Child Safety Seat Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS05012
2002 Honda Civic
California
July 2005

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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 forward facing child safety seat (CSS) that was installed in the second row middle position of a 2002 Honda Civic. The Honda Civic was occupied by a 22-year-old male driver, a 21-year-old front right seat passenger, and a 7-month-old female second row right passenger, restrained in a rear-facing infant safety seat. The infant seat was anchored to the case vehicle using the available lap and shoulder belt. The other vehicle was a Ford Ranger pickup truck that was being driven by a 27-year-old male. Both vehicles were traveling eastbound before the crash. The Ford was behind the Honda but at a considerable distance. The Honda had come to a stop in response to an emergency vehicle with lights and siren approaching from the west. The driver of the Ford Ranger did not stop in time and the front of the Ford Ranger struck the rear of the Honda Civic. The Honda Civic sustained major rear end damage. The 7-month-old rear seat occupant was fatally injured. Both front seat occupants did not report any injuries.

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Dynamic Science, Inc.
Crash Investigation
Case Number: DS05012

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BACKGROUND

This on-site investigation focused on a forward facing child safety seat (CSS) that was installed in the second row middle position of a 2002 Honda Civic. The Honda Civic was occupied by a 22-year-old male driver, a 21-year-old front right seat passenger, and a 7-month-old female second row right passenger, restrained in a rear-facing infant safety seat. The infant seat was anchored to the case vehicle using the available lap and shoulder belt. The other vehicle was a Ford Ranger pickup truck that was being driven by a 27-year-old male. Both vehicles were traveling eastbound before the crash. The Ford was behind the Honda but at a considerable distance. The Honda had come to a stop in response to an emergency vehicle with lights and siren approaching from the west. The driver of the Ford Ranger did not stop in time and the front of the Ford Ranger struck the rear of the Honda Civic. The Honda Civic sustained major rear end damage. The 7-month-old rear seat occupant was fatally injured. Both front seat occupants did not report any injuries.

Figure 1. Rear, 2002 Honda Civic

This child safety seat fatality case was identified by NHTSA from an on-line news article. DSI was notified on July 19, 2005. DSI located the vehicle and the child seat on July 22, 2005, and was assigned the case on July 25, 2005. The vehicle and seat inspections were conducted on July 25, 2005.

SUMMARY

Crash Site

This crash occurred in an unincorporated area of southern California. The surrounding area is rural. The crash occurred on a four lane, undivided east/west asphalt roadway. There are two traffic lanes for eastbound traffic, separated by broken white lines. There are two lanes for westbound traffic, separated by broken white lines. The eastbound and westbound lanes are separated by a solid double yellow lines. The roadway was straight and had a positive grade for eastbound travel. The posted speed limit is 97 km/h (60 mph). The weather was clear, the temperature 51 degrees C (91 degrees F), and there was a light wind coming from the southwest. Sunset occurred

Figure 2. Overview of vehicle approach (north)

at 2006 hours on the crash date. The crash occurred at dusk.

Pre-Crash

The case vehicle was a 2002 Honda Civic being driven by a restrained 22-year-old male. The front right seat was occupied by a 21-year-old female. The second row right seat was occupied by 7-month-old female seated in a rear-facing Graco SnugRide infant safety seat (69 cm/29 in, 7.4 kg/16 lbs). The Honda was traveling eastbound. The Honda had come to a stop in response to an emergency vehicle with lights and siren approaching from the west. The other vehicle was a 2001 Ford Ranger being driven by a 27-year-old male. The Ford Ranger was traveling eastbound at a considerable distance behind the Honda traveling at approximately 109 km/h (68 mph)[1]. According to a least one witness, this driver was speaking on a cell phone prior to the crash. According to the police report, this driver was also intoxicated.

Crash

The driver of the Ford Ranger did not stop in time and the front of the Ford Ranger struck the rear of the stopped Honda Civic (06BZEW6). The missing vehicle routine of the WinSmash program computed a delta V of 33.0 km/h (20.5 mph), based on the Honda's rear end crush profile. The longitudinal and lateral components were 33.0 km/h (20.5 mph) and 0 km/h (0 mph), respectively. The results appear low. Both front air bags in the Ford Ranger deployed at this point.

Post-Crash

The Honda was pushed forward and went into a counterclockwise rotation. The Honda completed one full rotation and came to rest facing north on the roadway center line after traveling approximately 29 m (94 ft). The Ford Ranger was redirected to the right and went into a clockwise rotation. The Ford rotated 180 degrees and came to rest on the east shoulder after traveling approximately 37 m (121 ft). Both vehicles were towed from the scene due to damage. The case vehicle was subsequently placed on a police hold pending their investigation.

The 7-month-old rear seat occupant of the case vehicle was fatally injured. The child was removed from the vehicle by the fire department shortly after their arrival. The driver of the emergency vehicle saw the crash and discontinued the emergency run in order to respond to this crash. He checked the condition of the child and noted that her condition was critical. He administered medical attention until he was relieved by other emergency personnel. The child was transported to the emergency room, arriving there at 2012 hours. She failed to respond to the Advanced Cardiac Life Support (ACLS) protocols and was pronounced dead at 2030 hours. She sustained fractures of the calvarium and base of skull, deep scalp and intramuscular hemorrhage, and multiple facial abrasions. According to the autopsy report, death was caused by fatal blunt force head injuries. Blood was found in the left ear canal which corresponds to blood found on the left interior surface of the child seat.

[1]Calculated using in-line linear momentum formula

Both front seat occupants did not report any injuries, though in the narrative of the police report their injuries have been described as minor.

The driver of the Ford Ranger was able to exit the vehicle under his own power. He declined medical attention.

VEHICLE DATA -2002 Honda Civic

The 2002 Honda Civic LX four-door sedan was identified by the Vehicle Identification Number (VIN): 2HGES16512Hxxxxxx. The Honda Civic was equipped with a 1.7 liter four cylinder engine, automatic transmission, front wheel drive, power steering, tilt steering wheel, front disc and rear drum brakes.

The 2002 Honda Civic was equipped with Nanking NE826 P185/70R14 tires. The manufacturer's recommended cold tire pressure was 276 kPa (40 psi). The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	152 kPa (22 psi)	5 mm (7/32 in)	No	No
LR	131 kPa (19 psi)	8 mm (8/32 in)	No	No
RR	Flat	8 mm (8/32 in)	Yes	Side wall cut
RF	159 kPa (23 psi)	5 mm (7/32 in)	No	No

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

VEHICLE DAMAGE

Exterior Damage - 2002 Honda Civic

The 2002 Honda Civic sustained major rear-end damage as a result of the impact with the Ford Ranger. The right rear bumper was pushed forward into the trunk compartment. The right rear quarter panel was holed and pushed into the passenger compartment. The right rear passenger door was pushed forward. The rear door handle was approximately 15.2 cm (6.0 in) from the front passenger door. Both right side doors were jammed shut. The right wheelbase was shortened by 13.0 cm (5.1 in). The right rear side glass and the backlight were both disintegrated. The direct damaged began at the right bumper corner and extended 47.0 cm (18.5 in) laterally. Four crush measurements were documented at the bumper level as follows: C1=0 cm (0 in), C2=8.0 cm (3.1 in), C3=39.0 cm (15.4 in), C4=64.0 cm (25.2 in).

CDC:	06BZEW6	
Delta V:	Total	33.0 km/h (20.5 mph)
	Longitudinal	33.0 km/h (20.5 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	48,103 joules 35,479 ft lbs

Figure 3. Right rear, Honda Civic

Interior Damage - 2002 Honda Civic

The 2002 Honda Civic sustained heavy damage as a result of passenger compartment intrusion. The bottom hinge for the second row right seat separated from its attachment. The rear seat and right C pillar sustained longitudinal intrusion. The movement of door and the tearing of the sheet metal essentially formed a hole in the right side that measured 46.0 cm (18.1 in) by 38.0 cm (14.9 in).

The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
Second row left	Seat back	10.0 cm (3.9 in)	Longitudinal
Second row middle	Seat back	24.0 cm (9.5 in)	Longitudinal
Second row right	Seat back	43.0 cm (16.9 in)	Longitudinal
Second row right	C pillar	Unknown	Longitudinal

MANUAL RESTRAINT SYSTEMS - 2002 Honda Civic

The Civic was configured with manual 3-point lap and shoulder belts for both front positions and all three rear seat positions. The front seat restraints were configured with adjustable shoulder belt upper anchorages that were in the full down position. All the seat belts were equipped with sliding latch plates. The driver's seat belt was equipped with an emergency locking retractor. The front right passenger's seat belt and all three rear seat belts were equipped with switchable retractors (retractors that can be changed from an emergency locking retractor to an automatic locking retractor to assist in securing child seats).

Supplemental Restraint System - 2002 Honda Civic

The Honda Civic was equipped with frontal air bags for the driver and front right passenger positions. The driver's air bag was housed in the steering wheel hub. The front right passenger's air bag was housed on top of the instrument panel. There were no air bag deployments.

Child Safety Seat

Graco SnugRide

A Graco SnugRide infant safety seat was positioned in the rear right of the Honda Accord. The model number was 7425 CLE and the date of manufacture was October 6, 2004. The seat was designed to be in the rear-facing position and was equipped with a 5-point internal harness. The seat can be used with or without the stay-in-vehicle base. The base was not being used at the time of the crash. The seat handle was in the up position at the time of inspection. A locking clip was available but was not used. The seat was anchored to the vehicle using the 3-point lap and shoulder belt. The seat belt has a switchable retractor, but the retracting mode is not known.

Figure 4. Graco SnugRide Infant Safety Set

A label on the infant seat outlined the recommended use of the seat as follows:

- Use only with children who weigh 20 lbs (9 kg) or less and whose height is 26 inches (66 cm) or less

The child in this crash met the weight recommendation (16 lbs), but was slightly taller than the height recommendation (27 in).

There was blood found on the left portion of the handle, on the left harness, on the left seat back above the left harness slot, and on the left side of the seat. There was a loading/flexion mark on the left side of the seat (right side if facing toward front of vehicle) at the top harness slot level. There were black smudges along the top of the carrying handle.

Figure 5. Load mark to seat back

VEHICLE DATA - 2001 Ford Ranger

Description:	2001 Ford Ranger Edge pickup	
VIN:	Unknown	
Odometer:	Unknown	
Engine:	4.0 liter, V6. Five speed manual transmission.	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	Major front end damage per police. The left side of the bumper was pushed to the rear. Left front lamp assembly broken. Left grille broken. Left rear of hood displaced upward. Windshield fractured. Left front tire detached.	
CDC:	Unknown	
Delta V:	Total	27.0 km/h (16.8 mph)
	Longitudinal	-27.0 km/h (-16.8 mph)
	Latitudinal	0 km/h (0 km/h)
	Energy	42,907 joules (31,646 ft lbs)

OCCUPANT DEMOGRAPHICS - 2002 Honda Civic

	Driver	Occupant 2	Occupant 3
Age/Sex:	22/Male	21/Female	7 month/Female
Seated Position:	Front left	Front right	Second row right
Seat Type:	Bucket	Bucket	Bench with folding back
Height:	173 cm (68 in)	Unknown	69 cm (27 in)
Weight:	68 kg (150 lbs)	Unknown	7.4 kg (16 lbs)
Occupation:	Unknown	Unknown	NA
Pre-existing Medical Condition:	None noted	None noted	None noted
Alcohol/Drug Involvement:	None	NA	NA
Driving Experience:	Unknown	NA	NA
Body Posture:	Normal, upright	Normal, upright	Seated in CSS
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Right foot likely on brake, left on floor	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used	Lap and shoulder belt used with child safety seat
Air bag:	Driver's air bag available, did not deploy	Front right passenger's air bag available, did not deploy	None

OCCUPANT DEMOGRAPHICS - 2001 Ford Ranger

	Driver
Age/Sex:	27/Male
Seated Position:	Front left
Seat Type:	Bucket
Height:	185 cm (73 in)
Weight:	91 kg (201 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	Had been drinking, under the influence
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, used
Air bag:	Driver’s air bag available, deployed

OCCUPANT INJURIES -2002 Honda Civic

Driver: No reported injuries.

Front right occupant: No reported injuries.

Second row right occupant: Injuries obtained from autopsy report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Fracture, frontal bone at suture	150400.2,5	Child seat handle	Probable
Fracture, left pretrous portion, temporal bone	150200.3,8	Child seat handle	Probable
Subgaleal hemorrhage, left and right side of forehead	190402.1,1 190402.1,2	Child seat handle	Probable
Abrasion, upper central forehead	290202.1, 7	Child seat handle	Probable
Abrasion, above and between eyebrows	290202.1, 7	Child seat handle	Probable
Abrasion, beginning at right eyebrow and extending into right temple	290202.1, 1	Child seat handle	Probable

OCCUPANT KINEMATICS - 2002 Honda Civic

Driver Kinematics

The 22-year-old male driver was seated in an upright posture and restrained by the 3-point manual lap and shoulder belt. The seat track was adjusted to the mid position. At impact, the driver initiated a rearward trajectory and loaded the driver's seat back. He rebounded forward and came to rest in his initial seat position. He was able to exit the vehicle under his own power. There were no reported injuries.

Figure 6. Driver's seat back

Front Right Occupant Kinematics

The 21-year-old female front right occupant was seated in an upright posture and restrained by the 3-point manual lap and shoulder belt. The seat track was adjusted to between the mid and rear most track position. At impact, the front right occupant initiated a rearward trajectory and loaded the front right seat back. She rebounded forward and came to rest in his initial seat position. She was able to exit the vehicle under her own power. There were no reported injuries.

Figure 7. Front right seat back

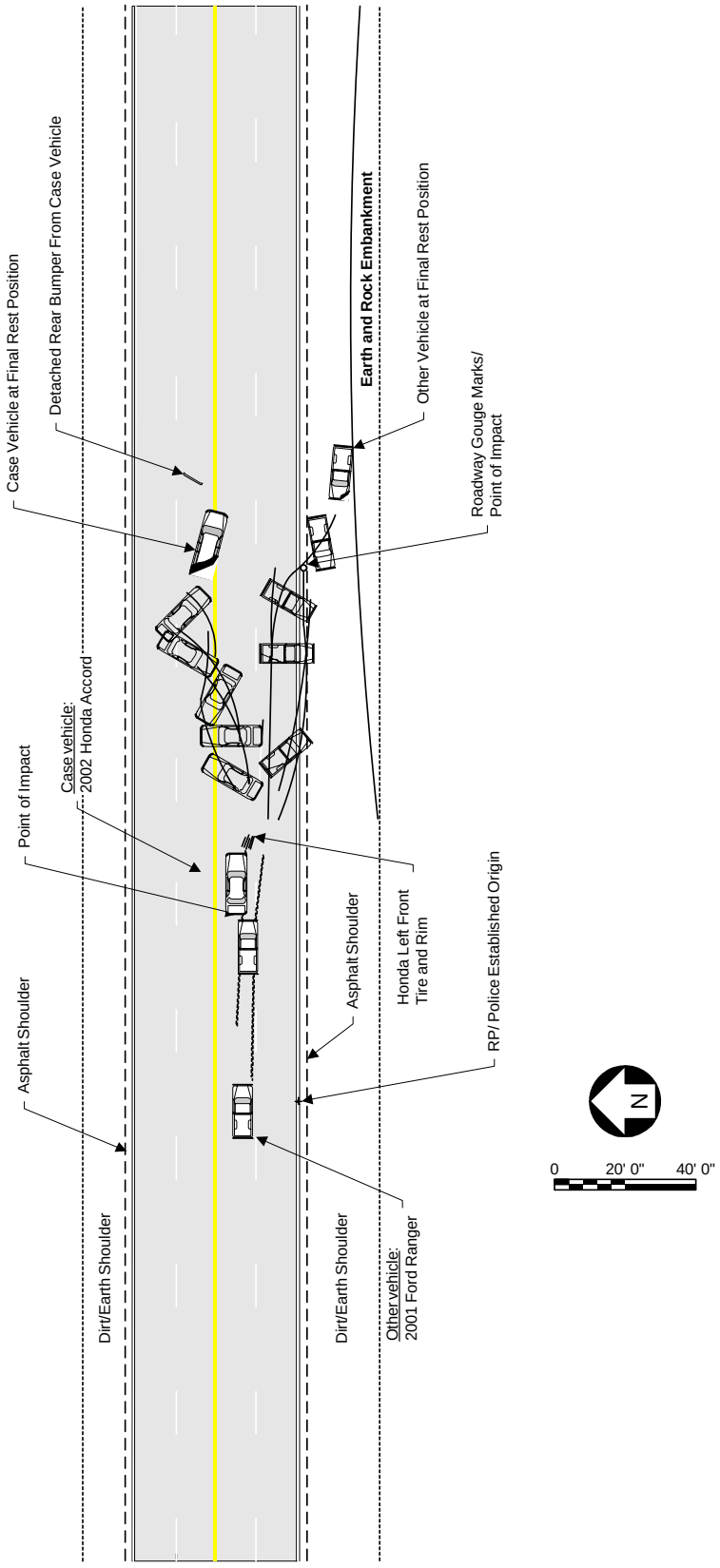
Second row right occupant kinematics

The 7-month-old female child was restrained in the rear-facing infant safety seat by the five-point harness. The seat was installed in the rear right position of the Honda Civic with the vehicle's 3-point safety belt. It appears more likely than not that the carrying handle was in the up position at the time of the crash. There were black smudges found on both the handle and on the right rear seat back. At impact, the child and child seat initiated a rearward trajectory. The intruding rear seat back forced the infant seat forward. The child appears to have struck the handle at the eyebrow level, causing the skull fractures and facial abrasions. The back of the infant seat was pressed against the back of the front right seat. The plastic seat back on the right side of the infant seat was deformed rearward. Portions of the plastic fascia on the right side of the vehicle interior were fractured by the intrusion. The child occupant died of head injuries.

Figure 8. Second row right seat position

Figure 9. Child safety seat in second row right seat position

Attachment 1. Scene Diagram



Attachment 2. Calculations

CASE NUMBER: DS05012

*** * LINEAR MOMENTUM * ***

W1 × V1 + W2 × V2 = W1 × V3 + W2 × V4
3084.00 × V1 + 2500.00 × 0.00 = 3084.00 × 34.08 + 2500.00 × 42.81
3084.00 × V1 + 0.00 = 105102.72 + 107025.00
3084.00 × V1 + 0.00 = 212127.72
3084.00 × V1 = 212127.72 - 0.00
3084.00 × V1 = 212127.72

$$V1 = \frac{212127.72}{3084.00}$$

V1 = 68.78

W1 = The Wt of Veh 1 in Pounds.
W2 = The Wt of Veh 2 in Pounds.
V1 = The Speed of Veh 1 in MPH.
V2 = The Speed of Veh 2 in MPH.
V3 = The Spd After Impact, Veh 1.
V4 = The Spd After Impact, Veh 2.

INPUTS:	
The Wt of Veh 1 in Pounds is:	3084.00
The Min. Spd After Impact, Veh 1 is:	34.08
The Wt of Veh 2 in Pounds is:	2500.00
The Impact Spd of Veh 2 is:	0.00
The Min. Spd After Impact, Veh 2 is:	42.81

RESULTS:	
The Spd of Veh 1 in MPH is:	68.78
The Vel of Veh 1 in FPS is:	100.87

7.50.13