

PB 297564



# NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

## HIGHWAY ACCIDENT REPORT

STATIONWAGON PENETRATION OF  
BRIDGERAIL, I-10  
NEAR ALHAMBRA, CALIFORNIA  
NOVEMBER 11, 1978

NTSB-HAR-79-5

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CONTENTS

	Page
SYNOPSIS. . . . .	1
INVESTIGATION . . . . .	1
The Accident. . . . .	1
Injuries to Persons . . . . .	3
Vehicle Information . . . . .	3
Vehicle Damage . . . . .	4
Driver Information. . . . .	6
Highway Information . . . . .	8
Meteorological Information . . . . .	13
Medical and Pathological Information. . . . .	13
ANALYSIS. . . . .	13
The Accident. . . . .	13
Driver. . . . .	14
Vehicle . . . . .	14
Road . . . . .	16
Bridgerailing . . . . .	16
CONCLUSIONS. . . . .	17
Findings . . . . .	17
Probable Cause . . . . .	18
RECOMMENDATIONS . . . . .	18

4

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HIGHWAY ACCIDENT REPORT

Adopted: June 7, 1979

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STATIONWAGON PENETRATION OF BRIDGERAIL,  
I-10, NEAR ALHAMBRA, CALIFORNIA  
NOVEMBER 11, 1978

SYNOPSIS

About 3:40 p.m., p.s.t., November 11, 1978, a stationwagon with 13 occupants exited from Interstate 10 (San Bernardino Freeway) onto a branch connection ramp which led to the southbound California State Route 7 (Long Beach Freeway). It was raining and the roadway was wet. As the stationwagon negotiated the ramp, the driver lost control of the vehicle and it crashed through the bridgerail and fell to the roadway below landing on its roof. The driver and six passengers were killed and six passengers were injured.

The National Transportation Safety Board determines that the probable cause of this accident was the driver's loss of control of the stationwagon on the branch connection ramp, which resulted from (1) the road surface's low coefficient of friction, (2) the speed of the vehicle, (3) the degraded condition of the vehicle, and (4) the intoxication of the driver. The severity of the crash was magnified by the failure of the bridgerail, known to be inadequate by current standards, to retain the vehicle.

INVESTIGATION

The Accident

Shortly before 3:00 p.m., on November 11, 1978, 13 persons (3 adults and 10 children) left together in a stationwagon from a party at a factory in South El Monte, California. The driver's wife stated that since 11 a.m. when they arrived at the party, she had seen her husband with two beers; however, she was not with him constantly and did not know how much he actually drank. She said she did not think he was intoxicated when they left the party in the stationwagon.

At about 3:40 p.m., 6 miles from the factory, the stationwagon exited eastbound Interstate 10 (San Bernardino Freeway), according to the driver's wife, onto a branch connection ramp which led to California State Route 7 (Long Beach Freeway). The single-lane connection ramp curved right and joined another ramp which originated at Ramona Boulevard. The two lanes continued across a bridge overpass and eventually merged with Route 7. (See figure 1.)

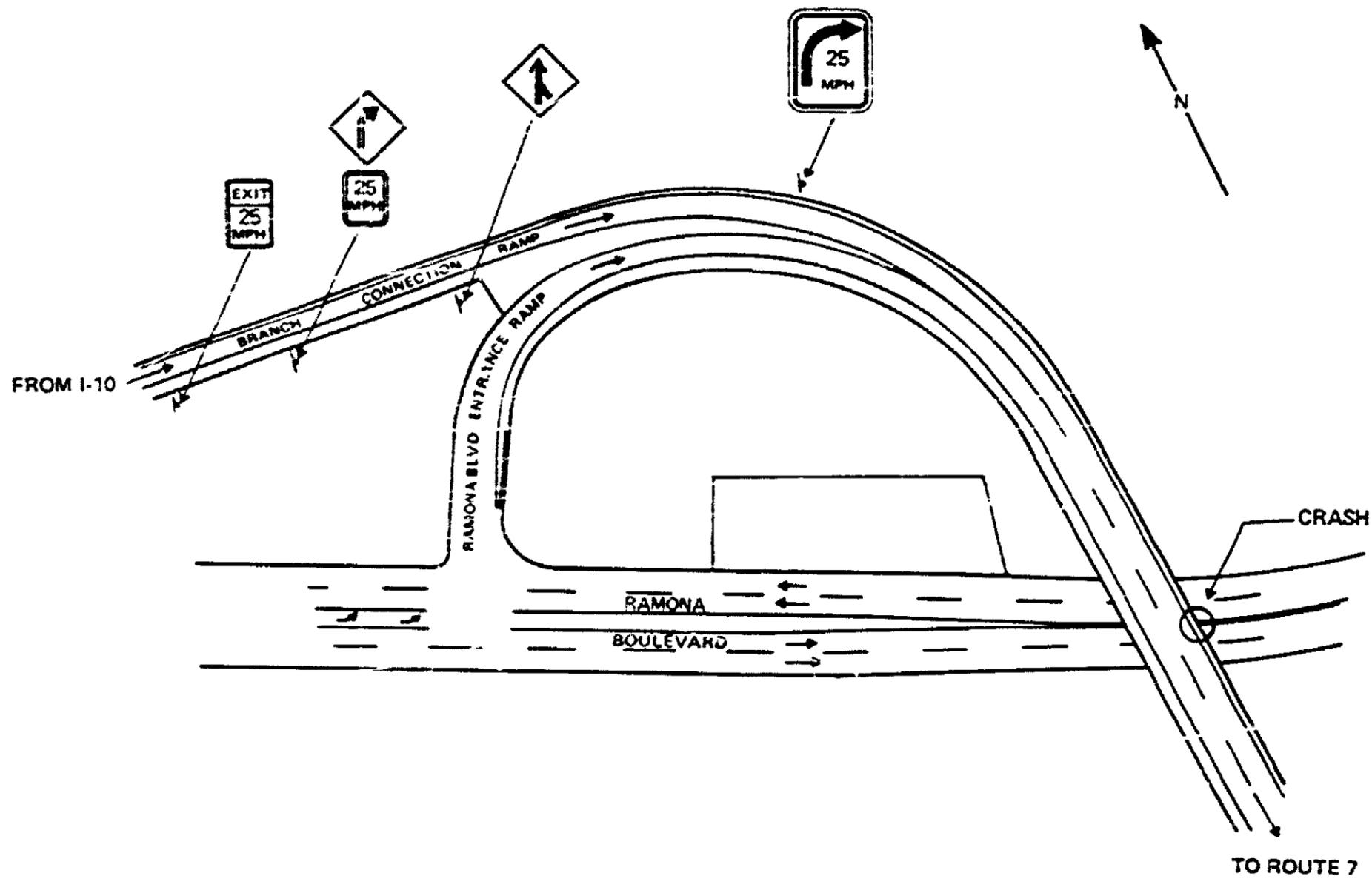


Figure 1. Plan of crash site.

It was raining and the roadway was wet. The driver's wife said the windows were fogged because of the number of people in the car, and she had to wipe the windshield to enable them to see.

A passenger in another eastbound vehicle, which was allegedly going about 20 mph on the branch connection ramp, stated that he saw the stationwagon coming from Ramona Boulevard and it appeared to be going "too fast for the conditions." He said that the stationwagon passed his vehicle on the right, and when it was about five car lengths ahead it went from the right to the left lane, began to "pull away," and spun out of control. It struck and mounted a concrete curb on the bridge overpass, crashed through the bridgerail, and fell to the roadway 22 feet below, landing on its roof.

Injuries to Persons

<u>Injuries</u>	<u>Driver</u>	<u>Passengers</u>	<u>Others</u>
Fatal	1	6	0
Nonfatal	0	6	0
Minor/None	0	0	0

Vehicle Information

The stationwagon was an eight-passenger, 1969 Ford Country Squire, vehicle identification number (VIN) 9J76Y138113. Although it was allegedly owned by the operator, the registration card bore a different name. It was powered by an eight-cylinder engine and was equipped with power steering, air conditioning, and automatic transmission. The odometer read 98,954 miles and the curb weight of the vehicle was 4,458 lbs. The service brakes were a split system -- power hydraulic with disc-type brakes on the front wheels and self-adjusting, drum-type brakes on the rear. Brake linings were of adequate thickness; the front wheel disc brake pads were 8/32 inch, and the rear wheel drum brake linings varied between 6/32 and 7/32 inch.

The maximum total occupant load specified by the manufacturer for this stationwagon was 1,200 lbs. The estimated <sup>1/</sup> weight of the thirteen passengers was 1,174 lbs. The estimate did not exceed the load limitation because 10 of the passengers were children between the ages of 3 and 15.

The following deficiencies were discovered during the postcrash vehicle examination:

1. The hydraulic system that services the rear-wheel brakes was completely void of hydraulic brake fluid. Upon application of the foot brake, no braking torque was developed at the rear wheels.

<sup>1/</sup> "Source of Infant and Child Measurements Interim Data, 1972"  
Richard G. Synder, PhD, Martha Spencer, M.D., Clyde Owings, M.D.,  
PhD., and Peter Van Eck, the University of Michigan.

2. The star wheel brake-adjusting assembly and self-adjusting linkage at the left-rear wheel was disconnected and lying loose inside the brake drum. (See figures 2 and 3.) The brake drum was scored.
3. The hydraulic brake system trouble warning light was disconnected.
4. The mechanical parking brake was out of adjustment and provided no braking torque to the rear wheels.
5. Two adjacent tread grooves on each rear tire were less than 1/32 inch in depth. <sup>2/</sup> The remaining four tread grooves on the right rear tire were between 5/32 and 6/32 inch in depth and the four remaining grooves on the left rear were between 2/32 and 6/32 inch.
6. Tire air pressure at the left rear wheel, which was the only tire that remained inflated, was 20 psi. The pressure recommended by the manufacturer for the rear tires was 32 psi.

The driver's wife stated that her husband was aware of a brake problem, but that he did not have time to make the necessary repairs.

#### Vehicle Damage

Damage to the stationwagon came from three sources: the initial striking and mounting of a 9-inch concrete curb, crashing through the bridgerail, and finally landing on its roof after a 22-foot fall.

All tires, except the left rear, were flat and the wheel rim flanges deformed. The outside wall of the left-front tire was cut through and the outer rim flange was bent. The right-front and right-rear tires, though flat, did not exhibit any visible tire cuts but the related wheel rim flanges were deformed due to impact.

The front of the left- and right-front fenders was pushed in and downward. There was imprint damage from a bridgerail vertical support pole in the side of the right-front fender, which was torn and crushed inward toward the rear at about 45°. (See figure 4.) The right-front wheel was pushed toward the rear about 10 inches. Contact damage was visible on the front of the right lower control arm, which was also pushed rearward. The right tie rod was fractured and the frame rail in this area was bent to the left. The left side of the front bumper was pushed in and down and the right corner was pulled out. The front grille was pushed in and the hood dented. The right-rear fender was dented and had a small tear. The rear axle was pushed toward the left

<sup>2/</sup> Section 27465 of the California Vehicle Code provides that no person shall use on a highway a pneumatic tire when the tire is so worn that less than one thirty-second of an inch tread depth remains in any two adjacent grooves at any location.

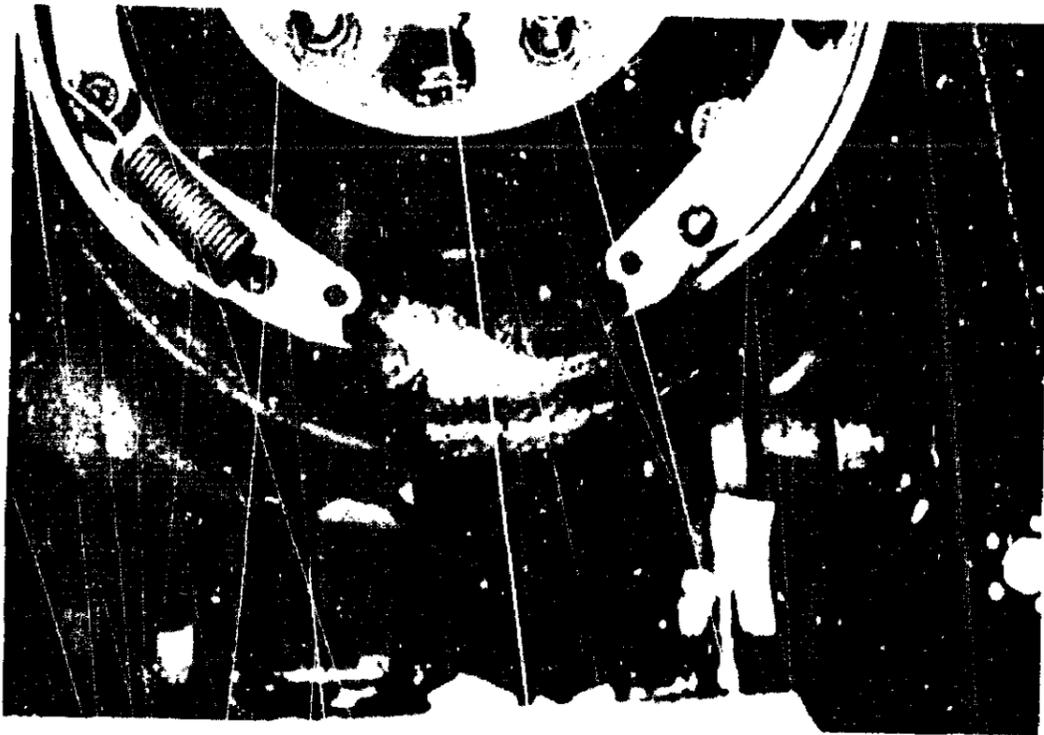


Figure 2. View of lower section of left rear wheel brakes showing absence of brake adjustment mechanism.

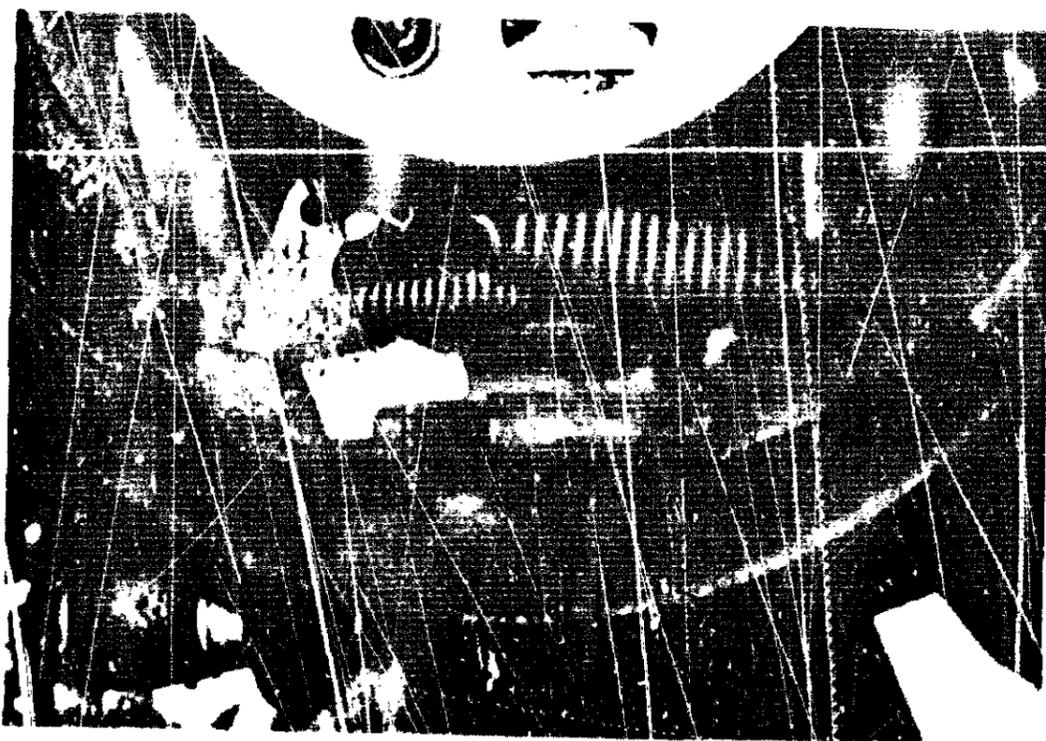


Figure 3. View of properly attached brake adjustment mechanism on right rear wheel.



Figure 4. View of stationwagon's right front fender, arrow indicates bridge rail imprint damage.

and tire rub marks were visible on the frame rail behind the right-rear wheel. The bottom of the muffler and right-rear frame rail had lateral scrape marks. The flexible coupling on the steering shaft was disconnected as a result of the crash. The roof supporting pillars and door frames were collapsed downward to window sill level; all window glass was broken. (See figures 5 and 6.)

#### Driver Information

The 31-year-old 210-pound stationwagon driver was a resident of Los Angeles, California, and was employed as a "stitcher" in a leather goods factory. In March 1977 he had been issued a State of California operator's license with no restrictions. It was suspended in July 1978 and was still suspended at the time of this accident.

His driving record in the State of California listed the following information:

- 2-11-77 -- Driving without a license or registration.
- 3-14-77 -- Operator's license issued.
- 2-10-78 -- Accident.

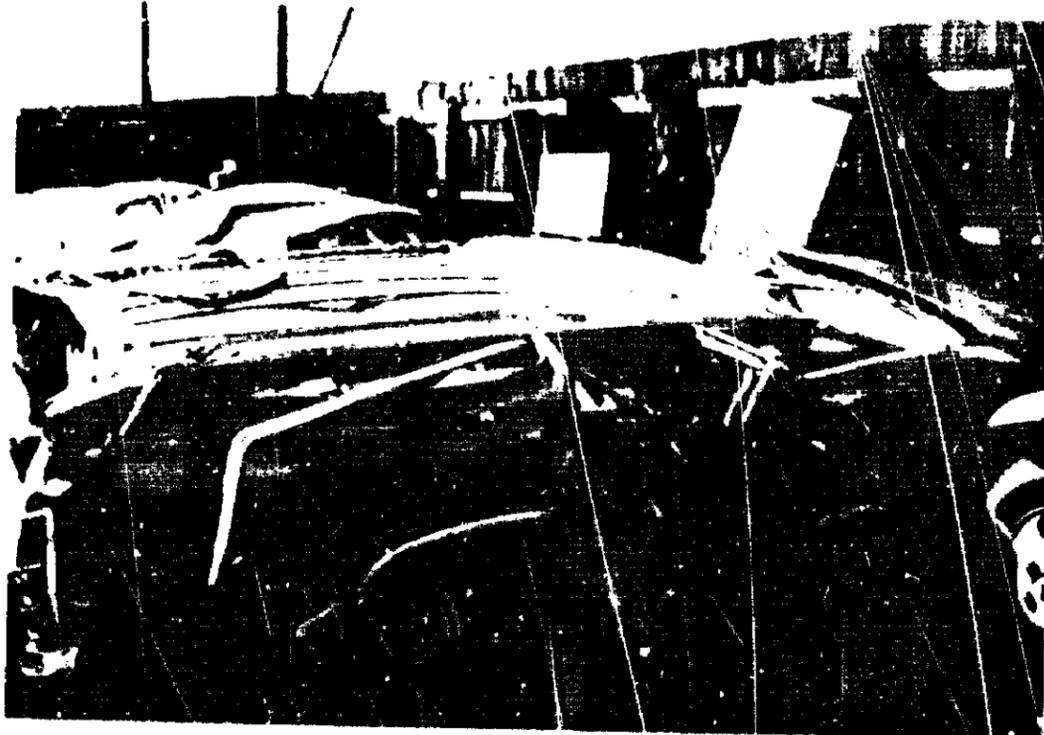


Figure 5. Right sideview of stationwagon.

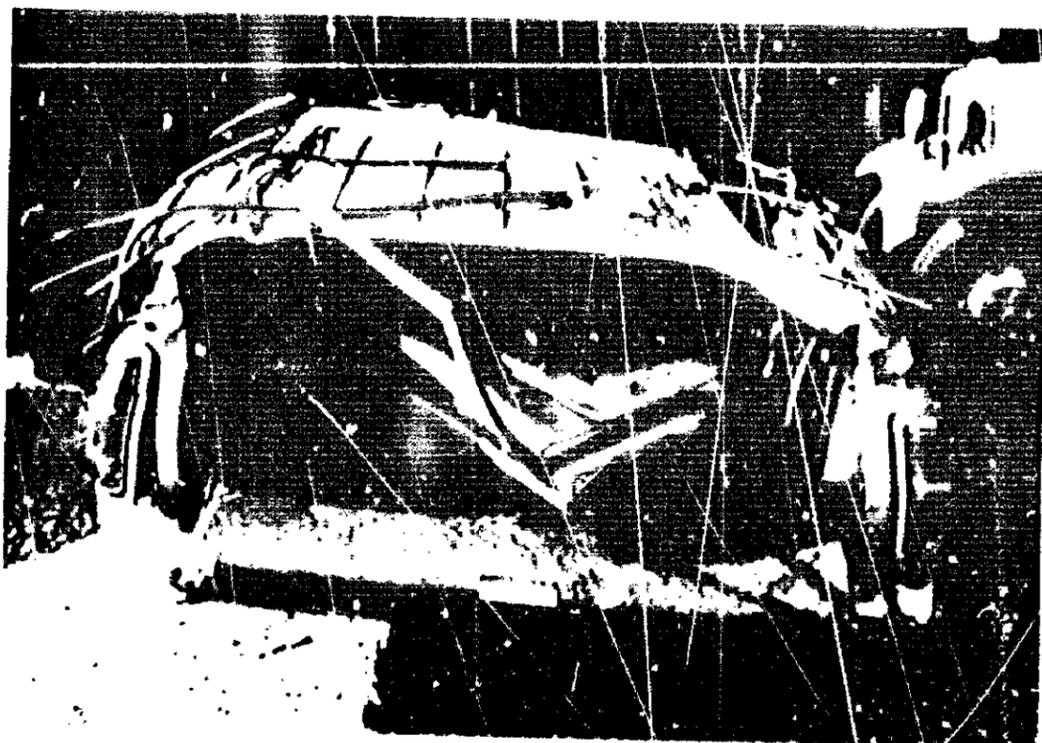


Figure 6. Rearview of stationwagon.

- 7-16-78 -- License suspended for failure to report an accident  
and failure to establish financial responsibility.
- 7-17-78 -- Intoxicated driving

#### Highway Information

The branch connection ramp where the accident occurred consists of two lanes. The left lane connects eastbound I-10 with southbound Route 7. (See figure 1.) The travel lane is 12 feet wide and the left shoulder varies in width from 2 to 6 feet. It has an initial grade of -3.6 percent as it simultaneously leads into a 400-foot vertical curve with a final grade of 6 percent and a 250-foot-radius horizontal curve. The pavement surface changed from Portland cement concrete to asphalt concrete at the beginning of the horizontal and vertical curves. The superelevation through the curves reached a maximum of 6 percent. At the beginning of the curves, the left lane is joined on the right by the Ramona Boulevard entrance ramp which, after a tapered, paved safety area, became the second lane of the connector ramp. The two lanes continue straight and parallel, separated by broken white lane lines, over Ramona Boulevard at a bridge overpass and begin to merge with Route 7 about 300 feet past the bridge overpass. The pavement surface of the bridge overpass is Portland cement concrete. (See figures 7 and 8.)

The branch connector ramp from I-10 was posted with four warning signs upstream of the Ramona Boulevard entrance ramp. The first three signs were spaced along the right shoulder and the fourth was on the left shoulder. (See figure 1.) The first sign was a 25-mph advisory exit speed sign, the second was a curve sign mounted above a 25-mph speed advisory sign, the third was a merge sign, and the fourth was an 8-foot by 8-foot, 25-mph speed advisory sign with a turn arrow. The only sign posted on the Ramona Boulevard entrance ramp was a "Landscape Construction Ahead" warning sign which was mounted on the right shoulder near the ramp entrance.

The bridge overpass is elevated 22 feet above Ramona Boulevard and has a 6 percent grade. It is bordered on the left by a 9-inch concrete curb and a steel, panel-type bridgerail, and on the right by a California type-9 barrier rail. (See figures 9 and 10.) Originally both sides of the overpass had concrete curbing and the steel, panel-type bridgerail; but in 1973 when the overpass was widened 11 feet on the right, the right-side curbing and bridgerail were removed and replaced with the California type-9 barrier rail.

Skid tests were conducted at this location by the California Department of Transportation (DOT) on July 14, 1978. The skid numbers at 25 mph for both lanes on the curve leading up to the bridge overpass were 29 for the outer lane and 28 for the inner. The minimum recommended

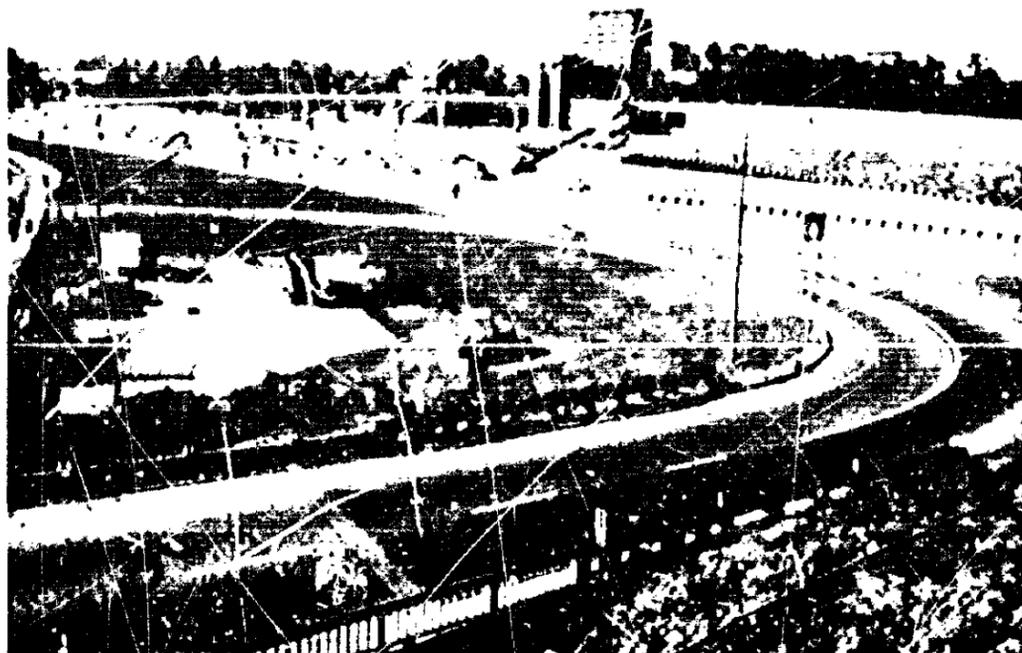


Figure 7. Overview of crash site showing:

1. Ramona Boulevard.
2. Ramona Boulevard Entrance Ramp to Route 7.
3. I-10 (San Bernardino Freeway).
4. Branch Connection Ramp - connecting I-10 to Route 7.
5. Ramona Boulevard Bridge Overpass (crash site).

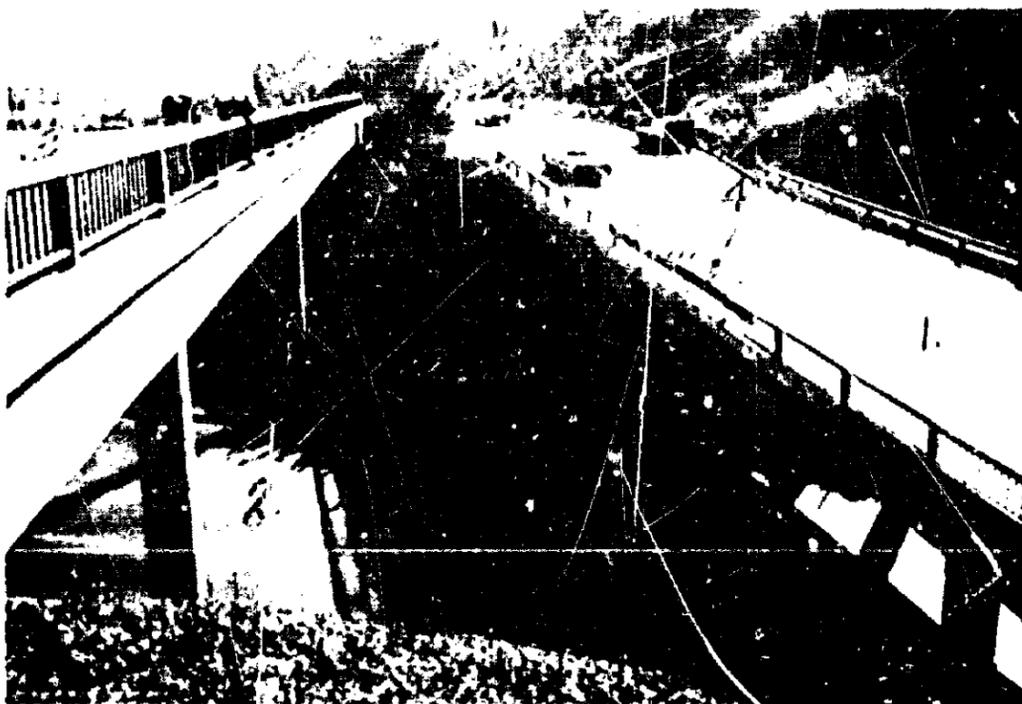


Figure 8. Southbound view of crash site.

1. Ramona Boulevard Bridge Overpass.
2. Ramona Boulevard.
3. Route 7 (Long Beach Freeway).
4. Temporary barrier where stationwagon crashed through bridge railing.

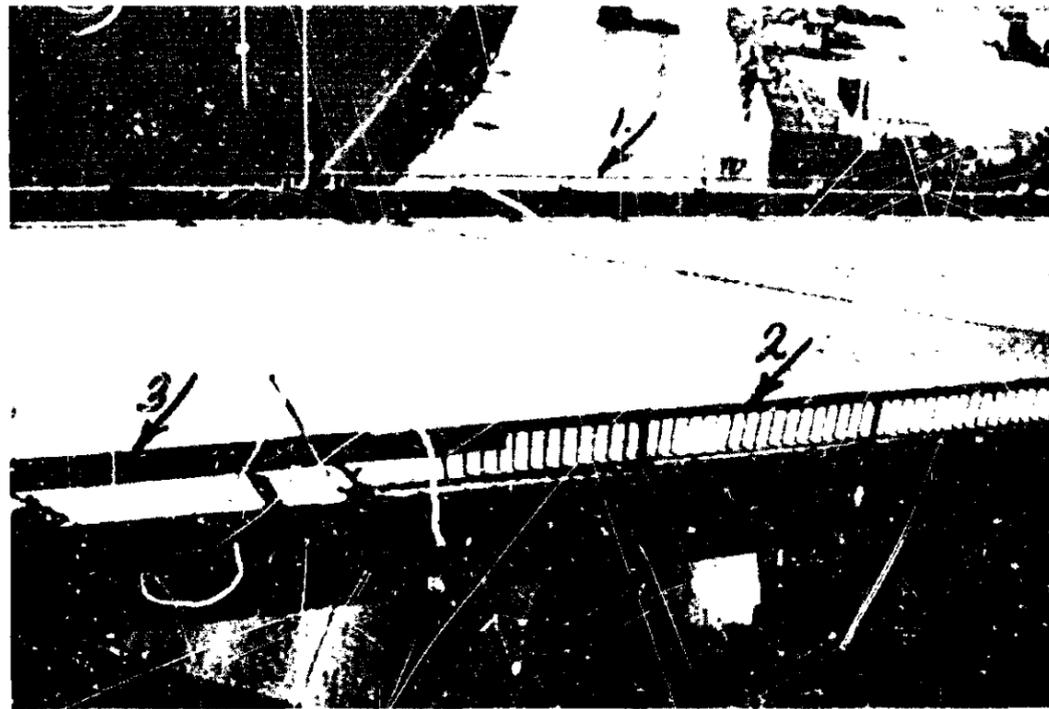


Figure 9. Ramona Boulevard Overpass  
Arrow 1 - California Type-9 Barrier Rail.  
Arrow 2 - Panel-Type Bridgerail.  
Arrow 3 - Temporary barrier where stationwagon  
crashed through bridgerail.

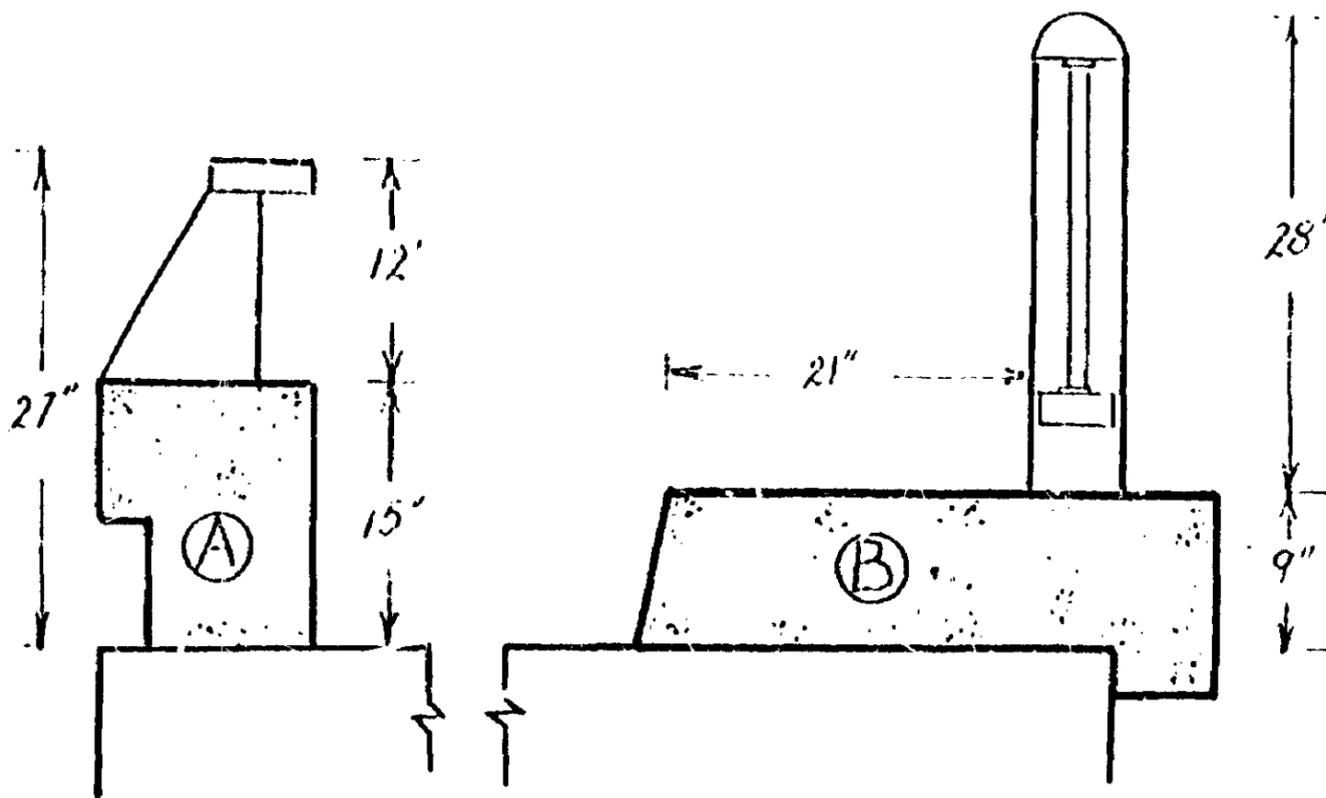


Figure 10. A - California "Type-9" Barrier Rail  
B - Panel-Type Bridgerail.

skid number at 25 mph for this pavement is 38, according to an extrapolation of the data in Federal Highway Administration's (FHWA) Highway Safety Program Manual No. 12. <sup>3/</sup>

The average daily traffic count at the Ramona Boulevard bridge overpass is 18,700 vehicles; 13,700 coming from the I-10 branch connection ramp and 5,000 from the Ramona Boulevard entrance ramp.

From 1975 to November 1978 there were 46 reported traffic accidents at this location; 24 (52 percent) of which occurred during wet weather. Thirty-nine accidents involved only one vehicle. Of the 37 accidents classified as fixed-object collisions, 12 (32 percent) involved the bridgerail. No one was killed in the previous 46 accidents. A local tow truck operator said that at least three vehicles had crashed through the bridgerail at this location and landed on the roadway below.

From January 1978 through October 1978 there were 11 reported accidents; 8 occurred in wet weather. From January 1978 to September 1978, loss reports from the maintenance section of the California DOT indicate that the panel bridgerail at the crash site had been repaired eight times as a result of being struck by motor vehicles. The repairs included replacing fourteen 10-foot bridgerail sections. Maintenance personnel said that State policy is to replace in kind, rather than upgrade the facility.

FHWA guidelines provide that, "Procedures should be established, if they are not presently used, for a plan of operation to repair and correct crash-damaged highway features that may create a hazard to the traveling public." <sup>4/</sup>

The California DOT had initiated a safety improvement project report for the crash site as part of its highway safety improvement program. The report, prepared during the summer of 1978, classified the location as a high-accident concentration location and proposed that the existing panel bridgerail be replaced and that the superelevation through the horizontal curve be increased by adding an asphalt pavement overlay. However, as of May 4, 1979, the safety improvement project has not been implemented. Since the accident another vehicle has crashed through the bridgerail at this site.

When the stationwagon struck the bridgerail, three bridgerail posts and three 10-foot sections of bridgerail were torn out. Tire scuff marks attributed to the stationwagon were found on the roadway, on the curb facing, and on top of the curb. (See figure 11.) Other tire marks and paint transfers not related to this crash were evident on both sides of the bridge overpass.

<sup>3/</sup> Highway Design, Construction, and Maintenance; Chapter IV, page 9.

<sup>4/</sup> Highway Design, Construction, and Maintenance, Highway Safety Program Manual Number 12, U.S. Department of Transportation, Federal Highway Administration, February 1974.

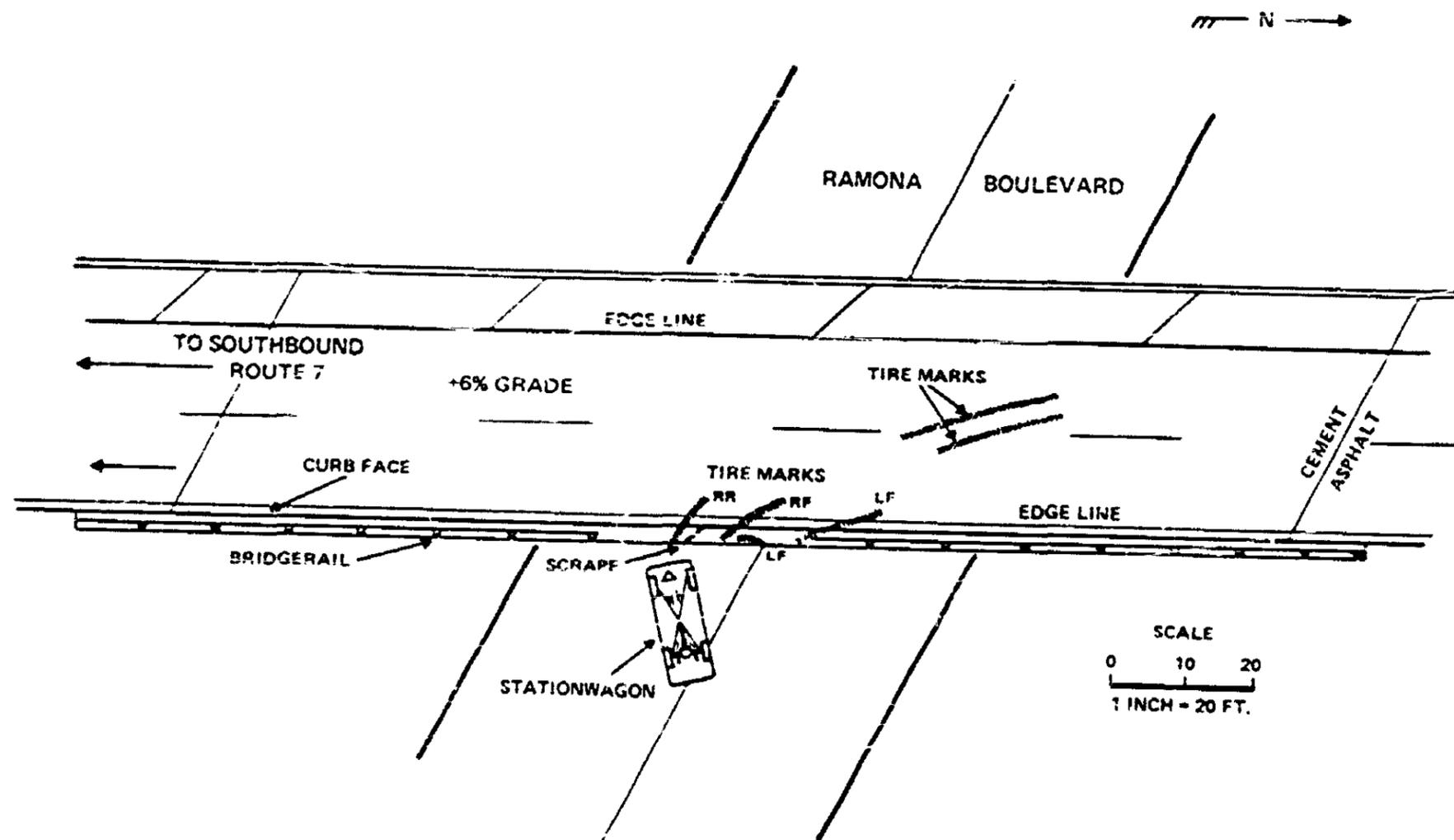


Figure 11. Accident scene diagram.

During the investigation of the crash site several days after the accident, a Safety Board investigator witnessed an accident in which a passenger car, while negotiating the Ramona Boulevard entrance ramp, spun out of control, struck a guardrail on the right side of the road, and came to rest facing the opposite direction, about 100 feet before the bridge overpass. It had just stopped raining and the road surface was wet. The driver said, "All I did was touch the brakes to slow -- I don't know what happened."

#### Meteorological Information

A weather analysis, prepared by the Safety Board staff, indicated that at the time of the accident it was daylight, the skies were cloudy, horizontal visibility was 2 to 3 miles, and there were moderate rain showers with a rainfall rate of .11 to .30 inch per hour. The temperature was 50 to 55° F and surface winds were 5 to 15 knots south to west.

#### Medical and Pathological Information

A postmortem analysis of the driver's blood revealed a .18 percent blood alcohol level. The California vehicle code states "If there was at the time .10 or more by weight of alcohol in the person's blood, it shall be presumed that the person was under the influence of intoxicating liquor at the time of the alleged offense." <sup>5/</sup>

### ANALYSIS

#### The Accident

Although there were conflicting statements about which ramp the stationwagon was on as it approached the crash site, it made no difference because the vehicle was alternately in both lanes and then apparently went out of control in an area where the two ramp lanes join and run parallel, shortly before the bridge overpass. The witness statement indicates that the stationwagon went from the right to the left lane after it had passed the witness' vehicle and went out of control in the left lane. Tire scuff marks in the right lane on the bridge overpass indicate that the stationwagon, after going out of control in the left lane, went into the right lane before veering across the left lane and into the cement curb and bridgerail.

The crash sequence at the bridgerail began when the stationwagon's left-front wheel struck and mounted the 9-inch cement curb on the left side of the overpass. The vehicle was at an approximate angle of 24° when the left-front corner struck the bridgerail and a bridgerail post, dislodging the post and a 10-foot section of bridgerail. The stationwagon then struck a second post with the side of the right-front fender, which

<sup>5/</sup> California Vehicle Code, Sec. 23126, Sub. 3.

before breaking away "snagged" the vehicle when the post became embedded against the front edge of the lower control arm of the right-front wheel, which is between the chassis frame and the right-front wheel. The already counterclockwise rotation of the stationwagon, which began with the initial contact between the left front and the bridgerail was accelerated as it pivoted about 90° on that post and crashed through two more sections of bridgerail before falling 22 feet to the roadway below. An approximation of the rotation, pitch, and roll sequence of the stationwagon as it crashed through the bridgerail and fell to the roadway below is illustrated in figure 12.

The Safety Board's investigation identified several major risk factors present in the elements that constitute the highway transportation system: the driver, the vehicle, and the road. Although the Safety Board was unable to determine to what degree each factor influenced this crash, it was apparent that the combination of these factors made this crash inevitable.

#### Driver

This driver's actions reflected an attitude of disregard for the safety of his passengers, and of other road users. He ignored his license suspension; allowed 12 passengers to ride in the eight-passenger stationwagon, knowing that it had defective brakes; was apparently driving above the 25-mph advised speed limit, during a rainstorm with his visibility reduced by a fogged windshield; and, according to all standards, was intoxicated. The level of intoxication represented by his .18-percent blood alcohol level is known to affect a driver's judgment, coordination, and willingness to take risks. <sup>6/</sup> However, the Board was unable to determine to what degree it influenced this accident.

Though a lack of physical evidence precluded a calculation of the stationwagon's speed, it is reasonable to assume that it was traveling in excess of the advised 25 mph. The witness thought that it was going "too fast for the conditions" when it passed him and accelerated when it was about 100 feet ahead. In addition, severe damage to strong components of the right front of the stationwagon were indicative of speeds in excess of 30 mph, especially since this damage was done after some energy was lost due to the collision with the 9-inch curb and the initial collision between the left front of the stationwagon and the bridgerail. The lane changes made by the stationwagon had the effect of flattening the curve and, therefore, its travel speed was not limited by the critical speed of the road curvature.

#### Vehicle

The lack of rear-wheel brakes decreased the braking efficiency of the vehicle and could have caused stability problems. However, there

<sup>6/</sup> Highway User Quarterly, September 1970.

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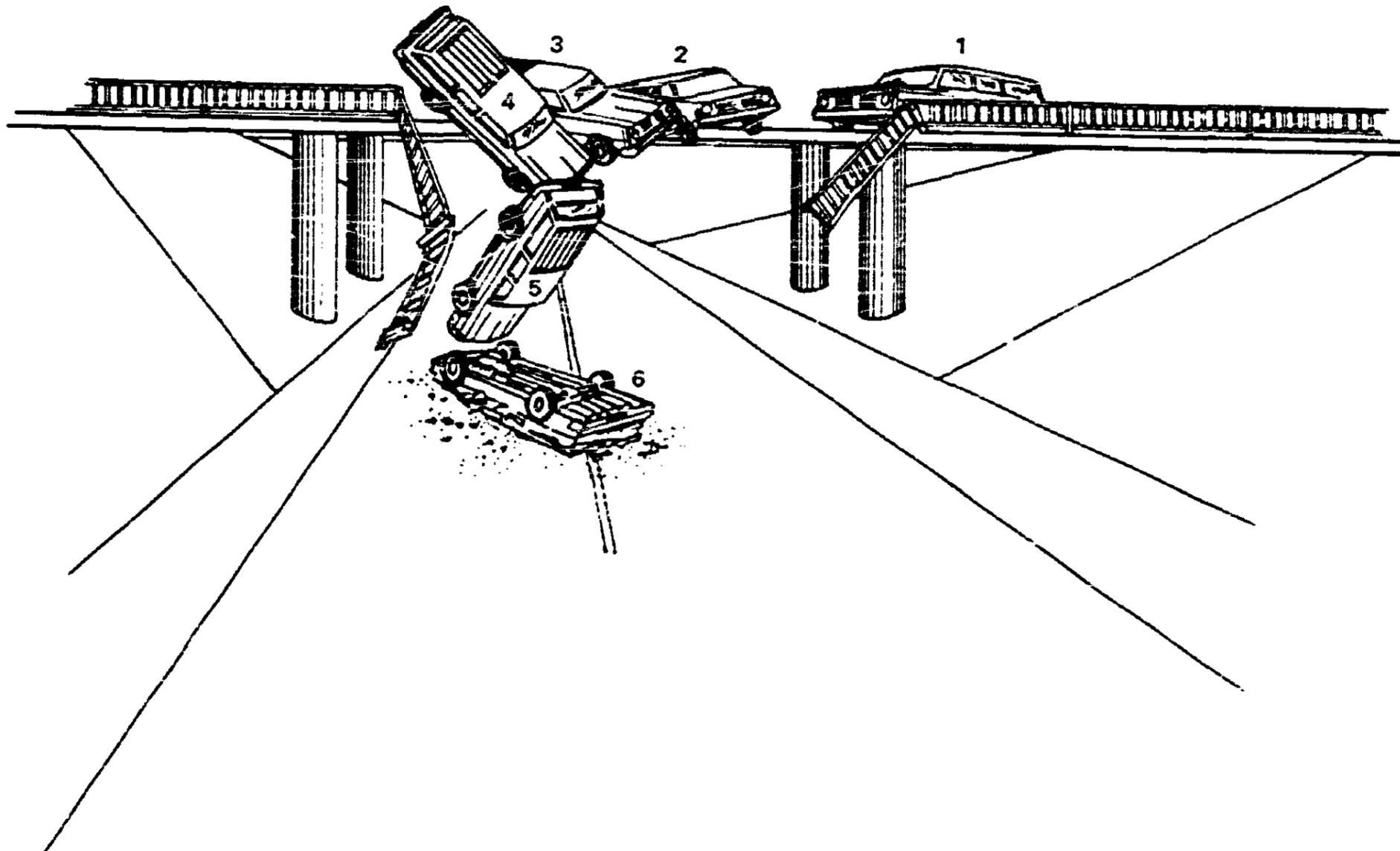


Figure 12. Estimate of vehicle attitude during the crash sequence from  
(1) initial contact with bridge rail, to (6) place of final rest.

was no evidence to indicate the brakes were applied during the sequential events leading to the crash.

If the underinflated left-rear tire was indicative of the unknown inflation pressures of the other three tires, this, coupled with the maximum capacity weight, would have reduced the cornering capability of the stationwagon.

Although the tread depths in two adjacent tread grooves on each rear tire were less than the legal limits established by the State of California, there was sufficient tread depth in the four remaining tread grooves on each tire to prevent this condition from being critical to the control of the stationwagon.

#### Road

The number of reported single-vehicle and wet-weather accidents at this site suggests that vehicles are experiencing control problems which are probably a result of a low road surface-to-tire coefficient of friction, the curvature of the roadway, and travel speeds in excess of 25 mph. Skid tests conducted by the California DOT at this site resulted in low skid numbers that, according to FHWA's Highway Safety Program Manual No. 12, indicate the location should be analyzed for corrective treatment.

The wet pavement critical speed for the curve leading up to the bridge overpass was computed to be between 30 and 35 mph. "Slippery When Wet" signs were not posted in advance of this location. The maximum superelevation in the curve is approximately 6 percent. The American Association of State Highway and Transportation Officials (AASHTO) recommends in its publication "A Policy on Design of Urban Highways and Arterials - 1973" that a ramp with a curve radius of 250 feet should have an 8-percent superelevation for a 30-mph speed. Although the ramp has an advisory posted speed of 25 mph, observed travel speeds are in excess of the posted speed.

#### Bridgerail

This bridgerail did not function to prevent the vehicle from going over the side of the bridge structure as recommended in AASHTO's "Guide for Selecting, Locating, and Designing Traffic Barriers." <sup>7/</sup> The guide also states that if a barrier installation is substandard, it is suggested that the barrier either be modified to conform to an operational system, or be replaced by an operational system. <sup>8/</sup>

<sup>7/</sup> Page 111.

<sup>8/</sup> Page 125.

In a report sponsored by the FHWA, <sup>9/</sup> bridgerailing similar to that used at the accident site was cited as "...older bridgerailing installations that do not perform satisfactorily..." A photograph of an accident scene where a vehicle crashed through panel-type bridgerail and had landed on the roadway below was used as an illustration. A chart in this publication rated panel-type bridgerail as "P" for poor.

FHWA Highway Safety Program Standard No. 12 requires that "...State and local jurisdictions establish programs to correct safety deficiencies on all urban and rural roads with new construction, reconstruction, and improved maintenance" and that "procedures should be established, if they are not presently used, for a plan of operation to repair and correct crash-damaged highway features that may create a hazard to the traveling public." It further states that highway appurtenances that are repeatedly damaged by vehicles should not be repaired without corrective action to reduce both hazards to the road user and frequency of maintenance. Although other vehicles had crashed through this bridgerail, the State of California had not eliminated the hazard, as suggested in the standard. In keeping with the standard, the bridgerail should have met current design practices for bridgerailing. Since there are bridgerails of the same or similar design throughout the State, the California DOT should have prepared an upgraded bridgerail design for maintenance purposes before the accident occurred. The design should have provided for an update of substandard systems as they were damaged.

#### CONCLUSIONS

##### Findings

1. Directional control of the stationwagon was lost before it reached the bridge overpass.
2. There were major risk factors present in all elements of the highway transportation system: the driver, the vehicle, and the road.
3. Although the driver was intoxicated, the Safety Board could not determine to what degree it influenced this crash.
4. Evidence indicates that this driver was traveling at more than the 25-mph advisory speed.
5. Although the brakes were defective, there is no evidence to indicate that they were causal to the crash.
6. Inadequate tire inflation combined with the heavily loaded vehicle reduced the cornering capability of the stationwagon.

<sup>9/</sup> Report No. FHWA RD-77-40 - "Upgrading Safety Performance in Retrofitting Traffic Railroad Systems."

7. Skid numbers at this location were below an FHWA-recommended level cited in Highway Safety Program Manual No. 12.
8. Road conditions indicate that "Slippery When Wet" warning signs should be placed at this site until corrective measures are taken.
9. The bridgerail failed to retain the stationwagon and prevent it from falling to the roadway below.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the driver's loss of control of the stationwagon on the branch connection ramp, which resulted from (1) the road surface's low coefficient of friction, (2) the speed of the vehicle, (3) the degraded condition of the vehicle, and (4) the intoxication of the driver. The severity of the crash was magnified by the failure of the bridgerail, known to be inadequate by current standards, to retain the vehicle.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board made the following recommendations to the State of California:

"Until the accident site is improved, install "Slippery When Wet" warning signs at the Ramona Boulevard entrance ramp and the branch connection ramp from I-10, and install a 25-mph speed advisory sign at the Ramona Boulevard entrance ramp. (Class I, Urgent Action) (H-79-36)

"Establish a policy and program consistent with Federal Highway Administration guidelines and safety standards that will provide for upgrading substandard bridgerailing that has been crash-damaged. (Class II, Priority Action) (H-79-37)

"Expedite action to complete and adopt the California Department of Transportation safety improvement project for the accident location and make the recommended safety improvements to comply with current safety guidelines. (Class II, Priority Action) (H-79-38)

"Establish a program to retrofit, on a priority basis, bridgerailing that does not meet Federal performance guidelines, which provide that bridgerailings be designed to minimize severity of impact, retain the vehicle, redirect the vehicle so that it will move parallel to the roadway, and minimize danger to traffic below. (Class II, Priority Action) (H-79-39)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING  
Chairman

/s/ ELWOOD T. DRIVER  
Vice Chairman

/s/ FRANCIS H. McADAMS  
Member

/s/ PHILIP A. HOGUE  
Member

June 7, 1979