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Special Crash Investigations On-Site Guardrail End Treatment Crash Investigation Vehicle: 2001 Toyota Corolla Location: Pennsylvania Crash Date: March 2018

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15. Supplementary Notes
Each crash represents a unique sequence of events, and generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems. This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was published.

16. Abstract
This report documents a sequential kinking terminal (SKT) guardrail end terminal struck by a 2001 Toyota Corolla. The Toyota was traveling east on a divided two-lane, limited-access, highway during daylight. It was driven by a belted 65-year-old male with a belted 40-year-old male front row right occupant. The driver lost control of the vehicle in wet/snow conditions, departed the right side of the road in a clockwise yaw, and struck the guardrail end treatment with the Toyota's left plane. The impact displaced the SKT end treatment along a portion of the guardrail, which extruded the W-beam to the field side. An ambulance transported the driver from the crash site to a local hospital for minor severity injuries. The front row right occupant of the Toyota was not injured or transported.

17. Key Words SKT end treatment, end terminal, guardrail, road departure, W-beam	**18. Distribution Statement** Document is available to the public from the National Technical Information Service, www.ntis.gov.

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Office of Defects Investigation
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BACKGROUND

This report documents a sequential kinking terminal (SKT) guardrail end terminal struck by a 2001 Toyota Corolla (**Figure 1**). The Toyota was traveling east on a divided, two-lane, limited-access highway in the afternoon. It was driven by a belted 65-year-old male with a belted 40-year-old male front row right occupant. The driver lost control of the vehicle in wet/snow conditions, departed the right side of the road in a clockwise yaw, and struck the guardrail end treatment with the Toyota's left plane. The force of the impact displaced the SKT end treatment along a portion of the guardrail, which extruded the W-beam to the field side. An ambulance transported the driver from the crash site to a local hospital for minor severity injuries. The front row right occupant of the Toyota was not injured or transported.

Figure 1. West-facing lookback view depicting the crash site and the Toyota at its final rest position. Image supplied by the PTC.

The crash was identified by the Pennsylvania Turnpike Commission (PTC), which in turn submitted notification to the Federal Highway Administration (FHWA). The FHWA determined that the crash type and guardrail end treatment met the criteria for further research and subsequently forwarded the notification to the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration in March 2018. The CID assigned an on-site investigation of the crash to the Special Crash Investigations (SCI) team at Crash Research & Analysis, Inc., the same day. The SCI team initiated contact with the PTC and an on-site investigation was conducted in March 2018. The scope of the on-site investigation documented the guardrail system and the damage it sustained during the crash in order to understand its performance. The physical environment of the roadway and the guardrail system were digitally photographed and measured using a Nikon total station. An inspection of the Toyota included the measurement of its exterior deformation, documentation of the interior damage and intrusion, identification of occupant contact, assessment of manual restraint systems, and an evaluation of the supplemental restraint system. Due to the Toyota's date of manufacture, it was not equipped with an event data recorder (EDR) supported by the Bosch Crash Data Retrieval (CDR) tool.

SUMMARY

Crash Site

The crash occurred on the right shoulder of the eastbound lanes of a limited-access, divided highway during daylight. At the time of the crash, the National Weather Service reported the temperature at 0.6 º C (33 ºF) with 69 percent humidity, cloudy skies and light snow. The police reported conditions were daylight and snow with icy patches on the roadway surfaces.

The roadway was straight with a negative grade of less than one percent in the vicinity of the crash site. The roadway consisted of two lanes in the east and westbound travel directions with a concrete median (Jersey type) barrier physically separating the travel directions **(Figure 2)**. The travel lanes and shoulder surfaces were asphalt. The left eastbound lane was 3.7 m (12.1 ft) wide while the right lane was 3.5 m (11.5 ft) wide. The north shoulder adjacent to the median barrier was 1.3 m (4.3 ft) wide. The south shoulder adjacent to the right lane was 3.6 m (11.8 ft) wide. A rumble strip (tactile warning device) was cut into the south shoulder adjacent to the travel lane. Painted lane delineations consisted of a solid south white edge line, broken white lane lines separating the travel lanes, and a solid yellow edge line at the north edge of the left lane.

Figure 2. Eastbound trajectory view of the crash site at 50 m pre-impact with the guardrail.

Figure 3. Eastbound view of the shoulder, roadside and struck SKT guardrail end treatment.

The end treatment and guardrail were installed on the right roadside and protected traffic from an increasing sloped roadside that transitioned to a drainage ditch. The grass roadside had an average slope of -19 percent at the point of impact. **Figure 3** is an east-facing trajectory view approximately 20 m (66 ft) from the point of impact (guardrail post 1). A crash diagram is included at the end of this report.

Pre-Crash

The 65-year-old male driver was driving east in the right lane of the divided roadway. He told police he was operating the vehicle at approximately 105 km/h (65 mph). He exited a shallow left curve located approximately 0.8 km (0.5 miles) west of the guardrail end treatment and entered a straight section of the interstate. While traveling on this straight segment, the driver lost control of the Toyota in wet/snow conditions, and the vehicle initiated a clockwise yaw. The Toyota departed the right (south) road edge onto the paved shoulder, traversed the asphalt shoulder in a left side leading attitude, and entered the grass roadside. During the SCI scene inspection, two tire marks were identified that evidenced the vehicle's trajectory (**Figure 4**). Reconstruction of the vehicle dynamics determined that the front tires created these two marks. The left front tire mark was 13.4 m (44.0 ft) in length and the right front mark measured 4.0 m (13.1 ft).

Figure 4. Easterly view of the left side tire yaw marks on the grass roadside.

An on-scene image provided by the PTC depicted the rear tire yaw marks on the icy shoulder **(Figure 5)**. These marks ended at the edge of the shoulder at the point of impact with the guardrail end treatment. The diverging orientation of the rear marks indicated that the Toyota had rotated beyond 90 degrees as it approached the impact with Post 1. Due to the passage of time between the dates of the crash and inspection and the change in surface conditions, the rear tire marks on the shoulder were not visible during the SCI inspection.

Figure 5. Easterly view of the on-scene tire yaw marks on the icy asphalt shoulder. Image provided by the PTC.

Crash

The left rear door panel of the Toyota struck the face of the end terminal. At the time of the impact, the vehicle had rotated clockwise approximately 125 degrees. The direction of the impact force was in the vehicle's 8 o'clock sector. The force of the impact displaced the SKT terminal head to the east, extruding the W-beam. The left rear door of the Toyota crushed and intruded into the second row as the striker tore away from the C-pillar. The off-road trajectory of the vehicle and its engagement with the end terminal caused the W-beam to bend toward the south at the Post 4 location.

The left rear quarter panel of the Toyota engaged the chute of the end treatment in a continuous damage pattern that extended to the back left aspect of the Toyota. With its momentum depleted,

the Toyota came to rest facing southwest, adjacent to the deformed guardrail and end terminal 6.4 m (21.0 ft) from the Post 1 impact location. **Figures 6** and **7** are final rest views of the Toyota (images provided by the PTC).

Figure 6. Southwesterly view of the final rest position of the Toyota engaged against the terminal end. Image provided by the PTC.

Figure 7. Westerly view of the final rest position of the Toyota. Image provided by the PTC.

Post-Crash

The Toyota came to final rest with the left rear door engaged against the SKT terminal end and the quarter panel in contact with the chute. At rest, the vehicle was facing in a southwesterly direction, 115 degrees clockwise of its initial travel direction/heading. The emergency response system was notified of the crash by cellphone calls. PTC maintenance arrived on-scene and provided traffic control. Police and emergency medical services (EMS) personnel responded to the crash site. The front row right occupant of the Toyota exited the vehicle under his own power, without assistance, through the right front door. The driver unbuckled his seat belt system and was assisted from the vehicle by EMS personnel through the left front door. He complained of back pain and was transported by ambulance to a local hospital where he was treated and released. The front row right occupant denied injury and refused medical treatment. The Toyota was subsequently towed from the crash site to a local tow yard, where it was inspected for this SCI investigation.

SKT END TREATMENT AND GUARDRAIL

The SKT end terminal was an energy absorbing end treatment used to terminate W-beam guardrail systems. The SKT installation was 15 m (50 ft) long and consisted of an SKT end terminal, two hinged posts at post locations 1 and 2, an anchor cable, and six standard steel posts at post locations 3 to 8 that supported the W-beam with composite block-outs and carriage bolts. The SKT installation was manufactured by Road Systems, Inc. The manufacturer's literature and installation manuals can be found at http://roadsystems.com/skt.html.

The guardrail was a tangent system installed adjacent to the paved shoulder. The height of the W-beam measured 70 cm (27.5 in) in an undamaged section of the beam at Post 7. The Toyota struck the face of the end terminal (**Figure 8**) at Post 1. The impact face measured 51 x 51 cm (20.0 x 20.0 in). The force of the impact displaced the end terminal to the east and extruded 3.2 m (10.5 ft) of the W-beam. The extruded W-beam curled to the field side, away from the road. The force of the impact displaced the end terminal between Posts 3 and 4 (**Figure 9**). The end terminal chute was bent approximately 10 degrees at its midpoint; refer to the overhead image

below. Posts 1 to 4 of the installation were damaged during the crash, along with 9.1 m (30.0 ft) of W-beam. The deformed guardrail was inspected and documented through measurements and photographs. The FHWA Guardrail Form documenting the crash and installation is included at the end of this report as **Appendix A**.

Figure 8. Image depicting the impacted end terminal and the extruded W-beam.

Figure 9. Overhead view of the location of the displaced end terminal.

Post 1 consisted of a 15 x 15 cm (6.0 x 6.0 in) upper box-beam that was attached via a hex bolt to the lower post section that was embedded into the ground. The hex bolt was correctly positioned on the upstream side of the post. The end terminal was attached to the box-beam by two shear bolts. The force of the impact overloaded the two shear bolts, thus allowing the displacement of the end terminal. The impact force also caused the lower aspect of the box-beam to shear at the hinged connection. In this crash, the box-beam separated from the lower section and was displaced to the east along the roadside. The cable anchor, originally attached between Post 1 and the W-beam, separated during the impact and was also displaced onto the roadside.

Post 2 consisted of two I-beam elements that were connected by a hex bolt located approximately at ground level. This hex bolt was correctly positioned on the downstream side of the post. The post bottom was embedded into the ground. The hinged upper section of Post 2 rotated 90 degrees to the east during the crash. At this post, the W-beam was originally bolted to an open slot in the upper aspect of the I-beam flange. The bolt released (slid) from the slot as the I-beam rotated to the east.

Posts 3 to 5 of the installation were 15 x 10 cm (5.9 x 3.9 in) I-beams and prior to the crash supported the W-beam with composite block-outs and carriage bolts. The posts did not appear to have weakening holes. During the crash, the heads of these bolts at Posts 3 and 4 pulled through the W-beam by deformation of the slot in the rail. Post 3 bent approximately 80 degrees toward the road as a result of contact with the left rear axle of the Toyota. At final rest, the left rear tire was resting on the post. Post 4 was bent approximately 20 degrees to the east. After the carriage bolt separated at Post 4, the W-beam bent through the slot approximately 90 degrees to the south and along with the Toyota contacted Post 4 as the vehicle came to rest. There was slight bending of Post 5 and 6 (less than 10 degrees). The repair of the guardrail necessitated replacement of the W-beam to the splice at Post 7.

2001 TOYOTA COROLLA

Figure 10. Left plane damage to the Toyota.

Description

The vehicle in this single-vehicle run-off-road crash was a 2001 Toyota Corolla CE 4-door sedan (**Figure 10**) manufactured in December 2000 and identified by the Vehicle Identification Number 2T1BR12E31Cxxxxxx. The front-wheel-drive platform was powered by a 1.8 liter, inline, transverse-mounted, 4-cylinder, gasoline engine linked to a 4-speed automatic transmission with a console-mounted shifter. Placarding listed the gross vehicle weight rating at 1,594 kg (3,515 lb), with gross axle weight ratings of 823 kg (1,815 lb) front and 780 kg (1,720 lb) rear. The curb weight was 1,095 kg (2,414 lb).

Standard features included power-assisted front disc/rear drum brakes, power-assisted rack-and-pinion steering, electronic brakeforce distribution, and a tilt steering wheel. The vehicle manufacturer recommended tire size was P185/65R14. At the time of the crash, the Toyota was equipped with Guardsman Plus all-season tires on the front axle and Starfire SF340 all-season tires on the rear axle. All tires were of the recommended size. Specific tire data at the time of the SCI inspection were as follows:

Position	Tire Identification Number	Measured Tread Depth	Restricted	Damage
LF	R77J LRA 4712	6 mm (8/32 in)	No	None
LR	R77J XKV xxxx	6 mm (7/32 in)	No	None
RR	R77J XKV 1312	6 mm (7/32 in)	No	None
RF	R77J LRA 4712	6 mm (7/32 in)	No	None

The interior of the Toyota was configured for seating of five occupants (2/3) with front row bucket seats and a second-row bench seat with split, forward folding seat backs. The front row bucket seats were 4-way manually adjustable with reclining seat backs and adjustable head restraints. At the time of the SCI vehicle inspection, both front row seats were adjusted to their rearmost track positions. The driver's head restraint was 3 cm (1 in) above the seat back, while the front row right head restraint was in the full-down position. The second row left and second row right positions were equipped with adjustable head restraints; both were in their respective full-down positions. All seat surfaces in the Toyota were cloth. Safety systems consisted of continuous loop 3-point lap and shoulder seat belts for the five seat positions and supplemental dual-stage frontal air bags for the driver and front row right positions. The front row seat belt retractors were configured with pretensioners. None of the air bags deployed and the retractors did not actuate in this left side impact crash.

Exterior Damage

Figure 11. Left side view of the Toyota depicting the damage pattern.

The Toyota sustained left plane damage consistent with the Event 1 impact with the guardrail system. The initial contact occurred on the left rear door immediately aft of the left B-pillar from engagement with the end terminal. The square profile of the end terminal was observed on the sheet metal of the separated door panel. The lateral impact force crushed the door inward into the second row occupant space. The C-pillar-mounted striker post pulled through the sheet metal mounting point causing an integrity loss at the door location. As the Toyota continued on its errant southeast trajectory, the guardrail system deformed by bending due to the off-axis loading. The left rear quarter panel contacted the chute aspect of the end terminal resulting in a continuous damage pattern that extended from the vehicle's left B-pillar to the back left corner. The total length of direct and induced damage was 187 cm (73.6 in) along the left plane. Maximum crush was 30 cm (11.8 in) located on the side impact protection beam of the left rear door. The door penetrated into the occupant compartment due to the striker separation from the C-pillar. The exterior door panel separated from the door frame. A crush profile (**Figure 11**) documented along the damage plane by the total station was as follows: C1 = 7 cm (2.8 in), C2 = 5 cm (2.1 in), C3 = 7 cm (2.8 in), C4 = 20 cm (7.9 in), C5 = 30 cm (11.8 in), and C6 = 6 cm (2.4 in). The left front door was jammed shut by the impact and forced open at the scene to assist the driver. The door would not close or re-latch due to body deformation. Both right side doors remained operational post-crash. The left wheelbase was reduced 1 cm (0.8 in); the right wheelbase was unchanged. The Collision Deformation Classification (CDC) attributed to this damage pattern was 08LZEW3. The barrier equivalent speed calculated by the damage algorithm of the WinSMASH program was 22 km/h (14 mph).

Event Data Recorder

The Toyota was not equipped with an EDR supported by the Bosch CDR tool/software. Support by the CDR tool/software for the Toyota Corolla model did not start until the 2002 model year; therefore, data relative to this crash was not available.

Interior Damage

Interior damage was limited to the intrusion of the left rear door into the second row left occupant space with separation of the interior door panel, minimal left B-pillar displacement, and occupant contact. Maximum intrusion measured 42 cm (16.5 in) of lateral displacement of the interior door panel into the second row left position. The sill at the second row left position was intruded 2 cm (0.8 in). The left B-pillar was displaced 2 cm (0.8 in) forward into the driver's position.

Occupant contact damage was limited to rearward displacement of the right front seat back. The seat back was deformed to a reclined angle of 60 degrees aft of vertical and was jammed. The seatback rotation resulted in 30 cm (12 in) of intrusion into the second row left and center positions **(Figure 12)**. The front row right occupant engaged the center console without physical

evidence. The driver contact occurred to the left front door panel and seatback; however, no physical evidence was observed. Glazing damage was limited to the operable window and the fixed quarter window of the left rear door. All other glazing remained intact at the time of the crash.

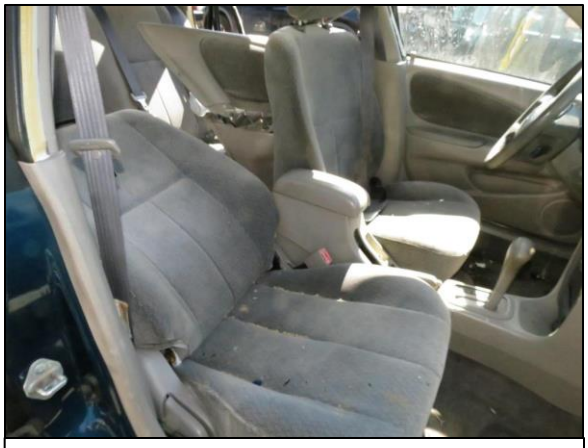


Figure 12. Overall interior view of the Toyota and the rearward deflection of the front row right seat back.

Manual Restraints

The Toyota was equipped with manual 3-point lap and shoulder seat belts for the five seat positions. All of the systems consisted of continuous loop webbing with sliding latch plates. The front row D-rings were adjustable; both the driver's and the front row right position were adjusted to their respective middle positions at the time of the SCI vehicle inspection. The driver's retractor was an emergency locking retractor (ELR) while the other four were switchable ELR/automatic locking retractors (ALR). Both front row retractors were configured with pretensioners. The pretensioners did not actuate during the crash. Inspection of the driver's seat belt webbing noted a safety pin that was routed through the webbing in place of the latch plate stop button that had separated from the webbing during the life of the vehicle. Both front row occupants were restrained by the manual seat belt systems.

The driver's retractor was locked/jammed by the left side exterior deformation to the Toyota. There was 155 cm (61.0 in) of webbing extended from the D-ring to the lower anchor. Outside of historical wear marks on the latch plate and belt webbing, there was no definitive occupant loading evidence on the system. This was due mostly to the lateral principal direction of force (PDOF) and continued clockwise rotation that displaced the driver laterally and rearward away from the belt webbing. The front row right seat belt webbing was found retracted and stowed against the B-pillar at the time of the SCI inspection. The system was operational with minor historical wear indicators on the latch plate and edge of the webbing. Similar to the driver's system, there was no occupant induced loading evidence to the hardware or webbing.

Supplemental Restraint Systems

The Toyota was equipped with dual-stage frontal air bags for the driver and front row right occupant positions. The system was controlled by and monitored by an air bag control module (ACM) that contained sensing and diagnostic functions. The ACM was mounted to the tunnel under the forward aspect of the center console. In addition to ACM sensing, the Toyota was configured with two upper radiator support-mounted satellite crash sensors. Display of system functionality was via an instrument panel indicator lamp that illuminated at ignition during diagnostic checks, or remained illuminated in the event of a system fault. At the time of the SCI vehicle inspection, the SCI Investigator energized the vehicle's ignition and observed that the air bag warning lamp cycled off.

The driver's frontal air bag was contained in the module mounted to the center hub of the four-spoke steering wheel and concealed by an H-configuration module cover. The passenger's

frontal air bag was mounted in the top aspect of the right instrument panel and concealed by a single cover flap. Both modules remained intact with no evidence of damage or malfunction. The Toyota was not equipped with supplemental side impact or rollover crash protection. There was no air bag deployment in this lateral left side impact crash.

2001 TOYOTA OCCUPANT DATA

Driver Demographics

Age/sex:	65 years/male
Height:	180 cm (71 in)
Weight:	91 kg (200 lb)
Eyewear:	Prescription glasses
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Full-rear
Manual restraint usage:	3-point lap and shoulder seat belt
Usage source:	Vehicle inspection
Air bags:	Driver's frontal air bag available; not deployed
Alcohol/drug data:	None
Egress from vehicle:	Exited with some assistance
Transport from scene:	Ambulance to a local hospital
Type of medical treatment:	Treated and released

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Strain of muscle, fascia, and tendon of lower back	640678.1	Driver seatback backed up by intruding left rear door	Certain

Source: hospital records.

Driver Kinematics

The driver of the Toyota was seated in an upright posture with a full-rear seat track adjustment. The seat back was reclined 15 degrees aft of vertical and the head restraint adjusted 3 cm (1.2 in) above the seat back. He was restrained by the manual seat belt system with the D-ring adjusted to a mid-level. Seat belt use was determined from the 155 cm (61.0 in) of extended webbing from the locked retractor. The retractor was locked due to damage resulting from exterior deformation.

As the vehicle lost traction on the wet road surface and initiated the clockwise yaw across the shoulder, the driver was minimally displaced to his left. As the vehicle continued to yaw and engaged the end terminal of the guardrail system, the driver responded to the lateral impact force by moving left, loading the left door panel. As the vehicle continued to rotate clockwise and displace the end treatment, he probably loaded the seat back and the left B-pillar. There was no direct contact evidence to these components. At the time of his loading, the left rear door intruded and contacted the seat back. This contact probably elicited a kinematic response by the driver that resulted in the lower back muscle strain.

The driver unbuckled the seat belt system, opened the left front door, and was assisted from the vehicle by EMS personnel. He was then transported by ambulance to a local hospital, where he was treated and released within hours of the crash.

Front Row Right Occupant Demographics

Age/sex:	40 years/male
Height:	178 cm (70 in)
Weight:	95 kg (210 lb)
Eyewear:	None
Seat type:	Forward-facing bucket seat with reclining seatback
Seat track position:	Full-rear
Manual restraint usage:	3-point lap and shoulder seat belt
Usage source:	Vehicle inspection
Air bags:	Frontal air bag; not deployed
Alcohol/drug data:	Unknown
Egress from vehicle:	Exited vehicle without assistance
Transport from scene:	None
Type of medical treatment:	None, not injured

Front Row Right Occupant Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Not injured	N/A	N/A	N/A

Source: police crash report (PAR); interview.

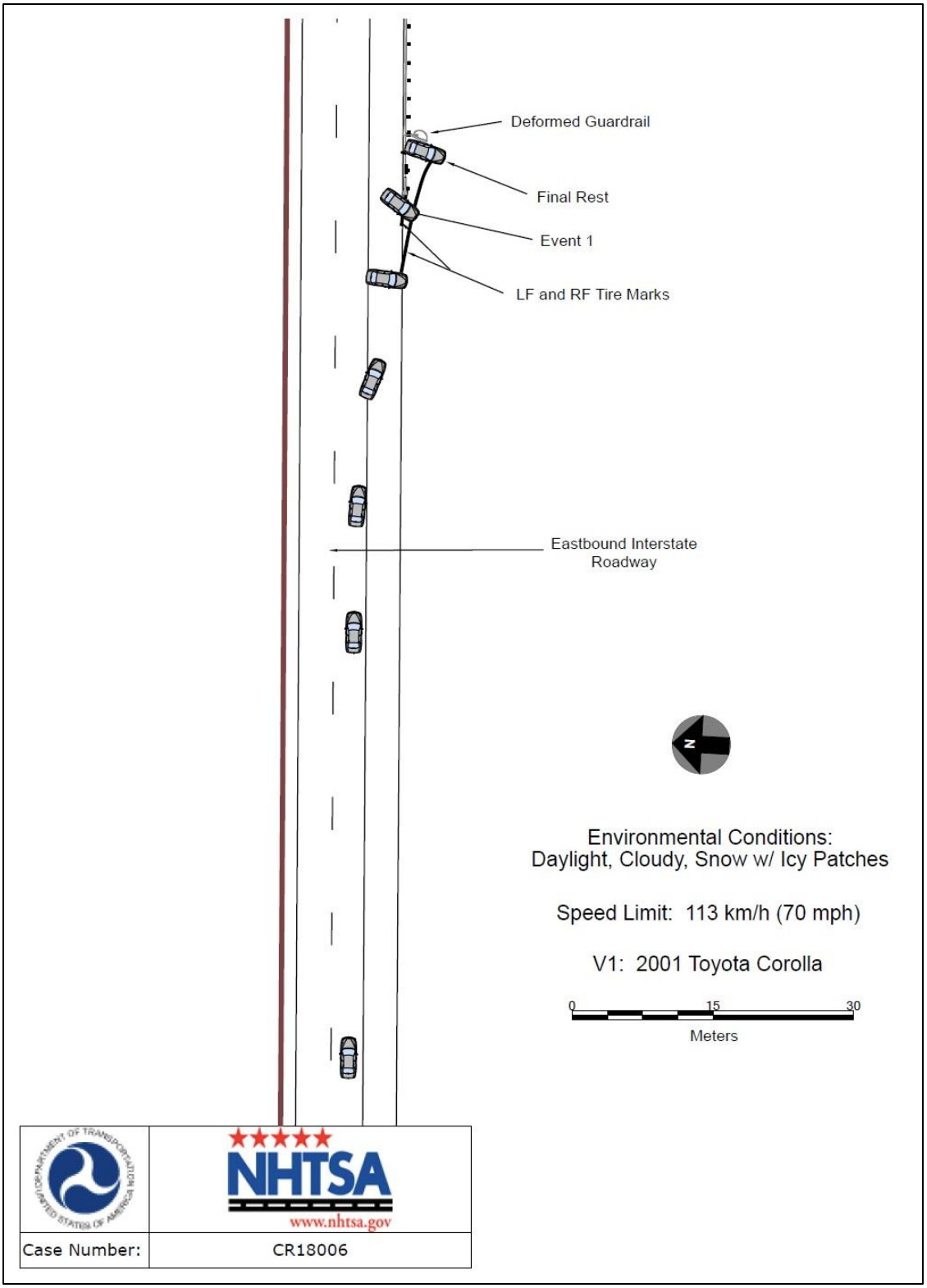
Front Row Right Occupant Kinematics

The front row right male occupant was seated in a full-rear track position with the head restraint adjusted to the full-down position. He was seated in an upright posture and restrained by the manual seat belt system.

As the Toyota yawed clockwise, the front row right occupant was minimally displaced to his left. At impact with the end treatment, he was displaced to his left and contacted the center console. As the Toyota continued to rotate clockwise, his kinematic response was translated rearward and he loaded the seatback, deforming the seatback to a measured angle of 60 degrees aft of vertical. The seat belt system held the occupant in his seat position as the Toyota came to rest.

He unbuckled his seat belt and exited the vehicle without assistance through the right front door. The occupant denied injury and refused medical attention.

CRASH DIAGRAM



APPENDIX A: Federal Highway Administration Guardrail Forms

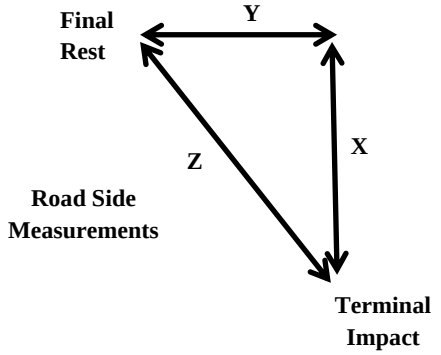
Case No.: CR18006

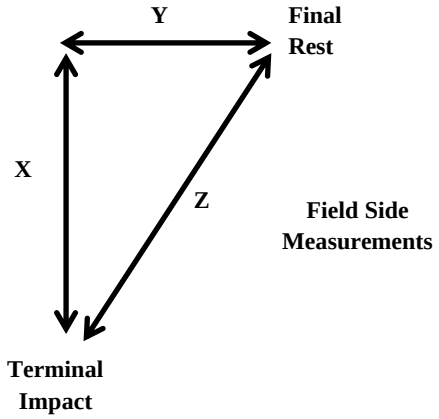
PREPOPULATED DATA (BY OTHERS)			
Date of Crash	March 2018	**Time of Crash (Military)**	Afternoon
Case Number	CR18006	**State**	PA
Traffic Route	Limited Access	**Direction (Southbound = SB)**	EB
Ambient Conditions (at time of crash)			
Temperature (°F)	33°	**Lighting**	Day
Atmospheric	Snow		

SCENE INFORMATION	
Type of area where crash occurred	☒Urban ❒Rural ❒Suburban
Terminal on a horizontal curve?	☒No ❒Curve/LT ❒Curve/RT
Estimated or Reconstructed Speed at Impact (MPH)	Estimated 65 mph Pre-Crash
Est. distance (straight line) from terminal impact to COM final rest position (ft.)	Z = 15.1 ft ☒Road side ❒Field Side
Est. distance (longitudinal) along guardrail from terminal impact to COM final resting location (ft.)	X = 13.5 ft
Est. distance (normal) from either 1. the white paint line; or 2. roadway/shoulder/pavement edge to COM rest position (ft.)	Y = 6.6 ft
Super elevation	❒>2% ❒<2% ☒NONE or FLAT
Curve Radius (ft.)	N/A

Key:

- COM - Center of Mass of Vehicle
- Distance Measurements





Case No.: CR18006

ON-SCENE INFORMATION		
End Treatment Type	☒ Extruder	❒ ET2000 ❒ ET-PLUS 4in ❒ ET-PLUS 5in ☒ SKT ❒ FLEAT ❒ SOFT STOP
	❒ Telescope	❒ X-LITE ❒ X-TENSION
Curb?	☒ No ❒ Yes	❒ AASHTO Type A ❒ AASHTO Type B ❒ AASHTO Type C ❒ AASHTO Type D ❒ AASHTO Type E ❒ AASHTO Type F ❒ AASHTO Type G ❒ AASHTO Type H
Curb Height: N/A		

GUARDRAIL INSTALLATION

Post No.	Post		Block-Out		Pre-Existing Damage		Offset to Post or Post Hole (ft.)		Spacing to Next Post (ft. -in.)
	Type	Dim.	Type	Dim.	Yes No Unknown	Describe	Travel Way	Curb	
	Steel Wood Other	D x W (in.) or Dia. (in.)	Steel Wood Composite	D x W (in.)					
1	Steel	6-3/4 x 7-1/4	None	N/A	No	N/A	23 in	N/A	N/A
2	Steel	4 x 6	None	N/A	No	N/A	16.0 in	N/A	6 ft - 4 in
3	Steel	4 x 6	Composite	4 x 7.5 x 14	No	N/A	26.0 in	N/A	6 ft - 5 in

Case No.: CR18006

GUARDRAIL INSTALLATION									
Post No.	Post		Block-Out		Pre-Existing Damage		Offset to Post or Post Hole (ft.)		Spacing to Next Post (ft. -in.)
	Type	Dim.	Type	Dim.	Yes No Unknown	Describe	Travel Way	Curb	
	Steel Wood Other	D x W (in.) or Dia. (in.)	Steel Wood Composite	D x W (in.)					
4	Steel	4 x 6	Composite	4 x 7.5 x 14	No	N/A	24.5 in	N/A	6 ft - 5 in
5	Steel	4 x 6	Composite	4 x 7.5 x 14	No	N/A	22.0 in	N/A	6 ft - 4 in
6	Steel	4 x 6	Composite	4 x 7.5 x 14	No	N/A	21.0 in	N/A	6 ft - 2 in
7	Steel	4 x 6	Composite	4 x 7.5 x 14	No	N/A	19.0 in	N/A	6 ft - 3 in

Additional Comments: Repairs required P1-P4, possibly P5, and W-beam to splice at post 7.

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EXTRUDER			
Feeder Channel Width at impact head	❒4inches ❒5 inches ☒Other 4.5 in		
Guide Chute Exit Height (in.)	20 in		
Connection of feeder channels to head damaged?	☒No ❒Yes	Are Welds Broken?	☒No ❒Yes
Anchor Cable Present?	❒No ☒Yes	Pre-crash Connected?	❒No ☒Yes
Rail Extrusion?	❒No ☒Yes	Length (ft. in.)	10 ft 6 in
Rail Extrusion Direction	❒Traffic Side ☒Field Side ❒N/A		
Total Length of Rail Damaged (ft.) [total length would include extruded rail plus damaged rail downstream from head.]	~30.0 ft (end of W-beam deflection); 38.3 ft to splice at post 7		

TELESCOPE					
Rail Displacement	❒No	❒Yes;	Length: Est.	No of Panels Displaced	❒1 ❒2 ❒3 ❒4 ❒5 ❒6

ALL-SYSTEM PERFORMANCE			
Railkinks Downstream of Head?	☒No	❒Yes	No. of Kinks:
Was there intrusion into the Occupant Compartment by foreign object (guardrail)?	❒No ☒Yes		
Did vehicle impact other objects after impact with terminal?	☒No ❒Yes		
Object Contacted	N/A		

ALL-SYSTEM PERFORMANCE ENVIRONMENT			
SIDESLOPE	**50 ft in Advance of Post 1**	**At Post 1**	**50 ft Past Post 1**
Percent - %	-17%	-20%	-25%
Adjacent Lane Width (ft)	11 ft-5 in		
Lane Type (NAS EDS Variable: Sur. Type)	Asphalt		
Shoulder Type	Asphalt		
Shoulder Width (ft)	11 ft -8 in		
Guardrail Height (in)	27.5 in at post 7		

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VEHICLE INFORMATION		
Vehicle Type (NHTSA Input)	2001 Toyota Corolla	
Vehicle Identification Number (VIN)	2T1BR12E31Cxxxxxx	
Vehicle Mass (NASS var.: veh.wgt)	2,414 lb	
Vehicle orientation upon impact	❒Case Type 1 ☒ Case Type 2 ❒ Case Type 3 ❒ Case Type 4 ❒ Case Type 5 ❒ Case Type 6 ❒ Case Type 7 ❒ Case Type 8 ❒ Other	
If 'Other', describe	N/A	
Collision Deformation Classification	08LZEW3	
Delta-V	14 mph (22 km/h)	
Occupant Compartment Penetration of rail	☒No	❒Yes; Describe:
Did the Vehicle Rollover?	❒Yes ☒No	
Quarter Turns (NASS EDS variable: Rollover)	❒1 ❒2 ❒3 ❒4 ❒5 ❒6 ❒7 ❒8 ❒9 ❒10 ❒11 ❒12 ❒13 ❒14 ❒15 ❒16 ❒17+	
Object Precipitating Rollover, (NASS EDS variable: Rollobj)	N/A	
Rollover Type, Terhune Scale, (NASS EDS variable: rolintyp)	N/A	

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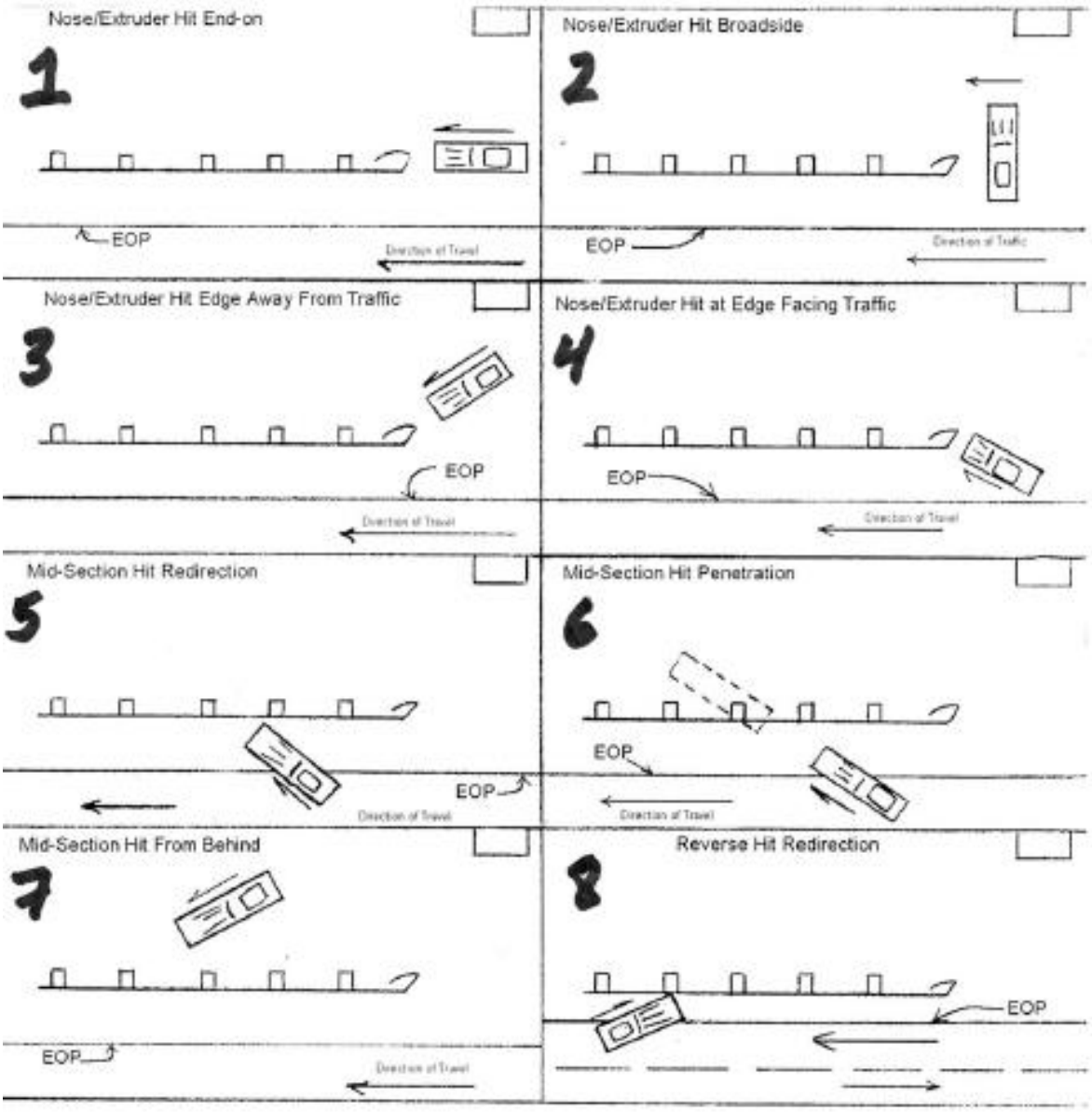

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**National Highway
Traffic Safety
Administration**

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