Child Safety Seat Fatality/ Vehicle to Object
Dynamic Science, Inc. / Case Number: DS02024
1998 Honda Accord
California
September, 2002

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient Catalog No.
DS02024		

4. Title and Subtitle	5. Report Date
Child Safety Seat Fatality	6. Performing Organization Report No.

7. Author(s)	8. Performing Organization Report No.
Dynamic Science, Inc.	

9. Performing Organization name and Address	10. Work Unit No. (TRAIS)
Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401	11. Contract or Grant no. DTNH22-01-C-27002

12. Sponsoring Agency Name and Address	13. Type of report and period Covered [Report Month, Year]
U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590	14. Sponsoring Agency Code

15. Supplemental Notes

16. Abstract

This on-site investigation focused on two child safety seats that were installed in the rear seat of a 1998 Honda Accord. This single vehicle, rollover type collision occurred in California in September, 2002 at 0242 hours. The crash occurred on the roadside of an interstate highway. The case vehicle is a 1998 Honda Accord four door sedan that was driven by a 23-year-old male. The front right seat was occupied by a 21-year-old female. The 2nd row left seat position was occupied by a 20-month-old male seated in a forward facing child safety seat. The 2nd row right seat position was occupied by a 6-week-old female that was seated in a rear facing child safety seat. The case vehicle was traveling southbound and for an unknown reason drove off the interstate, into the right shoulder area. It struck a metal/wood guardrail and rolled over. The vehicle then struck a concrete bridge abutment with its roof/top. The case vehicle was equipped with a driver and a front right passenger air bag that did not deploy. All four occupants in the case vehicle expired at the scene.

17. Key Words	18. Distribution Statement
Child seat, fatality, child occupant	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price

Dynamic Science, Inc.
Crash Investigation
Case Number:DS02024

TABLE OF CONTENTS

BACKGROUND:

Figure 1. Case vehicle at final rest.

This on-site investigation focused on two child safety seats that were installed in the rear seat of a 1998 Honda Accord. This single vehicle, rollover type collision occurred in California in September, 2002 at 0242 hours. The crash occurred on the roadside of an interstate highway. The case vehicle is a 1998 Honda Accord four door sedan that was driven by a 23-year-old male. The front right seat was occupied by a 21-year-old female. The 2nd row left seat position was occupied by a 20-month-old male seated in a forward facing child safety seat. The 2nd row right seat position was occupied by a 6-week-old female that was seated in a rear facing child safety seat. The case vehicle was traveling southbound and for an unknown reason drove off the interstate, into the right shoulder area. It struck a metal/wood guardrail and rolled over. The vehicle then struck a concrete bridge abutment with its roof/top (see Figure 1). The case vehicle was equipped with a driver and a front right passenger air bag that did not deploy. All four occupants in the case vehicle expired at the scene.

This case was reported to the NHTSA by DSI on November 6, 2002. The case was found through a television news report and a newspaper article. DSI was assigned the case on November 8, 2002.

SUMMARY

Crash Site

Figure 2. Approach to point of impact–south

This single vehicle crash occurred on the roadside of a six lane freeway in California at 0242 hours (see Figure 2). The weather was clear and the rain grooved concrete roadway surface was dry. It was dark at the time of the collision, however, the area of the crash was illuminated by streetlights. The speed limit is 105 km/h (65 mph).

Pre Crash

The case vehicle, a 1998 Honda Accord EX-V6, four door sedan, was being driven by a 23-year-old male who was fully restrained by the available three point manual lap and shoulder belt. A 21-year-old female was seated in the front right seat position fully restrained by the available three point manual lap and shoulder belt. A 20-month-old male was seated in the second left seat position. The toddler was seated in a forward facing

Century Encore convertible child seat with a tray shield harness. The child seat was anchored to the vehicle by the available lap and shoulder belt. A 6-week-old female was seated in the second right seat position. The infant was seated, rearward facing, in a Graco LiteRider Travel System infant seat with base and three point harness. The infant seat was anchored to the vehicle by the available lap and shoulder belt. The Honda was traveling south in the fourth lane from the west roadway edge approaching the location of the collision.

The Honda was traveling south engaged in a race with a non-contact vehicle. Witnesses to the collision estimated the speed of the Honda at around 161 km/h (100 mph). The driver of the Honda changed lanes to the right and lost control of the vehicle. The Honda began to skid laterally southwest in a clockwise rotation with the right side leading. The Honda traveled southwest across all lanes west of his position and across the west shoulder.

Figure 3. Point of impact

Figure 4. Struck concrete abutment. Occupant contacts are marked in boxes.

Crash

The Honda Accord mounted the west curb and its front end traveled over the turned down end of the west guardrail. The left rear tire contacted the west curb mounting the curb. The center of the undercarriage of Honda slid across the west guardrail (Impact 1). The Honda continued over the guardrail and traveled southwest along the uphill embankment. The left side of the Honda then struck the initial concrete bridge abutment of a bridge over pass (see Figures 3 and 4). The left rear side of the Honda struck the abutment leaving a tire strike mark from the rear left tire. The second row left occupant struck the bridge abutment with his head leaving a mark of blood and brain matter. The Honda then rolled longitudinally to its left about the abutment crossing in its roof (Impact 3). The Honda rotated counterclockwise around the bridge abutment on its roof. The Honda then rolled longitudinally to its right and onto its wheels where it came to final rest facing southeast.

A barrier run was conducted for the damage sustained to the left side of the case vehicle during Impact 2. The total Delta V 1 for Impact 2 was computed at 37.0 km/h (22.9 mph). The longitudinal Delta V was 0.0 km/h (00 mph). The latitudinal Delta V was 37.0 km/h (22.9 mph).

Post Crash

The state police, local fire department and coroner responded to the scene. They found all four occupants of the Honda deceased. The roof of the Honda was cut off to remove the bodies of the four fatally injured occupants.

VEHICLE DATA - 1998 Honda Accord

The 1998 Honda Accord was identified by the Vehicle Identification Number (VIN): 1HGCG1651WAxxxxxx. The vehicle's odometer could not be read, as there was no power to the instrument panel. The Honda Accord was a four-door, five-passenger sedan that was equipped with a 3.0 liter, six-cylinder engine, front wheel drive, four-speed automatic transmission, front/rear disc brakes, and a tilt steering wheel. The Accord was configured with Dunlop D65 Touring P205/65R15 tires. The cold tire inflation pressure is 210 kPa (30 psi). The specific tire information is as follows:

Position	Measured Pressure	Maximum Pressure	Tread Depth	Restricted	Damage
LF	Flat	241 kPa (35 psi)	3 mm (4/32 in)	No	None
LR	200 kPa (29 psi)	241 kPa (35 psi)	5 mm (6/32 in)	No	None
RF	Flat	241 kPa (35 psi)	5 mm (6/32 in)	No	Hole torn in sidewall
RR	193 kPa (28 psi)	241 kPa (35 psi)	5 mm (6/32 in)	No	None

The seating in the Honda Accord was configured with front bucket seats with adjustable head restraints and a rear bench seat with a folding back. Both front seats were adjusted to the rear most track positions. All seats were deformed to some extent by the intruding roof.

VEHICLE DAMAGE

Exterior Damage - 1998 Honda Accord

The 1998 Honda Accord sustained extensive damage during this crash (see Figures 5 and 6). The first impact was to the undercarriage as the vehicle overrode the guardrail. The second impact was to the left side as the vehicle initially contacted the bridge abutment. The direct damage began 19.0 cm (7.5 in) rear of the left rear axle and extended 165.0 cm (64.9 in) forward along the left side plane. Six crush measurements were documented along the left side as follows: C1=8.0 cm (3.1 in), C2=35.5 cm (13.9 in), C3=48.0 cm (18.9 in), C4=44.0 cm (17.3 in), C5=14.0 cm (5.5 in), C6=23.0 cm (9.0 in). The Collision Deformation Classification (CDC) for the initial abutment impact was 09LZEW3. The third impact was to the top of the vehicle as it rotated and pitched into the abutment. The entire roof area was essentially crushed to the hood/trunk lid area. The CDC for this impact was 00TPDW5.

Figure 5. Front left, Honda Accord

Figure 6. Rear left, Honda Accord

Interior Damage - 1998 Honda Accord

The 1998 Honda Accord sustained major interior damage as a result of passenger compartment intrusion. The left side doors and B/C pillars sustained lateral intrusion. The roof sustained vertical intrusion. It was removed during occupant extrication. All glazing at all positions was either disintegrated or removed during extrication. The front seat back were deformed to the right. Blood and bodily fluids were found on the right front door, and on the rear deck. The steering wheel rim was deformed forward. There were knee contacts to the left knee bolster and the right lower instrument panel.

The specific passenger intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
LF	Driver's seat back	41.0 cm (16.1 in)	Vertical
LF	Seat back	21.0 cm (8.3 in)	Lateral
RF	Front right seat back	43.0 cm (16.9 in)	Vertical
RF	Seat back	30.0 cm (11.8 in)	Lateral
LF	B pillar	26.0 cm (10.2 in)	Vertical
LF	B pillar	1.0 cm (0.4 in)	Lateral
LR	C pillar	35.0 cm (13.8 in)	Vertical
LR	C pillar	26.0 cm (10.2 in)	Lateral
LR	Door panel	21.0 cm (8.3 in)	Lateral
LR	Seat back	12.0 cm (4.7 in)	Lateral
MR	Seat back	8.0 cm (3.1 in)	Vertical

MANUAL RESTRAINT SYSTEMS - 1998 Honda Accord

The 1998 Honda Accord was configured with manual 3-point lap and shoulder belts for each seating position. Both front seat safety belts were equipped with shoulder belt anchorage D ring adjusters. The left adjuster was in the full up position; the right was in the full down position. The driver's seat belt was configured with a sliding latch and an Emergency Locking Retractor (ELR). The remaining seat belts were configured with sliding latch plates and switchable ELR/ALR retractors. The rear left seat belt was used to anchor a forward facing convertible child seat. The rear right seat belt was used to anchor a rear facing infant safety seat.

FRONTAL AIR BAG SYSTEM - 1998 Honda Accord

The 1998 Honda Accord was equipped with frontal air bags for the driver and front right passenger positions. There were no air bag deployments, nor would any deployments be expected in this crash configuration.

CHILD SAFETY SEAT - 1998 Honda Accord

Century Encore

A Century Encore convertible child safety seat was positioned in the left rear seat of the Honda Accord (see Figures 7 and 8). The model number was 4466 and the date of manufacture was May 9, 2001. The convertible CSS was configured with an overhead shield harness system. The manufacturer recommends that the seat be used in the rear facing mode for children from birth to 13.6 kg (30 lbs). Infants from birth to 9.0 kg (20 lbs) MUST use rear-facing mode. Infants or toddlers 9-13.6 kg (20-30 lbs) MAY use rear-facing mode. The manufacturer recommends that the seat be used in the forward-facing mode for children weight 9-18 kg (20-40 lbs). Toddlers who weigh 9-13.6 kg (20-30 lbs) who are capable of sitting upright unassisted may be forward-facing. Toddlers weighing 13.6-18 kg (30-40 lbs) and up to 102 cm (40 in) in height MUST use the forward-facing mode. The seat was being used in the forward facing mode during this crash. The 20-month-old child occupant weighed 13 kg (28 lbs) and was 81 cm (32 in) tall. The child met the forward-facing mode guidelines. The child seat was anchored to the vehicle using the available lap and shoulder belt. It is not known if the switchable retractor had been switched to the ALR mode during installation or not. At the time of the inspection, the harness straps were routed through the middle set of harness slots. According to the instruction manual, when the seat is being used in the forward-facing mode, the harness straps MUST be in the top set of slots. The overhead shield was damaged due to lateral intrusion resulting in the latchplate and harness system pulling through the plastic of the tray shield. Blood and body tissue was found on the upper left portion of the seat back.

Figure 7. Second row child seat configuration

Figure 8. Century Encore child safety seat

Graco LiteRider

A Graco LiteRider System infant seat was positioned in the right rear of the Honda Accord (see Figure 9). The model number was 8444 and the date of manufacture was November 3, 1999. The rear-facing infant safety seat was configured with a five-point harness system. The manufacturer recommends that the seat be used only for children who weigh 9 kg (20 lbs) or less and who were 66 cm (26 in) in height or less. The 6-week-old child weighed 5 kg (11 lbs) and was 53 cm (21 in) tall. The infant seat was appropriate for a child of this height and weight. The infant seat was anchored to the vehicle using the available lap and shoulder belt. It is not known if the switchable retractor had been switched to the ALR mode during installation or not.

Figure 9. Graco 8444 infant safety seat

OCCUPANT DEMOGRAPHICS - 1998 Honda Accord

	Driver	Occupant 2
Age/Sex:	23/Male	21/Female
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat adjusted to rear most track position. Seat back deformed by intruding roof.	Fabric covered bucket seat adjusted to rear most track position. Seat back deformed by intruding roof.
Height:	175 cm (69 in)	157 cm (62 in)
Weight:	80 kg (176 lbs)	66 kg (146 lbs)
Occupation:	Military	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Unknown	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used
Air bag:	Steering wheel mounted air bag, did not deploy	Top instrument panel mounted air bag, did not deploy

	Occupant 3	Occupant 4
Age/Sex:	20 months/Male	6 weeks/Female
Seated Position:	Second row left	Second row right
Seat Type:	Fabric covered bench seat with a folding back	Fabric covered bench seat with a folding back
Height:	81 cm (32 in)	53 cm (21 in)
Weight:	13 kg (28 lbs)	5 kg (11 lbs)
Occupation:	NA	NA
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	NA	NA
Body Posture:	Sitting in child seat	Lying in infant seat
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used with forward facing convertible child safety seat	Lap and shoulder belt used with rear facing infant safety seat

OCCUPANT INJURIES - 1998 Honda Accord

Driver: Injuries obtained from autopsy report.

Injury	OIC Code	Injury Source	Confidence Level
Spine fracture: T8 angulated/compressed of the vertebral body pointing left laterally	640450.5,7	Roof	Certain
Spleen laceration (comminuted)	544228.5,2	Steering wheel rim	Probable
Skull fracture: Transverse hinge fracture	150206.4,8	Roof	Certain
Rib Fractures: Left anterior 3-9, Left posterior all, Right anterior 3-6, Right posterior 1-5 and 8-10.	450240.4,3	Steering wheel rim	Probable
Laceration of the diaphragm with herniation of intestines into left pleural cavity	440606.4,8	Steering wheel rim	Probable
Bilateral lung lacerations	441450.4,3	Steering wheel rim	Probable
Bilateral lung contusions	441410.4,3	Steering wheel rim	Probable
Right and left subarachnoid hemorrhage	140466.3,6	Roof	Certain
Fracture of the right tibia (open)	853422.3,1	Left instrument panel	Probable
Left temporal contusion (medial aspect). Right frontal convexity contusion.	140620.3,3	Roof	Certain
Cerebellar inferior (cesternal) contusion	140402.3,6	Roof	Certain
Left tibia fracture (Displaced)	853414.2,2	Left instrument panel	Probable
Left fibula fracture (Displaced)	851610.2,2	Left instrument panel	Probable
Fracture of the left humerus (closed)	752602.2,2	Steering wheel rim	Possible
Dislocation of left acromioclavicular joint	750230.2,2	Roof	Probable

Left inferior orbital ridge fracture (step off fracture)	251202.2,2	Roof	Probable
Left lateral clavicular fracture (closed)	752200.2,2	Roof	Probable
Liver laceration	541820.2,1	Steering wheel rim	Possible
Laceration of right kidney	541622.2,1	Steering wheel rim	Possible
Lacerations of left kidney	541622.2,2	Steering wheel rim	Possible
Esophagus contusion	440802.2,4	Roof	Possible
Laceration of the pericardial sac	441602.2,4	Steering wheel rim	Possible
Mesentery contusion	542010.2,8	Safety belt webbing	Possible
Contusion of the right pulmonary artery takeoff	441002.1,4	Steering wheel rim	Possible
Bilateral atrium contusion	441002.1,4	Steering wheel rim	Probable
Bilateral testes contusions	544610.1,3	Drivers' thighs	Probable
Contusion of the right adrenal	540212.1,1	Steering wheel rim	Possible
Contusion right cheek	290402.1,1	Steering wheel rim	Possible
Abrasion right cheek	290202.1,1	Steering wheel rim	Possible
Abrasions left forearm	790202.1,2	Steering wheel rim	Possible
Contusion left upper arm	790402.1,2	Left side interior	Possible
Abrasions right upper arm. Mild abrasion right elbow.	790202.1,1	Center console	Probable
Contusions right flank	490402.1,1	Center console	Probable
Abrasions left shoulder	790202.1,2	Left side interior	Probable
"Dicing" lacerations left upper arm	790602.1,2	Flying glass	Possible
Contusion left flank	790402.1,2	Left side interior	Possible
Abrasions overlying left collarbone	790202.1,2	Roof	Possible
Contusions across abdomen	590402.1,0	Safety belt webbing	Possible
Abrasions on left side of abdomen	590402.1,2	Safety belt webbing	Possible
Contusions on right upper thigh	890402.1,1	Steering wheel rim	Certain

“Dicing” lacerations of left knee	890602.1,2	Left instrument panel	Possible
Abrasions on left shoulder (posteriorly)	790202.1,2	Seat back	Possible
Abrasions of lower back	690202.1,8	Seat back	Probable
Left occipital subgaleal contusion	190402.1,2	Roof	Probable
Bilateral pectoral contusions	490402.1,3	Steering wheel rim	Probable

Front right occupant: Injuries obtained from autopsy report.

Injury	OIC Code	Injury Source	Confidence Level
Eggshell fracture of the calvarium (right greater than left) with partial avulsion of the brain	150406.4,1	Concrete pillar of bridge abutment	Certain
Compound fracture of the right tibia	853405.3,1	Right instrument panel	Possible
Cervical spine fracture	650216.2,6	Roof	Probable
Fracture of the thoracic spine	650416.2,7	Roof	Probable
Fractured left humerus	752602.2,2	Center console	Possible
Large avulsion type laceration on the scalp to the right side of the head	190804.2,1	Concrete pillar of bridge abutment	Probable
Large avulsion type laceration on the scalp to the left side of the head	190804.2,2	Concrete pillar of bridge abutment	Probable
Fractured right post-maxilla	250800.2,1	Concrete pillar of bridge abutment	Probable
Fractured right and left zygomatic	251800.2,3	Concrete pillar of bridge abutment	Probable
Fractured sternum	450804.2,4	Unknown	Unknown
Chest contusions	490402.1,0	Unknown	Unknown
Abrasion across right breast	490202.1,1	Safety belt webbing	Possible
Contusion left upper arm	790402.1,2	Unknown	Unknown
Chest abrasions (left)	490202.1,2	Unknown	Unknown

Abdomen abrasions (left)	590202.1,2	Safety belt webbing	Possible
Abrasions left forearm	790202.1,2	Unknown	Unknown
Abrasions left hand	790202.1,2	Unknown	Unknown
Contusions to right thigh	890402.1,1	Right side interior	Probable
Abrasions to right thigh	890202.1,1	Right side interior	Probable
Contusion left thigh	890402.1,2	Center console	Probable
Abrasion left knee	890202.1,2	Right instrument panel	Probable
Contusion left shin	890402.1,2	Right instrument panel and below	Probable
Abrasions left ankle	890202.1,2	Right instrument panel and below	Possible
Contusion left foot	890402.1,2	Right instrument panel and below	Possible
Abrasions left upper arm. Abrasions left shoulder and back.	790202.1,2	Roof	Probable
Laceration in center of back	690602.1,4	Unknown	Unknown
Abrasions lower right back	690202.1,8	Right side interior	Possible
Contusions across waist posteriorly	690402.1,8	Unknown	Unknown
Abrasion center of lower back	690202.1,8	Front right seat back	Probable
Contusion right side of neck	390402.1,1	Safety belt webbing	Possible
Right upper arm contusion. Contusions right hand.	790402.1,1	Right side interior	Possible
Abrasions right forearm	790202.1,1	Right side interior	Possible
Contusion right hip	890402.1,1	Right side interior	Possible
Abrasions left flank	490202.1,2	Center console	Probable
Contusion left flank	490402.1,2	Center console	Probable
Fractured right mandible	250602.1,1	Concrete pillar of bridge abutment	Possible
Facial abrasions to the right side of the face	290202.1,1	Concrete pillar of bridge abutment	Possible

Fractured bridge of nose	251000.1,4	Concrete pillar of bridge abutment	Possible

Second row left occupant: Injuries obtained from autopsy report.

Injury	OIC Code	Injury Source	Confidence Level
Frontal, eggshell calvarium fractures	150406.4,5	Concrete pillar of bridge abutment	Certain
Right midshaft femur fracture	851814.3,1	Left side interior surface	Certain
Left distal femur fracture	851814.3,2	Left side interior surface	Certain
Right orbital fracture	251202.2,1	Concrete pillar of bridge abutment	Possible
Left orbital fracture	251202.2,2	Concrete pillar of bridge abutment	Probable
Right zygomatic fracture	251800.2,1	Concrete pillar of bridge abutment	Possible
Left zygomatic fracture	251800.2,2	Concrete pillar of bridge abutment	Probable
Maxilla fracture	250800.2,9	Concrete pillar of bridge abutment	Probable
Fracture of anterior mandible (alveolar ridge) in incisor area	250200.2,8	Concrete pillar of bridge abutment	Probable
Large abrasion to left forearm	790202.1,2	Unknown	Unknown
Abrasion/contusion to left upper arm. Abrasion/contusion to top of left hand.	790202.1,2	Unknown	Unknown
Abrasion right forearm	790202.1,1	O3 Child safety seat	Possible
Laceration at tip of left ring finger	790602.1,2	Unknown	Unknown
Abrasion on palm and wrist of left hand	790202.1,2	Flying glass	Possible
Laceration below left knee and on left shin	890602.1,2	Left side interior surface	Probable
Abrasions on posterior of left calf	890202.1,2	O3 Child safety seat	Possible

Contusion on posterior of right calf	890402.1,1	O3 Child safety seat	Possible
Contusion below right knee on right side	890402.1,1	O3 Child safety seat	Possible
Abrasion on right side of right ankle	890202.1,1	Second seat cushion	Possible
Abrasion below right knee on right side	890202.1,1	O3 Child safety seat	Possible
Fracture of nasal bridge	251002.1,4	Concrete pillar of bridge abutment	Probable
Two lacerations in left orbital area	290600.1,2	Concrete pillar of bridge abutment	Possible
Laceration above right eye	290600.1,1	Concrete pillar of bridge abutment	Possible
Abrasions on left side of face	290202.1,2	Concrete pillar of bridge abutment	Probable
Abrasions on right side of face	290202.1,1	Unknown	Unknown
Contusion on tip of nose	290402.1,4	Unknown	Unknown

Second row right occupant: Injuries obtained from autopsy report.

Injury	OIC Code	Injury Source	Confidence Level
Multiple calvarial fractures with flattening of occiput and focal distortion of frontal area	150408.4,	Roof	Probable
Fracture of left femoral shaft	851814.3,2	O3 Child safety seat	Probable
Fracture of right distal femur	851800.3,1	Unknown	Unknown
Fracture at medial left superior orbit	251202.2,2	Roof	Probable
Abrasions on posterior of right forearm	790202.1,1	O4 Child safety seat	Probable
Abrasions on posterior of right head	190202.1,6	O4 Child safety seat	Probable

Abrasion on upper right thigh	890202.1,1	O4 Child safety seat webbing	Probable
Abrasion on right knee	890202.1,1	O4 Child safety seat	Probable
Contusion below right knee	890402.1,1	O4 Child safety seat	Probable
Abrasion on lower portion of left thigh	890202.1,2	O4 Child safety seat	Probable
Contusions on right side of forehead	290402.1,1	Roof	Probable
Abrasion on right side of forehead	290202.1,1	Roof	Probable
Abrasion above left eye	290202.1,2	Roof	Probable
Abrasion to bridge of nose	290202.1,4	Roof	Probable
Contusion on back of right side of head	190402.1,1	O4 Child safety seat	Probable

OCCUPANT KINEMATICS - 1998 Honda Accord

Driver kinematics

Figure 10. Driver position

The 23-year-old male driver was seated in an upright posture and restrained by the 3-point manual lap and shoulder belt (see Figure 10). The seat track was adjusted to the rear most position. As the vehicle began its clockwise rotation, the driver likely pitched to the left in response to the rotational forces. The effect of the vehicle overriding the guardrail was likely negligible. At impact with the bridge abutment, the driver pitched sharply to the left and slightly forward in response to the 9 o'clock direction of force. The driver sustained numerous injuries related to contacts to the steering wheel rim, left instrument panel, and left door; including: spleen laceration, multiple rib fractures, left tibia/fibula fractures, left humerus fracture, kidney lacerations, and a liver laceration. As the vehicle pitched onto its roof, and the roof intruded into the passenger compartment, the driver sustained major injuries related to the roof contact, including: a transverse skull fracture, and a T-8 spinal fracture.

Front right seat occupant kinematics

The 21-year-old female front right occupant was seated in an upright posture restrained by the 3-point manual lap and shoulder belt (see Figure 11). The seat track was adjusted to the rear most position. As the vehicle began its clockwise rotation, this occupant pitched to the left in response to the rotational forces. The effect of the vehicle overriding the guardrail was likely negligible. At impact with the bridge abutment, this occupant pitched sharply to the left and forward in response to the 9 o'clock direction of force. She engaged the center console and the driver's seat back–causing a humerus fracture and multiple left side abrasions and contusions. She also engaged the right lower instrument panel–causing multiple lower leg injuries. As the vehicle overturned and the roof was crushed, she sustained multiple skull fractures, spinal fractures, and facial fractures. These injuries occurred in combination with this occupant's head also striking the concrete abutment through the sun roof (see Figure 12).

Figure 11. Front right occupant seated position

Figure 12. Overhead view showing front right occupant through the sun roof.

Second row left occupant kinematics

The 20-month-old male child was restrained in a forward facing convertible child safety seat by the overhead shield. The child seat was anchored in the second row left seat position with the vehicle's manual 3-point safety belt. As the vehicle began its clockwise rotation, this occupant pitched to the left in response to the rotational forces. The effect of the vehicle overriding the guardrail was likely negligible. At impact with the bridge abutment, this occupant pitched sharply to the left and forward in response to the 9 o'clock direction of force. His lower legs sustained fractures due to the intruding door panel as it came into the lower part of the child seat. The child's head came into contact with the bridge abutment during the initial impact–causing multiple skull and facial fractures. The seat in this position was deformed to the right (see Figure 13) and this occupant and the child seat came into contact with the child seat in the second row right position. There were a number of contusions and abrasions related to this contact.

Figure 13. Second row left occupant seated position

Second row right occupant kinematics

The 6-week-old female child was restrained in the rear-facing infant seat by the five point harness. The child seat was anchored in the second row right seat position with the vehicle's manual 3-point safety belt (see Figure 14). As the vehicle began its clockwise rotation, this occupant pitched to the left in response to the rotational forces. The effect of the vehicle overriding the guardrail was likely negligible. At impact with the bridge abutment, this occupant pitched sharply to the left and forward in response to the 9 o'clock direction of force. She contacted the second row left child seat as it was being pushed to the right by vehicle intrusion. She sustained a left femur fracture from this contact, as well as numerous abrasions and contusions. As the vehicle overturned, and the roof was crushed, the intruding roof contacted this occupant's head causing multiple calvarial fractures.

Figure 14. Second row right passenger area

Attachment 1. Scene Diagram