Rollover Investigation / Vehicle v. Object
Dynamic Science, Inc. / Case Number: DS07015
2006 Honda Civic
California
February 2007

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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 on site investigation focused on a 2006 Honda Civic that was involved in a rollover crash. This single vehicle crash occurred in February 2007 at 0050 hours. The crash occurred on a five-lane divided state highway. The speed limit at this location is 105 km/h (65 mph). The case vehicle is a 2006 Honda Civic that was being driven by a restrained 24-year-old male. The Honda Civic was traveling westbound at a police reported speed of 129 km/h (80 mph) in the fourth lane from the right. According to the driver of the Honda Civic, the crash was caused by a non-contact vehicle braking in front of the Civic. The investigating police agency did not find any evidence of any other involved parties. The driver of the Civic lost control of his vehicle. The Civic veered across the adjacent lanes to the right. The Civic departed the roadway and struck a dirt/shrub covered embankment. The driver's frontal air bag deployed at this point. The Civic was redirected back onto the roadway shoulder where it rolled onto its roof. The left and right side air curtains and the driver's side air bag deployed during the rollover. The driver of the Civic sustained a neck strain and minor hand abrasions. He was transported to a local hospital for treatment. The Honda Civic was towed from the scene due to damage. It was later declared to be a total loss by the insurance company.

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Crash Investigation
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BACKGROUND

This on site investigation focused on a 2006 Honda Civic that was involved in a rollover crash (**Figures 1-2**). This single vehicle crash occurred in February at 0050 hours. The crash occurred on a five-lane divided state highway. The speed limit at this location is 105 km/h (65 mph). The case vehicle is a 2006 Honda Civic that was being driven by a restrained 24-year-old male. The Honda Civic was traveling westbound at a police reported speed of 129 km/h (80 mph) in the fourth lane from the right. According to the driver of the Honda Civic, the crash was caused by a non-contact vehicle braking in front of the Civic. The investigating police agency did not find any evidence of any other involved parties. The driver of the Civic lost control of his vehicle. The Civic veered across the adjacent lanes to the right. The Civic departed the roadway and struck and dirt/shrub covered embankment. The driver's frontal air bag deployed at this point. The Civic was redirected back onto the roadway shoulder where it rolled onto its roof. The left and right side air curtains and the driver's side air bag deployed during the rollover. The driver of the Civic sustained a neck strain and minor hand abrasions. He was transported to a local hospital for treatment. The Honda Civic was towed from the scene due to damage. It was later declared to be a total loss by the insurance company.

This Rollover case was identified by NHTSA during a review of police reports. DSI was faxed the report on April 7, 2007. DSI located the case vehicle and obtained permission to inspect the vehicle on April 16, 2007. DSI was assigned the case on April 17, 2007. Field work was completed on April 19, 2007.

Figure 1. Case vehicle, 2006 Honda Civic

Figure 2. Exemplar view, 2006 Honda Civic

SUMMARY

Crash Site

This single vehicle crash occurred on the roadside of a state highway in February 2007 at 0050 hours. At the time of the crash, there were no adverse weather conditions and the concrete roadway surface was dry. The state highway was configured with five lanes for westbound traffic (**Figure 3**). Each lane was delineated by broken painted white lines. The traffic lanes were bordered on the south by a solid painted yellow line, an asphalt shoulder and a concrete median barrier. The traffic lanes were bordered on the north by a solid painted white line, an asphalt shoulder and an ascending dirt/shrub covered embankment. It was dark at the time of the crash and there were no streetlights present. The speed limit at this location is 105 km/h (65 mph).

Figure 3. Approach to area of impact/rollover (west)

Pre-Crash

The 2006 Honda Civic was traveling in the fourth lane from the right at a driver estimated speed of 121-129 km/h (75-80 mph). According to the driver, there was a non-contact vehicle in front of him that suddenly braked, causing the driver of the Civic to brake and lose control of his vehicle. The investigating police agency found no evidence to substantiate this claim. It appears more likely the driver lost control due to speed and a unsafe lane maneuver. The Civic veered to the right and crossed the three adjacent lanes. The Civic was in a clockwise yaw as it departed the roadway.

Crash

The Civic departed the roadway and struck the dirt/shrub covered embankment with its front end. The driver's frontal air bag deployed as result of the longitudinal deceleration of the Civic during the impact with the embankment. The barrier routine of the WinSmash program computed a total delta V of 12.0 km/h (7.5 mph). The longitudinal and lateral components were -10.4 km/h (-6.5 mph) and 6.0 km/h (3.7 mph), respectively. The results appear low, given the deployment of the frontal air bag. The Civic went up the embankment where it appears to have contacted some low terrain objects(s) with its right side. The Civic continued rotating until it rolled two quarter turns with its left side leading. The driver's side air bag and side air curtains likely deployed during the rollover sequence–primarily the left side contact. The front right passenger's frontal and side air bags did not deploy. The Civic rolled two quarter turns before coming to rest on its roof on the shoulder facing southeast.

Post-Crash

The driver of the Civic sustained minor hand abrasions and a neck strain. He was transported to a local hospital for treatment. He arrived with a Glasgow Coma Score (GCS) of 15. He was treated and released. The Honda Civic was towed from the scene due to damage. It was later declared to be a total loss by the insurance company.

Vehicle Data -2006 Honda Civic

The Honda Civic was identified by the Vehicle Identification Number (VIN): 2HGHF11846Hxxxxxx. The vehicle's odometer could not be read, as there was no power to the instrument panel when the ignition was turned on. The Honda Civic was a two-door coupe that was equipped with a 1.8 liter, four cylinder engine, a manual transmission, front disc brakes with ABS, power steering, a telescoping steering wheel. The Civic was configured with Bridgestone Potenza P205/55R16 tires. The vehicle manufacturer's recommended cold tire pressure was 220 kPa (32 psi). The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Flat	6 mm (8/32 in)	Yes	Flat, sidewall torn
LR	186 kPa (27 psi)	7 mm (9/32 in)	No	None
RR	Flat	6 mm (8/32 in)	No	Debeaded, rim scratched
RF	Flat	6 mm (8/32 in)	No	Debeaded, rim scratched

The seating in the Honda Civic was configured with fabric covered front bucket seats with adjustable head restraints and a rear bench seat with adjustable head rests. The driver's seat was located in the mid track position. The seat back was at an 18 degree angle from the vertical and the seat cushion was a 13 degree angle from the horizontal.

Vehicle Damage

Exterior Damage -2006 Honda Civic

The 2006 Honda Civic sustained moderate front end damage as a result of the impact with the embankment (**Figure 4**). The direct damage began on the left front bumper corner and extended 68 cm (26.8 in) laterally across the bumper face. The bumper fascia was knocked off during the crash (**Figure 5**). The bumper was shifted laterally 12 cm (4.7 in) to the right (**Figure 6**). Six crush

Figure 4. Front end damage, Honda Civic

measurements were documented at the bumper level as follows: C1 = 10 cm (3.9 in), C2 = 3 cm (1.2 in), C3 = 1 cm (0.4 in), C4 = 0.5 cm (0.2 in), C5 = 0 cm, C6 = 0 cm. The Collision Deformation Classification (CDC) for the impact with the embankment was 11FYEW1.

There was direct damage to the right lower frame rail area that measured 78 cm (30.7 in). There was also damage to the lower A pillar area on the right side. The right front tire was flattened. It appears that this damage occurred as the vehicle went up the embankment and struck some low terrain object(s). The CDC assigned for this impact was 99RDLW1 (**Figure 7**).

The Honda Civic sustained moderate roof damage as a result of the left side leading rollover **(Figure 8**). The direct damage began at the hood edge and extended rearward past the windshield header. The maximum lateral and vertical crush was located at the left A pillar and measured 16 cm (6.3 in) and 6 cm (2.4 in), respectively. The CDC for the rollover was 00TYDO2.

The windshield was damaged and holed as a result of the rollover. The driver's side window and the roof glass disintegrated. Both front doors remained closed and operation. The left front, right rear, and right front tires were flattened.

Figure 5. Front bumper fascia

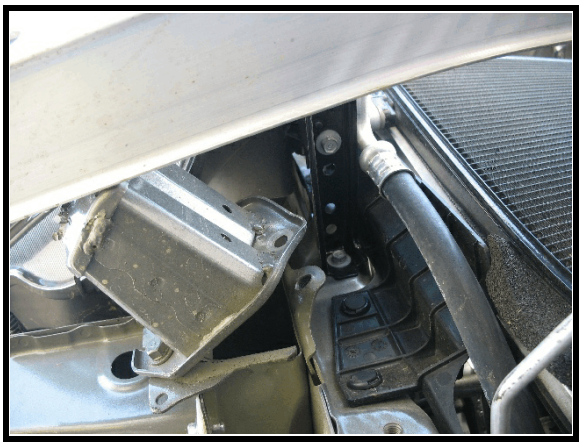

Figure 6. Movement of the right bumper mount

Figure 7. Right side damage (forward of rear tire)

Figure 8. Roof crush

Interior Damage -2006 Honda Civic

The 2006 Honda Civic sustained moderate interior damage as a result of passenger compartment intrusion. The left A pillar and left side rail intruded laterally (**Figure 9-10**). The roof, left A pillar, roof and windshield header intruded vertically. There was occupant contact damage to the left interior door and door handle.

The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
LF	A pillar	11.0 cm (4.3 in)	Vertical
LF	Side rail	11.0 cm (4.3 in)	Lateral
LF	A pillar	11.0 cm (4.3 in)	Lateral
LF	Side rail	5.0 cm (2.0 in)	Vertical
LF	Roof	9.0 cm (3.5 in)	Vertical
LF	Windshield header	10.0 cm (3.9 in)	Vertical
RF	Windshield header	3.0 cm (1.2 in)	Vertical

Figure 9. Exterior view of left side intrusion

Figure 10. Interior view of left side intrusion

Rollover Dynamics

The Honda Civic was two-door coupe that was equipped with a a manual transmission, front disc brakes with ABS, and power steering**.** The Civic had a Static Stability Factor (SSF)[1] of 1.43 and a Rollover Resistance Rating (RRR)[2] of four out of five stars (with a 10 percent chance of rolling over). For un known reasons, the Civic veered to the right, began a clockwise yaw, and crossed the three adjacent lanes. As the vehicle departed the roadway, it struck the dirt/shrub covered embankment with its front end. The Civic ascended the embankment while continuing to rotate. As the Civic reached a rotation of approximately 90 degrees, the left side tires engaged the embankment surface and the Civic began a left side leading rollover. The Civic rolled two quarter turns before coming to rest on its roof on the shoulder facing southeast.

Manual Restraints -2006 Honda Civic

The 2006 Honda Civic was configured with 3-point manual lap and shoulder belts for all five seat positions. Both front seat safety belts were equipped with retractor pretensioners with force limiters. The driver's safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). The remaining safety belts were configured with sliding latch plates and switchable ELR/Automatic Locking Retractors (ALR).

The second row outboard seating positions were equipped with the lower anchor points that are part of this vehicle's Lower Anchors and Tethers for Children (LATCH) system. All three second row seating positions were equipped with child safety seat top tether anchor points.

Both front seat belt exhibited indications of historical usage. The driver's seat belt was locked in the used position.

Supplemental Restraint Systems -2006 Honda Civic

The Honda Civic was equipped with advanced occupant protection systems including dual-stage, dual-threshold Certified Advanced 208-Compliant (CAC) driver and front right passenger air bags. The CAC bags were certified by the manufacturer to meet the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The system included a passenger side Occupant Position Detection System (OPDS). The Civic was also equipped with driver and front right passenger seat back mounted side air bags and left/right head curtain air bags. The driver's frontal air bag deployed as result of the longitudinal deceleration of the Civic during the impact with the embankment. The driver's side air bag and left side air curtain likely deployed during the rollover sequence–primarily the left side contact. It is not known when the right side curtain deployed. The front right passenger's frontal and side air bags did not deploy.

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[1]The SSF is a number that relates the height of the center of gravity (CG) of a vehicle to its track width (TW). The SSF is computed by dividing the TW by two times the CG height. It is used to compare the relative stabilities of different vehicles.

[2]Source: www.safercar.gov

The driver's air bag deployed from the center of the steering wheel hub through asymmetrical H-configuration cover flaps (**Figure 11**). The top flap measured 13 cm (5.1 in) in width and 3.5 cm (1.4 in) in height. The bottom flap measured 13 cm (5.1 in) in width and 8 cm (3.1 in) in height. The deployed air bag measured 50 cm (19.7 in) in its deflated state. The air bag was tethered by a single internal strap. Two circular vent ports were located at the 11 and 1 o'clock aspects on the rear of the air bag. There were no indications of occupant contact or any damage to the air bag.

Figure 11. Interior view, left curtain and driver's air bag

The driver's side air bag deployed from the left side seat back (**Figure 12**). The deployed air bag measured 50 cm (19.7 in) in height and 31 cm (12.2 in) in width. There were three small vent ports on both sides of the air bag. There were no indications of occupant contact or any damage to the air bag.

Figure 12. Exterior view, left side curtain and left side air bag

Both side air curtains deployed during the crash. The side curtains extended from the A pillar to the C pillar. The front of the curtain was secured to the A pillar by a 6 cm (2.4 in) tether. The total length of the curtain was 144 cm (56.7 in) with a height of 40 cm (15.7 in).

OCCUPANT DEMOGRAPHICS - 2006 Honda Civic

	Driver
Age/Sex:	24/Male
Seated Position:	Front left
Seat Type:	Fabric covered bucket seat
Height:	175 cm (69 in)
Weight:	86 kg (190 lbs)
Pre-existing Medical Condition:	None
Alcohol/Drug Involvement:	None
Driving Experience:	5 years
Body Posture:	Normal, upright

Hand Position:	Both hands on steering wheel, actively steering
Foot Position:	Right foot on brake, left on floorboard
Restraint Usage:	Lap and shoulder belt available, used

INJURIES - 2006 Honda Civic

Driver: Injuries obtained from emergency room records and radiologic reports.

Injury	OIC Code	Injury Mechanism	Confidence Level
Neck strain	640278.1,6	Impact forces	Certain
Bilateral hand abrasions	790202.1,1 790202.1,2	Glass	Probable

Driver Kinematics

The 24-year-old male driver was seated in an upright posture and was restrained by the 3-point lap and shoulder belt. The seat was positioned at the mid track position. The driver's seat back was at an 18 degree angle from the vertical; the seat cushion was at a 13 degree angle from the horizontal. The driver was actively steering and braking. The case vehicle appears to have been in a slightly clockwise yaw prior to impact. At impact with the embankment, the driver's frontal air bag deployed. The driver initiated a forward and slightly left lateral trajectory. He loaded the safety belt. As the vehicle engaged the embankment it began a sharper clockwise rotation. The vehicle tripped and began a left side leading rollover. The driver engaged the left door with the left side of his torso and abdomen (**Figure 13**). The door and handle were damaged, but there were no related injuries. The case vehicle continued the rollover and came to rest on its roof. The driver was able to exit the vehicle under his own power. He sustained minor hand abrasions and a neck strain. He was transported to a local hospital where he was treated and released.

Figure 13. Occupant contact damage to door

Attachment 1. Scene Diagram