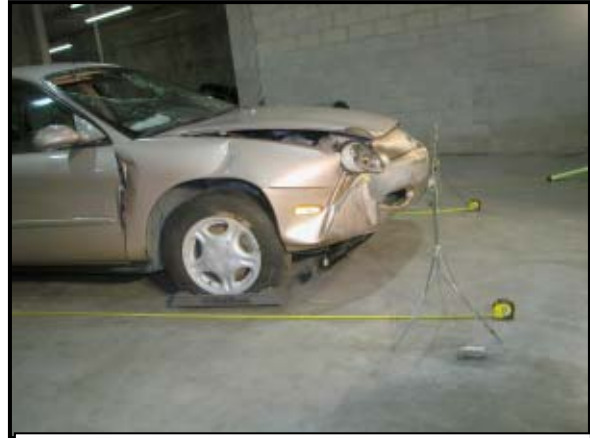


Figure 8: Right lateral view.

Interior Damage

There was no interior damage or intrusion related to the exterior forces of the crash. All the interior damage was related to the deployment of the vehicle's Supplemental Restraint System and the occupant's interior contacts.

The lack of electrical power precluded moving the powered driver seat at the time of the inspection. Its position was measured with respect to the manual front right seat, **Figure 9**. The front right seat was adjusted to the full rear track position. The total seat track travel measured 22.4 cm (8.8 in). The driver seat was located in a mid-track position and measured 10 cm (4 in) forward of full rear. The seat back angle measured 12 degrees aft of vertical. The horizontal distance from the center of the air bag module to the seat back measured 62.2 cm (24.5 in).

The 4-spoke steering wheel was turned 30 degrees counterclockwise at inspection. The tilt adjustment was in the center position. There was no deformation of the steering wheel rim. The steering column had completely separated from its shear capsules. The displacement of both the left and right shear capsule measured 4.0 cm (1.6 in).



Figure 9: Driver seat position.

Inspection of the padded driver's knee bolster revealed a minor scuff attributed to contact with the driver's right lower extremity. A 3.8 cm x 3.8 cm (1.5 in x 1.5 in) minor scuff was located

9.7 cm (3.8 in) right of the steering column center line. A review of the autopsy report indicated this contact did not result in injury.

Manual Restraint System

The manual restraint system in the subject vehicle consisted of 3-point lap and shoulder belts with continuous loop webbing and light weight locking latch plates for the four outboard positions. The front center position was equipped with a lap belt. The rear center position was equipped with a lap belt and a detachable shoulder belt.

The driver's restraint was stowed within the Emergency Locking Retractor (ELR) upon inspection and was operational. The overall condition of the webbing and latch plate revealed indications of historical use. The condition of the restraint was consistent with the statements of the driver's family that she was a habitual belt user. Inspection of the safety belt webbing was unremarkable. There was no crash related evidence identified on the webbing or any of the hardware surfaces. However, given the minor severity of the impact, crash related evidence on the webbing or potential seat belt related injury(s) would not be expected. The EMS personnel reported to the hospital that the driver was observed to be unrestrained at the time of their arrival. The driver had already been transported prior to the arrival of the investigating police officer. The police report indicated the driver was unrestrained. Based on all the evidence gathered during the SCI inspection, it could not be determined if the driver was restrained. Therefore, the driver's use of the manual restraint was unknown.

Supplemental Restraint System

The Supplemental Restraint System (SRS) in the 1996 Ford Taurus consisted of air bags for the driver and front right passenger. The SRS was controlled and monitored by an electronic module located under the center instrument panel. The system utilized two impact sensors located on the left and right sides of the radiator support for crash recognition. The SRS did not have Event Data Recording (EDR) capabilities.

The driver air bag module was located in the center hub of the steering wheel. The air bag was housed in a module that had H-configuration cover flaps. The top flap measured 5.8 cm x 7.6 cm (5.8 in x 3.0 in), width by height. The lower flap measured 14.0 cm x 5.1 cm (5.5 in x 2.0 in). The deployed driver air bag, **Figure 10**, measured 61 cm (24 in) in diameter in its deflated state. It was tethered by two 8 cm (3 in) wide straps. It was not externally vented. The face of the air bag was soiled / smudged with dirt in its 3, 6 and 9 o'clock sectors from probable post-crash handling. There was an 8.9 cm (3.5 in) diagonal ink mark (pen) in the 5 to 6 o'clock sector.



Figure 10: Driver air bag.

Inspection of the remainder of the air bag was unremarkable. There was no direct evidence of driver contact to the air bag.

The front right passenger air bag was a top-mount design located in the right aspect of the instrument panel. The module cover flap was elliptical in shape and was tethered to the module. The cover flap impacted and fractured the windshield during the deployment sequence. The cover flap measured 43 cm x 30 cm (17 in x 12 in), width by depth. The face of the passenger air bag measured 64 cm x 56 cm (25 in x 22 in), width by height. The rearward excursion of the air bag measured 41 cm (16 in). The face of the bag was tethered by a 51 cm (20 in) wide strap. The bag was not externally vented. The bag fabric was soiled from post-crash handling. There was no evidence of driver contact noted of the bag.

DRIVER DEMOGRAPHICS

Age/Sex: 27 year old/Female
 Height: 175 cm (69 in)
 Weight: 68 kg (150 lb)
 Seat Position: Mid-track position
 Restraint Use: Unrestrained
 Usage Source: SCI inspection
 Medical Treatment: Transported by ambulance to a local Level II trauma center where she was pronounced deceased 57 minutes post-crash.

DRIVER INJURY

<i>Injury</i>	<i>Injury Severity (AIS 98 update)</i>	<i>Injury Mechanism</i>
Bilateral ribs fractures with bilateral hemothorax; Right second - fifth fractured anteriorly, Left second and third fractured laterally, Left first rib fractured posteriorly	Severe (450232.4,3)	Deploying driver air bag
0.6 cm laceration of the superior vena cava just above the right atrium; abundant hemorrhage anterior mediastinum, 260 cc hemopericardium, moderate hemorrhage right retro peritoneum	Serious (421804.3,4)	Deploying driver air bag
Contusion abrasion of the undersurface of the chin	Minor (290202.1,8) (290402.1,8)	Deploying driver air bag
Contusion abrasion of the upper right and left aspects of the chest	Minor (490202.1,3) (490402.1,3)	Deploying driver air bag
Contusion abrasion on the top of the left shoulder	Minor (790202.1,2) (790402.1,2)	Deploying driver air bag
The autopsy report describes the above contusion abrasion as continuous over a 18 x 7 cm area		

<i>Injury</i>	<i>Injury Severity (AIS 98 update)</i>	<i>Injury Mechanism</i>
5 cm irregular abrasion overlying the medial aspect of the right breast	Minor (490202.1,1)	Deploying driver air bag
7 x 5 cm diagonal scrape abrasion overlying the medial aspect of the left breast	Minor (490202.1,2)	Deploying driver air bag

Note: the above referenced injuries were identified in the driver's autopsy report dated March 12, 2000.

DRIVER KINEMATICS

Immediately prior to the crash, the 27 year old driver was seated in a mid-track position with a presumed normal posture. For reasons that could not be determined, the driver lost directional control of the vehicle and the impact with the retaining wall occurred. It was possible the driver sat more upright and closer to the steering wheel in an effort to regain control of the vehicle during the late stages of the pre-crash envelope. The force of the impact was sufficient to cause the deployment of the vehicle's Supplemental Restraint System.

It is theorized that the driver's upper body was in close proximity to the steering wheel hub at impact as a result of her attempts to regain control of the vehicle. The driver's forward position placed her chest within the punch out/inflation zone of the driver air bag. The driver air bag impacted the driver's chest early in its deployment sequence. The driver sustained bilateral rib fractures with hemothorax and a superior vena cava laceration with associated mediastinum, pericardial and retroperitoneal hemorrhage as a result of that contact. As the air bag expanded, the driver sustained the identified abrasions and contusion abrasions of the chest, shoulder and chin. The combination of the driver's forward kinematic pattern and the air bag inflation loaded the steering column and caused the shear capsule separation. The driver then rebounded back into her seat where she was found. She was found unresponsive with her pupils fixed and dilated. She was transported by ambulance to a Level II trauma center where she was pronounced deceased 57 minutes post-crash without regaining any life signs.

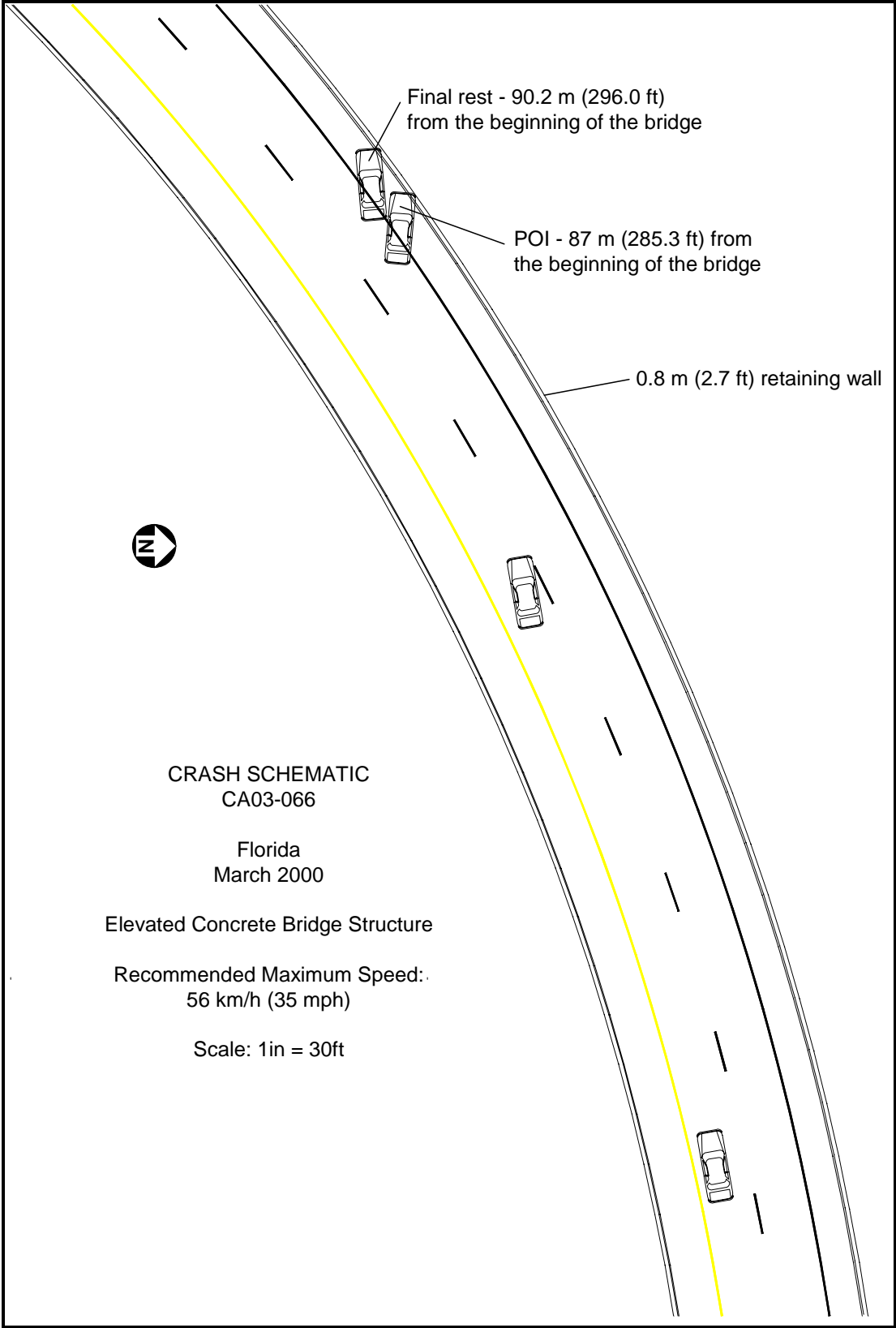


Figure 11. Crash Schematic