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**TRI-LEVEL ACCIDENT
INVESTIGATION STUDY
Volume 2
Final Technical Report**

**Contract No. DOT-HS-031-2-454
September 1973
Final Report**

**PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
WASHINGTON, D.C. 20590**

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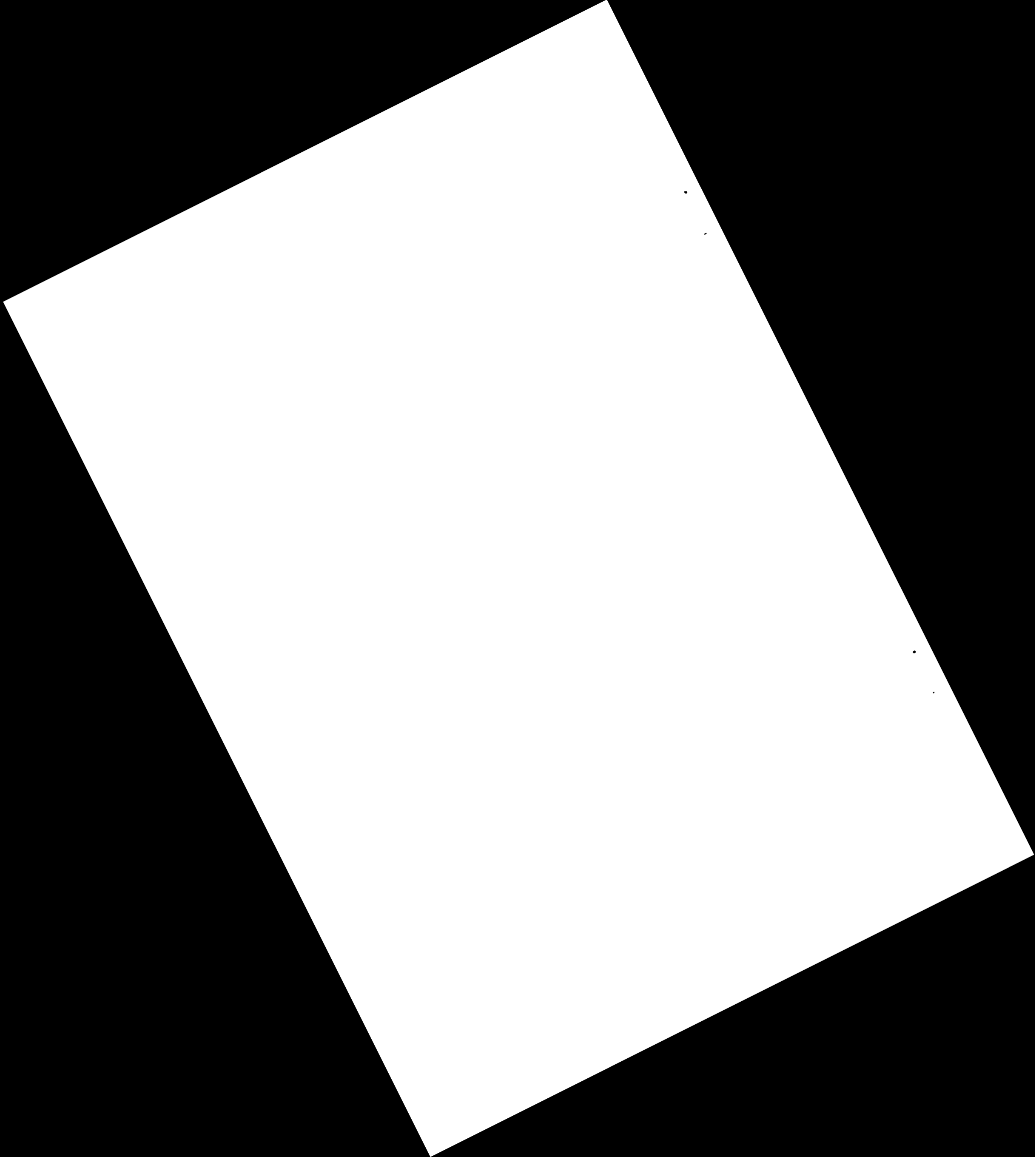
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LIST OF RESOURCES

Auto Manufacturers

Ford Motor Company
General Motors Corporation
Chrysler Corporation
American Motors Corporation
Motor Vehicle Manufacturers Association
International Harvester
Wayne Corporation (School Buses)

Medical

U of M Hospital Emergency Room
U of M Hospital Medical Records Office
U of M Department of Pathology
St. Josephs Mercy Hospital Medical Records Office
St. Josephs Mercy Hospital Pathology Department
Beyer Memorial Hospital
Fontana Taylor Ambulance Service

Police

Michigan State Police
Ann Arbor City Police Department
Washtenaw County Sheriff's Department

Highway

Washtenaw County Highway Department
Michigan Department of Highways
City of Ann Arbor Traffic Engineering Department

Auto Repair

Sakstrup's Motor Service
Northside Towing
Frain's Lake Service
Dick's Union 76
H & H Service
Brewer's North Campus Gulf Service
Barko's Parking
Smith's Service Station

Miscellaneous

Michigan Secretary of State (licensing and registration)
R & L Associates (photo service)
Midwest Research Institute

Summary

This report describes a program of accident investigation studies which were based on varying levels of accident detail and analysis of the resultant data. The program was sponsored by the Accident Investigation Division of the Research Institute, National Highway Traffic Safety Administration, Washington, D.C., and conducted by the Highway Safety Research Institute of the University of Michigan. This final report covers the second year of a Tri-Level Accident Investigation Study which was continued under contract no. DOT-HS-031-2-454 for the period of July 1, 1972 - June 30, 1973. During this period William E. Scott was Chief of the Accident Investigation Division at NHTSA and Wayne Van Wagoner was the contract Technical Manager.

In the Tri-Level study concept various levels of detailed accident data, and related driver-vehicle information are incorporated within a broad program of field accident investigations conducted in a fixed geographic area with the objective of identifying and analyzing problems and topics relating to highway safety.

The final report consists of two volumes.

Volume I discusses the methodology used to examine accidents of special interest and the resultant levels of accident data obtained from these investigations. In-depth, multidisciplinary accident case studies are grouped and discussed with summaries of findings relative to the human, vehicle and environmental aspects of accidents. Special studies involving small car-large car involvements, parked vehicle accidents, side impact performance, windshield retention failure, seat belt retractor mechanisms, multi-purpose vehicles and hood-windshield penetration are also included in this volume.

Volume II contains summaries of 50 Level III, multidisciplinary case studies which were completed and submitted to NHTSA during

the course of the program. All reports are available for public viewing and/or sale in the Technical Reference Division, Room 5108, National Highway Traffic Safety Administration, 400 Seventh Street, S.W., Washington, D.C. 20590.

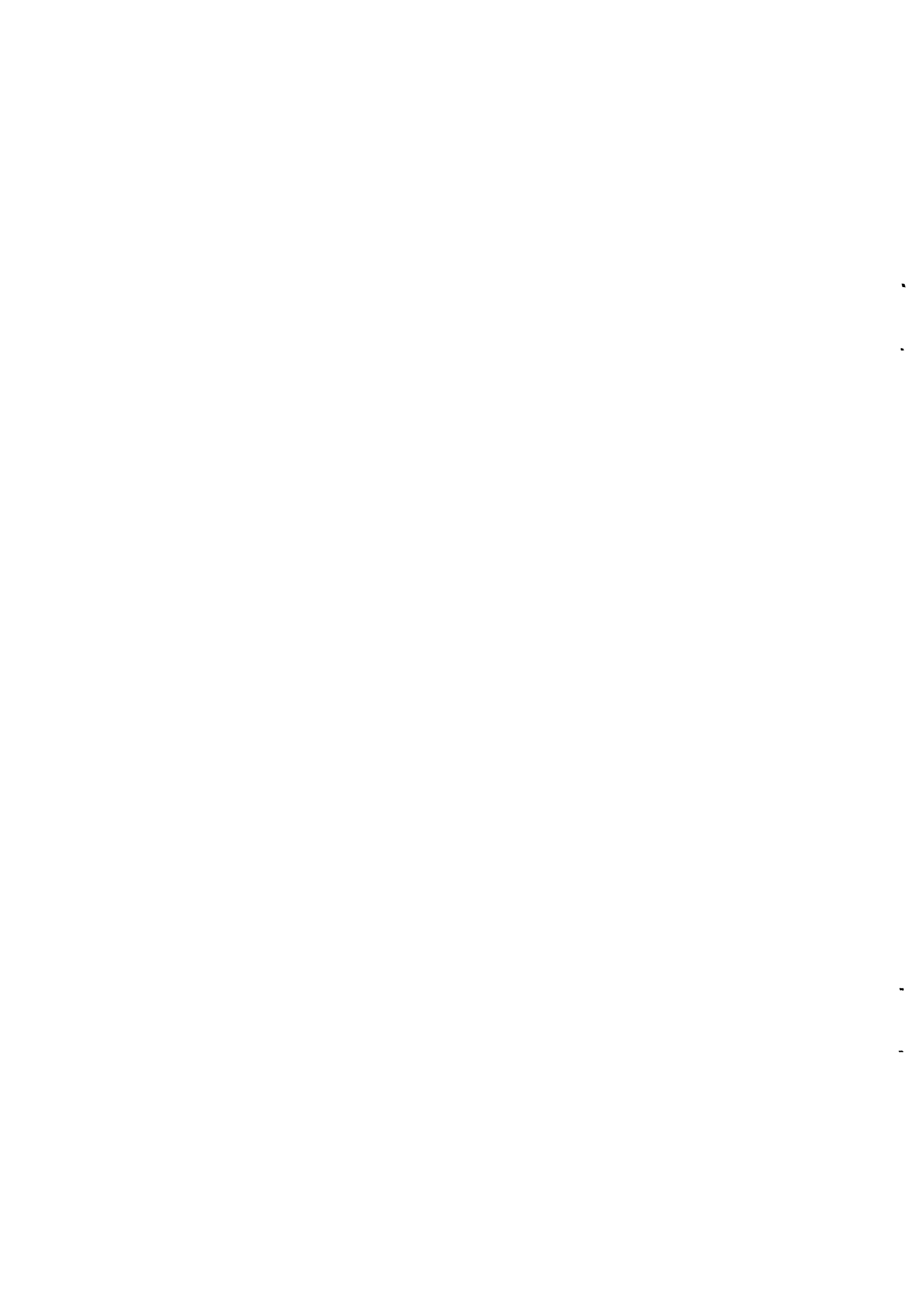
Introduction

In the Tri-Level Accident Investigation Study Program accidents are investigated in varying degree of accident detail, and the assembled data analyzed in order to better understand the accident process, i.e., to determine accident and injury causation. When functional problems in highway safety are identified, effective countermeasures are recommended.

The relatively limited number* of in-depth case studies completed, and the non-random selection methods used to obtain these cases, have posed some limitations on interpretation of the data relative to the general accident population. Police reported (mass) accident data within the study region represent a census, which permits an assessment of frequency of accident by type, severity, etc. The level of detail is not great, but such data do serve as a baseline, or foundation, for more detailed analyses of those specific problems posed or identified during the in-depth multidisciplinary investigations.

In multidisciplinary, in-depth case studies, the entire spectrum of a crash is examined -- human, vehicle, and environmental in each phase of the collision (pre-crash, crash, and post-crash). Even though the total sample of these accidents is relatively small, the collection of data is useful in studying causes and effects as they related to accidents. Over 800 different data variables (items of information) are collected in multidisciplinary accident case studies. They are used in numerous topical subject areas for comparative evaluation, and indication of trends between or among variables. This report includes some of these studies, as well as a general description of all accident investigations conducted during the year plus findings, both evident and inferred, derived therefrom.

* A total of 50 in-depth multidisciplinary accident case studies were completed within the one program.



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THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-301
CASE SUMMARY

Identification

This accident occurred at the late section of Division and Washington Streets in the city of Ann Arbor, Washtenaw County, Michigan on Saturday, June 17, 1972 at 1:39 p.m. involving a mail delivery vehicle and a compact convertible colliding at right angles within the intersection. The accident was injury producing - AAS Injury Severity Code 1, minor.

Weather

Daylight, overcast skies, no precipitation, 70°F, 85% humidity, no wind, roads were dry.

Roadway

Division Street is a major one-way arterial, south to north through the city of Ann Arbor which intersects with Washington Street, a city collector. Eastward Washington Street is two-way traffic from the intersection and westward Washington Street is one-way traffic from the intersection. Washington Street is 66 feet wide, consisting of 4 lanes with 2 travel lanes and 2 parking lanes. Division Street is 42 feet wide, consisting of 4 lanes with no divider or median. Both roadway surfaces consist of well-traveled asphalt. The intersection is bordered with standard 6"-high concrete curbs. Both streets are straight and crowned for drainage. Division Street is level and there is a 1/2 degree slope on Washington Street east to west. Mercury vapor luminaires border both streets. There are 4 intersections and 60 drives per quarter mile along Division Street and 4 intersections with 45 drives per quarter mile along Washington Street. Both streets include 100 poles and trees per quarter mile from the intersection. The intersection has a history of 21 accidents over a 3-year period, with 14 accidents actually within the intersection proper. Of these 14 accidents, 10 were intersection-type accidents similar to this accident case study. Of the 14 accidents within the intersection, 4 involved a right turn while the remaining 10 had both vehicles in each accident going straight ahead. Nine were property damage and 5 injury producing with no fatal accidents. One involved the use of alcohol.

Traffic Controls

There are no posted speed limits on either roadway. The speed limit is 25 mph by city ordinance along a 1/2 mile strip. Each street contains one-way traffic signs and solid white lines for a pedestrian walkway. No traffic and one-way signs on both streets are legible and clearly visible. The intersection is signal controlled with two 12 signal overhead units set back from the intersection. A north-south bound one-way traffic from Division Street and a westward traffic from Washington Street.

Vehicles

Vehicle #1, a 1953 Plymouth Valiant, 2-door convertible, red exterior, white top, red interior, with odometer at 67,780 miles. No evidence of vehicle inspection or any vehicle inspection not required in Michigan, which uses a system of vehicle check lanes. Last maintenance consisted of lubrication at 60,600 miles. Tread depth on rear tires 1/32 inch. Uneven tire inflation pressures. Oil leakage evident from front shock absorbers. No interior damage from occupant contact. After market seat belts installed, but not used. Damage to front left corner area with deformation to fender and hood. VBI: 4-1-68.

Vehicle #2, a 1953 Buick Wildcat 100, 4-door station wagon especially made for postal mail delivery. Odometer reading 6522 miles. Owned and maintained by U.S. Postal Service and subjected to regular shop maintenance schedule. Conventional color white, and blue U.S. Postal Department marking exterior. Single blue covered driver seat situated on right side of vehicle. Damage to right front corner area from first impact and to vehicle body including ruptured gas tank, from second impact. Lap belt worn in accordance to Post Office Department policy. No damage evident to interior from occupant contact, but driver occupant did contact upper A-pillar area and right door from first impact.

Occupants

Driver and sole occupant of Vehicle #1, 28 years, Caucasian, female, 67", 125 lbs. Driving in past 3 years and averaging 5,000 miles per year with the exception of the past year in which the driver drove an average of 10,000 miles. Driver had a regular Wisconsin operator's license with no restrictions. Husband had owned the vehicle 2 1/2 years and she had driven it through the time of the accident exclusively the preceding 11 months. She was en route to a local department store for shopping. 4 miles from origin, 1/2 mile from destination. No stress or pressure. Completed high school driver education course. Familiar with area. Alcohol or narcotics not involved in accident. Lap restraints available but not utilized. Injuries sustained were a laceration left arm, contusion mid-lateral left thigh, sore left shoulder and neck. AIS injury severity code 01.

Driver and sole occupant of Vehicle #2, 27 years, male, Caucasian, 72", 155 lbs. He is married and has been a resident of the Arbor all of his life. Employed by the U.S. Postal Service Department for the preceding 8 months and was familiar with the postal vehicle. Driver had a State of Michigan operator's license as well as a U.S. Government driver's license. Contact lens eye glasses were worn by the driver in the accident. Ten years driving experience, averaging 20,000 miles per year, and had driven an average of 20 miles per week on the job for the U.S. Postal Department the previous 8 months. The driver had accepted a series of deliveries and was returning to the post office by a route normally taken only on Saturdays. 1/4 mile from origin and destination. Physical and mental condition good. Alcohol or narcotics were not involved in this accident. Completed a two-phase high school driver education course with both classroom and road instruction. Driver was driven from first impact and moved forward and to the right side to move the vehicle transmission selector lever into reverse with his left leg. The vehicle accelerator pedal also jammed and the driver saw the vehicle then accelerated rearward 300 feet striking a street lamp pole.

The driver contacted the right pillar and door upon the first impact and was ejected (or ejected himself). He was in his usual seated position upon second impact, conscious and coherent, and exited the vehicle immediately. She landed 1 1/2" later in posterior scapular from right A-pillar, bruise on right arm striking the instrument panel, and a bruise to the right calf from striking the lower portion of right door. AIS injury severity: 01.

Description

Event A: Vehicle #1 was traveling west on Washington Street in the westbound lane and speed of 20 mph while Vehicle #2 was traveling east on Division Street in lane #2, also at 20 mph. A collision occurred into Vehicle #1 about 10 minutes prior to this accident while the driver of Vehicle #1 was at the roadway edge of the Lavin, Division Street traffic light. While the drivers of Vehicle #1 and Vehicle #2 were aware of the previous accident and the accident vehicles in the roadway, neither driver had this prior accident as a sufficient distraction to cause a lapse in their attentiveness to driving. The driver of Vehicle #1 had stopped for a red traffic signal at a previous intersection and intended to continue northbound through the accident intersection. He called to police officers that he thought the traffic light was amber and stated in the HSRM interview that he thought it was green. His opinion was that he did not observe the signal. The driver of Vehicle #2 had slowed for the intersection and intended to turn south onto Division Street which is one-way traffic. Upon noticing that it was one-way, she then proceeded straight through into the intersection. The driver of Vehicle #1 had noticed people milling around the site of the accident the first accident. Her radio was on. She proceeded into the intersection with a green traffic signal and did not observe Vehicle #2 until immediately prior to impact. She braked, which was her only reaction. Vehicle #1 then skidded forward and impressed the right front of Vehicle #2, at the center of the intersection.

Crash: The driver of Vehicle #1 did not brace himself, concentrating only on driving. She was traveling against the left door. Upon she rebounded back into the driver's seat remaining in an upright position after sustaining a bruise to the left arm, a contusion to the mid lateral thigh and a sore left shoulder from striking the left front door. A severe sore to the right side of her neck also resulted from the jolt of impact. Vehicle #1 traveled at 70 mph, and skidded 10 feet with Vehicle #2 being pushed to the east. The driver of Vehicle #2 was unaware of the impending collision and failed to see Vehicle #1 prior to the collision. She braked, she fell forward and to the right, contacting the right door and upper leg. She rebounded back into her original seated position. Immediately impacted, Vehicle #2 moved forward and contacted the curb on the east side of the intersection. She was wearing the seat belt. Immediately after the driver was rebounding forward, she was ejected from the driver's seat leg may have contacted the transmission belt. She fell to the left of his seat and landed in forward into "reverse." Her rear end movement of the transmission forced the vehicle to reverse. Vehicle #2, with gas pedal stuck, moved forward and struck the curb on the east side of Division Street, causing to the driver to impact the curb and breach a mercury vapor

luminaire one block south of the accident site. The driver was not injured in the second impact. He had been dazed from the first impact; however, had regained alertness at second impact. Injuries sustained from the first impact were a 1 1/2" laceration to the scalp and a bruise to the left thigh as a result of striking the right A-pillar and instrument panel, respectively. A bruise to the right lateral calf was sustained as a result of contacting the right door.

Post-Crash: While bystanders were standing about as a result of the previous accident, no one actually witnessed the collision. Police were nearby and immediately located an ambulance which arrived within 3 to 5 minutes and transported the driver of Vehicle #2 to a local hospital, approximately 1 mile away. The driver of Vehicle #1 exited and stood by her vehicle until questioned by police. The driver of Vehicle #2 was aware of the spill of gasoline upon exiting. This was deposited on the curb and roadway over a ruptured fuel tank as a result of the impact with the luminaire. A fire department vehicle unit was subsequently dispatched and hosed down the roadway. Both accident vehicles were removed by local towing vehicles, and spilled gas hosed down within 1/2 hour. An electric utility field unit serviced the luminaire posts to minimize it's hazard to traffic and pedestrians within 3 hours after the accident.

Standards

The following Highway Safety Program Standards (HSPS) and/or Motor Vehicle Program Standards (MVPS) which were relevant to this case study are:

- | | |
|-----------|---|
| HSPPS #5 | Driver Licensing relevant inasmuch as the driver of Vehicle #1 also was issued a government driver's license. |
| HSPPS #16 | Debris Load Control and Clean-up. Fuel leakage from Vehicle #2 required dispatching a special fire truck to come to hose down area. |
| HSPPS #12 | Highway Design, Construction and Maintenance
Luminaire struck by Vehicle #2 was rigidly anchored and adjacent to roadway. |
| MVPS #201 | Occupant Protection in Interior Impact. Not required for compliance in classification of Vehicle #2. |
| MVPS #202 | Head Rest Rints/Passenger Cars. Not required for compliance in classification of Vehicle #2. |
| MVPS #203 | Impact Protection for the driver from steering control system. |
| MVPS #301 | Fuel tanks, fuel tank filler pipes, and fuel tank connections. |

Causal Factors, Conclusions, and Recommendations

The primary causal factor in this accident was the preoccupation of both drivers, particularly the driver of Vehicle #2, with concerns other than the immediate task of driving. That is, the driver of Vehicle #1, unfamiliar with the route, changed her route plan at the intersection upon observing the one-way street. The driver of Vehicle #2 may have been distracted by a girl car attendant at an adjacent car rental agency, as observed by a witness. Both drivers were cognizant of the location and damaged vehicles in the roadway from the previous accident. While both denied this may have had an effect on their driving attentiveness, it did detract from their immediate task of driving.

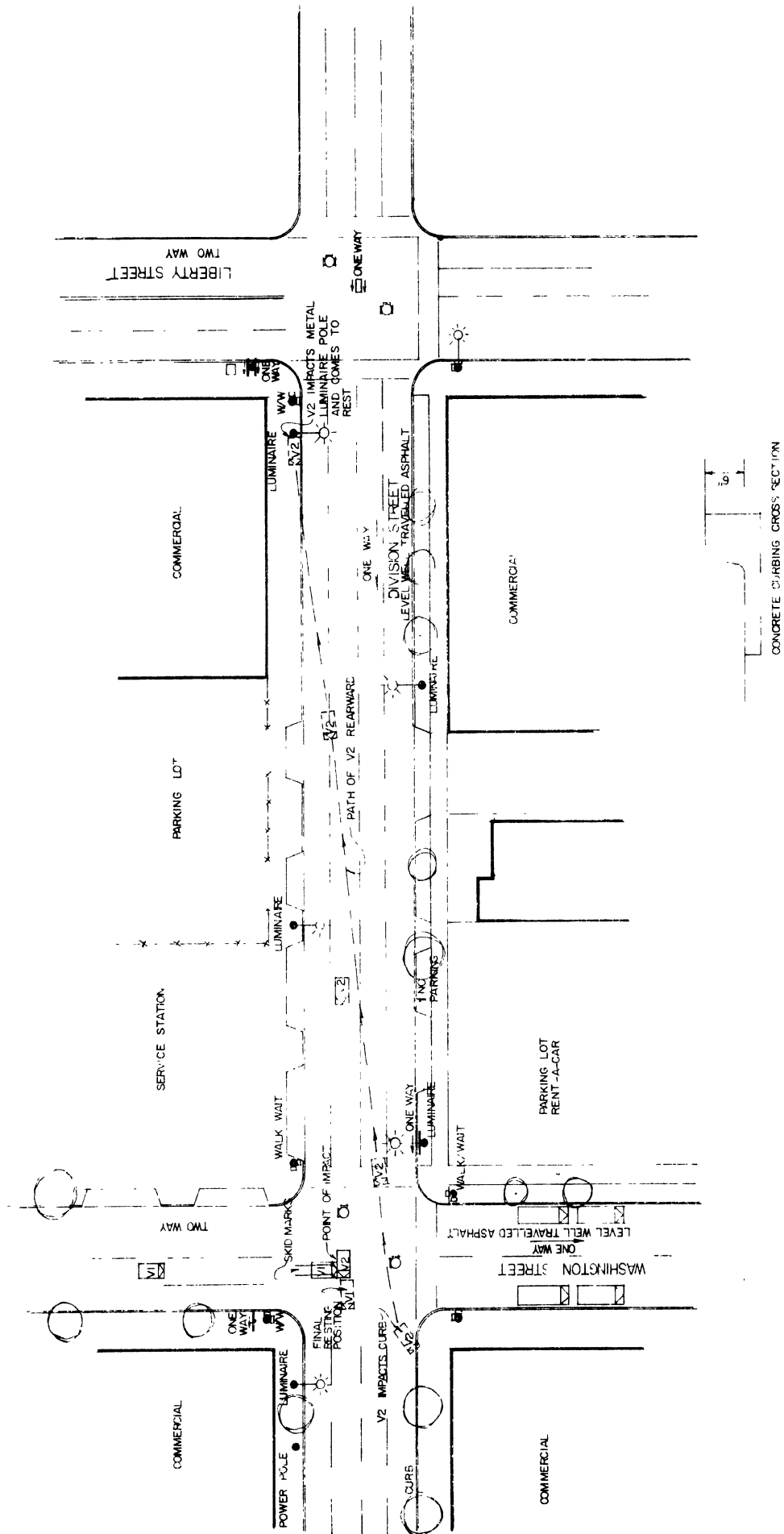
The susceptibility of fire to the Jeep mail vehicle from a rear-end collision is increased by the location of its fuel tank. In addition, the sliding door design, through which the driver enters and exits for mail pickup and delivery, as well as to be sufficiently reinforced to resist passenger compartment intrusion from side impacts and should be taken into consideration in future similar vehicle specifications.

<u>Matrix Cell</u>	<u>Explanation</u>
-1	Both drivers inattentive to immediate driving task upon entering the intersection. This was more recognizable on the part of the driver of Vehicle #2 as he entered the intersection against a red traffic signal.
+1	The braking of Vehicle #1 by its driver indicated good reaction to the impending impact once the potential collision was detected.
+3	The driver of Vehicle #2 was able to recover quickly from his dazed condition and, realizing the danger from spilled fuel, exited quickly.
+4	Vehicle #2 was well maintained and in good condition for its use, particularly the brakes.
-4	The 2-speed GM powerglide automatic transmission utilized on Vehicle #2 does have characteristics such that the gear position can be put into reverse while the vehicle is moving forward, as opposed to the more conventional 3-speed no-shafted transmission which will not go into reverse gear except at a speed high enough to destroy the transmission.
-4	The driver of Vehicle #2 sustained injuries which could have been avoided through the use of an upper torso restraint. The lack of this restraint may also have been influential in causing the second impact to Vehicle #2, in that reduced driver movement may not have nudged the gear shift lever into reverse.

Major Findings

Explanation

- 1 Vehicle #2 interior design with little, if any, consideration for occupant safety.
- +4 Vehicle #1 interior padded in conformance to current standards (NFPA 2401) with the exception of sunvisors. This is noteworthy considering the age of the vehicle.
- 4 Vehicle #2 reversed direction as a result of driver movement resulting from first impact.
- 4 Faulty lock location on Vehicle #2 adjacent to rear bumper resulted in direct frontal damage and fire from rear end impact.
- 4 Vehicle #2 utilized dissimilar tires in a mix which also included passenger tires with conventional tread tires.
- +5 Vehicle #1 secondary hood latch remained latched during collision.
- 5 Vehicle #2 accelerator jammed from exterior damage sustained from first impact.
- 6 Vehicle #2 driver door jammed (right side), necessitating exit through rear door.
- 7 Prior accident may have been distracting to both drivers.
- 7 Vehicle #2 driver may have been "glad watching" when approaching intersection.
- 7 Accident history of intersection indicates that the majority of collisions at this intersection were right angle, or minor, intersection collisions similar to this accident.
- +8 The street lighting was obscured by the Jeep during the second impact resulting in night driver impact, without posing danger to roadway traffic or pedestrians.



AA 301



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-302
CASE SUMMARY

Identification

Accident occurred at the intersection of East Summit Street and North Fifth Avenue, a residential-commercial area in the city of Ann Arbor, Washtenaw County, Michigan, on Thursday, July 13, 1972 at 1725 o'clock. Right-angle collision of two passenger cars. Injury Severity AIS code 01, minor.*

Ambience

Daylight, no breeze, hot and humid, temperature 85°, humidity 95%. Intermittent showers, rain imminent. Roadway dry.

Highway

East Summit Street and North Fifth Avenue are both local streets, 34 feet wide, two lanes, no dividers or medians. Both well-traveled asphalt, standard 6-inch-high curbs. Both roadways are straight and crowned for drainage. Slopes are: North Fifth from Depot to Summit, +1 1/2° north to south; North Fifth from Summit to Beakes, +8° north to south; Summit from Fourth to Fifth, 0° west to east; and Summit from Fifth to Division, +2° west to east. One mercury vapor luminaire over intersection. Three intersections and 25 drives within quarter-mile radius of East Summit; two intersections and 20 drives within quarter-mile radius of North Fifth. Numerous trees and poles in area. No significant accident history.

Traffic Controls

Both streets 25 mph per city ordinance. East Summit has intermittent yellow center line; North Fifth has no pavement markings. Two "Stop" signs and numerous "No Parking" signs on North Fifth, all legible. No signals or traffic control devices at intersection.

Vehicles

Vehicle 1, a 1963 Pontiac Bonneville 2-door hardtop. Light blue exterior with dark blue vinyl top, light and dark blue interior. Odometer 66,310 miles. No previous vehicle inspection (vehicle inspection not mandatory in Michigan). Power steering and power brakes, automatic transmission. No padding on sunvisors; padding on upper instrument panel cracked; light padding on doors. After-market lap restraints in front seat only. Brake lining and drums in very good condition for old car. No air filter; glass in rearview mirror missing; accelerator damp around master braking cylinder; accelerator pedal loose at bottom; parking brake

*American Medical Association Abbreviated Injury Scale (AIS).

pedal wired up; front tires lightly worn; rear tires badly worn (left, 1/32-inch tread; right, 3/32-inch tread). No record of previous maintenance. Damage was mainly to left front: sheet metal damage to grill area, bumper, and left front fender, and lower left headlight broken. Left rear quarter panel damaged. Direction of force to Vehicle 1, 11:00 o'clock. VDI:11-FYEW-1, 09-LPNW-1.

Vehicle 2, a 1970 Ford Maverick 2-door sedan. Dark green exterior, black interior with black and white plaid seats. Odometer 3,758. No previous vehicle inspection (vehicle inspection not mandatory in Michigan). No power accessories. Padded sunvisors, upper instrument panel, and arm rests; light spoke padding on wide-spoke steering wheel. Lap and shoulder restraints, no retractors; Driver 2's belt was improperly fastened and came unbuckled (because there is no retractor, it is possible for the belt buckle to stay together without being completely fastened). No defects, Vehicle 2 in overall good condition and well maintained. Last maintenance on May 10, 1972 at 3,429 miles, oil, filter, and lubrication, transmission and differential checked, new air filter. Sheet metal damage to right front wheel well area; upper shock mount moved inward, struck air filter and snapped off carburetor at base; fender mount at rear of front fender separated; small dent at belt line of right A-pillar; right rear quarter panel dented. Direction of force to Vehicle 2, 2:00 o'clock. VDI:02-RFEW-3, 03-RBMW-1.

Occupants

Driver 1, 21 years, female, Black, 64 inches, 130 pounds. Driving experience unknown. Driving record indicated three moving violations for excessive speed in past three years, and a citation for not having a driver's license on her person over a three-year period. Reexamined December 23, 1971 after accumulating 12 points; no further violations after reexamination. Traveling from friend's house; driving brother's car, familiarity with vehicle unknown; familiar with area. Had taken driver education in high school. A year before the accident, Driver 1 had fallen at work, hitting left temporal lobe on concrete, and was momentarily unconscious. Although medical tests revealed no problems, she reportedly was suffering from headaches, inability to maintain peripheral glance to right side, and fatigue, and was attempting to collect compensation. Driver 1 was defensive and uncooperative, refusing to answer questions. No blood alcohol involved in investigator's opinion. Probably unrestrained. Injuries: soreness over left anterior ribs and left abdomen, contusion of right elbow, and contusion of right knee. Injury Severity AIS code 01, minor.

Right front passenger, Vehicle 1, 25 years, female, Black, 65½ inches, 165 pounds. Unrestrained, thrown forward and to the left. Injury Severity AIS code 0, no injury.

Left rear passenger, Vehicle 1, 2 years, female, Black, 35 inches, 30 pounds. No restraints available, kneeling on seat, nearly ejected out open window. Injury Severity AIS code 0, no injury.

Center rear passenger, Vehicle 1, 8 years, male, Black, 51 inches, 55 pounds. No restraints available. Injury Severity AIS code 0, no injury.

Right rear passenger, Vehicle 1, 7 years, male, Black, 44 inches, 50 pounds. No restraints available. Injury Severity AIS, code 0, no injury.

Driver 2, 79 years, female, Caucasian, 61 inches, 109 pounds. Fifty-six years driving experience; used to drive about 18,000 miles yearly, for past five years about 2,000 miles yearly on local trips. In the past drove extensively in adverse weather and in rush-hour traffic; now drives 01% at night; 15% on freeways, 85% on urban areas, none on rural roads. Had one intersection accident five years prior to this accident, and two moving violations in six-year period (disobeying red traffic signal, speeding). Owned Vehicle 2 for two years, reasonably familiar with it. Had owned own cars since 1926, always Chevrolets and Fords; husband owned Buicks; had also driven 1-1/2-ton pickup truck. Driving from Gandy Dancer Restaurant to Greyhound Bus Terminal; taking passenger to catch a bus but was not pressed for time because had 30 minutes to get there. Not too familiar with roadway, having driven in that area only occasionally. No driver education. Driver 2 farsighted and has astigmatism, corrected to normal vision by glasses. Has peripheral vascular insufficiency and generalized arteriosclerosis which may affect mental processes depending on area affected. Takes calcium tablets for slipped disc, and four 6-milligram tablets of Arlidin per day to relax smooth muscles (the effects of Arlidin last four hours and it was more than four hours since she had taken one). Alert and interested, in a contented mood at time of accident; after accident, confused. Had one cocktail before dinner; blood alcohol not considered a factor. Wearing lap belt which was improperly fastened and came undone. Injuries: minor abrasion to right arm below elbow, and bruised left wrist, small laceration and abrasion on left knee. Injury Severity AIS code 01, minor.

Right front passenger, Vehicle 2, 66 years, female, Caucasian, 66 inches, 118 pounds. Lap restraint worn. Closed fracture of right clavicle. Injury Severity AIS code 01, minor.

Right rear passenger, Vehicle 2, 56 years, female, Caucasian, 65 inches, 165 pounds. Lap restraint worn. Hit head on front seat head restraint, no loss of consciousness, bruises, or other marks. Injury Severity AIS code 0, no injury.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|-----------|--|
| MVPS #201 | Occupant Protection in Interior Impact - Passenger Cars. Driver 2 contacted either the emergency brake release lever or the adjacent convenience tray and sustained small laceration and abrasion to left knee. Right front passenger in Vehicle 2 broke right clavicle as a result of striking unpadded upper door. |
| MVPS #209 | Seat Belt Assemblies - Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. The design of Driver 2's seat belt allowed it to stay together though not completely fastened; therefore, it opened on impact. |

- TSPS #1 Periodic Motor Vehicle Inspection. Rear tires on Vehicle 1 were too worn to pass a motor vehicle inspection had one been mandatory in Michigan.
- TSPS #5 Driver Licensing. Driver 1's poor driving record with an accumulated 12 points resulted in mandatory reexamination. At accident scene, police officer filed a reexamination request for Driver 2 because of her advanced age (79 years).

Description

Precrash: Vehicle 2, southbound on North Fifth Avenue. Driver 2 looked to the right, and then to the left for a longer than usual time because a building, parked car, and utility pole partially obstructed her view. Without coming to a full stop at the stop sign, and still looking to the left, she proceeded into the intersection. Driver 1, eastbound on East Summit at excess speed (38.0 mph estimated from skid marks), did not see Vehicle 2 until seconds prior to impact despite clear field of vision. Driver 1 braked, leaving 14 feet of unswerving skid marks. Driver 2 did not see Vehicle 1 before impact, so made no evasive maneuver. Driver 1's speeding and Driver 2's rolling stop were both traffic violations.

Crash: Left front of Vehicle 1 impacted right side of Vehicle 2. The greater mass of Vehicle 1 caused Vehicle 2 to rotate counterclockwise and skid; Driver 2 did not brake but steered in the direction of the skid. Driver 1 and the right front passenger in Vehicle 1 were thrown forward and to the left. Driver 1 contacted the armrest causing soreness over left anterior ribs and left abdomen, and sustained a contusion of right knee from lower instrument panel. The three rear seat passengers in Vehicle 1 were also thrown forward and to the left, but were not knocked off seat. The two-year-old right rear passenger was standing on the seat and would have been ejected out open window if the eight-year-old center rear passenger hadn't restrained her.

Driver 2 was thrown forward and to the right, arms impacting the steering wheel and knees glancing off instrument panel; she received minor abrasions, and a small laceration to left knee. Torso of right front passenger of Vehicle 2 contacted right door, right clavicle fractured. Left rear passenger of Vehicle 2 saw Vehicle 1 prior to impact, screamed, and reached forward to grab front seat back, hit head on front seat head restraint but was uninjured because of bracing herself.

Postcrash: No extrication problems; all vehicle doors operable and occupants exited themselves. Police and emergency response prompt; bandages applied to Driver 2's lacerations and abrasions; both passengers in Vehicle 2 and Driver 1 transported by ambulance to St. Joseph's Mercy Hospital in Ann Arbor. Radiator fluid leaked from Vehicle 1, no fire hazard or explosion. No problem with debris or traffic tie-up.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environment	7	8	9

Accident Causation

Matrix Cell

Explanation

Primary or Principle Cause(s)

- 1 Driver 2 slowed for stop sign, but did not come to a complete stop. (Definite)
- 1 After her long look to the left, Driver 2 exhibited error in judgement by not looking again to the right before entering the intersection. (Definite)
- 1 Driver 1 exceeded speed limit. (Definite)
- 1 Driver 1 evidenced inattention to driving task by not seeing Vehicle 2 until moment before impact despite clear field of vision. (Definite)

Severity Increasing Factor(s)

- 2 Injury tolerance of right front passenger in Vehicle 2 may have been affected by age; perhaps bones brittle and more susceptible to injury. (Possible)
- 5 Lack of padding on upper door of Vehicle 2 could have contributed to right front passenger's fractured clavicle. (Possible)

Relevant Conditions

- 1 Age of Driver 2, combined with her having arteriosclerosis and atherosclerosis, may have slowed her mental processes and reflexes. (Possible)
- 7 Building, parked car, and utility pole obstructed Driver 2's vision to the left, causing her to look longer than usual in that direction. (Definite)
- *4 Vehicle 1 had good brakes for a 10-year-old car. (Definite)
- 1 Driver 1 was attempting to collect compensation for a head injury suffered in a fall at work, although medical tests indicated no disability; if in fact there was a disability, it could have had an effect on the accident. (Possible)

Matrix Cell

Explanation

Injury Causation

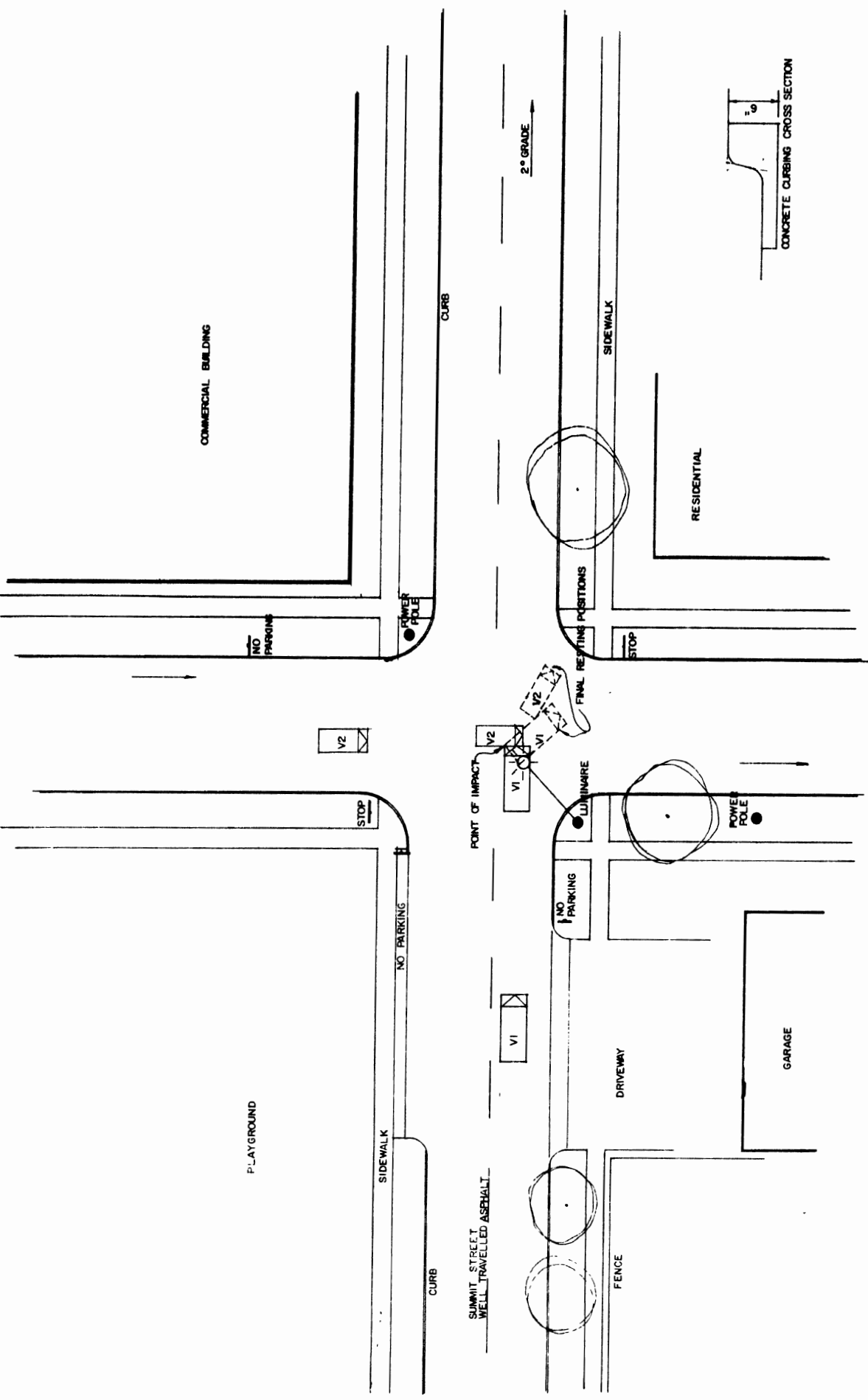
- 5 Driver 2's lap belt improperly fastened and opened on impact--it is possible for this type of seat belt to remain closed without actually being buckled. (Definite)
- *2 Two passengers in Vehicle 2 were restrained, their injuries were minimized. (Definite)
- 2 Driver 2's minor knee injury may have been from contacting emergency brake release. (Possible)

Postcrash Factor

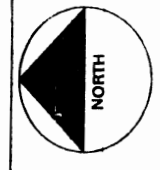
- 3 Police and ambulance response prompt and efficient. (Definite)

Recommendations

- 1 Considering the advanced age and physical disabilities of Driver 2, a licensing reexamination, including an on-road as well as a written test, should be given to be sure she is still capable of driving.
- 4 Seat belt locking mechanism should be redesigned to insure against intermediate locking position.
- 4 Area immediately beneath window on vehicle door should be padded to prevent injuries.
- 1 Restructure driver's education courses to include emphasis on defensive driving, and use such programs for reeducating delinquent drivers.



ACCIDENT SCHEMATIC AA 302



UNIVERSITY OF MICHIGAN HSRI

THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-303
CASE SUMMARY

Identification

Interstate Highway 94 near US-12 exit, southeast of Ypsilanti, Washtenaw County, Michigan, a residential area, on Tuesday, July 18, 1972, at 0950 o'clock. An oblique head-on collision between two station wagons, in which one crossed the highway median that had no barrier, and struck a station wagon in oncoming traffic. Injury severity AIS* code 09, fatal.

Ambience

Daylight, hazy, overcast with defused lighting, unlimited visibility, hot and humid. Temperature 88°F, humidity 80%, wind from southwest to 10 knots. Roadway dry.

Highway

Interstate Highway 94, 24-foot-wide roadway, 1-lanes, two in each direction separated by a grass median, depressed for drainage. No median barrier.** Roadway well-traveled concrete with 10-foot-wide asphalt shoulders on outside lanes in both directions. No interior shoulders, but 3-foot-wide asphalt shoulders installed six weeks after accident. Roadway curved just prior to accident site; however, accident occurred on tangent section adjacent to curved portion. Vehicle 1 left roadway 300 feet from curved roadway section. Roadway straight and level at accident site with elliptical crown for drainage. No lighting; one interchange within a quarter mile radius. No poles or trees within a quarter mile of expressway right of way. A similar accident occurred on November 6, 1971,† in which a vehicle left the eastbound I-94 roadway similar to Vehicle 1 in this case study, with a 2-inch road-to-shoulder differential established as a primary cause factor. Over 17 previous accidents have occurred on the 3/4-mile section where this accident took place. A significantly lower accident rate existed on adjacent sections.

Traffic Controls

Speed limit posted at 70 mph maximum and 45 mph minimum. Continuous white painted road edge delineation with intermittent white center line delineating two traffic lanes. Two "Construction Zone Ahead" warning signs were present for westbound traffic, one of which was struck by Vehicle 2 after impact. Signs were temporary but clear and legible. No traffic signals in area.

* American Medical Association Abbreviated Injury Scale (AIS).

** A median barrier was installed at the accident location at the time of this writing, five months after the accident.

† HSRJ Case Study #AA-159.

Vehicles

Vehicle 1, a 1971 Plymouth Satellite station wagon, green exterior, green vinyl interior. Odometer 18,562 miles. No record of vehicle inspection (mandatory vehicle inspection not required in Michigan). Equipped with power steering, power brakes, and automatic transmission; padded upper instrument panel, sunvisors, and armrests. Included lap and upper torso restraints, but not used. No vehicle defects. Last maintenance unknown but leasee policy included periodic maintenance of leased vehicles. Damage concentrated to frontal area with extensive crush to hood and fenders. VDI*:01-FDEW-4. Damage included engine mount separation, 2.95-inches steering column compression with 2.0-inches shear capsule separation. Equipped with radial tires.

Vehicle 2, a 1968 Chevrolet Impala station wagon, blue exterior, blue vinyl interior. Odometer 74,793 miles. No recorded evidence of vehicle inspection. Equipped with power steering, power brakes, and automatic transmission, with padded upper instrument panel, sunvisors, and armrests. Lap and upper torso restraints installed in front seats with lap belts only in rear seats. Lap belts utilized by both front seat occupants. No vehicle defects detectable in postcrash examination. Last maintenance unknown; however, brake wheel cylinders and wheel bearings were in good condition. Damage included extensive crush to vehicle left front to left A-pillar area, including fenders and door. VDI:11-FLAW-5 from initial impact and 00-XDAO-1 from roll-over. Steering column compression 2.2 inches.

Occupants

Vehicle 1, driver, Caucasian, male, 20 years old, 69 inches and 200 pounds. Four years driving experience averaging over 15,000 miles per year, primarily in urban areas and expressways. En route from Milan, Michigan to Wyandotte, Michigan to deliver electrical parts; 13 miles from origin, and 31 miles from destination. Familiar with vehicle. Received high school driver education consisting of two-phase classroom and on-road training. Physical condition good with no history of serious illness. Vision normal. Mental condition unknown in period prior to becoming angered with construction zone traffic; however, Driver 1 was scheduled for a military preinduction physical examination the following day which may have had an effect on physiological behavior. No alcohol or drug involvement. Lap and upper torso restraints installed but not worn. Injuries: small abrasion to chin; laceration above right elbow; laceration dorsal aspect right wrist; large abrasion right knee; 2-inch laceration below right knee; closed fracture left radius; displaced fracture left ulna, midshaft; and closed undisplaced fracture left tibia and fibula at upper shaft. Unconscious a few seconds after impact. Injury severity AIS code 03, non-dangerous, severe.

Vehicle 2, driver, Caucasian, male, 41 years old, 69 inches and 235 pounds. Twenty-three years driving experience averaging 12,000 miles yearly. En route from home in Dearborn, Michigan to Dundee, Michigan with family where he was constructing a new home. Accident

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

took place 20 miles from origin and 25 miles from destination. Familiar with vehicle which he purchased new in 1968 and accumulated most of its mileage. Familiar with route which he traveled twice weekly during previous three months. A self-taught driver with no previous driver training. Physical condition good, vision normal and no history of serious or debilitating illnesses. Mental condition good; anticipating completion and move into new home. No alcohol or drug involvement. Wore lap restraint only. (See Figure 11). Injuries included basilar skull fracture; multiple left side rib fractures; multiple right side rib fractures; fracture of left distal humerus and ulna. Combination compressive force impacting door and torsional force, from abrupt vehicle rotation, resulted in pelvis rotated within lap belt causing dislocation of pubic symphysis and fracture with dislocation of left pelvis at sacroiliac joint. Injury severity AIS code 09, fatal.

Vehicle 2, right front passenger, wife of driver, age 32 years, Caucasian, female, 61 inches and 128 pounds. Also wearing lap restraint. Thrust forward to left on impact contacting instrument panel. Injuries: fractured nasal bones; fractured tibia; avulsion to anterior surface of left leg; laceration to lip and inside of mouth from broken glass. Conscious and coherent but did sustain retrograde amnesia for events immediately after accident. Injury severity AIS code 02, moderate.

Vehicle 2, four rear seat passengers, offspring of front seat parents:

<u>Position</u>	<u>Age</u>	<u>Sex</u>	<u>Race</u>	<u>Height</u>	<u>Weight</u>	<u>AIS Code</u>
Left Rear	11	M	Caucasian	56"	75 lbs.	06, fatal
Center Left Rear	5	M	Caucasian	40"	35 lbs.	06, fatal
Center Right Rear	3	M	Caucasian	36"	30 lbs.	04, severe
Right Rear	13	F	Caucasian	59"	100 lbs.	06, fatal

Left rear offspring: profuse bleeding from left ear indicating severe concussion; left center offspring: fatal head injuries from blade of shovel, stored with scoop forward in the rear compartment of station wagon; injury included head laceration and brain contusions; rear right center offspring: major injuries to left side, lacerated spleen, left renal hematoma, fracture mid-shaft left humerus, multiple fractures left radius and ulnar, laceration left upper eyelid, abrasions to malar area and nose edema over occipital lobe; unconscious; right rear child: severe head injury.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were directly relevant to this accident.

TSPS #4	Driver Education. Risk taking while driving resulted from impatience and anger with construction delays.
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- TSPS #9 Identification and Surveillance of Accident Locations. High accident rate to location and one previous multidisciplinary investigation of similar accident.
- TSPS #11 Emergency Medical Services. Vehicle 2 right front passenger fractured leg not splinted prior to transport to hospital.
- TSPS #12 Highway Design, Construction, and Maintenance. Road shoulder dressing maintenance insufficient.
- TSPS #15 Police Traffic Control. Police patrol car parked on evidence of Vehicle 1's precrash movement.

Description

Precrash: Eastbound Vehicle 1 tailgating car ahead about 35 mph in traffic-controlled construction zone. Upon exiting construction zone, Vehicle 1 moved from lane 1 into lane 2, accelerating to a speed of 55 to 60 mph. A Volkswagen sedan preceding it, also abruptly pulled into lane 2 to move ahead of vehicles which were lined up in lane 1. This incensed driver of Vehicle 1 and caused him to accelerate faster (to 70 mph) and attempt to pass the Volkswagen along the median edge of lane 2. The left wheels of Vehicle 1 left roadway onto undressed shoulder at the transition of a superelevated curve into a level tangent section. Upon leaving the roadway, with left wheels on the shoulder, Vehicle 1 fishtailed while attempting to regain the roadway, then suddenly skidded diagonally across the grassy median. Vehicle 1 became airborne on the far side of the median due to its positive grade and struck Vehicle 2 nearly head-on. Vehicle 2 was traveling westbound between 45 and 50 mph in lane 1 amid widely spaced westbound traffic. The impending collision was a complete surprise to Driver 2 and the front seat occupant of Vehicle 2.

Crash: Vehicle 1 crashed nearly head-on with Vehicle 2 with a force vector of 1:00 o'clock to Vehicle 1 and 11:00 o'clock to Vehicle 2. Vehicle 2 rotated counterclockwise postimpact through a circular arc of 90° whereupon it "tripped" on the sodded area adjacent to the right roadway shoulder causing Vehicle 2 to roll over onto its roof, coming to rest 35 feet from the initial point of impact oriented perpendicular to the westbound lanes 10 feet from the road edge. Vehicle 1 on impact also rotated abruptly counterclockwise through an arc of 280°, coming to rest 5 feet from initial point of impact, facing the oncoming traffic diagonally across lane 2 of the westbound lanes.

Driver 1 was thrust forward to the right into the mid-instrument panel area of Vehicle 1 while the vehicle rotation carried him into the right door and right A-pillar area. He contacted the radio, air vents, ashtray, and glove compartment, sustaining a small abrasion to the chin from the instrument panel, laceration above the right elbow from the right door and/or far right instrument panel; laceration of dorsal aspect of the right wrist from the door; large abrasion on the right knee and 2-inch laceration below the right knee from contacting the instrument panel; closed fracture of the left radius and displaced fracture left ulna midshaft from the instrument panel as well as a closed undisplaced

fracture of the left tibia and fibula at the upper shaft from the instrument panel. The windshield was not contacted, but the centrifugal force from the abrupt counterclockwise spin of the vehicle after impact caused Driver 1 to strike the right front door with force. This resulted in door deformation outward from both loading by the driver and induced deformation from his impact. The armrest was scuffed and door fabric covering torn from this contact. Vehicle 1 sustained extensive crush just left of center front with over 10 inches of broad crush inward. Damage was concentrated to the frontal area, hood and fenders with engine mount separation, energy-absorbing steering device compressed 2.95 inches with 2.0 inches shear cap separation.

Driver 2 on impact also moved forward and to the left contacting left upper A-pillar, with torso pressed against left door. Right thorax contacted steering wheel. Final resting position of driver was inverted with Vehicle 2 on its roof. He was partially restrained by lap belt within the inverted vehicle. Driver 2 sustained severe basilar skull fracture from contacting A-pillar, multiple left side rib fractures from left door and steering wheel with fracture to pelvic area resulting from compressive and torsional forces on the movement of the body while restrained with a lap belt.

Right front passenger of Vehicle 2 moved forward and to the left contacting the instrument panel, resulting in fractured nasal bones. A fractured tibia resulted from loading of right leg between floor and lower instrument panel. Avulsion of right leg came from contacting aftermarket tissue dispenser installed on lower instrument panel, with superficial lacerations to lip and mouth from broken glass.

Four rear seat passengers of Vehicle 2 were unrestrained with exact kinematics unknown due to rollover sequence after impact. Based on injuries, left rear passenger moved forward and to the left impacting head on B-pillar and thighs on front seatback, and had profuse bleeding from ear indicating severe concussion. Left center rear passenger, most probably standing on seat facing rearward, sustained fatal head injuries from blade of shovel stored in rear compartment with scoop forward; injury included 15 cm x 1 cm laceration just anterior of bregma and 14 cm x 3 cm bone fracture with lacerations and contusions to frontal lobe of brain. Right center rear passenger propelled into seatback sustaining major injuries to left side, then contacted roof area during rollover. Suffered lacerated spleen, left renal hematoma, fracture mid-shaft left humerus, multiple fractures left radius and ulna, lacerated left upper eyelid, abrasions to malar area and nose, and edema over occipital lobe; unconscious. Right rear passenger sustained severe head injuries from impacting rear of front seat and windshield header.

Postcrash: A Red Cross station wagon in traffic to the rear of Vehicle 1 radioed for emergency assistance. An ambulance arrived on-scene within five minutes. Vehicle 2 rear seated children and front seated mother extricated through right front door and windows. Rear right passenger removed face down to help maintain an airway. A physician stopped and assisted in maintaining a clear air passage to the center left rear child by suction, with the right front mother conscious and coherent. Her lacerations were bandaged by EMS personnel, but a leg splint was not applied to a fractured leg. This could have resulted in arterial damage. No life signs to left rear child, with center left rear

child dead on arrival at hospital emergency room. The center right rear and right rear children were unconscious. The right rear child was also bleeding profusely from mouth.

Driver 1 extricated on full backboard by area fire department 15 minutes after impact. Driver 2 no life signs. Extricated 45 minutes after crash upon righting overturned Vehicle 2. Rear seated children in Vehicle 2 were initially taken to a hospital in Ypsilanti, Michigan then moved to the University of Michigan Hospital in Ann Arbor. Right front seat female passenger in Vehicle 2 was taken to the Ypsilanti hospital while Driver 2 was transported to the University of Michigan Hospital in Ann Arbor.

No fires or explosions. Traffic tied up intermittently on westbound lanes. Scene cleared approximately one and a quarter hours after crash. Debris in the form of vehicle parts and trim, and fluids on the roadway and tire scuffs on the grassy median helped establish the precrash and postcrash movements of both vehicles.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell Explanation

Accident Causation

Primary or Principle Causes

- 1 Maneuver to regain roadway at high speed with pronounced road edge differentiation contributed to Vehicle 1 loss of control. (Definite)
- 1 Driver 1 evidenced careless driving in attempt to pass Volkswagen sedan which also moved into same traffic lane as Vehicle 1. (Definite)
- 1 Upon rebounding off road edge, Vehicle 1 loss of control was compounded by panic braking which resulted in Vehicle 1 skidding across median into westbound traffic. (Definite)
- 7 Poor roadway shoulder maintenance resulted in excessive road-edge-to-shoulder elevation differential. (Definite)
- 8 Lack of median barrier permitted out-of-control Vehicle 1 to cross median into opposing traffic. (Definite)

Relevant Conditions

- 1 Driver 1 impatient and angry after delay in moving through controlled construction zone. (Definite)
- 4 Use of radial tires on Vehicle 1, a station wagon, not designed for their use, degraded lateral control. (Definite)
- 7 Median side roadway shoulders should have been of a more permanent material to minimize shoulder deterioration which causes road-edge-to-shoulder level differentials. (Definite)
- 7 Elliptical crown on curved portion of roadway before accident site was maintained throughout entire curve. This resulted in improper elevation in lane 2 near end of curve which enhanced Vehicle 1's movement to road edge upon passing car ahead. (Probable)

Severity Increasing Factors

- 5 Vehicle 1 front door jammed closed. (Definite)
- 5 Aftermarket metal tissue dispenser on instrument panel of Vehicle 2 inflicted injury to right front passenger. (Definite)

Injury Causation

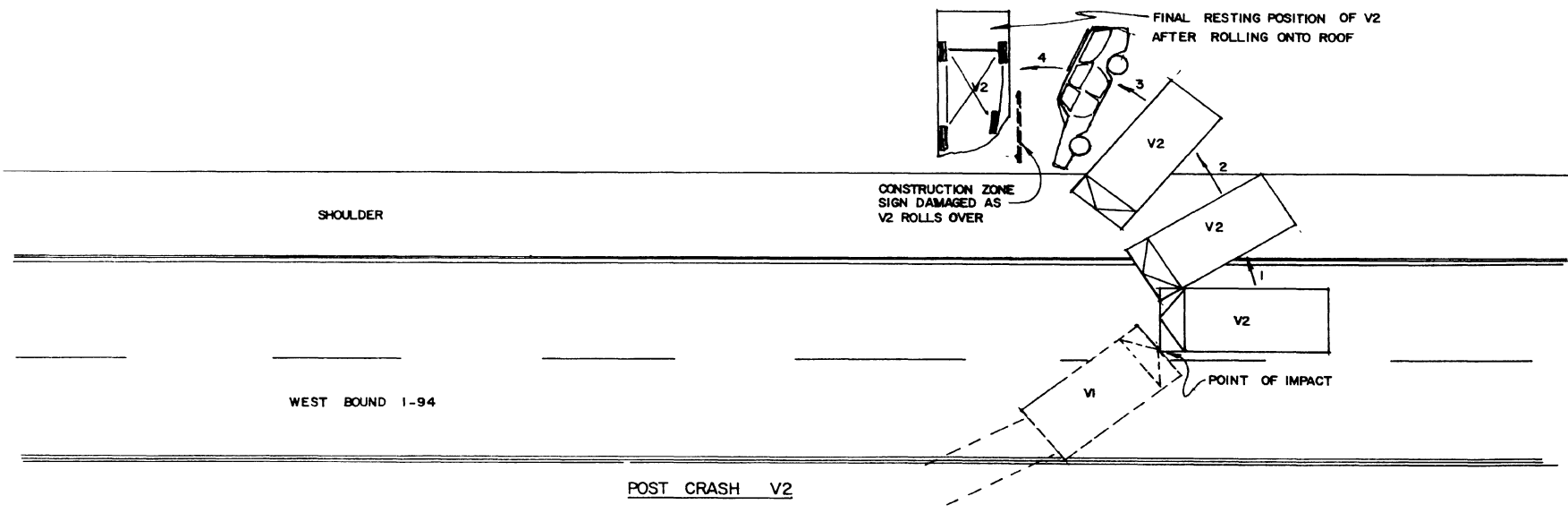
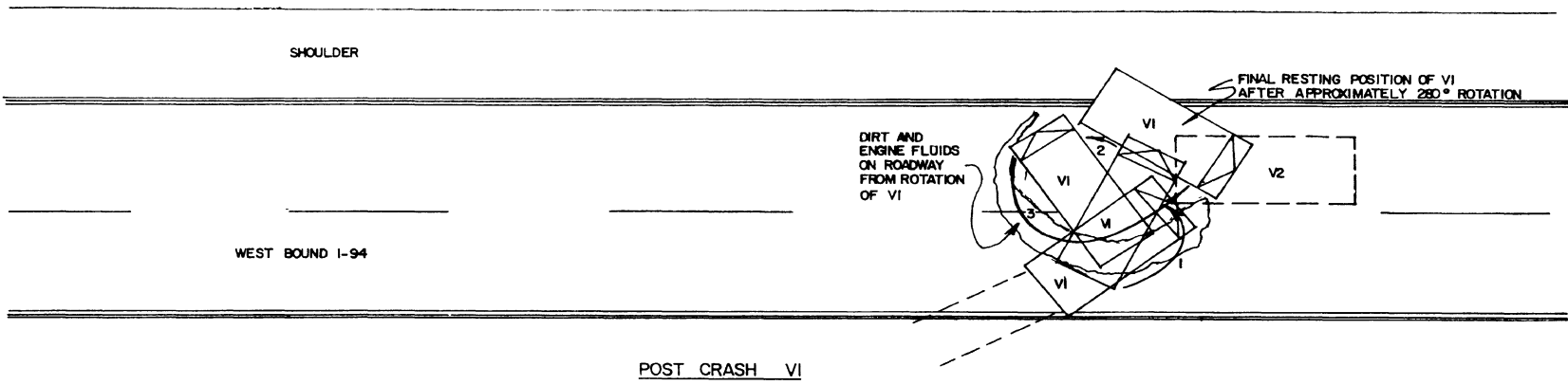
- 5 Interior loose objects contributed significantly to occupant injury. (Definite)
- 2 Driver 1 and Vehicle 2 rear seat occupants unbelted, which contributed to their injuries. (Definite)
- *2 Vehicle 2 right front passenger belted which minimized further injury. (Definite)

Postcrash Factors

- *3 EMS response prompt. First aid rendered where needed and effective. Use of full backboards where indicated helped minimize further injury in transport and handling. (Definite)
- *3 Physician stopped on-scene and assisted EMS personnel with injured occupants. (Definite)
- *9 Road edge dressing at accident site was effected within a day after accident. Asphalt shoulders on median edge of roadway were installed within weeks. (Definite)

Recommendations

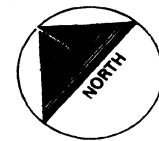
- 1 Greater emphasis in driver training on effects of temper and emotional factors on driver judgement and action.
- 1 Driver training should stress the lethal effects of interior loose objects in a head-on collision.
- 9 Greater use of median barriers at critical locations of highways, such as at this accident site.
- 7 Improved periodic maintenance of divided, limited accessed highways to prohibit road edge differentials of magnitude (4") as at the site in this accident.
- 4 Greater education of public on effects of vehicle control and handling characteristics when using radial tires.



ACCIDENT SCHEMATIC AA 303



UNIVERSITY OF MICHIGAN HSRI



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-304
CASE SUMMARY

Identification

This accident took place on Wednesday, July 26, 1972, 1545 o'clock, at the complicated intersection of Division, Detroit, Beakes, Summit, Broadway, Carey, and High Streets, in the city of Ann Arbor, Michigan, Washtenaw County, in a residential area in transition into a commercial area. Two cars collided with each other within the intersection at right angles. Injury Severity AIS code 2, moderate.

Ambience

Daylight, but overcast, and immediately following an intermittent light rainfall after a long period of dry weather. Temperature 72°F with humidity between 90 and 100%. There was no wind. The pavement was wet and slippery.

Roadway

An intersection of three major arterials, one collector, and three local streets whose roadway widths vary between 34' and 44'. Two lanes at actual point of impact within the intersection, no median, surface consisting of well-traveled asphalt. Roadway bordered with standard city 6" high concrete curbing. A multi-way junction of seven streets with -4.50 grade to the northeast at the point of impact. Roadway is crowned for drainage. A major urban intersection surrounded by a grid pattern of intersections of other streets, each radiating from the intersection, with numerous residential and commercial driveways intersecting with them. There were several hundred poles and trees within a quarter-mile radius of the intersection. Accident history includes 11 accidents over the years 1968-1970 of which nine were within the intersection proper similar to this accident.

Traffic Controls

Speed limit 25 mph by city ordinance, not posted in intersection area. Pavement markings consisted of intermittent white lane delineator on only one of the seven streets. No signals or traffic control devices at the intersection.

Vehicles

Vehicle 1, a 1971 Ford Ranch Wagon, station wagon, dark green exterior, green interior, odometer 45,136 miles. No previous vehicle inspection (mandatory vehicle inspection not required in Michigan). Last maintenance at 42,180 miles, oil and lubrication. Automatic transmission, power steering, power brakes, and disc front brakes, including a trailer brake assembly. Padded instrument panel, sunvisors, door panels, and wide-spoked steering wheel. An after-

market directional compass attached to the left A-pillar. Lap and upper torso restraints installed, but not used. Left rear tire underinflated with spotted wear on outer edge of tread on left front tire. Adequate brake lining and no evidence of inadequate braking ability. Evidence of worn seals on rear end differential. Equipped with additional radiator for transmission fluid cooling. Force of impact at 2:00 o'clock with damage to right front corner, bumper bent, grill work fractured. On impact with the left side of Vehicle 2, Vehicle 1 rotated counterclockwise, engaged with Vehicle 2 and slid approximately 70 feet down the roadway. VDI:02-RFEW-2.

Vehicle 2, a 1969 Fiat, Sport 850 Convertible, black exterior, black vinyl interior, odometer 30,168 miles. Manual transmission, steering, brakes, with disc front wheel brakes. No previous inspection (mandatory vehicle inspection not required in Michigan), and previous maintenance unknown due to illegible maintenance sticker and uncertainty of driver. Padded instrument panel, sunvisors, and door panel. Lap restraints only, not used. Left front tire worn with no remaining tread stock. No evidence of inadequate braking capability. Equipped with radial front tires and belted bias-ply rear tires. Force of impact 10:00 o'clock with left door crushed inward, damaging left seat back and separating left door hinges. Convertible top opened upward on impact. Fractured left side glass contacted driver who also contacted door and choke controls on console. Engaged with Vehicle 1 through counterclockwise rotation after impact, contacting utility pole. VDI:09-LPHW-3.

Occupants

Driver 1, male, Caucasian, 65 years, 70 inches, 165 lbs. Over 43 years driving experience averaging 12,000 miles per year until previous year when 30,000 miles were driven as a result of extended trips. En route with grandson from Veteran's Hospital in Ann Arbor to University Hospital where boy's mother employed, a distance of three miles. Not hurried. Owned Vehicle 1 for 1½ years, accumulated 45,000 miles driving. Familiar with area and accident intersection, a self-taught driver, physical and mental condition good, no alcohol involvement. Lap and upper torso restraints installed but not used. No injuries.

Right front passenger of Vehicle 1, male, Caucasian, 11 years, 60 inches, 90 lbs. Lap and upper torso restraints installed but not used. Contacted right side of head on side glass with no apparent injury.

Driver 2, male, Caucasian, 22 years, 66 inches, 135 lbs. Six years driving experience averaging 20,000 miles yearly. En route from school to home, a distance of 20 miles. Had driven approximately two miles, not hurried, no specific time of arrival planned. Owned case vehicle one year and had accumulated 8,000 miles. Had traveled through case accident intersection twice daily for past six months. Received high school driver education course. Good mental condition, but had not eaten prior 24 hours. No alcohol involvement. Lap restraints installed but not used. Pain to left back persisted for

more than four days, resulting in exploratory surgery with diagnosis of contusion to left posterior abdominal wall. Injury Severity AIS code 2, moderate.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were relevant to this case study:

- MVPS #201 Occupant Protection in Interior Impact. Inside door panel padding on Vehicle 2, contacted by the driver, consisted of light padding offering little impact protection to occupants.
- MVPS #204 Steering Control Rearward Displacement. Vehicle 2's steering column design incorporated a spider and twin yoke universal joint to prevent rearward displacement on impact. This design should also restrict any lateral displacement on impact.
- MVPS #206 Door Locks and Door Retention Components. Upper and lower hinges on left door, as well as door latch, separated on Vehicle 2.
- MVPS #207 Anchorage of Seats. Vehicle 2's front seat remained firmly anchored despite impact which resulted in severe left seat back deformation.
- MVPS #214 Side Door Strength. Vehicle 2's left front door sustained inward crush resulting in passenger compartment intrusion and reduction in the size. (This standard will not be effective until 1/1/73).
- TSPS #1 Periodic Motor Vehicle Inspection. If mandatory vehicle inspection were required in Michigan, it is likely that the worn left front tire on Vehicle 2 would have been detected and corrected.
- TSPS #12 Highway Design, Construction, and Maintenance. The confusing geometric road layout at the accident intersection created an element of risk for drivers attempting to traverse it contrary to normal major traffic flow.
- TSPS #13 Traffic Control Devices. The confusing geometric intersection lacked any traffic control devices so as to enhance its traffic capacity and increase safety.

Description

Pre-Crash: Vehicle 1 was southbound through the intersection having just crossed a bridge southbound on Broadway Street. The

driver had stopped to wait for oncoming traffic on Division Street before crossing the intersection to enter Carey Street. Vehicle 2 was northbound on Division Street, one-way arterial traffic, moving 15 mph in excess of the speed limit. Before pulling out, Driver 1 looked down Carey Street after glancing up Division Street, and then proceeded to cross the intersection. He first noticed Vehicle 2 an instant before impact, with insufficient time to react to the impending collision. Driver 1's sight distance up Division Street was limited because of its grade (4%) at the complicated intersection, and as he attempted to accelerate into the intersection, he did not see Vehicle 2 also about to enter the intersection. Because of the wet roadway, Driver 1 sensed that he was losing traction upon attempting to accelerate. In retrospect, Driver 1 felt that if he had not lost traction, he would have cleared Vehicle 2, averting the accident.

Driver 2, elated from a successful day at school, was proceeding to cross the intersection to Carey Street. He noticed Vehicle 1 but believing it would stop, did not look toward it again until an instant before impact with insufficient time to initiate any evasive action. There were no skid marks or evidence of pre-crash braking by either car.

Crash: Vehicle 1 struck the center left of Vehicle 2 with a force vector of 2:00 o'clock with a force vector of 10:00 o'clock to Vehicle 2. The right front corner area of Vehicle 1 crushed in the left door area of Vehicle 2 with both vehicles engaged throughout the complete accident sequence, coming to final rest still engaged. Both vehicles rotated engaged together, counterclockwise, sliding down the grade of Carey Street with the right rear corner of Vehicle 2 grazing the telephone pole adjacent to the corner of Carey and High Streets. The slide of both vehicles was aggravated by the change of roadway surface from asphalt to brick. Driver 1 held firmly onto the steering wheel, braced himself, and did not contact any part of the car's interior. Vehicle 1's right front passenger moved forward and to the right, contacting the side glass with his head. There was no evidence of injury except for a slight soreness to the bumped area of the head. On impact to the left side, Driver 2 rebounded off the left door, was thrown toward the right side of the front seat area, contacted the choke control knob on the center console of the vehicle, and came to rest stretched across the console. In addition to soreness of the neck and left shoulder, Driver 2 sustained minor lacerations from the side glass which shattered on impact. Vehicle 1 damage was to the right front bumper fender and grill area, with 9 inches of sheet metal crush to the right front wheel well. Vehicle 2 damage was to the left side door which separated at hinges and latch, with 15 inches of sheet metal crush inward into the passenger compartment. Also, the driver's seat back in Vehicle 2 was deformed to the right, with the left B-pillar separated at its base and the A-pillar dented.

Post-Crash: After both engaged vehicles came to a stop, Driver 1 exited on his own through a left front door. The passenger in Vehicle 1 remained seated throughout the post accident sequence.

Driver 2 was conscious but in pain and stayed in the car until an ambulance arrived, whereupon he was assisted in exiting by ambulance attendants. Egress was accomplished by lifting the convertible top and climbing out through the roof area of the car. Lacerations to Driver 2 were bandaged by ambulance attendants, after which he was transported to a hospital approximately one-half mile from the accident site. Pain and general soreness to the lumbar region persisted for 4 days, whereupon exploratory surgery identified the injury as a contusion to left posterior abdominal wall. Wreckage and debris, as well as the damaged vehicles, were removed promptly and efficiently by a wrecker crew. Traffic along Division Street (a major arterial) was backed up many blocks. This was further aggravated by an area bridge which had been closed down for repairs.

Causal Factors, Conclusions, and Recommendations

Accident Causation

<u>Matrix Cell</u>	<u>Explanation</u>
<u>Primary or Principle Causes</u>	
1	Driver 2 entered intersection at a speed too high for traffic conditions at the intersection. (Definite)
1	Driver 1 did not see Vehicle 2 entering the intersection, and was unobservant of any forward motion by Vehicle 2. (Definite)

Severity Increasing Factor(s)

1	Driver 1 did not attempt to brake or slow Vehicle 1. (Definite)
1	Had Vehicle 2 been moving at less speed, impact with Vehicle 1 may not have been to left mid-door area, but perhaps more forward on Vehicle 2 without passenger compartment intrusion. (Possible)
5	Crash geometry, Vehicle 1 into left door of Vehicle 2, resulting in greater damage to Vehicle 2 and injury to Driver 2. (Probable)
4	Had Vehicle 2 been equipped with side door guard beam type construction, penetration into passenger compartment would have been reduced. (Probable)
4	Vehicle 1 crash performance good relative to Vehicle 2. (Definite)

Matrix Cell

Explanation

Severity Increasing Factor(s) (continued)

4 Telephone pole closeness to road edge
a traffic safety hazard. (Definite)

Relevant Condition(s)

1 Driver 2 had not eaten 24 hours prior
to accident which would have affected
his driving ability. (Possible)

1 Driver 1's surprise and preoccupation
with loss of traction upon attempting
to accelerate across intersection on
wet roadway may have made him less
cognizant of on-coming traffic. (Possible)

1 Driver 2 elated by academic success,
which affected attentiveness to driving.
(Definite)

7 Complicated intersection required drivers
to be fully attentive to driving task.
(Definite)

4 Vehicle 2 tire type mix could affect
slip angle and produce oversteer. (Probable)

7 Light rain after extended dry spell caused
slippery roadway. (Definite)

5 Vehicle 2's seat remained firmly anchored
despite impact which severely damaged seat
back. (Definite)

1 Driver's age of 65 years may have reduced
his alertness and reaction time to unex-
pected situations while driving. (Possible)

7 Roadway grade (4°) had an effect on
Driver 1's ability to cross intersection
with confidence in traffic. (Possible)

7 Driver 1's sight distance along Division
Street compromised by curvature and grade
of roadway. (Definite)

8 Vehicle 1 and Vehicle 2 while engaged and
rotating after impact, were slowed from
further movement down the grade of Carey
Street by striking the curb. (Probable)

4 Relatively small size of Vehicle 2 pro-
vided lower visual profile to Driver 1.
(Definite)

Matrix Cell

Explanation

Relevant Condition(s) (continued)

- 7 Complicated geometry of multi-way junction was confusing and demanding of drivers. (Definite)
- 1 Driver 2's poor driving record and response to interview questions indicated tendency toward speeding and inattention to driving task. (Probable)

Injury Causation

- 4 Door side strength of Vehicle 2 marginal in terms of resistance to penetration into passenger compartment with impact. (Definite)
- 4 Vehicle 2 console with raised choke control is potentially injury producing. (Definite)
- 1 Driver 1 unbelted yet was uninjured. (Definite)
- 1 Driver 2 unbelted but injuries may have been more severe if he had been belted and kept from moving away from the left door. (Probable)
- 5 Vehicle 2 side door structure design permitted intrusion into passenger compartment. (Definite)
- 5 Side glass in Vehicle 2, fractured from the impact, contributed to driver injury. (Definite)

Post-Crash Factor(s)

- 3 Driver extrication made easy through convertible roof. (Definite)
- 3 Driver 2 did not attempt to exit vehicle, but awaited first aid and assistance in egress. (Definite)
- 9 Intersection geometry being redesigned for improved safety and traffic flow. (Definite)
- 9 Vehicles and accident debris removed promptly. (Definite)

Matrix Cell

Explanation

Post-Crash Factor(s) (continued)

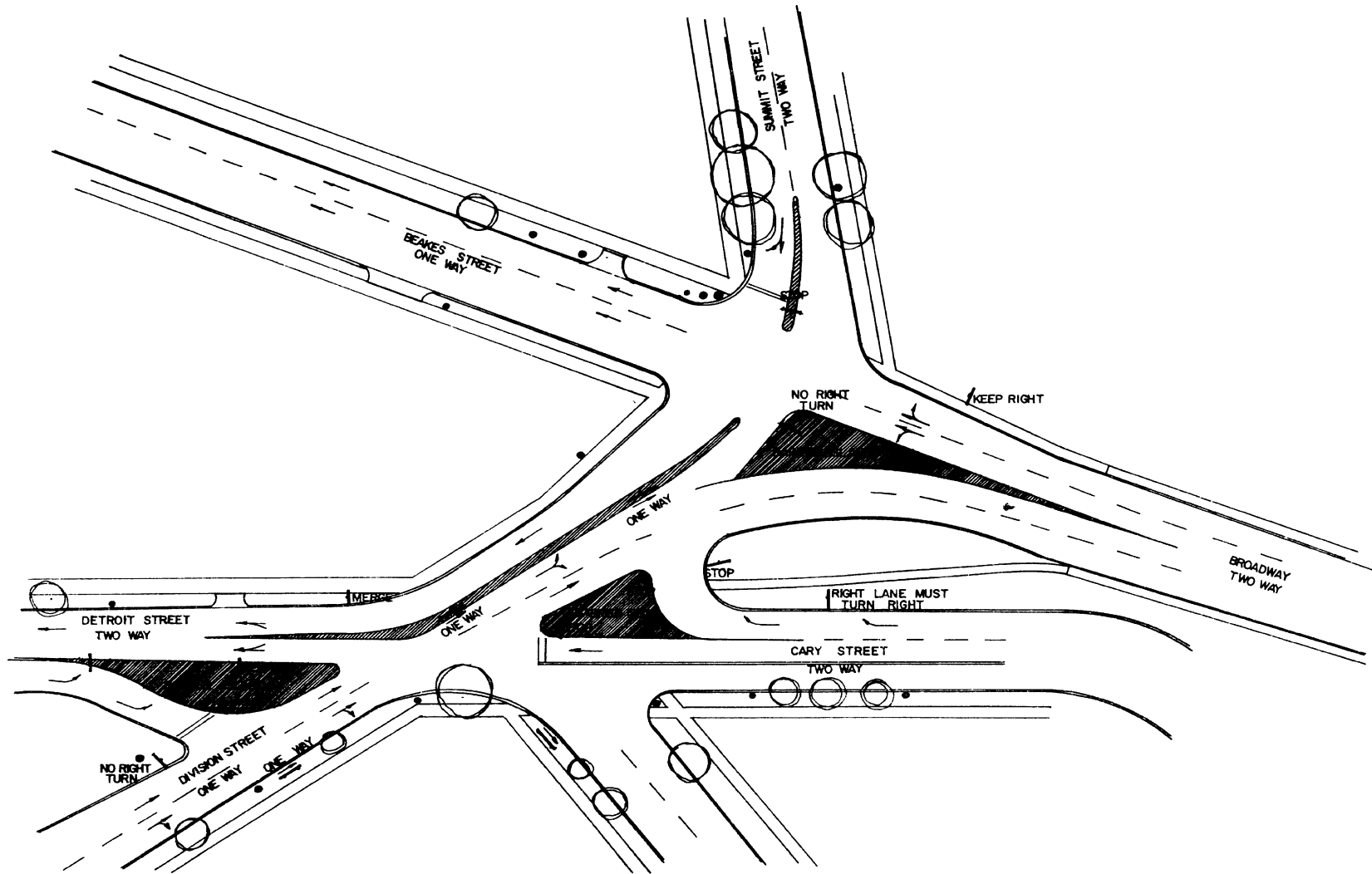
- 9 Ambulance response fast with treatment effective. (Definite)

- 9 Traffic snarled and blocked by accident and by area bridge which was closed for repairs. (Definite)

Recommendations

- 9 Complicated geometry of intersection be improved for both traffic flow and safety. (Note: This recommended improvement was scheduled by the City of Ann Arbor at the time of this writing.)

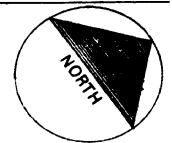
- 1 The dissimilarity of vehicles in major urban traffic stream and the safety of their respective occupants, when involved in accidents with other vehicles with such differences in physical size, structure, or design as these two vehicles, should be more effectively stressed to the motoring public.

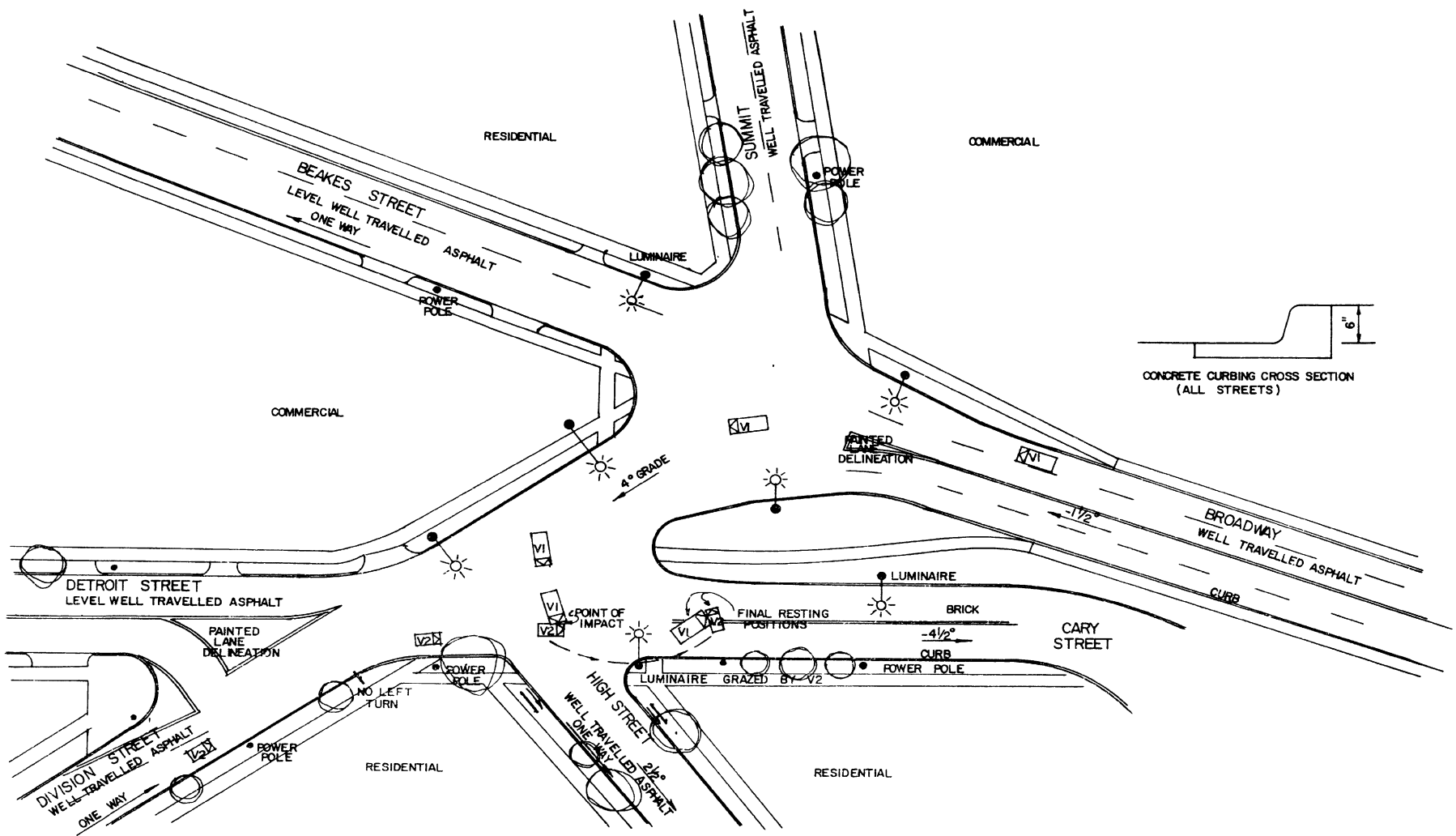


ACCIDENT SCHEMATIC AA 304



UNIVERSITY OF MICHIGAN **HSRI**



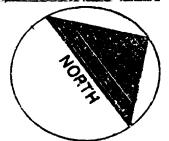


ACCIDENT SCHEMATIC

AA 304



UNIVERSITY OF MICHIGAN **HSR**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-305
CASE SUMMARY

Identification

This accident occurred on Ann Arbor-Saline Road, an open rural roadway, in Lodi Township, Washtenaw County, Michigan, on Tuesday, August 8, 1972, between 230 and 400 o'clock. An agricultural area four miles south of the City of Ann Arbor. Single vehicle, out of control, impacted concrete bridge rail. Injury Severity AIS code 7, fatal.

Ambience

Nighttime, during a period of intermittent light showers, and wind gusts to 20 mph from the west. Temperature 50°, humidity 95 to 100 percent, visibility clear but with sky heavily overcast. Roadway was wet but without standing water.

Highway

A rural collector roadway, 22 feet wide, two lanes without divider. Road surface well-traveled asphalt, estimated coefficient of friction 0.6; crowned for drainage, with freshly dressed loose filled shoulders. Roadway straight at point of impact but curved 250 feet before accident site. No roadway lighting, one intersection and six driveways, and 50 poles and trees within a quarter-mile radius. Roadway and general area have no significant history of prior accidents.

Traffic Controls

Speed limit 65 mph in daylight and 55 mph at nighttime by basic Michigan speed law. Pavement markings consisted of continuous double yellow center line restricting passing, with white road-edge delineation. No signs or signals in the area.

Vehicle

Vehicle 1, a 1970 Volvo, model 164, 4-door sedan, dark green exterior and beige interior. Odometer 36,568 miles. No previous inspection (mandatory vehicle inspection not required in Michigan). Power steering, power brakes, four-wheel disk brakes, and automatic transmission. Padded sunvisors, instrument panel, door panels, and wide load-distributing steering wheel spokes. A three-point lap and upper torso restraint system with inertial reel take-up. No vehicle defects with last maintenance at 35,801 miles; oil, lubrication and filter on July 25, 1972. Damage to right front corner area toward vehicle center with crush rearward of 36 inches, suspension damaged, upper anchorage and bracketing for snock mounting severed. VDI:01-FREW-5.

Occupant

Driver 1, 49 years, Caucasian, male, 67 inches, 155 pounds. Had been driving 26 years, averaging 10,000 miles per year. Visited friends

in Ann Arbor on the evening of the accident. Left at 10:45 p.m. saying he was going to get something to eat. Destination undetermined; however, probably went to bar and remained until 2:00-2:30 a.m. closing. Traveling home at time of accident. Collision occurred approximately seven miles from point of origin, 21 miles from destination. Owned vehicle two years and had accumulated approximately 20,000 miles. Probably unfamiliar with road as generally took considerably longer expressway route. No driver education course, self-taught driver. Vision corrected to normal, no other debilitating physical conditions. Ten hours sleep in past 24 hours. Mental stress possible contributing factor. History of neurosis. Previously had drinking problem and attempted suicide with overdose of sleeping pills. Major life change five months before accident, involving becoming self-employed and changing residence. Behavior changes approximately three weeks before accident indicated that driver was under some stress. Alcohol involved, BAC 0.10. Habitually wore restraints when traveling with wife, but not worn evening of accident.

Injuries were minor facial lacerations and abrasions, small puncture wound to occipital scalp, no concussion, lateral abrasion and contusion midthorax, fractured ribs (left 3-9, right 3-7) at anterior axillary line, fracture at base of sternum, small laceration to liver, minimal hemoperitoneum, deep laceration tunneling into perineal and scrotal region, avulsion right testicle, laceration anterior urinary bladder, fractured left pubic ramus, separation pubic symphysis, intermittent small abrasions to lateral left thigh and knee, medium avulsion anterior surface right leg, small lacerations to ankles. Cause of death exsanguination from perineal and scrotal laceration, and flail chest. Injury Severity AIS code 7, fatal.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were relevant to this case study:

- | | |
|-----------|---|
| TSPS #12 | Highway Design, Construction, and Maintenance. Soft fill in newly dressed roadway shoulder not compacted; contributed to loss of control of Vehicle 1. Bridge rail not protected by guard-rail. Sloped area adjacent to bridge rail and road edge also unprotected, permitting Vehicle 1 to go down ravine and roll over. |
| TSPS #8 | Alcohol in Relation to Highway Safety. Driver of Vehicle 1 was intoxicated (BAC 0.10), which impaired his ability to operate a motor vehicle. |
| MVPS #201 | Occupant Protection in Interior Impact. Driver injuries were enhanced due to the rigid and shatterable plastic used in components under the instrument panel. |
| MVPS #203 | Impact Protection for the Driver from the Steering Control System. Unbelted driver of Vehicle 1 sustained fatal injuries from contacting the steering wheel and column. |
| MVPS #204 | Steering Control Rearward Displacement. Although perhaps of minor consequence considering the severity |

of the impact, the rearward displacement of the steering column was measured at one inch.

MVPS #207 Anchorage of Seats. Seat anchorage of right front passenger seat in Vehicle 1 failed at impact.

Description

Precrash: Driver of Vehicle 1, traveling southbound at a speed too fast for conditions, was intoxicated. As Vehicle 1 began to drift over into the opposing traffic lane. Driver 1, who may have been preoccupied and inattentive or dozing, corrected by steering to the right. He overcorrected so that the vehicle went off the roadway and onto the right soft shoulder, whereupon the driver lost control. His final effort was an attempt to bring the vehicle back onto the roadway and avoid striking the bridge rail. Tire scuffs on the roadway and tire prints in the soft fill shoulder material clearly described the vehicle's movement prior to impact. Braking was not attempted and there were no skidmarks.

Crash: Vehicle 1 crashed into the bridge rail with a force vector of 1:00 and the point of contact to the inside of the right front headlight. Driver 1 was attempting to regain control of the car and evidence indicated that in the final few feet of travel, Vehicle 1 turned slightly to the right after turning hard to the left. After impact, Vehicle 1 rebounded back from the bridge rail onto the grassy slope adjacent to the soft shoulders of the roadway. Gravity carried it down into the ravine where it rolled onto its left side. Injuries resulted from the unbelted driver moving directly forward into the steering wheel, horn rim, steering column, and lower instrument panel area. Damage to Vehicle 1 was concentrated on the hood, engine, right front fender, and forward suspension, with 36 inches of rearward crush. The right A-pillars (upper and lower) were damaged and the lower right B-pillar was twisted.

Postcrash: Exact time of accident unknown; investigator estimates that the driver remained in the vehicle after impact from between one to two and one half hours. Police and ambulance response good. The initial examination of the driver by attending police indicated that the driver was deceased. The vehicle rolled over on two wheels to resting position on right side in ravine. Vehicle was righted, driver extracted through the right front door with assistance provided by attendant in the rear seat. (Seat back on driver's seat removed in extrication.) There were no problems from environmental considerations, debris, or traffic control.

Causal Factors and Recommendations

Accident Causation

Matrix Cell

Explanation

(*indicates positive factor)

Primary or Principle Cause(s)

- | | |
|---|--|
| 1 | Driver 1 intoxicated and driving too fast for conditions and roadway design. (Definite) |
| 1 | Driver 1 overcorrected steering to rectify drift into opposing lane causing loss of control of vehicle. (Definite) |

Matrix Cell

Explanation

Primary or Principle Cause(s) (continued)

7 Roadway shoulders consisted of newly dressed soft fill which was not compacted and contributed to Driver 1's loss of control. (Definite)

Severity Increasing Factor(s)

5 Vehicle hood penetrated windshield and right front seat anchorage failed. Not related to occupant injury, but to vehicle damage only. (Definite)

8 Bridge rail struck by Vehicle 1, area adjacent to rail, and road shoulder edge not protected by guardrail. (Definite)

7 Wet roadway contributed to failure of abrupt steering correction by driver to regain proper travel lane. (Probable)

Relevant Conditions

1 Driver 1 under stress created by maladjustment and a change in life style. (Possible)

1 Driver 1 had limited familiarity with road. (Definite)

*7 Roadway was new with uniform crown, was wider than before with shoulder properly dressed, and consisted of new asphalt surfacing. Also newly painted road markings. (Definite)

7 Darkness, combined with driver's impaired condition and unfamiliarity with the roadway, contributed further to poor judgement. (Possible)

Injury Causation

2 Driver 1 unbelted. Injuries would have been reduced significantly had driver utilized the belts available. (Definite)

*5 In relation to the current vehicle population, safety features on Vehicle 1 were judged excellent. (Definite)

3 Flail chest and exsanguination were fatal due to extended time period before discovery of accident. (Definite)

Recommendations

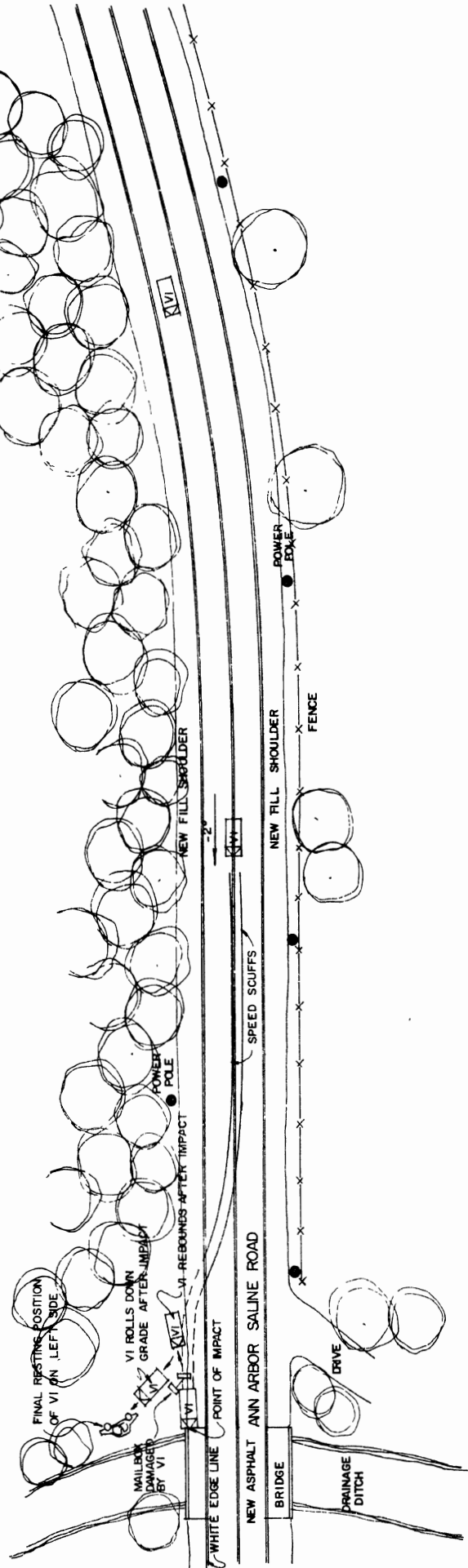
7 When building and dressing new roadway shoulders, particularly using soft fill, the operation should include compacting the material.

ROADWAY			
-3°	-4°	-2°	5°

SECTION THROUGH CURVE
LOOKING NORTHEAST

SHOULDER	ROADWAY	SHOULDER
-20°	-3 1/2°	-2°
		5°
		15°

SECTION THROUGH ROADWAY AT POINT WHERE VI LEFT ROADWAY
LOOKING NORTHEAST



ACCIDENT SCHEMATIC AA 305



UNIVERSITY OF MICHIGAN **HSRI**

THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-306
CASE SUMMARY

Identification

Interstate 94, city of Ann Arbor, Washtenaw County, Michigan; Wednesday, August 9, 1972, at 1346 o'clock. Commercial and agricultural area. Two cars, front to side impact. Injury Severity AIS* code 09, fatal.

Ambience

Daylight; clear sky, with 50% coverage cumulus fair-weather clouds; roadway dry. Wind from northwest up to 10 mph, humidity 60%, temperature 75°F.

Highway

Interstate 94, a divided expressway, two traffic lanes in each direction; roadway 24 feet wide, two 12-foot lanes; grassy median 19½ feet wide, 3-foot-wide asphalt shoulders on median side and 8-foot-wide asphalt shoulders on outside. Surface well-traveled concrete, no divider or median barrier. Configuration straight, roadway crowned and grade of -1½ degrees east to west as a result of a railroad overpass one-half mile to the east. No lighting, one major interchange, and no poles or trees in the freeway right-of-way within a quarter mile radius. Roadway marked with reflectorized delineators. Area surrounding roadway wooded on both sides; no significant history of prior accidents. However, intersection of State Road and I-94 (0.6 miles west of accident site) does have extensive accident history.

Traffic Controls

Posted speed limit 70 mph maximum and 45 mph minimum. Continuous white road-edge delineation, intermittent white center-line delineation. In the immediate area posted speed was clearly legible. No signals or other traffic controls.

Vehicles

Vehicle 1, a 1968 Chrysler Newport, Custom 4-door sedan, odometer reading 53,011 miles, no vehicle inspection (mandatory vehicle inspection not required in state of Minnesota). Power brakes, power steering, and automatic transmission. Padded sunvisors, instrument panel, armrests, and seatbacks. Door panels lightly padded. Lap restraints with locking retractors and upper torso belts installed. No vehicle defects. Last maintenance at 50,185 miles (6-18-72) consisting of lubrication, oil, and filter change. Damage primarily concentrated to broad frontal area with crush to front grill, bumper, hood, doors, and extensive damage within engine compartment with transmission housing fractured. Vehicle

*American Medical Association Abbreviated Injury Scale (AIS).

serviced for trip, and included new brakes and exhaust system. Overall condition indicated well maintained. An after-market trailer-brake assembly was installed to permit the vehicle to tow a camper trailer on long camping trips. Dark blue exterior with blue vinyl interior. VDI:11-FDAW-6.

Vehicle 2, a 1972 Pontiac Grand Prix, 2-door sport coupe. Odometer reading 14,184 miles, no record of vehicle inspection (mandatory inspection not required in Michigan). Automatic transmission, power steering, power brakes, power windows, air conditioning, and disc front brakes. Padded sunvisors, instrument panel, armrests, door panels, and seatbacks. Lap and torso restraints with non-locking retractors installed. No apparent vehicle defects other than tire tread stock thickness varying between 2/32's to 3/32's of an inch. Last maintenance at 11,915 miles with oil, lubrication, and battery check (7-19-72). Extensive damage to entire right side with inward crush including right front door into back of rear seat. Complete separation of body from frame, engine, transmission, and drive train. Vehicle driven hard, average of 25,000 miles per year. Vehicle had also been in three previous accidents requiring extensive body and trim repair. Silver metallic exterior, black vinyl top with black interior. Primary VDI:01-RDAW-9; secondary VDI:08-LBEW-1.*

Occupants

Driver 1, male, Caucasian, 56 years, 70 inches, and 190 pounds. Driving for 36 years, averaging 16,000 miles per year. En route from Minneapolis, Minnesota to Mount Clemens, Michigan to visit relatives. Accident occurred approximately 700 miles from Minneapolis and 55 miles from destination. Driver purchased Vehicle 1 two months before accident and accumulated approximately 2000 miles. Acquainted with area and roadway, having traveled same route before on previous trips. No formal driver education. Good physical and mental condition. Alcohol and drugs not involved. Was restrained by lap belt. Superficial injuries sustained were a small laceration at the base of the nose, a 10 x 10 cm. ecchymosis to right anterior chest, a small laceration to left elbow. Fractures and internal injuries included fractures to left ribs 3-8 and right ribs 1 and 5 posterior, left pulmonary contusion, fracture to midshaft of left humerus, closed compound fracture to styloid of right radius and ulna, two closed fractures to left femur at proximal end and at midshaft, compressive fracture of right patella. Injury Severity AIS code 03, severe, not life-threatening.

Right front passenger, Vehicle 1, Caucasian, son of driver, 15 years old, 69 inches and 135 pounds. Was wearing lap belt. Injuries included multiple facial lacerations, fractured mandible, severe abrasion and subsequent loss of right eye, abrasion of left eye, compound fracture right scapula, multiple fracture right femur, simple fracture of left femur, fracture of left ankle. Injury Severity AIS code 03, severe, not life-threatening.

Rear seat passenger, Vehicle 1, Caucasian, wife of driver, 56 years old, 65 inches and 150 pounds. Passenger unrestrained. Injuries included multiple facial lacerations, avulsed fracture of nose, comminuted

* Vehicle Deformation Index (VDI).

fracture of left maxilla, concussion and brain hemorrhage, fractured lower cervical vertebra, hematoma to lower anterior surface of neck, fractured right clavicle, hemorrhage in pleural space and lungs, small liver laceration, fractured 8th thoracic vertebra, abrasions anterior aspect of right arm, abrasions ventral surface of both hands, small laceration inner aspect left thigh and abrasions anterior surface of left foot. Cause of death brain hemorrhage. Injury Severity AIS code 06, fatal.

Driver 2, male, Black, 30 years, 67 inches, and 168 pounds. Driving for 13 years, averaging 20,000 miles per year. En route from Ypsilanti, Michigan to home in Ann Arbor, Michigan. Accident occurred seven miles from origin of trip and three miles from destination. Good vehicle familiarity; driver was a major user of vehicle. Good area and road familiarity. No formal driver education, taught by grandfather. Physical condition good. No stress. History of risk-taking and irresponsible driving behavior. Unrestrained. Alcohol involvement doubtful, possible drug involvement. Extensive injuries included massive skull fractures and concussion, fractured mandible, multiple bilateral rib fractures, laceration and perforation of lungs and heart, ruptured diaphragm, crushed liver, ruptured kidney and bladder, bilateral pubic fractures, fracture of right radius, right hip and knee. Injury Severity AIS code 09, fatal.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|-----------|--|
| MVPS #203 | Impact Protection for the Driver from Steering Controls. Energy absorbing steering column compressed 2.7 inches, 28% of its total compressibility. |
| MVPS #206 | Door Locks and Door Retention Components. Vehicle 2's right door was completely crushed in; the intact left door jammed requiring deceased driver to be cut out of wreckage. |
| MVPS #207 | Anchorage of Seats. Vehicle 1 and Vehicle 2 seats badly deformed from impact, but not separated from mounting. |
| MVPS #214 | Side Door Strength. Side door guard beam design of Vehicle 2 had little effect on the resulting damage and intrusion into passenger compartment due to severity of impact. |
| MVPS #301 | Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections. Fuel tanks on both vehicles were deformed and damaged but fuel leaks did not develop. |
| TSPS #5 | Driver Licensing. Driver 2 had an illegal, or "alias," driver's license. |
| TSPS #7 | Traffic Courts. Driver 2 received a suspended license which did not prevent him from driving. |

Description

Precrash: Vehicle 1, eastbound on divided I-94 expressway, traveling at 60 mph in outside lane; Vehicle 2, westbound traveling at approximately 90 mph. Driver 2 initiated an "S" lane-changing maneuver, moving from the inside lane to pass a Volkswagen ahead of him which was traveling at approximately 70 mph, and then again steered to outside lane to pass a vehicle approximately 150 feet ahead of him which had slowed to exit at State Road. Driver 2 lost control of the vehicle upon returning to the outside lane, as steering would not respond at excessive speed after "S" lane-change maneuver. Vehicle 2 crossed the median on a tangent while rotating counterclockwise, then entered eastbound lane. Driver 2 turned wheels hard right while crossing the median but made no other attempt to bring vehicle under control. Skid marks on grassy median and on eastbound roadway indicated out-of-control movement of Vehicle 2. Excessive speed and reckless driving by Driver 2 were violation of law.

Crash: Vehicle 1 struck right front side of Vehicle 2 with force vector of 11:00 o'clock to Vehicle 1, and 1:00 o'clock to Vehicle 2. On impact, both vehicles fused momentarily and rotated clockwise, with Vehicle 1 penetrating further into right side of Vehicle 2. Vehicle 1 separated from Vehicle 2 and came to final rest on eastbound roadway right shoulder, having completed a clockwise rotation of 225°. Upon disengagement, Vehicle 2 continued rotating clockwise for an additional 90°, contacting a guardrail with left rear corner, and coming to final rest similar to Vehicle 1. Vehicle 2 was prevented from going off the steep (42°) grade adjacent to the roadway by guardrail. At final rest, the vehicles were 15 feet apart, both oriented about 45° toward roadway and facing into opposing traffic, partially on roadway and partially on shoulder.

Force of impact impelled all passengers of Vehicle 1 forward and to the left. Unbelted center rear passenger loaded front seat back and center armrest heavily and was thrown forward into front passenger compartment. Bowing of seat back and intrusion of rear seat passenger thrust driver to left into upper A-pillar and windshield, and right front passenger into right B-pillar. Driver sustained thoracic injuries from steering wheel contact, fracture of left humerus from impact with left door, fractures to left femur from lower instrument panel, and fracture of right patella from contact with after-market brake assembly fastened beneath the steering column. Right front passenger sustained multiple facial lacerations including abrasions to both eyes and a fractured mandible from A-pillar contact and flying glass, compound fracture of right scapula from right door contact, fractures to both legs and lower instrument panel. Unbelted rear passenger's face and head impacted steering wheel hub and instrument panel above steering wheel. This impact caused concussion, severe facial injuries, and fracture of cervical vertebra. Internal injuries probably resulted from impact against seat back. The initial impact caused Driver 2 to move forward and to the right. The subsequent inward pushing of Vehicle 1 into Vehicle 2 crushed Driver 2 against the left door, lower B-pillar area, and behind left front driver's

seat, and forced him inward to final resting place with head and upper torso extended exterior to left rear window. Extensive head injuries probably were sustained from striking intruded A-pillar at initial impact. Severe crushing injuries to thorax, abdomen and pelvic areas were incurred as driver was pinned between front seat and intruded side surfaces. Driver's left leg was fractured at the distal end of the femur, probably from contacting intruded heater core and nearby hardware.

Postcrash: Damage to Vehicle 1 concentrated entirely across frontal area. Hood's rear edge elevated and contacted windshield with hinges damaged and separated. Sheet metal crush included fenders, door, damage to engine compartment area, and fracture and separation of the transmission casing. Upper left and right A-pillars and B-pillars separated from roof. Center front seat area severely deformed from impact and loading by rear seat passenger.

Extensive damage across front to mid-center right side of Vehicle 2 included separation of left upper A-pillar with all other A-pillars damaged. Entire right A-pillar and lower right B-pillar separated with both right and left C-pillars deformed. Vehicle 2's hood separated from its mounting; fuel tank was deformed, but did not leak.

Portable carbide saw used to extricate Driver 2, obviously killed instantly by impact. Extrication methodical and unhurried; only urgency clearing area and restoring traffic flow. Driver 1, as well as right front and rear passengers of Vehicle 1, was removed through vehicle doors by ambulance attendants. First aid administered to lacerations of all occupants, with extensive dressings applied to facial area of rear seat passenger. Fluids and debris from crashed vehicles presented marginal threat and were hosed down by a township fire department which responded to the accident. Debris extending into Lane 1 of I-94 eastbound lanes combined with emergency vehicles and heavy traffic, caused a traffic tie-up both westbound and eastbound intermittently throughout postcrash cleanup. Ambulance response was rapid, with traffic handled by a variety of area police (city, county, and state).

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environment	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Vehicle 2 traveling at excessive speed. (Definite)
- 1 Driver 2 maneuver was executed recklessly in lane-changing and passing on westbound lanes. (Definite)
- 1 Driver 2's actions to bring Vehicle 2 under control after loss of control were under panic conditions and were ineffective. (Probable)

Severity Increasing Factors

- 7 Divided highway lacked median barrier in accident area. (Definite)
- *9 Roadside guardrail contained Vehicle 2 from dropping down steep slope after impact. (Definite)

Relevant Conditions or Modifying Factors

- 1 Driver 2's life style included history of maladjustment and risk-taking. (Definite)
- 1 Driver 2 involved with drugs. (Possible)
- 1 Driver 1's fatigue from long period of driving may have affected his response in reacting to Vehicle 2's collision course with Vehicle 1. (Possible)
- 4 Condition of Vehicle 2's tires marginal, but certainly poor considering the risk-taking driving habits of Driver 2. (Definite)
- 7 State Road and I-94 interchange, on which a vehicle ahead of Vehicle 2 slowed to exit, lacks a deceleration lane and requires exiting traffic to decelerate on traffic lane. This relates to Driver 2's reckless lane-changing maneuver which, in addition to speed, caused him to lose control. (Probable)

Injury Causation

- 2 All occupants of Vehicle 1 did not use upper torso restraints, with rear seat occupant wearing neither lap nor upper restraints. (Definite)
- 5 After-market trailer brake assembly installed on Vehicle 1 contributed to injury of Driver 1. (Definite)

Matrix Cell

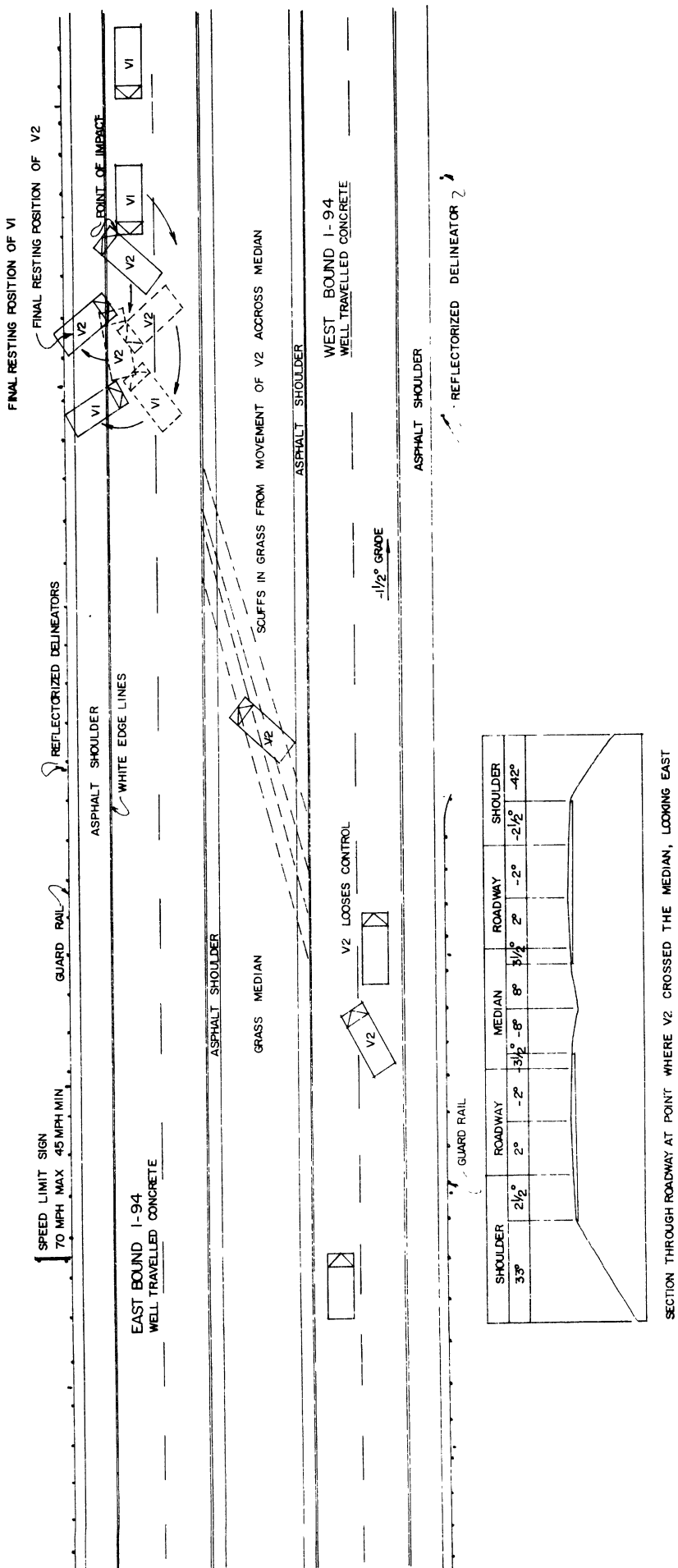
Explanation

Postcrash Factors

- | | |
|----|---|
| *3 | Ambulance response to accident was rapid. (Definite) |
| *3 | Adequate first aid was given on-scene by responding ambulance personnel. (Definite) |
| *6 | Vehicle removal was efficient and timely under difficult circumstances. (Definite) |
| 9 | Traffic backup on I-94 was over two miles in each direction at times. (Definite) |

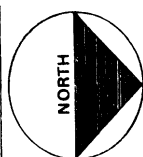
Recommendations

- | | |
|---|---|
| 8 | Install median barrier on sections of I-94 where median is relatively narrow and can permit vehicles to cross over into opposing lanes when out-of-control. |
| 1 | Make operator's license suspensions more effective with controls to keep unlicensed drivers off road. |
| 4 | Some consideration in design of energy-absorbing steering column mechanism should include its effectiveness with degrees of off-axis loading. |



SHOULDER	ROADWAY	MEDIAN	ROADWAY	SHOULDER
3°	2°	-3 1/2°	2°	-2 1/2°
	-2°	8'	8'	-42°
		3 1/2'	2'	

SECTION THROUGH ROADWAY AT POINT WHERE V2 CROSSED THE MEDIAN, LOOKING EAST



UNIVERSITY OF MICHIGAN HSRI

ACCIDENT SCHEMATIC AA 306



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-307
MOTORCYCLE/PASSENGER CAR/REAR-END COLLISION
CASE SUMMARY

Identification

US-23, a divided highway near Pontiac Trail Road overpass in Ann Arbor, Washtenaw County, Michigan. An open expressway in an agricultural area. Friday, August 18, 1972 at 1550 o'clock. One motorcycle, one car, rear-end impact. Injury Severity AIS code 1, minor.

Ambience

Daylight. no precipitation, temperature 80⁰F, humidity 60-70%, visibility unlimited. Roadway and shoulders dry. Estimated coefficient of friction 0.55.

Highway

US-23, a divided expressway, 24-foot-wide roadway in each direction, each 2 lanes; a grassy median strip with no median barrier. Asphalt roadway shoulders, 10 feet wide on outside, 3 feet wide on median side. Roadway straight and level, crowned for drainage; no lighting, poles, or trees in freeway right-of-way within a quarter mile of accident site. One interchange within a quarter mile of accident site. No significant accident history at accident location.

Traffic Controls

Posted speed limit 70 mph maximum and 45 mph minimum. Intermittent white lane delineation, and solid white road-edge delineation. Roadway marking clear and legible: legible "emergency and authorized vehicles only" sign denoting median crossover road.

Vehicles

Vehicle 1, a Harley Davidson, Super Glide 1972 motorcycle. Odometer 2,767 miles. Maintained by owner. (Vehicle inspection by Florida Highway Patrol, no date, serial #1731795.) No vehicle defects; damage to front wheel, fork, front suspension, fender, head lamp, handle bars, frame, and fuel tank, including bent choke control knob on instrument console from occupant contact. Impact force vector 11:00 o'clock.

Vehicle 2, a 1969 Pontiac, Catalina, 4-door station wagon, blue exterior, blue interior, odometer 43,231 miles. No previous inspection (mandatory vehicle inspection not required in Michigan). Power steering and power brakes; automatic transmission; padded sunvisors, instrument panel, door panels, head restraints, and arm rests; and wide load distribution spokes on steering wheel. No vehicle defects,

last indicated maintenance at 26,264 miles consisting of oil, filter, and lubrication. Damage to tailgate sheet metal and rear bumper causing tailgate window mechanism to bind. VDI:07-RCEN-1.

Occupants

Driver 1, 22 years, male, Caucasian, 66 inches, and 130 pounds. Six years driving experience with average of 10,000 miles yearly on motorcycles. Had driven motorcycle for past six years, limited experience with passenger cars. Drove up to 50,000 miles per year (jeeps and military trucks) during two years in military service. En route from East Liverpool, Ohio, to destination in Alma, Michigan, a distance of 400 miles. Accident occurred 289 miles from origin. Driver made five stops prior to accident. No estimated time of arrival. Well familiar with expressways. No high school driver education; but had a two-phase driver education course in the service for driving jeeps and military trucks. Physical and mental condition good; highway fatigue possible situational factor. No drugs or alcohol involved. Overall soreness to body with marked soreness to back and left ribs. Injury Severity AIS code 1, minor.

Passenger, Vehicle 1, male, Caucasian, 13 years, 60 inches, 100 pounds. Hairline fracture to left radius, and fracture to left carpal. Injury Severity AIS code 1, minor.

Driver 2, 38 years, male, Caucasian, 68 inches, and 155 pounds. Twenty-four years driving experience, accumulated 25,000 miles per year. Traveling from home in Ann Arbor to vacation cottage in Clare, Michigan. Estimated time of arrival flexible. Collision occurred four miles from origin, 142 miles from destination. Accumulated 15,000 miles on case vehicle, owned nine months. Familiar with area. Completed two-phase driver education course in service for operating army trucks. Physical condition good. Overall mental condition normal; cautious, somewhat rigid individual. Alcohol not involved. Wore lap belt (lap and upper torso restraints available). No injuries. Injury Severity AIS code 0.

Center front passenger, Vehicle 2, 3 years, male, Caucasian, 36 inches, and 40 pounds. Lap belt worn (available lap restraint). Injury Severity AIS code 0.

Right front passenger, Vehicle 2, 29 years, female, Caucasian, 62 inches, and 125 pounds. Lap belt worn (available lap and upper torso restraints). Injury Severity AIS code 0.

Left rear passenger, Vehicle 2, 5 years, female, Caucasian, 42 inches, and 40 pounds. Lap belt available but not worn. Injury Severity AIS code 0.

Right rear passenger, Vehicle 2, 11 years, female, Caucasian, 61 inches, and 100 pounds. Lap belt available but not worn. Injury Severity AIS code 0.

Description

PreCrash: Driver 2 stopped on the right shoulder off the east-bound roadway to check for clearance prior to turning onto emergency

median crossover to effect U-turn on expressway. Driver's intention was to reverse direction and retrace route taken to recover jacket which had blown out of the car. Driver 2 saw the motorcycle approaching (estimated distance one quarter mile), but continued with the maneuver to cross the median. Stopping and crossing the median of an expressway is a violation of the law. Driver 1 did not perceive Vehicle 2 until a second prior to the collision, then swerved left in evasive attempt. Driver 2 simultaneously saw Vehicle 1 in rear-view mirror and increased speed in an attempt to avoid collision. No precrash skids were evident.

Crash: Upon striking the rear of Vehicle 2, Driver 1 and passenger 1 became airborne with a trajectory obliquely over the mid-center roof area of Vehicle 2, made a brushing contact with the roof, and landed on the grassy median and median edge respectively. Driver 1's helmet visor and feet scraped the portable luggage crossbar on the roof of Vehicle 2, separating the visor from helmet. Passenger 1 followed a similar trajectory, landing approximately 50 feet from the point of impact onto the grassy median adjacent to the emergency crossover road being crossed by Vehicle 2. Precise projectory of Vehicle 1 unknown. No injury to occupants of Vehicle 2. Driver 1 sustained sore neck and back from landing on the median, and soreness to legs from contacting the motorcycle handlebars. Passenger 1 received a hairline fracture of the left radius and fractured carpal from landing on the median. No distinctive marks or scuffs on roof area of Vehicle 2, indicating light contact, if any. Direction of force to Vehicle 2 was 7:00 o'clock with damage to tailgate and rear bumper, with rear tailgate window intact but binding near bottom of travel. Direction of force to Vehicle 1 was 11:00 o'clock with damage to front fork, wheel, handlebars, and seat fastener; deformation to gas tank; bent front wheel rim; and deformed choke control.

Postcrash: Vehicle 2 continued onto median crossover road and stopped. Passing motorists notified police. Police and ambulance response prompt. No first aid required on scene. Both Driver 1 and Passenger 1 transported on full backboard, with spinal injuries suspect. Motorcycle removed completely off roadway by alert Driver 2. No traffic problem. Fuel spillage evident, but no action taken to neutralize its potential for fire. Driver 1 not x-rayed at receiving hospital, despite extreme overall soreness and discomfort.

Standards

The following Traffic Safety Program Standards (TSPS) were relevant to this case study:

TSPS 1: Periodic Motor Vehicle Inspection. Vehicle 1 carried sticker of inspection by Florida Highway Patrol.

TSPS 3: Motorcycle Safety. Helmet worn by driver and passenger gave no indication (markings) of being DOT approved, but did provide protection.

TSPS 15: Police Traffic Services. Neither driver was cited nor was fault of accident established.

TSPS 16: Debris Hazard Control and Clean-up. Prompt removal of Vehicle 1 from roadway by Driver 2 minimized danger to traffic.

Causal Factors, Conclusions, and Recommendations

Accident Causation

Matrix Cell

Explanation

(*indicates positive factor)

Primary or Principle Cause(s)

- | | |
|---|--|
| 1 | Driver 1, moving to left as a result of not anticipating Vehicle 2's movement toward crossover road, displayed an error in judgement. (Probable) |
| 1 | Driver 2 violated law and good driving sense in attempting illegal crossover on expressway. (Definite) |

Severity Increasing Factor(s)

- | | |
|----|--|
| *6 | Driver 2 immediately pulled Vehicle 1 off roadway, reducing potential for compounding accident. (Definite) |
|----|--|

Relevant Conditions or Modifying Factor(s)

- | | |
|----|--|
| 1 | Driver 1's travel of 289 miles of planned trip prior to accident may have brought on fatigue, dulling his responses to impending impact and increasing his reaction time. (Probable) |
| 1 | Prior to reentering roadway, Driver 2 evidenced error in estimating speed and/or distance of Vehicle 1. (Definite) |
| 1 | Driver 2's preoccupation with compelling need to reverse his direction detracted from attentiveness to his immediate driving responsibility. (Probable) |
| *2 | Driver 1 and Passenger 1 sustained relatively minor injuries. This is noteworthy considering the severity of the crash and its potential for serious injury. (Probable) |
| *3 | Emergency medical service response was prompt and on-scene procedures in handling and moving injured with full backboard proper. (Definite) |

Matrix Cell

Explanation

Relevant Conditions or Modifying Factor(s) (continued)

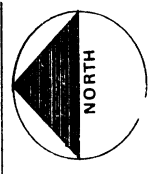
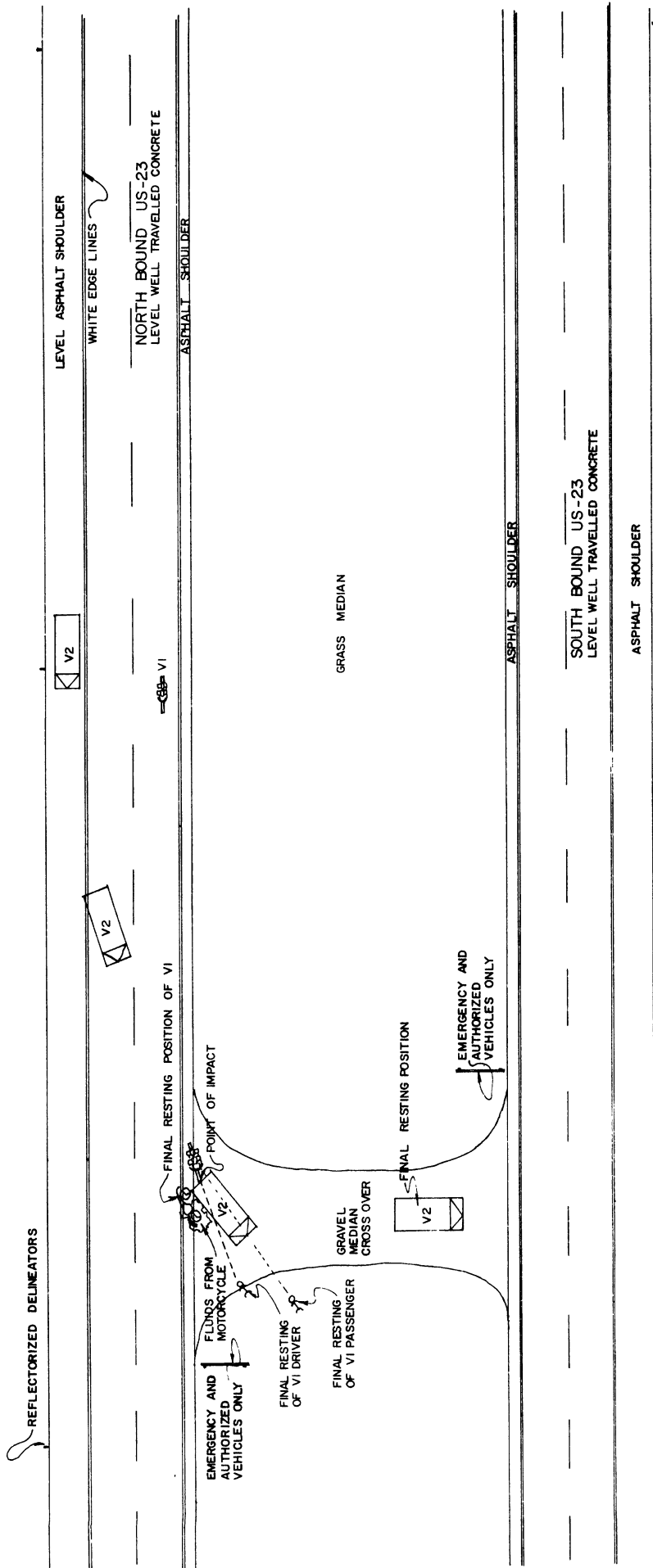
- *6 Sign denoting divided highway crossover and its restricted use for authorized vehicles only, was well placed, legible, and large. (Definite)

Injury Causation

- *2 Use of helmets was instrumental in preventing injury to the head of both driver and passenger of Vehicle 1. (Definite)
- 6 Fuel spillage created potential for post-crash fire if ignited. (Possible)
- 5 Vehicle 1 choke knob location is potentially injury producing; pants of Driver 1 caught and torn by contacting knob. (Definite)
- 5 Cap on gas tank of Vehicle 1 separated on impact, which under different crash circumstances could be injury-producing, or create greater potential for fire. (Possible)

Recommendations

- 3 Neither driver cited in accident. A more uniform enforcement of traffic laws is recommended.
- 1 Driver education curriculum should give more attention to perceiving and estimating speed distance, and understanding the controlling dynamics and stability of motorcycles as compared to more conventional motor vehicles.



UNIVERSITY OF MICHIGAN HSRI

ACCIDENT SCHEMATIC AA 307

THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-308
CASE SUMMARY

Identification

Accident occurred Monday, August 21, 1972, at 0930 hours at the intersection of Packard Road and Platt Road, a commercial area, in Ann Arbor, Michigan, Washtenaw County. Two vehicles collided at right angles, T-type, within the intersection. Injury severity AIS* code 01, minor.

Ambience

Daylight, clear, and sunny. Temperature 79^oF, humidity 85%. Wind southwest 0 to 5 mph. Pavement was dry.

Roadway

The right-angle intersection is formed by Packard Road, a major arterial, 60 feet wide, and Platt Road, a collector, 50 feet wide. Both roads have five lanes, center lane being reserved for left turn only, no median dividers. Well-traveled, well-maintained asphalt surfaces, bordered with standard city 6-inch-high concrete curbsings.** Both roads are straight, level, and crowned for drainage. Mercury vapor lights illuminate both roadways and the intersection. This major city intersection is immediately surrounded by gas stations, stores, and other commercial enterprises, beyond which lies a grid system of improved and unimproved streets lined with middle class homes. Packard Road has five driveways and two intersections; 25 poles and 15 trees within a quarter mile radius. A combination parking lot and service road borders Packard Road immediately to the south. Platt Road has 12 driveways and one intersection; 15 poles and 30 trees within a quarter mile radius.

Traffic Controls

Posted speed limit on Packard Road is 40 mph and on Platt Road 30 mph. On both roads, pavement markings consist of clearly visible intermittent white lane delineators and solid yellow lines for the center left turn lane. All are in accordance with the current Uniform Traffic Control Devices Manual. Also, there are clearly visible roadside "No Parking At Any Time" signs. There are three overhead, three color, traffic control signals on fixed time as follows: Packard Road, (one light), 31 seconds red, 4 seconds yellow, 35 seconds green; Platt Road (two lights), 39 seconds red, 4 seconds yellow, 27 seconds green.

Vehicles

Vehicle 1, a 1972 GMC Van, rebuilt by Tram Corporation into a Titan #1 Ambulance. White with orange striping, odometer 9,786 miles. No

* American Medical Association Abbreviated Injury Scale (AIS).

** Standard curbsings in city of Ann Arbor, Michigan are six inches high.

previous vehicle inspection (mandatory vehicle inspection not required in Michigan). Last maintenance performed at 9,158 miles but what was done not recorded. Vehicle equipped with power steering, power brakes, padded sunvisors, and lap belts only. Vehicle also equipped with a sealed vehicle recorder. No vehicle defects were observed. Force of impact was at 2:00 o'clock causing extensive damage to right front corner, front, and hood, including 18 inches of frontal crush. The hood contacted the windshield, there was 100% windshield bond separation. Both hood hinges were damaged, and the right hinge separated at the pin. The right upper and lower A-pillar was damaged. After impact, Vehicle 1 rotated counterclockwise 200° and came to rest in the intersection. VDI*:02-RFEW-3.

Vehicle 2, a 1967 Cadillac Deville, brown-gold colored, odometer 66,126 miles, was equipped with power steering, power brakes, power windows, power seats. Padding included sunvisors, door, instrument panel, seatbacks, and armrests. Lap belts only. No previous vehicle inspection (mandatory vehicle inspection not required in Michigan). Last maintenance at 62,617 miles which included oil and oil filter change. Vehicle was very clean and well-maintained. No defects were noted. Force of impact was received at 9:00 o'clock resulting in extensive damage to the left side. Left door hinge and B-pillar separated. Damage to sheet metal included left center, door, and quarter panels. After impact with Vehicle 1, Vehicle 2 rotated counterclockwise 210° across the intersection and while moving rearward, struck a light pole northwest of the intersection. Force of impact was at 7:00 o'clock. The inside of the open left door caught on the pole. Also, the left rear after-market wheel cracked upon striking the curb. VDI:10-LPAW-3. Secondary VDI:07-LPAN-1.

Occupants

Driver 1, 25-year-old Caucasian male, 73 inches and 240 pounds. Over nine years driving experience averaging 10,000 miles per year plus 1,000 miles in past three months as driver of emergency vehicle. Was en route with ambulance attendant 0.9 miles from point of origin (ambulance station) responding to a heart attack case in Milan, Michigan, 15 miles away. Driver 1 drove with a sense of urgency and had both siren and flasher operating. Had traveled the area and intersection daily for past three months. Had completed high school driver education course plus informal instruction in driving an emergency vehicle. Was in good physical and mental condition. Nearsighted but was wearing corrective lenses per restriction on license. No alcohol involvement. He did not wear the installed lap belt. Sustained 1½" laceration on his forehead, two small abrasions above right eye, and a bump and abrasion on right forehead. Was conscious. Injury severity AIS code 01, minor.

Right front passenger, Vehicle 1, male, Caucasian, 21 years old, 71 inches, and 145 pounds. He was the ambulance attendant. He did not wear the installed lap belt. Sustained abrasions below right knee and postcrash hypoglycemia induced by anxiety reaction to accident. Injury severity AIS code 01, minor.

Driver 2, 25-year-old Spanish Caucasian male, 66 inches and 148 pounds. Nine years driving experience averaging 8,000 miles per year plus military service as a vehicle driver. Was en route one mile from his home in an apartment on East Packard Road one mile east of accident to downtown Ann Arbor six miles west to get his tape player fixed and to

* Vehicle Deformation Index (VDI).

do shopping with no deadline to accomplish. Owned Vehicle 2 for two months and had accumulated 1,000 miles. Very familiar with area and intersection. Had completed high school driver education. Good physical and mental health except for nearsightedness, but was wearing corrective lenses per driving license restriction. Seat belt not worn. Sustained $1\frac{1}{2}$ cm laceration at apex of skull, laceration to left knee, pain in back and shoulders, momentary unconsciousness, and slight shock. Injury severity AIS code 01, minor.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were specifically relevant to this case.

- MVPS #201 Occupant Protection in Interior Impact. Although a 1967 model, Vehicle 2 met the standard and was well padded so that Driver 2 was protected while inside the car.
- MVPS #205 Glazing Materials. Windshields of Vehicle 1 and Vehicle 2 met the standard and did not break up in injury-producing fashion.
- MVPS #206 Door Locks, Door Retention Components. Driver 2 sustained soreness to back and shoulders when ejected. Had this standard applied to Vehicle 2, it could have played a role in reducing injury.
- MVPS #208 Seat Belt Installation--Passenger Cars. Both of the vehicles in this accident were equipped with lap belts according to standards, but none of the occupants wore them, resulting in unnecessary injury to all three.
- MVPS #212 Windshield Mounting. The windshield of Vehicle 1, a modified truck, fell out, potentially allowing ejection of occupants. Standard #212, if applied to commercial vehicles, would have reduced such a possibility.
- MVPS #214 Side Door Strength. Driver 2 sustained soreness to back and shoulders from ejection. Had this standard applied to Vehicle 2, it could have contributed to injury reduction.
- TSPS #4 Driver Education. Driver 1 went through a red light without due caution having assumed all other drivers in the vicinity could see and hear his flasher and siren and would yield automatically. Driver 2 was not attentive to traffic and environment and was unprepared for the sudden appearance of the emergency vehicle.

Description

Pre-crash: Vehicle 1 was northbound on Platt Road on the inside lane traveling at about 50 mph with siren and flasher on. A garbage truck was

making a lefthand turn from westbound Packard Road to southbound Platt Road. Driver 1 gradually slowed to 20 mph and was about 100 feet from the intersection when the garbage truck completed its left turn and was southbound on Platt. Against a red light, Driver 1 entered the intersection, looking first right, then left, and continued north. Meanwhile, Vehicle 2 was proceeding westbound on Packard Road on the inside lane at an estimated 40 mph. Driver 1, who thought all westbound traffic had stopped, noticed Vehicle 2 only after his ambulance assistant, the right front seat passenger, shouted a warning "Not yet!" Driver 1 then applied his brakes. Driver 2 continued westbound and entered the intersection at about 40 mph. Driver 2 said he did not hear any siren because of the sounds made by his radio and air conditioner which were on and the noisy engine of a truck which was in the left turn lane. Only after Vehicle 2 was in the intersection did Driver 2 see Vehicle 1 bearing down on him. Driver 2 then accelerated in an attempt to avoid collision with Vehicle 1. Meanwhile, all other traffic in the vicinity, aware of the presence of Vehicle 1, an emergency vehicle, had yielded. Vehicle 1 moving at about 15 mph just before impact, made about 16 feet of precrash skid marks in the intersection. Vehicle 2 left no precrash skid marks or scuffing and was traveling at about 40 mph just before crash.

Crash: The right front of Vehicle 1 struck the left side door of Vehicle 2 with a force vector of 2:00 o'clock impinging on Vehicle 2 a force vector of 9:00 o'clock. Vehicle 2 rotated 210° counterclockwise through the intersection and, while moving rearward, struck a luminaire pole in the northwest corner of the intersection at a force vector of 7:00 o'clock and then came to rest with the left door open and caught on the pole. Vehicle 1 rotated counterclockwise 200° and came to rest in the intersection. Driver 1 first was thrown upward to the right, and then ended up sprawled over the console. The passenger in Vehicle 1 was thrown forward to the right and then fell back into the seat. Driver 2 went left and forward into the windshield and later, when Vehicle 2 hit the light pole, he fell out the open left door and landed on his back and shoulder on the sidewalk. Driver 1 struck his forehead on the siren and public address control boxes located above the windshield to the right. The passenger in Vehicle 1 struck his knee on an emergency kit box mounted on the shelf below the right instrument panel, but he made no contact with the windshield. Driver 2 struck his head on the windshield, struck the left knee on the lower left instrument panel and struck his back and shoulders on the sidewalk. In the crash with Vehicle 2, Vehicle 1 sustained extensive damage to right front corner and front, including the hood which contacted the windshield. The windshield fell out. Vehicle 2, when struck by Vehicle 1, sustained extensive sheet metal damage to the left fender, left door, and left quarter panel. Also, the left door hinge and B-pillar separated. The left side of the windshield on Vehicle 2 cracked when Driver 2's head struck it. When Vehicle 2 rotated counterclockwise toward the luminaire pole, the left rear after-market wheel cracked when hitting the curb.

Postcrash: When both vehicles finally came to rest, Driver 1 exited on his own through the left front door. The passenger in Vehicle 1 was visibly shaken up and eventually had to be extricated on a board through the window of the right front door, which had jammed. Driver 2 who had fallen out onto the sidewalk, got up, was initially shaken up complaining about loss of his wallet and showing concern about unknown items in the trunk of Vehicle 2. Another ambulance from the same company that owned

Vehicle 1 appeared on the scene shortly. Attendants removed the passenger from Vehicle 1, rendered appropriate first aid to him and Driver 1, then took both to a hospital about five miles away. Driver 2 refused first aid and hospitalization. Later, he accepted first aid from a passing telephone company truck driver. Postcrash traffic was light. The Ann Arbor police soon arrived on-scene, got everything under control, and cooperated fully with the investigators. Scattered debris which was quickly removed consisted mainly of the windshield, plastic grill, and radiator fluid from Vehicle 1, plus odd pieces of metal and glass. At the hospital, Driver 1 was treated for lacerations and abrasions to the head and released. Driver 2 later was taken to the hospital by relatives, treated for head laceration, and released.

Causal Factors, Conclusions, and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	<u>Precrash</u>	<u>Crash</u>	<u>Postcrash</u>
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver 1 drove emergency vehicle into the intersection against red light without due caution assuming all other traffic had heard or seen him and would yield. (Definite)
- 1 Driver 2 failed to see or hear on-coming emergency vehicle or to note that other traffic had yielded and so entered the intersection with a green light. (Definite)

Relevant Conditions

- 1 Driver 2 did not hear the emergency vehicle siren because of the sounds generated by his radio and air conditioner. (Probable)
- 1 Because of his rather flamboyant and egocentric attitude, Driver 2 was insensitive to the yielding of other traffic. (Possible)
- 2 No occupants were belted, allowing increased injury to all and ejection of Driver 2. (Definite)
- *2 Driver 2 allegedly increased speed just prior to impact to avoid collision. (Possible)

Matrix Cell

Explanation

Relevant Conditions (continued)

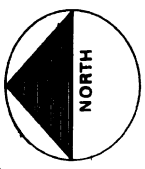
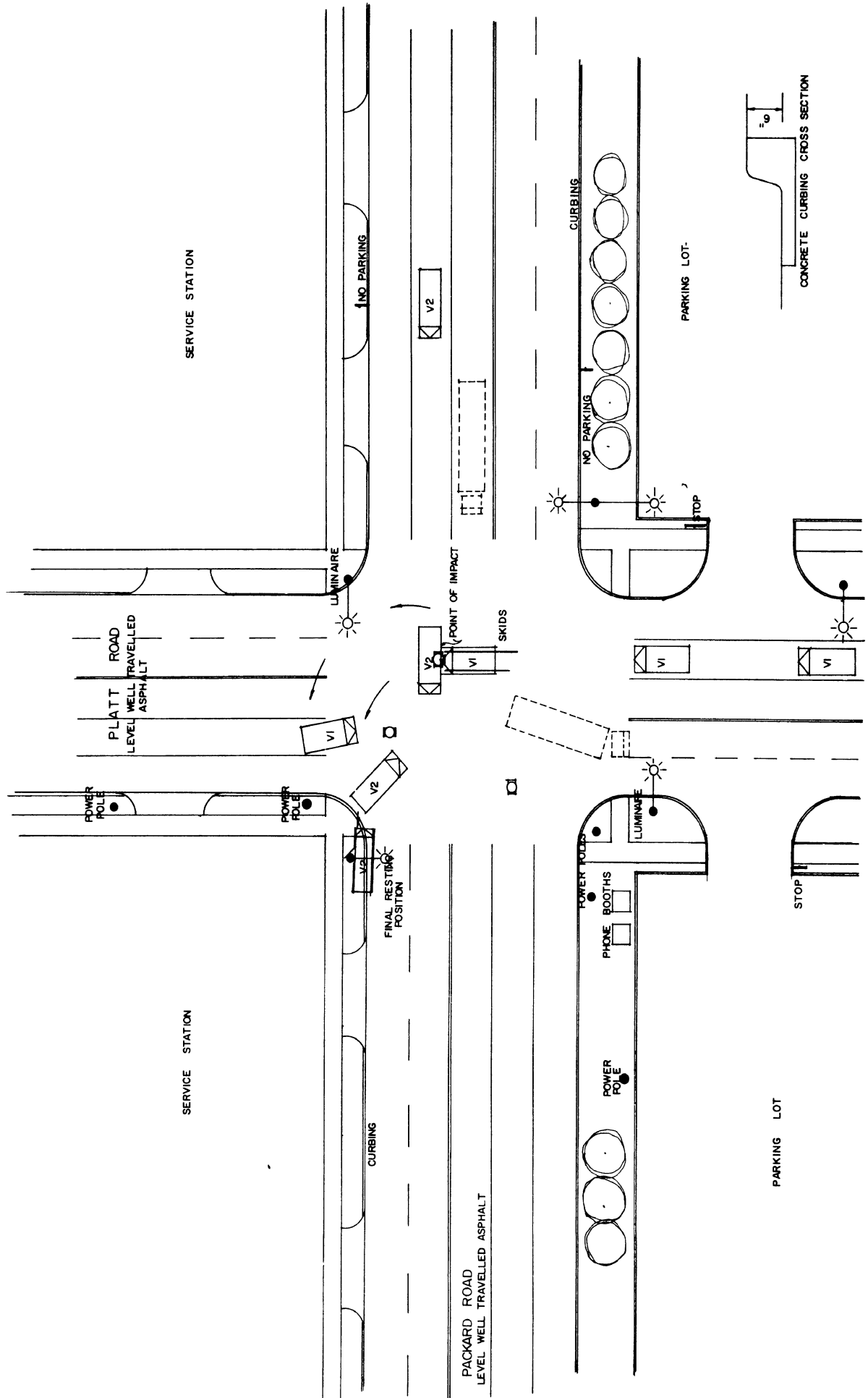
- *2 Driver 2 had his left window down limiting the potential for being cut by door glass. (Probable)
- 2 Passenger of Vehicle 1 suffered hypoglycemia induced by anxiety reaction to crash. (Definite)
- 4 After-market, add-on, emergency signal and medical equipment inside Vehicle 1 contributed to injuries. (Definite)
- *5 Superior interior padding and successful performance of high penetration resistance windshield in Vehicle 2 lessened injury to Driver 2. (Probable)
- 5 B-pillar separation in Vehicle 2 which led to the door becoming open allowed Driver 2 to fall out, thereby increasing injury potential. (Definite)

Postcrash Factors

- *3 Immediate ambulance response and appropriate on-scene and at-hospital emergency services reduced injury potential. (Definite)

Recommendations

- 1 Drivers of emergency medical service vehicles be well-trained in regulations, operational criteria, and precautions to be taken when deciding to override traffic control devices and assume priority over other traffic.
- 7 Drivers of emergency medical service vehicles and the driving public be alerted to the hazard created by failure to detect the presence of emergency service vehicles due to improved soundproofing of passenger vehicles and the distracting sounds of radios, tape players, air conditioners, and heaters.
- 5 MVPS #212, Windshield Mounting--which calls for retention of windshield bonding in passenger cars--also be made applicable to emergency medical vehicles.
- 2 Emergency medical vehicle drivers and attendants be required to use installed lap belts.
- 5 MVPS #201, Occupant Protection in Interior Impact--be made applicable to emergency medical service vehicles and their associated after-market emergency control equipment and medical kits.



AA 308



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-312
CASE SUMMARY

Identification

This accident took place on the M-14 bypass and North Main Street outside the north edge of the city of Ann Arbor, Washtenaw County, Michigan, September 15, 1972, 1338 o'clock, Friday. A divided limited access expressway. Injury Severity AIS code 01, minor.*

Ambience

Daylight, weather dry and clear. Temperature approximately 68°F, with wind from the west northwest up to 5 mph. Humidity 60%, roadway dry and clear.

Highway

M-14 bypass is northern-most leg of limited access belt line circling the city of Ann Arbor. Divided and limited access expressway, four lanes, paved median. Roadway surface well-traveled concrete with road edge a combination of asphalt and gravel shoulder. Roadway configuration at point of impact straight and level at a tangent to a rather broad vertical sagged curve. No lighting in area other than illuminating directional signs. Paved median had two-tier guardrail with roadway crowned for drainage. Roadway grade level to +1½⁰. One interchange per quarter mile with no poles or trees (only highway signs) within radius of one-quarter mile.

Traffic Controls

Posted speed limit 70 mph maximum and 45 mph minimum. Road edge delineated by solid white line and traffic lane delineated by intermittent white lines. A channelizing line leading to the exit ramp delineated by solid white line. All roadway markings clear and visible. Sign indicating exit located about one-quarter mile before exit ramp. Directional sign and roadway identification sign were at point of impact. Signs clean and legible. No signals in area.

Vehicles

Vehicle 1, a 1970 Pontiac Firebird, brown exterior and tan interior, odometer 46,593 miles. No indication of previous inspection (mandatory inspection not required in Michigan). No power accessories. Padded instrument panel, sunvisors, doors, and armrests. Lap and shoulder restraints installed with a 4-point non-locking retractor. No vehicle defects found with last maintenance at 38,070 miles on June 6, 1972, consisting of oil, filter change, lubrication, and transmission fluid check. Damage to right front corner, including crush to fender, grill, and hood approximately 20 inches rearward from right front corner. Damage to steering system with steering wheel rim slightly deformed from force of impact and firm grip of driver. No internal occupant contact and no

* American Medical Association Abbreviated Injury Scale (AIS).

occupant injuries. Right rear edge of hood contacted windshield; fractured same but without penetration. The investigator estimated vehicle at time of impact traveling between 35 and 40 mph. VDI:12-FREW-3.

Vehicle 2, a 1968 Plymouth Valiant, 4-door sedan, dark blue exterior and blue interior, odometer 26,380 miles, no indication of previous inspection (mandatory inspection not required in Michigan). No power accessories; automatic transmission; padded middle and lower instrument panel, sunvisors, and armrests. Lap and upper torso restraints installed, but not used by occupant. No head restraint, which by Standard #202 was required effective January 1, 1969. Vehicle periodically maintained by neighborhood service station; appeared to be well maintained with exception of rear tires which were worn with remaining tread stock of 3/32 inches. Damage: 29 inches of crush to left rear corner, left corner panel demolished. fuel tank filler pipe separated from fuel tank, bumper and trunk deformed, left leaf spring buckled, and front seat adjuster deformed. VDI:06-BLEW-5.

Occupants

Driver 1, a 16-year-old male, 71 inches, 163 pounds, Caucasian. Driving experience of two years (originally licensed in Iowa where an operator's license may be obtained at the age of 15), averaging 20,000 miles per year. Driver, sole occupant, en route from home to meet girlfriend at local high school. Collision occurred two miles from origin of trip and only one mile from destination. Driver familiarity with vehicle good, having accumulated about 40,000 miles driving since September, 1970. Good familiarity with area and roadway. Received two-phase driver education course including use of a simulator. Driver 1's physical condition excellent. Mental condition good, but commented at interview that he had premonition of an accident at the time. No alcohol or drugs involved. Driver unrestrained. Injuries: bruised right arm above elbow and bump on head. Injury Severity AIS code 01, minor.

Driver 2, an 88-year-old female, Caucasian, 65 inches, and 125 pounds. Driving experience of over 55 years, with decreasing yearly driving of late so as to average approximately 650 miles per year at present time. En route to University of Michigan Hospital from home in South Lyon, Michigan, to visit daughter. Accident occurred 23 miles from origin and one mile from destination. Vehicle familiarity good having owned the vehicle the preceding four years. Area and road familiarity limited inasmuch as driver had only traveled that route once before. No formal driver education: taught by husband in 1917. Overall physical condition good, but with moderate hearing loss in right ear. Operator's license indicated a restriction for corrective lenses which the driver had on at the time of the crash. Mental condition good. No alcohol or drug involvement. Both driver and passenger in Vehicle 2 claimed to be wearing lap belts at time of collision, but investigators certain they were unrestrained as belts were buried down in seat. Injuries: bruised ribs and upper thorax, bruises and scrapes on both shins below knees, twisted right ankle. Injury Severity AIS code 01, minor.

Right front passenger, Vehicle 2, female. Caucasian, 68 years, 60 inches, and 101 pounds. Believed to be unrestrained. Sustained minor bruise to right knee. Injury Severity AIS code 01, minor.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were relevant to this case study:

- MVPS #201 Occupant Protection in Interior Impact. Windshield cracked when Driver 1's head contacted it. Break-away mirror did break away when contacted with Driver 1's right arm above elbow. In Vehicle 2, ashtray flew out rearward, without contacting any occupants.
- MVPS #202 Head Restraints. Vehicle 2 not equipped with head restraints (mandatory effective January 1, 1969); would have had little effect if they had been installed.
- MVPS #203 Impact Protection for the Driver from Steering Control System. Driver 1 contacted steering wheel with thorax, but was not injured.
- MVPS #207 Anchorage of Seats--Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. The seats in Vehicle 2 remained anchored throughout the crash sequence, but were deformed by the rearward rebounding motion of the front seat occupants and had some rearward displacement.
- MVPS #301 Fuel Tanks. Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. The filler pipe separated from the fuel tank on Vehicle 2.
- TSPS #4 Driver Education. Elderly driver of Vehicle 2 did not comprehend the danger and seriousness of her attempt to backup on a limited access expressway.
- TSPS #5 Driver Licensing. Driver 2's hearing loss and probable slowed reactions due to advanced age indicate need to reexamine elderly drivers to be sure they are still capable of driving.
- TSPS #11 Emergency Medical Services. The ambulance dispatched to the accident took the wrong route and arrived on-scene going southbound in the northbound lane of the expressway, and parked on the other side of the median guardrail from the collided vehicles.

Description

Pre-crash: Both Vehicle 1 and Vehicle 2 were southbound on M-14. Vehicle 2 preceded Vehicle 1 by approximately one minute, with Driver 2 intending to exit on ramp which channels traffic southbound on North Main Street of Ann Arbor. Driver 2 missed the ramp and stopped on the expressway, then put Vehicle 2 into reverse to bring the vehicle into a position

so as to pull forward onto the exit ramp. Driver 1 saw Vehicle 2 approximately $\frac{1}{4}$ mile prior to exit ramp, and assumed that it was moving in proper direction. Driver 1 was distracted by three cars stopped on road edge prior to exit ramp; when he looked ahead, traveling 50 mph, it was too late to avoid a collision with the rear of Vehicle 2 as it was moving rearward. Driver 1 applied his brakes, swerved slightly to left just prior to impact. Driver 2 in violation of law by stopping on minimum speed expressway and backing with Vehicle 2 in a traffic lane. Physical evidence of gas spillage, scuffs, and wreckage debris easily defined the point of impact and movements of both vehicles upon impact.

Crash: Vehicle 1 crashed into rear of Vehicle 2, right front to left rear, as Driver 1 began braking. There were no pre-impact skids or scuffs from Vehicle 1. Impact caused Vehicle 2 to rotate counterclockwise from travel lane 1 (southbound) 160° so as to come to final rest seven feet off roadway edge on gravel shoulder facing northeast. Vehicle 1 went forward upon impact to left counterclockwise approximately 5°, coming to rest in lane 1 (southbound) with left side of vehicle straddling lane delineation line. On impact, Driver 2 thrown back into seat, then rebounded forward into steering wheel and instrument panel sustaining minor contusions and abrasions below both knees. On rebounding back into the driver seat, Driver 2's legs flew up so as to contact the lower instrument panel. The passenger in Vehicle 2 also went back then forward, and sustained a contusion to right knee from contacting instrument panel similarly to Driver 2. Driver 1 went forward on impact contacting windshield with his head and rear mirror with right arm (separating mirror from its mounting), whereupon he rebounded back into his seat in his prior driving position. Vehicle 2 sustained 29-inch crush to left rear corner with damage to left corner panel, fuel neck separated from fuel tank, bumper and trunk area deformed, left leaf spring buckled, and front seat adjusters deformed. Vehicle 1 had 20-inch crush rearward to right front corner, with damage to fender, grill, and hood. Steering mechanism also damaged with steering wheel rim deformed slightly from the firm grip of driver upon impact. Force direction to Vehicle 1 12:00 and to Vehicle 2 6:00.

Postcrash: Nearby police officers, who were in group of three cars parked on road edge distracting Driver 1, assisted Driver 2 and Passenger 2 from their car into police car. Driver 1 exited without assistance. No first aid was required; a dispatched ambulance was turned back when all parties involved stated they did not need medical assistance. Although there was fuel spillage, there was no fire or explosion; no environmental problems. Traffic in early afternoon light, and the open southbound traffic lane (lane 2) permitted an unhindered flow of traffic. Debris included oils and fuel as well as broken glass from damaged vehicles, but little on roadway. Most debris was on road shoulder and expelled from trunk area of Vehicle 2. Police and ambulance response was prompt, although ambulance not required. There was some confusion as to the route to the accident scene causing the ambulance to approach the accident site going south in the northbound lane; they parked on opposite side of median guard barrier from accident. Traffic control consisted of blocking lane 1 with a patrol car with full emergency lights on, and a policeman directing traffic southbound on lane 2.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (+) preceding a number indicates a positive factor.

	Preocrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environment	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principal Causal Factors

- 1 Driver 1's awareness of police cars stopped on road edge distracted from his observing the rearward movement of Vehicle 2. (Probable)
- 1 Driver 2 attempted to back rearward on shoulder and regain missed exit ramp on expressway. (Definite)

Severity Increasing Factors

- 5 Displaced rearward movement of hood on Vehicle 1 contacted windshield, cracking or fracturing same, but without penetration. (Definite)
- 5 Seat adjustors on front seat of Vehicle 2 deformed as a result of rearward movement of front seat from impact. (Definite)

Injury Causation

- 2 Unbelted Driver 1 moved forward contacting windshield and steering wheel; however, his injuries were minor. (Definite)
- 2 The bracing and firm grip of Driver 1 onto steering wheel helped to minimize his forward movement and reduced injuries. (Probable)
- 2 Driver 2 and Passenger 2 unrestrained but this had little if any effect on injury sustained. (Definite)
- 5 The ashtray in Vehicle 2 separated from its instrument panel mounted position and flew rearward upon impact. This constituted an unguided missile within the passenger compartment which could have been injury-producing. (Probable)
- *5 Seat deformation in Vehicle 2 and its movement rearward dissipated energy which could have resulted in whiplash to Driver 2 and Passenger 2 had the seats not yielded when both front seat occupants rebounded rearward. (Probable)

Matrix Cell

Explanation

- *5 Separation of break-away rearview mirror of Vehicle 1 by contact of Driver 1 lessened injury. (Definite)

Relevant Causal Factors

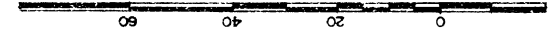
- 1 The hearing loss of Driver 2 as she was receiving driving instructions from the right front passenger in Vehicle 2 helped in her misinterpreting proper point of exit M-14. (Probable)
- *1 Driver 1 slowed when observed stopped cars on road edge of expressway. (Definite)
- 1 Driver 2 unfamiliar with roadway and exit area. (Definite)
- 1 Driver 2's concern for ill daughter may have had an adverse effect on her driving alertness. (Possible)
- 1 Passenger in Vehicle 2 collaborated in maneuver of backing to regain missed exit ramp. (Definite)
- 6 Damage to fuel system on Vehicle 2 resulted in fuel spillage and potential fire hazard. (Definite)
- 7 The three cars stopped on edge of M-14 roadway were distracting to southbound motorists. (Definite)

Postcrash Factors

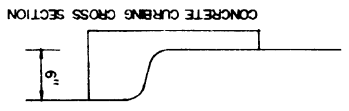
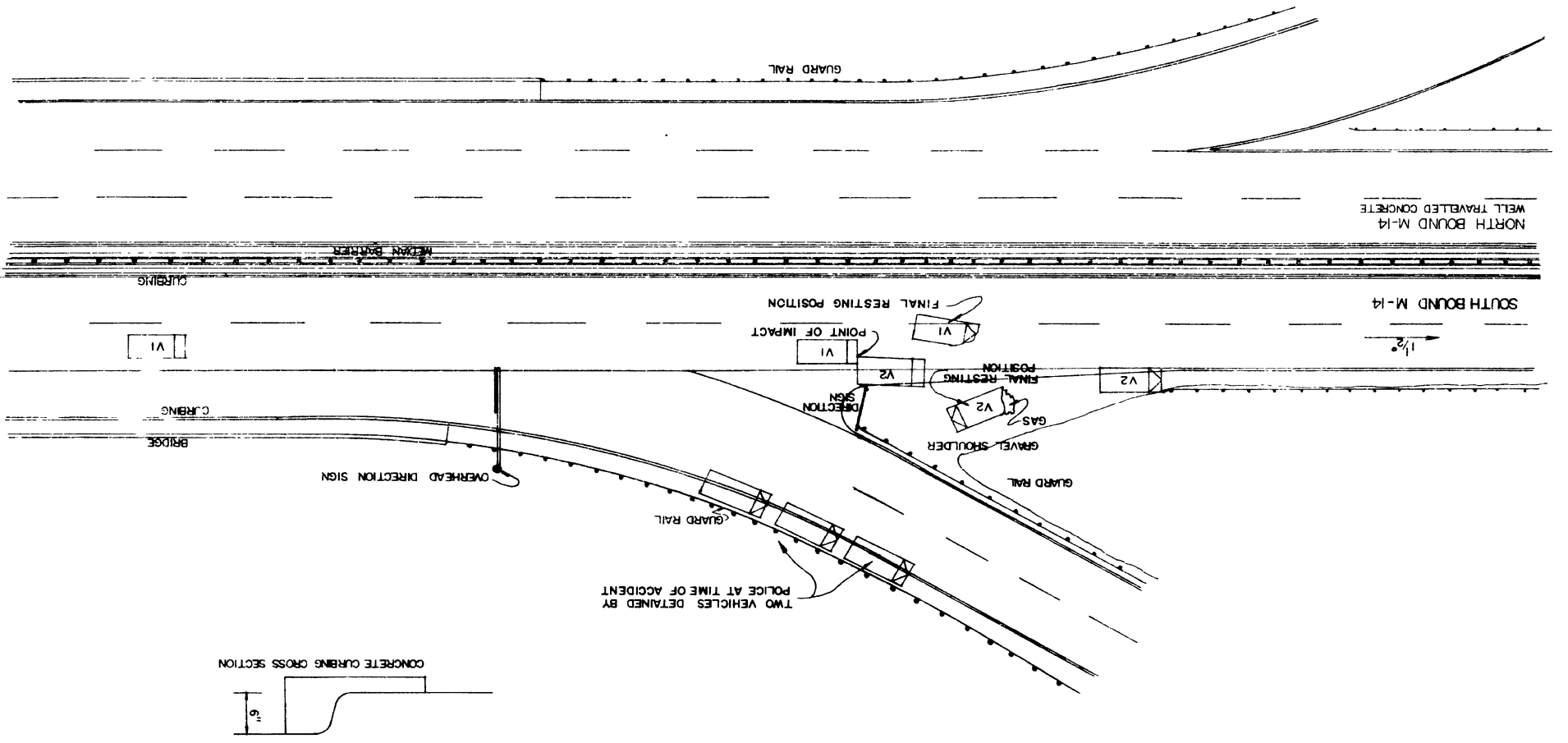
- 3 Route of ambulance to accident site indicated irresponsible behavior of driver. Ambulance drove wrong way on section of expressway to reach accident site. (Definite)
- 9 Stopped ambulance facing southbound on travel lanes on northbound M-14 was startling and a potential source for additional accidents to northbound motorists. (Probable)

Recommendations

- 1 Traffic Safety Program Standard #4, Driver Education; and #5, Driver Licensing, be reevaluated and improved with provisions for updating driver skills, particularly those of elderly drivers, so that their knowledge of the highway transportation system will be consistent with the increasing complexity of today's expressways.



AA 312



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-314
CASE SUMMARY

Identification

Accident occurred on Plymouth Road at Bishop Street, city of Ann Arbor, Washtenaw County, Michigan, on Wednesday, September 20, 1972 at 1707 o'clock. Area residential. Two passenger cars, head-on collision. Injury severity AIS* code 01, minor.

Ambience

Clear sunny afternoon, temperature 70°F, relative humidity 35%, wind 10 mph from the southeast. Roadway dry.

Highway

Plymouth Road, major arterial, 34 feet wide; 3-lanes, center lane for left turn only. No divider. Well-traveled, well-maintained asphalt. Packed dirt shoulder on north side, 21 feet wide; 6-inch* curb on south side. Roadway slightly curved; level at accident site, $-1\frac{1}{2}^{\circ}$ grade west to east, -1° grade east to west. Only lighting two mercury vapor luminaires. Within a quarter mile radius, no driveways or interchanges, three intersections, 15 utility poles, and 30 trees.

Traffic Controls

Speed limit posted at 40 mph. Solid and intermittent yellow left turn lane delineators, good visibility. Traffic signs included "Center Left Only," "No Parking," and speed limit. No signals.

Vehicles

Vehicle 1, passenger car, 1971 Ford Mustang, 2-door hardtop, odometer 22,314 miles. No indication of vehicle inspection (periodic vehicle inspection not mandatory in Michigan). Manual transmission, no power accessories. Padded upper instrument panel, sunvisors, armrests. Lap belts and upper torso restraints available. No vehicle defects, no recorded maintenance. Vehicle 1 sustained 13 inches of frontal crush; sheet metal damage to hood, left front fender, bumper, grill and radiator. VDI*:12-FYEW-2.

Vehicle 2, passenger car, 1964 Mercury Comet, 2-door sedan, odometer greater than 70,000 miles. No indication of vehicle inspection (periodic vehicle inspection not mandatory in Michigan). No power accessories, manual transmission; light padding on armrests, no other padded components. No restraints available. No vehicle defects, no recorded maintenance;

* American Medical Association Abbreviated Injury Scale (AIS).

* Six-inch curbs standard in city of Ann Arbor, Michigan.

* Vehicle Deformation Index (VDI).

well-maintained appearance, only minor body rust considering model year and geographic area. Front sheet metal damage to left front fender, hood, grill, and bumper; 6 inches of crush. VDI:12-FYEW-1.

Occupants

Driver 1, 19-year-old Black female, 63 inches, and 130 pounds. Three years of very limited driving experience; during month prior to accident, had driven 300 miles with it. Traveling from place of work in Ypsilanti to babysitter in Ann Arbor, then planned to pick up husband at University of Michigan Hospital. Seven miles from origin, two miles from first destination. Adequately familiar with Vehicle 1; not very familiar with route having traveled in only about a dozen times. Completed two-phase driver education course in high school, including on-road and classroom training. Overall physical condition good, very fatigued; under stress from life situation, afraid of driving. No alcohol involved. Driver unrestrained. Injuries: overall soreness, especially to thorax. Injury severity AIS code 01, minor.

Driver 2, 25-year-old Caucasian female, 64 inches, and 135 pounds. Eight years driving experience, averaging 8,000-10,000 miles per year. Driving from work in Ann Arbor to home; three miles from origin, quarter mile from destination. Owned car four years and drove it regularly; traveled route daily for past six months. Completed two-phase driver education course in high school. Overall physical and mental condition good. Unrestrained driver sustained soreness to thorax. Injury severity AIS code 01, minor.

Standards

The following Traffic Safety Program Standards (TSPS) were specifically relevant to this case:

- | | |
|----------|---|
| TSPP #4 | Driver Licensing. Driver 1 may not have had driver license. |
| TSPP #5 | Driver Education. Driver 1 very tired, claimed black-out, did not seek medical help postcrash. Driver education courses need to caution students that fatigue contributes to automobile accidents and to emphasize prudence of seeking immediate medical treatment after accident, even when injuries seem minor. |
| TSPP #15 | Police Traffic Services. Medical treatment not requested for Driver 1 who may have temporarily loss consciousness due to some medical reason; help should have been sought. Driver 1's driver license number not recorded on police report. |

Description

Pre-crash: Vehicle 1 headed southwest at 30 mph, Vehicle 2 northeast on Plymouth Road at 35 mph, both in respective lanes. Vehicle 1 drifted to center left-turn lane, then crossed into westbound lane of traffic. Driver 2 first thought Driver 1 intended to turn down Bishop, but when

she realized Driver 1 wasn't turning, she braked to 20 mph prior to impact. Driver 1's failing to have her vehicle under control and driving to left of center line both violations of traffic laws. Police cited Driver 1 for hazardous driving. No precrash physical evidence, skids, or scuffs.

Crash: On impact, Vehicle 1 rotated 45° clockwise, Vehicle 2 rotated 25° counterclockwise. Both vehicles came to final rest in the eastbound lane, slightly turned toward center of roadway, approximately six feet apart. Both drivers thrown forward into steering wheel, then rebounded backwards into their seats. Contact with steering wheel caused overall soreness, especially to thorax, of Driver 1, and soreness to thorax of Driver 2. Vehicle 1 had sheet metal damage to hood, left front fender, bumper, grill, and radiator; 13 inches of frontal crush. Vehicle 2 sustained six inches of frontal crush and sheet metal damage to left front fender, hood, grill, and bumper. Direction of force 12:00 o'clock to both cars.

Postcrash: Both drivers exited themselves. Passerby called police who arrived promptly considering heavy traffic; no ambulance summoned. No first aid administered. Radiator fluid leaked from both vehicles; pieces of grill and headlight glass on roadway. No fires or explosions. Traffic congestion on Plymouth Road worst it had been in recent years (see Narrative); police routed traffic around accident into two open lanes.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	<u>Precrash</u>	<u>Crash</u>	<u>Postcrash</u>
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

1 Driver 1 crossed into opposing lane of traffic into path of Vehicle 2. (Definite)

Severity Increasing Factor

*1 Driver 2 saw Driver entering her lane and braked, thus decreased accident severity. (Definite)

Relevant Conditions

1 Driver 1 fatigued from loss of sleep and long work day. (Definite)

Matrix Cell

Explanation

Relevant Conditions (continued)

- | | |
|---|--|
| 1 | Driver 1 under stress with assumption of new responsibilities in marriage, new baby, and job. Driver 1 also inexperienced driver, afraid to drive husbands car. (Definite) |
| 1 | Driver 1 experienced momentary loss of consciousness. (Probable) |

Injury Causation

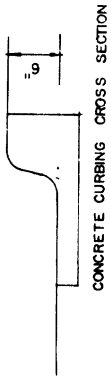
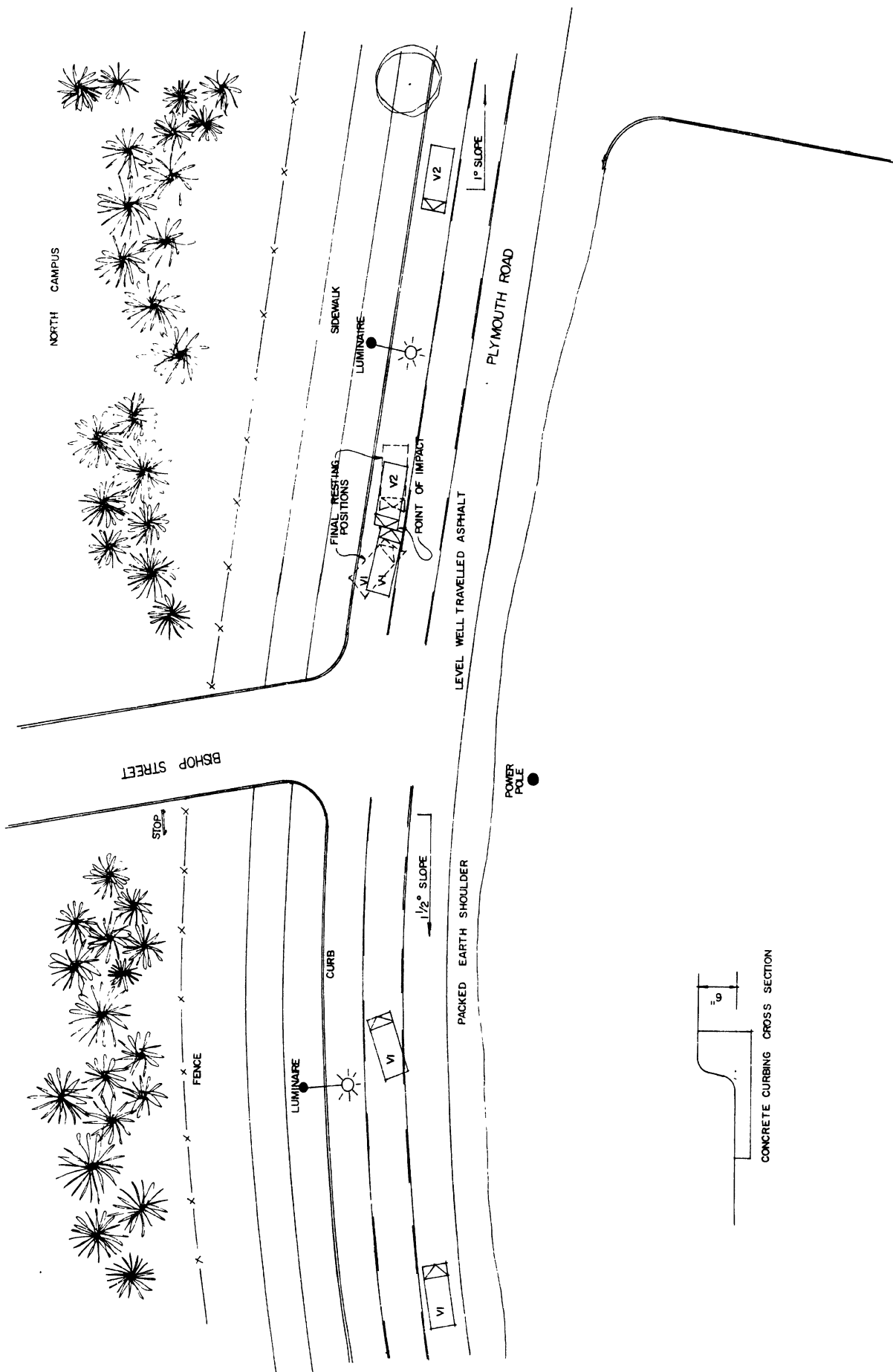
- | | |
|---|--|
| 2 | Minor injuries to Driver 1 and Driver 2 would have been prevented had they worn restraints. (Definite) |
|---|--|

Postcrash Factors

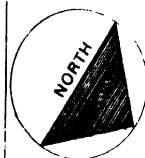
- | | |
|---|--|
| 3 | Ambulance should have been summoned for Driver 1 who may have had a medical problem causing her to black-out. (Definite) |
| 3 | Driver 1's license number should have been recorded on traffic accident report. |

Recommendations

- | | |
|---|--|
| 1 | Driver education courses should stress that people who are fatigued and under stress should avoid driving. |
| 3 | Emergency medical treatment should always be made available when a driver has loss of consciousness, even momentarily. |



AA 314



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-315
CASE SUMMARY

Identification

Accident occurred at the intersection of Detroit Street, Catherine Street and North Fourth Avenue, three collectors in the city of Ann Arbor, Washtenaw County, Michigan, on Wednesday, September 20, 1972 at 1725 o'clock. Area commercial, old section of city. Injury Severity AIS code 01, minor.*

Weather

Bright, sunny day, temperature 75⁰, humidity 60%, wind from west at 3 mph. Roadway dry.

Highway

Detroit Street, 38 feet wide, and North Fourth Avenue, 42 feet wide, two-lane collectors, well-traveled, poorly maintained brick on the north side of Catherine Street, well-traveled asphalt on the south side; no dividers. Catherine, four-lane collector, 44 feet wide, well-traveled asphalt; no divider. Standard six-inch curbs. Streets straight and crowned for drainage; -1¹⁰/₂ grade on North Fourth Avenue. Five mercury vapor luminaires. Within a quarter mile radius of Detroit Street, 15 driveways, 3 intersections, 10 poles, and 6 trees; of Catherine Street, 12 driveways, 4 intersections, 15 poles, and 20 trees; and of North Fourth Avenue, 15 driveways, 2 intersections, 6 poles, and 12 trees.

Traffic Controls

Speed limit on all three streets 25 mph by state statute. Pavement markings included broken white lane delineators on Detroit and North Fourth; broken white lane delineators and yellow double solid center line on Catherine; visibility good. White crosswalk lines on Catherine worn away and barely visible. No symbols or words on pavement. Four Stop signs, one No Parking sign. No traffic signals. Accident history over three-year period: one intersection accident on Detroit; five accidents on Catherine in or near intersection during rush hour; no previous pedestrian accidents.

Vehicle

Passenger Car, 1970 Chevrolet Nova, 2-door sedan, white exterior and gold interior; odometer 12,465 miles. No indication of vehicle inspection (periodic vehicle inspection not mandatory in Michigan). No power accessories; automatic transmission; padded upper instrument panel, armrests, and sunvisors. Lap and upper torso restraints. No vehicle defects; medium to heavy wear on brake shoes. Last maintenance at 36,789 miles; oil, filter, and lubrication. Significant aspect of vehicle in

* American Medical Association Abbreviated Injury Scale (AIS).

regard to this accident was blunt front end design. No damage.
VDI*:12--FLEN-0.

Occupant

Driver, 40-year-old Caucasian, male, 71 inches and 158 pounds. Driving 20 years averaging 15,000 miles per year. Had driven from home to downtown Ann Arbor to go shopping; en route to convalescent home outside Ann Arbor to visit mother. Accident site 18 miles from driver's home, one mile from downtown Ann Arbor, and 19 miles from destination. Owned vehicle three years, had accumulated all mileage. Unfamiliar with area, had traveled route before but not recently; route was preplanned. Taught to drive by uncle; no formal driver education course. Overall physical condition good; wears bifocals, vision corrected to normal. Good mood, under no stress. No alcohol involved. Unrestrained, no injuries. Injury Severity AIS code 0, no injury.

Pedestrian

Pedestrian, 15-year-old Black, female, 62 inches and 118 pounds. Trip plan unknown, possibly headed home four blocks from site. Familiar with area. Overall physical condition good; had cystic growth in neck and shaft of right femur, growth present three years and becoming more severe. Mental condition unknown; postcrash seemed to be very dramatic and pseudo-hysterical. No alcohol involved. No injury other than complaint of pain in right femur. Injury Severity AIS code 01, minor.

Standards

The following Traffic Safety Program Standard (TSPS) is specifically relevant to this case:

TSPS #14	Pedestrian Safety. Preexisting crosswalk lines on Catherine Street barely visible; no traffic controls for pedestrian crossing; need to teach children caution in crossing streets.
----------	---

Description

Preocrash: Vehicle headed west on Catherine in outside lane at 5 mph. Driver intended to turn right on North Main Street one block west of accident site. Pedestrian stepped off traffic island south of accident site, crossed two lanes of eastbound traffic, and one lane of westbound traffic which was backed up from North Main Street. Without checking for clearance, pedestrian entered outside westbound lane directly in path of Chevrolet Nova. Driver didn't see pedestrian until she stepped into his lane; then he braked, leaving three feet of wheel skid marks. No traffic violations on part of either driver or pedestrian.

Crash: Left front corner of vehicle hit pedestrian's right leg and hip, and threw her forward about four feet. Pedestrian's final resting position on left side, facing south; complained of pain in right femur from contact with vehicle. No vehicle damage; direction of force to vehicle, 12:00 o'clock.

* VDI = Vehicle Damage Index.

Postcrash: Passerby phoned for help; police and ambulance response prompt. As pre-cautionary measures, ambulance attendants applied splint to pedestrian's right thigh in case of fracture, and transported her on a backboard. No environmental problems as accident occurred at end of 5:00 rush hour. Two squad cars and six policemen directed traffic and prevented a traffic tie-up.

Causal Factors and Recommendations:

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Pre-crash	Crash	Post-crash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell Explanation

Accident Causation

Primary or Principle Causes

- 1 Pedestrian inattentive. (Definite)
- 7 Accident occurred in older section of city, which is not designed to handle rush hour traffic and which has no safe provisions for pedestrian crossing. (Definite)

Severity Increasing Factor

- 1 Pedestrian preexisting cystic growth on right femur aggravated by contact with vehicle and may have been source of alleged pain. (Probable)

Injury Causation

- *5 Blunt frontal design of vehicle minimized pedestrian injury potential. (Definite)

Postcrash Factors

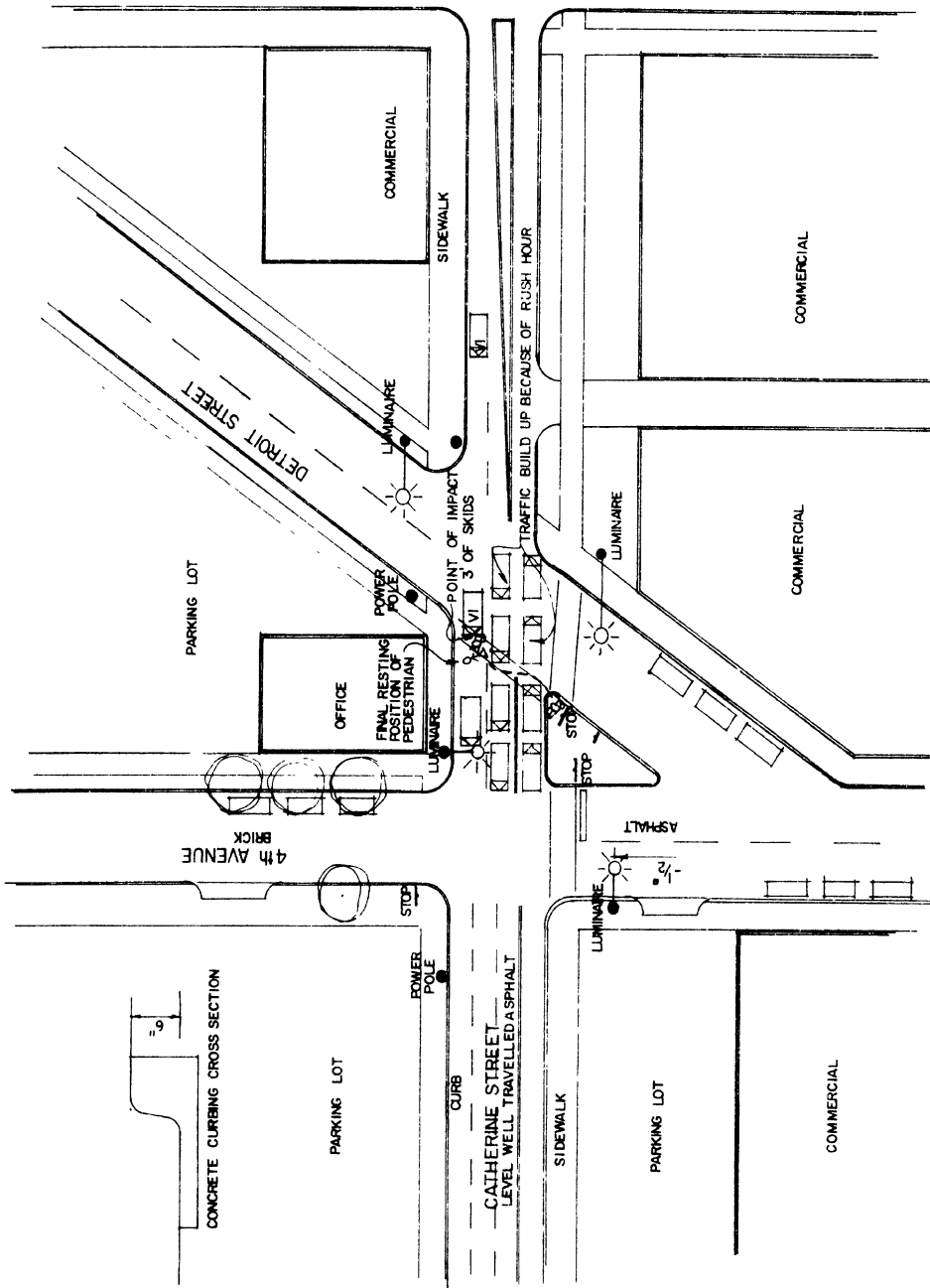
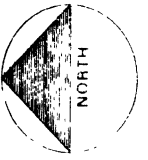
- *3 Ambulance response prompt; use of splint and backboard proper precautions. (Definite)
- *3 White police maintained calm in face of hostile black crowd. (Probable)
- *3 Police maintained smooth traffic flow after accident. (Definite)

Matrix Cell

Explanation

Recommendations

- | | |
|---|--|
| 1 | Pedestrian education necessary, beginning with very small children; should be part of all safety programs. |
| 7 | Pedestrian crossing signs and crosswalk markings at accident site would be helpful. |
| 7 | Need to simplify intersection to clearly define pedestrian crossing area. |



AA 315



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-316
CASE SUMMARY

Identification

Accident occurred at the intersection of Arkona Road and Sanford Road, in rural agricultural area adjacent to town of Milan, Augusta Township, Washtenaw County, Michigan, on Monday, October 2, 1972, at 0820 hours. School bus and passenger car, oblique T-type intersection collision. Injury severity AIS* code 03, severe, non-threatening.

Ambience

Daylight; clear and sunny; unlimited visibility. Temperature 54°, relative humidity 91%, wind 4 mph from southwest. Roadway dry.

Highway

Arkona Road, 24 feet wide, and Sanford Road, 20 feet wide, both 2-lane local roadways. No divider. Arkona newly surfaced, Sanford well-traveled and well maintained; Arkona--concrete, Sanford--asphalt. Grass shoulders. Both straight, level, and crowned for drainage. No lighting. Accesses within a quarter-mile radius of Arkona: no driveways, 12 utility poles, no trees; of Sanford: 1 driveway, 8 utility poles, 5 trees. The only recorded accident at this location is another bus/car accident that occurred in 1967. A copy of the accident report is shown in Appendix B.

Traffic Controls

Speed limit 40 mph--posted on Arkona, by statute on Sanford. Intermittant yellow center line, visibility good. "Dead End Road" and "Speed Limit 40" signs on Arkona; "Yield" signs on Sanford. No signals.

Vehicles

Vehicle 1, school bus, 1970 International Harvester Loadstar 1600 with a Wayne body; odometer 38,166 miles; exterior chrome yellow with black stripes. Inspection sticker #3818 dated February 1, 1972. No power accessories or padded components; air brakes. Lap belt available for driver only (but not used). Vehicle in excellent condition, no defects; six new tires at 36,035 miles; at 37,837 miles brakes checked and adjusted, clutch adjusted, lubrication, carburetor replaced. Damage to steering gear box, roof dented, frame shifted to right 6 inches in engine compartment area, front leaf springs shifted to left fender, sheet metal damage to hood, bumper, and grill (8 inches of crush to front bumper), bumper mount partially separated. Significant finding: no shoe separation from

* American Medical Association Abbreviated Injury Scale (AIS).

reinforcement web; passenger compartment integrity remained intact. Primary VDI*:10-LFEW-2, secondary VDI:00-LDHW-1.

Vehicle 2, passenger car, 1964 Dodge Dart 170, 2-door sedan; odometer 62,567 miles; silvery blue exterior, light blue interior. No indication of vehicle inspection (periodic vehicle inspection not mandatory in Michigan). Automatic transmission; no power accessories, no padded components. After-market seat belts in front seat. Body badly rusted; brake linings and drums heavily grooved. Last recorded maintenance at 46,750 miles on February 26, 1970, consisted of oil change, new oil filter, and lubrication. Extensive damage to left side, right side and roof. Significant findings: gas tank deformed on left side and right front corner, tank contact with shock absorber mount caused fuel leakage; right front brake line cracked just before mount leading to rubber hose; right upper door hinge separated. Primary VDI:02-RDAW-6; secondary VDI:00-TPGW-3.

Occupants

Driver 1, 53 years, female, Caucasian, 67 inches and 175 pounds. Had been driving school bus 21 years. Driving on regular school route to pick up students; was 20 minutes into second route, running a few minutes ahead of schedule. Familiar with vehicle, which she drove every school day, and with route, which she traveled four times a day. Underwent a summer course in 1972 for school bus drivers at Eastern Michigan University, Ypsilanti, Michigan. Physical and mental condition good. No alcohol or drug involvement. Driver unrestrained. Injuries: multiple superficial lacerations and abrasions to forehead and scalp, extending three inches, superior to hairline, 1-inch tearing laceration center forehead, minor laceration left cheek. 3 inch x 7 inch contusion posterior left shoulder, 3 inch x 2 inch contusion posterior right arm over deltoid muscle, contused elbows, 4 inch x 5 inch contusion left hip, contusion left lower back, left knee abrasion, fracture of first lumbar vertebra. Injury severity AIS code 03, severe, non-threatening.

Passengers, Vehicle 1. See Bus Diagram on attached sheet.

A2, 12 years, female, Caucasian, 62 inches and 103 pounds. Injuries: minor bumps and scratches. Injury severity AIS code 01, minor.

A3, 11 years, male, Caucasian, 59 inches and 87 pounds. Injury severity AIS code 00, no injuries.

A4, 13 years, male, Caucasian, 62 inches and 104 pounds. Injury severity AIS code 00, no injuries.

A5, 12 years, male, Caucasian, 57 inches and 95 pounds. Injury severity AIS code 00, no injuries.

A6, 12 years, male. Caucasian, 60 inches and 95 pounds. Injury severity AIS code 00, no injuries.

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a. and currently utilized in NHTSA sponsored multidisciplinary accident investigations.

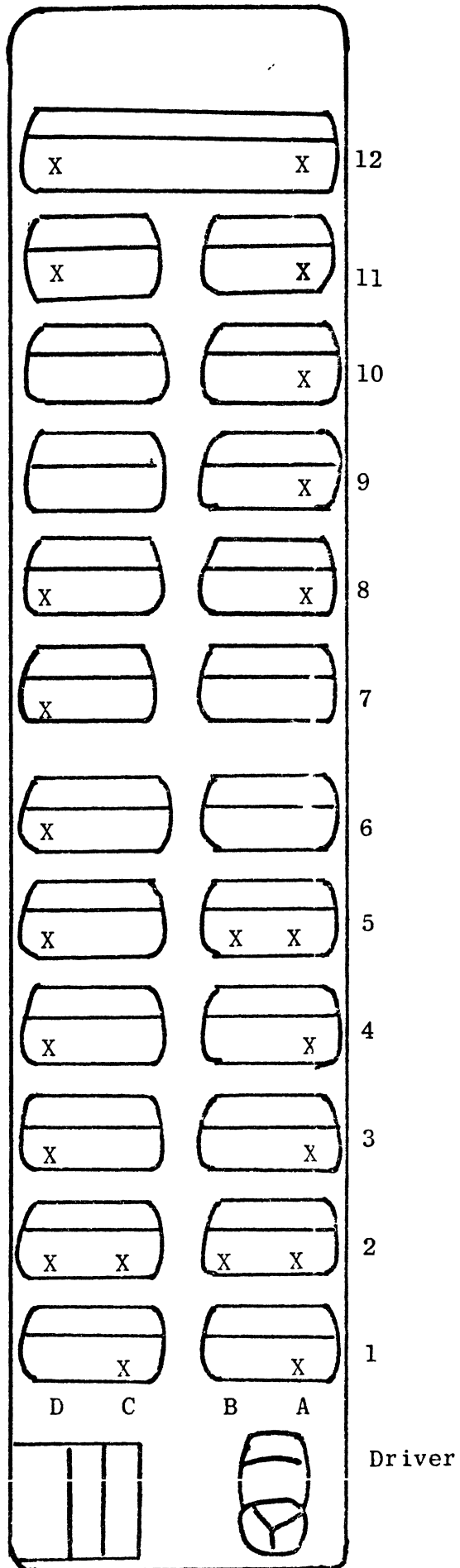


Diagram of Bus and Positions at which Occupants were Seated.
81

A7, 12 years, female, Caucasian, height and weight unknown.
Injuries: contusion right upper lip and cheek, superficial laceration to left thumb, and contusion to right foot. Injury severity AIS code 01, minor.

A8, 14 years, female, Caucasian, 60 inches and 110 pounds.
Injuries: minor contusions (non-specific). Injury severity AIS code 01, minor.

A11, 15 years, female, Caucasian, 63 inches and 134 pounds.
Injuries: contusion center forehead, and $1\frac{1}{2}$ -inch laceration to lumbar area. Injury severity AIS code 01, minor.

A12, 18 years, male, Caucasian, 72 inches and 165 pounds.
Injury: mid-back strain. Injury severity AIS code 01, minor.

B1, 11 years, female, Caucasian, 55 inches and 65 pounds.
Injuries: contusions both knees and right upper arm. Injury severity AIS code 01, minor.

B2, 12 years, female, Caucasian, 60 inches and 90 pounds.
Injuries: laceration over left eye, abdominal pain, minor contusions (momentary loss of consciousness), nauseated. Injury severity AIS code 02, moderate, non-dangerous.

C2, 12 years, male, Caucasian, $62\frac{1}{2}$ inches and 126 pounds.
Injuries: contusions on both legs. Injury severity AIS code 01, minor.

C5, 14 years, male, Caucasian, 67 inches and 130 pounds.
Injury: contusion to left leg. Injury severity AIS code 01, minor.

D1, 12 years, male, Caucasian, 61 inches and 135 pounds.
Injuries: bruises over right clavicle and left elbow. Injury severity AIS code 01, minor.

D2, 12 years, male, Caucasian, 61 inches and 110 pounds.
Injuries: contusions to right leg. Injury severity AIS code 01, minor.

D3, 15 years, female, Caucasian, 66 inches and 140 pounds.
Injuries: contusions right posterior scalp, lower back, and right buttock, severe headache. Injury severity AIS code 01, minor.

D4, 14 years, male, Caucasian, 65 inches and 145 pounds.
Injuries: contusions left thigh and right foot. Injury severity AIS code 01, minor.

D5, 13 years, male, Caucasian, 65 inches and 115 pounds.
Injuries: swelling on forehead. contusions legs and arms; momentarily unconscious. Injury severity AIS code 02, moderate, non-dangerous.

D8, 16 years, male, Caucasian, 66 inches and 130 pounds.
Injuries: complaint of pain to chin, contusions over left ribs and left thigh. Injury severity AIS code 01, minor.

D9, 16 years, female, Caucasian, 62 inches and 106 pounds. Injuries: contusions right hand, left shoulder, and upper back; pain left side of neck. Injury severity AIS code 01, minor.

D11, 14 years, female, Caucasian, 59 inches and 100 pounds. Injuries: contusions left arm and upper back. Injury severity AIS code 01, minor.

D12, 13 years, female, Caucasian, 64 inches and 126 pounds. Injuries: contusion on nose, 1-inch laceration left parietal area, complaint of pain left arm and neck; unconscious five to ten minutes. Injury severity AIS code 02, moderate, non-dangerous.

Driver 2, 23 years, female, Caucasian, 60 inches and 118 pounds. Seven years driving experience averaging 6,000 miles per year. Driving from home in Milan to place of employment in Ann Arbor; accident occurred two miles from origin and 14 miles from destination. Had owned Vehicle 2 three months and had accumulated 2,000 miles driving. Very familiar with roadway, lived in area and traveled same route daily to place of employment. Two-phase driver education course in high school. Good physical and mental condition. No alcohol or drugs involved. Driver unrestrained. Injuries: multiple fractures to right side of face, right sacral fracture, two lacerations beneath right eye, laceration to anterior aspect of right elbow, contusions to left mid-upper arm, contusions and abrasions to left chest, contusions to right anterior mid-thigh and outer aspect right knee; unconscious one-half hour, disoriented with partial amnesia for approximately 24 hours. Injury severity AIS code 03, severe, non-threatening.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|-----------|---|
| MVPS #201 | Occupant Protection in Interior Impact-- Passenger Cars. Severe interior damage to Vehicle 2, including rotated panels, twisted seats, opened glove compartment door, and sharp apertances, increased potential for occupant injury (Vehicle 2 pre-standard). |
| MVPS #206 | Door Locks and Door Retention Components-- Passenger Cars and Multipurpose Passenger Vehicles. Upper hinge on right door of Vehicle 2 separated with severe side damage; and latch released on left door allowing lower extremities of driver to be ejected (Vehicle 2 pre-standard). |
| MVPS #212 | Windshield Mounting--Passenger Cars. Roof damage on Vehicle 2 so severe that windshield totally separated, allowing space for possible occupant ejection (Vehicle 2 pre-standard). |

- MVPS #214 Side Door Strength--Passenger Cars. Although impact exceeded standard test requirements, had side guard door beams been installed in Vehicle 2, the structure would have absorbed some of the energy and decreased penetration into the passenger compartment (Vehicle 2 pre-standard).
- MVPS #216 Roof Crush Resistance--Passenger Cars. Had Vehicle 2 complied (standard not effective until August 15, 1973), roof crush would have been lessened and penetration into passenger compartment decreased.
- MVPS #301 Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. Vehicle 2's gas tank leaked because of contact with shock absorber during crash (Vehicle 2 pre-standard).
- MVPS #301 Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. Vehicle 2's gas tank leaked because of contact with shock absorber during crash (Vehicle 2 pre-standard).
- TSPS #4 Driver Education. Driver 2 assumed intersection traffic clear because alleged vehicle ahead of Vehicle 2 proceeded through, hence Driver 2 disregarded "Yield" sign; need to emphasize caution at intersections, especially in familiar areas. Continue to stress need to wear safety restraint systems for maximum protection in impact (Driver 1 and Driver 2 unrestrained).
- TSPS #11 Emergency Medical Services. Driver 2 initially transported to hospital not equipped to treat her injuries.
- TSPS #17 (Proposed) Pupil Transportation Safety. Driver of school bus unrestrained; this proposed standard in its current form will require use of lap restraints when available and vehicle is in motion.

Description

Pre-crash: Vehicle 1 westbound at approximately 20 mph on Arkona Road and Vehicle 2 northbound on Sanford Road, both in respective lanes. Vehicle 2 entered intersection at a driver-estimated 35 mph without visually checking for on-coming traffic at intersection crossing and without yielding right of way. When Driver 1 realized collision was imminent, turned hard right to avoid Vehicle 2 or minimize consequences of direct impact (or perhaps action was a conditioned reaction). Vehicle 1 struck mid-right side of Vehicle 2. Driver 2 did not see Vehicle 1 before impact, so took no evasive maneuver. Driver 2's failure to obey "Yield" sign violation of traffic laws. Pre-crash vehicle movements indicated by critical turning scuff marks left by left wheels of Vehicle 1.

Crash: Vehicle 2 struck in right side by left front corner of Vehicle 1, rotated clockwise 60°, continued across intersection doing almost an eighth roll, left roadway at shoulder, vaulting over ditch and impacting utility pole at northeast corner of intersection with roof. Came to final rest upright on all four wheels at base of pole. Vehicle 1 continued to rotate clockwise 135°, "tripped" on far side of intersection, rolling over onto left side while continuing to rotate across pavement; came to final rest oriented northeast with vehicle frontal section on shoulder, mid to rear of bus on pavement. On impact, Driver 1 thrown forward and to left, contacting the left side passenger mirror with her head and the control panel to left of seat with left hip. Her left knee also struck the instrument panel, possibly impacting the heater knobs. As the bus rolled over, the front portion of the left window fractured and Driver 1 was partially ejected and came to final rest facing forward, pinned with left shoulder against the ground and right shoulder against the upper window frame. Driver 1 sustained multiple superficial lacerations and abrasions to forehead and scalp, extending three inches superior to hairline, from side window glass and contact with ground, and possibly from hitting left passenger mirror; 1-inch tearing laceration center forehead from top of window frame; minor laceration to left cheek from window glass; 3 inch by 7 inch contusion posterior left shoulder from striking the earth; 3 inch by 2 inch contusion posterior right arm over deltoid muscle from upper window frame; contused elbows from ground and window frame; 4 inch by 5 inch contusion left hip from heater and control panel to left of driver's seat; contusion left lower back from impacting side of bus; left knee abrasion possibly from heater control knob; and fracture of first lumbar vertebra probably from movement left forward into instrument panel.

Kinematics and resultant injuries of Vehicle 1 passengers:

A2: turned facing aisle precrash; fell to floor on impact; at rollover fell against left window and adjacent passenger fell on top of her. Minor bumps and scratches.

A3: braced arms against seat back at impact and remained in seat; fell to left side at rollover. No injury.

A4: braced knees and arms against seatback at impact and remained in seat; fell against left side at rollover. No injury.

A5: thrown forward at impact, lightly striking seat back; put arms over head and fell against left side at rollover. No injury.

A6: braced self on seat back and retained seat at impact; fell against left window at rollover. No injury.

A7: kinematics unknown. Contusion right upper lip and cheek, superficial laceration left thumb, contusion right foot.

A8: thrown forward against seat back at impact, against left side of bus at rollover. Minor contusions, non specific.

All: thrown forward at impact, hitting head on seat back; thrown against left window at rollover. Contusion center forehead, 1½-inch laceration lumbar area from broken glass.

A12: seated with back against window and legs across seat precrash; impacted back against left window. Mid-back strain.

B1: exact movements unknown; probably impacted divider behind driver's seat. Contusions both knees and right upper arm.

B2: fainted and fell into aisle on impact, fell against passenger A2 on rollover; poked in face with sharp object. Laceration over left eye, abdominal pain, nauseated, minor contusions, momentary loss of consciousness.

C1: fell into aisle on impact and against left window area at rollover, seat cushion came loose and landed on his legs. Contusions on both legs.

C5: fell into aisle on impact, leg hit seat frame across aisle during rollover. Contusion to left leg.

D1: seated sideways with knee on seat; fell sharply to left and hit left arm and shoulder on front left corner near light. Bruise over right clavicle and left elbow.

D2: kinematics unknown. Contusion right leg.

D3: leaning head on window precrash, may have hit head on right window at impact; fell to left at rollover and hit back against seat frame. Contusion right posterior scalp, lower back, and right buttock; severe headache.

D4: seated sideways facing aisle precrash; on impact thrown to floor and to left; impacted window and occupant A4 at rollover. Contusions to left thigh and right foot.

D5: facing front before crash; bumped head on seat back at impact. Swelling on forehead, contusions legs and arms, momentarily unconscious.

D8: bumped chin on seat frame at impact and left side against side of bus at rollover. Complaint of pain to chin; contusions over left ribs and left thigh.

D9: impacted top of bus, side by window, and adjacent occupant on rollover. Contusions right hand, left shoulder, and upper back; pain left side of neck.

D11: braced arms on seat back at impact; bumped against seat frame, ceiling, and adjacent window area at rollover. Contusions left arm and upper back.

D12: hit nose on seat frame and impacted head against left side of bus during rollover. Unconscious five to ten minutes; contusion on nose, 1-inch laceration left parietal area from broken window glass, complaint of pain left arm and neck. Injury severity AIS code 02, moderate, non-dangerous.

At first impact (with bus), Driver 2's head and upper torso moved forward into right A-pillar area where front of bus penetrated. Received severe facial fractures from contact with right A-pillar, and superficial chest and left arm injuries from striking upper instrument panel. At second impact (with pole), Driver 2 thrown up and to the left. Left door sprung open when airborne car impacted pole, and driver was partially ejected, coming to final rest laying across seat with lower torso protruding out left door. Leg contusions probably incurred from instrument panel or lower steering column. Sacral fracture most likely resulted from compression as driver heavily impacted A-pillar during either the first or second impact. Unconscious for half hour, and disoriented with partial amnesia approximately 24 hours.

Most damage to Vehicle 1 was to left front corner where it struck Vehicle 2. There was sheet metal damage to the hood, bumper, and grill, with eight inches of crush to front bumper. Vehicle 1's frame displaced to the right six inches in the engine compartment area, front leaf springs shifted to left fender, steering gear box was damaged, roof was dented, and the bumper mount partially separated. Driver's window and left rear passenger window broke. Vehicle 2 sustained extensive damage to left side, right side, and roof, and the right upper door hinge separated. Gas tank deformed on left side and right front corner and there was fuel leakage from where the tank contacted the shock absorber mount. Right front brake line cracked just before mount leading to rubber hose. Directions of force were 10:00 o'clock to Vehicle 1; and to Vehicle 2, 2:00 o'clock from impact with bus, 9:00 o'clock from secondary impact with pole.

Postcrash: Nearby resident called police. Truck driver who was immediately on-scene removed Driver 2 from her car because he feared airway obstruction when he saw extent of her facial injuries. Children were helped out of the bus by an eighteen-year-old bus passenger; Driver 1 was pinned in the bus. First ambulance transported Driver 2 on a backboard and six of the school children to Saline Community Hospital where children were treated and released. Driver 2's head injuries were too severe to be treated there; her wounds were cleansed and she was moved to St. Joseph's Mercy Hospital in Ann Arbor, Michigan. Driver 1's superficial injuries were treated on-scene, then the second ambulance transported her on a backboard and two of the school children to St. Joseph's. Attendants from the third ambulance helped extricate Driver 1, but did not transport any occupants. No fires, explosions, or environmental problems; only debris was glass from Vehicle 1 and glass, trim parts, and gasoline from Vehicle 2. Site hosed down by area fire department upon vehicle removal. No traffic controls needed, as the roadway location was lightly traveled.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Cause

- 1 Driver 2 failed to yield right-of-way, entering intersection without checking for crossroad traffic. (Definite)

Severity Increasing Factors

- 1 Driver 1's evasive maneuver of turning to right enhanced vehicle instability. (Definite)
- 4 Relative high center of gravity of Vehicle 1, in such a counterclockwise skid, contributed to rollover. (Definite)
- 5 Relative size of Vehicle 1 and Vehicle 2, significantly dissimilar vehicles, increased severity of impact to Vehicle 2 because of frame override. (Definite)
- 5 Rusted condition and old age of Vehicle 2 reduced crash resistance and permitted greater passenger compartment intrusion. (Probable)
- 5 Lack of side guard door beam structure in Vehicle 2, due to vintage of vehicle, permitted greater penetration of Vehicle 1 into Vehicle 2. (Probable)

Relevant Conditions

- 1 Driver 1 preoccupied with bus route, with knowledge of lightly traveled intersection ahead, did not exercise caution when approaching intersection. (Possible)
- 1 Driver 2 assumed intersection clear when car allegedly preceding Vehicle 2 moved through intersection; Driver 2 followed this car without looking for crossroad traffic. (Possible)

Matrix Cell

Explanation

Relevant Conditions (continued)

- 7 Use of "Yield" signs on Sanford Road rather than on Arkona Road inappropriate because they serve to stop traffic on the most traveled roadway; paving of Arkona makes it appear to be the major thoroughfare. (Definite)

Injury Causation

- 1 Driver 1 and Driver 2 did not use available safety restraints. (Definite)
- 5 Left door latch released on Vehicle 2, permitting partial ejection of Driver 2. (Definite)
- 5 Unforgiving interior of Vehicle 1 (metal seat frames, unpadded seat backs, and tempered side glass) increased injury to Vehicle 1 occupants. (Definite)
- 5 Loss of left front side glass in Vehicle 1 at impact permitted partial ejection of Driver 1. (Definite)
- 5 Breakage of rear left side window glazing in bus could have permitted passenger ejection in a more severe crash with same geometry. (Probable)

Postcrash Factors

- *3 Driver 1 and Driver 2 removed and transported on full backboard. (Definite)
- *3 and 3 Student passenger and passing truck driver aided in extrication of injured; no harm was contributed in this accident, but untrained people moving injured victims where serious and latent injuries are not apparent is most dangerous. (Definite)
- 3 Treatment of Driver 2 delayed in re-transport to second hospital. (Definite)
- 3 Partial ejection of Driver 1 with Vehicle 1 resting on left side trapped Driver 1 in a position between bus and earth making extrication complicated--left front roof rail portion of Vehicle 1 had to be elevated off ground to free Driver 1. (Definite)

Matrix Cell

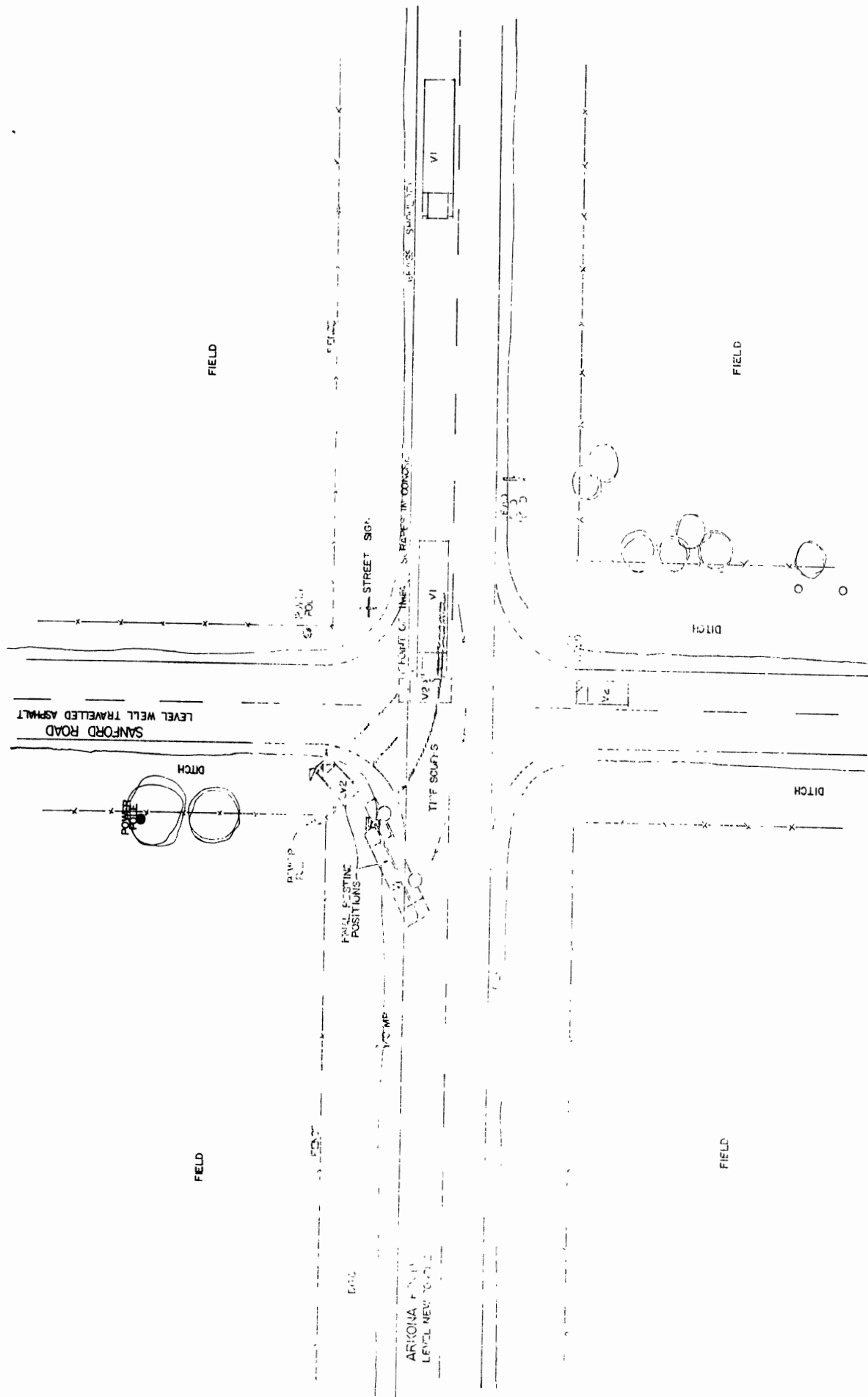
Explanation

Postcrash Factors (continued)

- | | |
|----|--|
| 3 | Although accident resulted from clear violation of failing to yield by Driver 2, no citation was given to Driver 2. (Definite) |
| 6 | Fuel tank on Vehicle 2 punctured with fuel spillage causing fire hazard. (Definite) |
| *6 | Rear emergency exit doors in Vehicle 1 were most useful in providing egress for injured and uninjured passengers from bus which was in rolled-over orientation. (Definite) |
| *9 | Area fire truck stood by during postcrash vehicle removal to aid in case of possible fire; then hosed down accident area upon removal of vehicles. (Definite) |

Recommendations

- | | |
|---|---|
| 1 | Driver education courses should emphasize need for caution in rural areas, and especially in familiar areas. |
| 1 | School bus drivers should be required to wear seat belts to optimize ability to keep control of bus. Promulgation and acceptance of proposed TSPS #17 would help to ensure this. |
| 4 | Interior designers of school buses should be more cognizant of potential injury mechanisms and design to minimize them. In general, school bus interiors are "unforgiving" when impacted by occupants. Significant safety improvements to interior could be achieved with relatively small costs in terms of the overall vehicle costs. |
| 7 | "Yield" signs on Sanford Road should be moved to Arkona Road to give Sanford Road, the major route, the right of way. |



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-318
CASE SUMMARY

Identification

Accident occurred at unmarked intersection of Maplewood Street and Oakwood Street, a residential area in the city of Ann Arbor, Washtenaw County, Michigan, on Thursday, October 19, 1972, at 1440 hours. Two passenger cars, side impact, Driver 2 ejected. Injury severity AIS*code 06. fatal.

Ambience

Sunny afternoon, temperature 43^oF. relative humidity 38%, wind 7 mph from northwest. Roadway dry.

Highway

Maplewood and Oakwood 2-lane local streets, both 32 feet wide, no dividers. Both streets well-traveled asphalt with 6-inch curbs,** straight, level, and crowned for drainage. One mercury vapor luminaire over intersection. Within quarter-mile radius of Oakwood: 10 driveways, 4 intersections, 10 utility poles, 25 trees; of Maplewood: 10 driveways, 2 intersections, no utility poles, 25 trees. Three-year accident history of intersection shows two two-vehicle collisions in rain on wet roadway.

Traffic Controls

Speed limit 25 mph by statute. No pavement markings, signs, or signals at intersection.

Vehicles

Vehicle 1, passenger car, 1968 Plymouth Satellite, 2-door hardtop; dark green exterior, black interior; odometer 61,987 miles. No indication of vehicle inspection (periodic vehicle inspection not mandatory in Michigan). Power steering, automatic transmission; padded armrests, upper and lower instrument panel, sunvisors, and ashtray. Lap belts only, no retractor; no upper torso restraints. No head rests; heavy wear on front tires, 2/32-inch tread on left, 3/32-inch tread on right. No sticker to show maintenance. Frontal damage to fenders, hood, grill, and bumper, with sheet metal pushed to the left; right exhaust manifold punctured from impact with upper mount of shock absorber; hood latch released. VDI+:02-FDEW-1.

* American Medical Association Abbreviated Injury Scale (AIS).

** Standard curb height in Ann Arbor, Michigan is six inches.

+ Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Vehicle 2, passenger car, 1971 Chevrolet Bel Air, 4-door sedan; brown exterior, light tan interior; odometer 19,376 miles. No indication of inspection (periodic vehicle inspection not mandatory in Michigan). Automatic transmission, power steering, power brakes, front disc brakes. Padded upper instrument panel, sunvisors, arm-rests, and seat backs; with padded steering wheel spokes. Lap belts with no retractors and upper torso restraints in front seat; rear seat belts under seat. Outside of right front tire bald; front end needed alignment. Maintenance on September 16, 1972 at 16,754 miles included oil lubrication, new oil filter, air filter, and fuel filter, transmission and pollution control valve checked. Damage to left front and rear doors and part of quarter panel, left front door latch released, left B-pillar dented at belt line, upper and left C-pillars damaged, left roof side rails buckled near B- and C-pillars, rear seat damaged from exterior crush, 15% bond separation of rear window, rip in roof lining at left C-pillar, and left rear tire cut by fender. Doors had side guard door beams, a significant safety feature. VDI:10-LZEW-2.

Occupants

Vehicle 1, driver, 26 years, female, Caucasian, 58 inches and 147 pounds. Four years driving experience; little experience in first two years, approximately 5,000 miles per year in last two years. Going home after doing errands on east side of Ann Arbor; nine miles from origin, three miles from destination. Familiar with vehicle; not very familiar with area, had driven there only a few times. Good physical and mental condition. Lap restraint worn. No alcohol involved. Injuries: slight "seat belt" contusions over hip bones, minor laceration on lateral aspect of left arm, slight abrasion to hands and wrists, abrasions on both knees. Injury severity code 01, minor.

Right rear passenger, Vehicle 1, 11-month old baby, female, Caucasian, 29 inches, and 19 pounds. Seated in hook-under type padded child safety seat (manufactured by Questor Corporation, Kantwet Division). No injuries. Injury severity AIS code 00, no injury.

Vehicle 2, driver, 47 years, female, Black, 62 inches, and 165 pounds. Thirty years driving experience, averaging 6,000 miles per year. Traveling from Washtenaw County Juvenile Court, following runaway niece who was running in front of car. Three-quarters of a mile from origin, no destination. Had owned Vehicle 2 four or five months and was adequately familiar with it; had not driven in area previously. Had had no driver education. Overall physical condition good; suffered from high blood pressure, and hypertension, controlled by medication and low blood sugar controlled by diet. No apparent life stress, but situational stress. No alcohol involved. Restraints not worn. Injuries: multiple abrasions and contusions, fractured right hip and right acetabulum, bilateral fracture of pubic rami, fractured left scapula, internal hemorrhage associated with pelvic injuries, and liver laceration. Did not lose consciousness. Died in hospital 16 hours later. Cause of death shock, cardiac arrest resulting from multiple injuries. Injury severity AIS code 06, fatal.

Right front passenger, Vehicle 2, 44 years, female, Black, 64 inches and 150 pounds. Unrestrained. Injuries: soreness to left shoulder. Injury severity AIS code 01, minor.

Right rear passenger, Vehicle 2, 22 years, male, Black, 71 inches and 170 pounds. Unrestrained. Injuries: swelling of right occipital lobe and right side of neck stiff. No loss of consciousness. Injury severity AIS code 01, minor.

Center rear passenger, Vehicle 2, 51 years, female, Black, 65 inches, 120 pounds. Unrestrained. Injuries: tenderness to lower left ribs and fractured tenth left rib; mid-frontal abrasion and small right frontal laceration to head; no loss of consciousness. Injury severity AIS code 02, moderate.

Left rear passenger, Vehicle 2, 30 years, male, Black, 74 inches and 200 pounds. Unrestrained. Injuries: 1½ to 2-inch laceration to left side of head, no loss of consciousness. Injury severity AIS code 01, minor.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were specifically relevant to this case.

- | | |
|-----------|---|
| TSPS #4 | Driver Education. Driver 1 did not yield right-of-way to vehicle on her right; driver education courses should stress need for great attention at uncontrolled intersections. |
| MVPS #201 | Occupant Protection in Interior Impact-- Passenger Cars. Padding on back of front seat in Vehicle 2 minimized head injury to center rear passenger. |
| MVPS #206 | Door Locks and Doot Retention Components-- Passenger Cars and Multipurpose Passenger Vehicles. Left front door latch on Vehicle 2 released, allowing Driver 2 to be ejected. |
| MVPS #213 | Child Seating Systems--Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. Child safety seat which restrained the infant in Vehicle 1 minimized the likelihood of injury. |
| MVPS #214 | Side Door Strength--Passenger Cars. The side guard door beams on Vehicle 2 minimized penetration of Vehicle 1 into occupant compartment. |

Description

Piccrash: Vehicle 1 westbound on Oakwood and Vehicle 2 southbound on Maplewood, each in their respective lanes (both are 2-lane

local streets). No driver action or maneuvers. Driver 1's failing to yield right-of-way to vehicle on her right at unmarked intersection a violation of traffic law. No precrash physical evidence, skids, or scuffs.

Crash: Right front of Vehicle 1 impacted rear left side of Vehicle 2. Vehicle 1 continued 100 feet west-southwest onto a lawn, coming to final rest still facing in that direction. Vehicle 2 rotated 360° before stopping south of the intersection, facing southward with both right wheels resting just over the curb. Restrained Driver 1 thrown forward, impacted steering wheel with thorax and instrument panel with lower torso causing minor knee abrasions; her hands flew off the steering wheel, hitting it and instrument panel, resulting in minor abrasions to her hands and wrists. Driver 1 also sustained slight contusions over hip bones from lap belt, and minor laceration on lateral aspect of left arm from shattered glass from side window. Infant restrained in child safety seat hooked under right rear seat was thrown forward but was uninjured. Vehicle 2 occupants first thrown left on impact, then to the right as car rotated. Driver 2's door opened on impact and driver was ejected when left front tire struck curb after vehicle's 180° rotation, and occupants were again thrown left. Driver 2 ejected onto lawn by curb, was picked up by car as it continued to rotate, and came to final rest under car with head against curb. Driver 2 sustained multiple abrasions and contusions, fractured right hip and right acetabulum, bilateral fracture of pubic rami, fractured left scapula, internal hemorrhage associated with pelvic injuries, and liver laceration. Right front passenger in Vehicle 2 suffered soreness to left shoulder from contact either with driver or instrument panel. Left rear passenger impacted left side window frame and B-pillar and received a 1½ to 2-inch laceration to the left side of his head from broken window glass; glass found in his wound. Also impacted left door heavily, but uninjured from this. Center rear passenger heavily impacted left rear passenger, causing tenderness to lower left ribs and fracture of tenth left rib; sustained a mid-frontal head abrasion from hitting front seat back; and had a small right frontal head laceration from either flying glass or from striking right rear passenger. Right rear passenger had swelling of right occipital lobe from hitting head on either right window or upper B-pillar, and suffered stiffness to right side of neck. Vehicle 1 had frontal damage to fenders, hood, grill, and bumper; sheet metal pushed to left; right exhaust manifold punctured from impact with upper mount of shock absorber; hood latch released, but hood did not fly up. Vehicle 2 sustained damage to left front and rear doors and part of quarter panel, left front door latch released, left B-pillar dented at belt line, upper and lower left C-pillars damaged, left roof side rails buckled near B- and C-pillars, rear seat damage from exterior crush, 15% bond separation of rear window, a rip in roof lining at left C-pillar, and left rear tire cut by fender. Directions of force were 2:00 o'clock to Vehicle 1, 10:00 o'clock to Vehicle 2.

Postcrash: Nearby resident called for help. Driver 1 exited without assistance; Vehicle 2 passengers also exited themselves, and tried to jack up Vehicle 2 to release Driver 2 pinned underneath. Police and ambulance response prompt. Wrecker responding

to call raised back of Vehicle 2, Driver 2 extricated; first aid administered on-scene to Driver 2 and to Vehicle 2's center rear passenger's head laceration, both transported to hospital. Runaway niece who Driver 2 was following hysterical and in shock, also taken to hospital. Other Vehicle 2 passengers remained on-scene and sat in social worker's car (social worker also following runaway girl). No fires, explosions, or environmental problems. Broken side window from Vehicle 2 on street. No traffic controls needed as vehicles not blocking roadway.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	<u>Precrash</u>	<u>Crash</u>	<u>Postcrash</u>
Human	1	2	3
Vehicle	4	5	6
Environment	7	8	9

Matrix Cell Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver 1 did not check for clearance before entering intersection. (Definite)
 - 1 Driver 2 exceeding speed limit. (Possible)
 - 1 Driver 2 did not see Vehicle prior to impact. (Definite)
- Relevant Factors
- 1 Driver 1's limited driving experience may have contributed to lack of caution at intersection. (Probable)
 - 1 Driver 2 under situational stress. (Definite)
 - 1 Excitement of Vehicle 2 passengers stemming from the chase was distracting to Driver 2. (Definite)

Injury Causation

- *2 Lap belt worn by Driver 1 and child safety seat used to restrain baby significantly reduced injury. (Definite)

Matrix Cell Explanation

Injury Causation (continued)

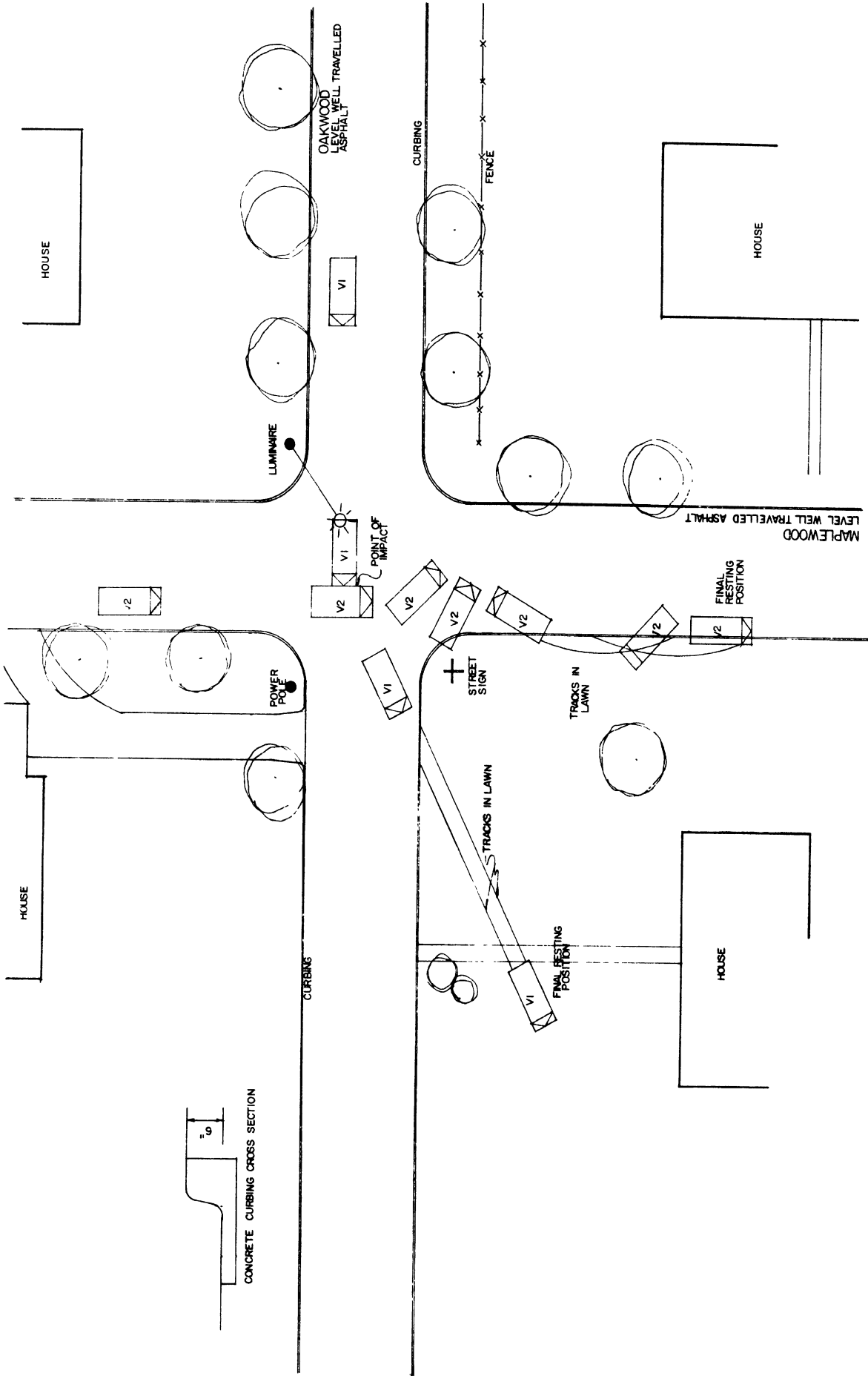
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| 2 | Use of restraints would have prevented ejection and injury of Driver 2 and would have minimized injuries to Vehicle 2 passengers. (Definite) |
| 1 | Driver 2's history of high blood pressure and hypertension contributed to severity of injuries. (Probable) |
| 5 | Left door latch on Vehicle 2 released, allowing Driver 2 to be ejected. (Definite) |
| *5 | Vehicle 2's side guard door beam minimized penetration of Vehicle 1 into Vehicle 2's occupant compartment. (Definite) |
| 5 | Lack of padding on door of Vehicle 2 increased injury to right rear passenger. (Definite) |
| *5 | Padding on back of front seat of Vehicle 2 minimized head injury to center rear passenger. (Definite) |
| *5 | Padding on Vehicle 1's lower instrument panel minimized injury to Driver 1. (Definite) |

Postcrash Factors

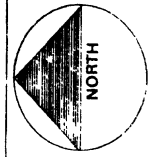
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|----|--|
| *8 | Intersection singularly free of roadside hazards. (Definite) |
|----|--|

Recommendations

- | | |
|---|---|
| 4 | Reevaluation of MVPS #206, Door Locks and Door Retention Components---Passenger Cars and Multi-purpose Passenger Cars. |
| 1 | Drivers need to be cautioned to exercise added care at unmarked intersections, and to avoid driving while under stress. |



AA 318



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-319
CASE SUMMARY

Identification

The accident occurred at the intersection of Talladay Road and Tuttle Hill Road, Augusta Township, Washtenaw County, Michigan, on Friday, October 20, 1972, at 1520 o'clock. Local dirt roads in agricultural-residential area. Two passenger cars, T-type collision. Injury Severity AIS code 01, minor.*

Ambience

Bright, clear, sunny day. Temperature 49^oF, relative humidity 36%, wind 10 mph from the southwest. Roadway dry.

Highway

Both Tuttle Hill and Talladay Roads local, two-lane roadways of packed earth, poorly maintained. Tuttle Hill 20 feet wide, Talladay 23 feet wide. No dividers, no road edge shoulder, curb, or guardrail. Both straight and level. Within quarter mile radius of Talladay, five driveways, 15 poles, five trees; of Tuttle Hill, three driveways, five poles, 10 trees.

Traffic Controls

Speed limit 50 mph by state statute. No pavement markings and no signals. Two yield signs for Tuttle Hill Road; weight limit sign for bridge on Talladay west of intersection, all legible. Previous accident history indicates one property damage accident involving two-vehicle head-on collision one-half mile from intersection.

Vehicles

Vehicle 1, 1972 American Motors Hornet, 2-door sedan, light green exterior, dark green vinyl top, dark green interior, odometer reading 23,574 miles. No indication of vehicle inspection (periodic vehicle inspection not mandatory in Michigan). Automatic transmission, no power accessories. Padded upper instrument panel, sunvisors, and armrests. Lap belts and upper torso belts available, but lap belts were inside plastic housing and inaccessible. No vehicle defects; last maintenance at 19,535 miles on September 9, 1972 included lubrication, oil, filter. Frontal damage, sheet metal wiped to the left. Rear edge of hood elevated, but did not move rearward; left engine mount separated, right one twisted; left front door shifted by fender movement, but still operable; steering wheel rim slightly deformed, plastic cracked. Significant findings from damage inspection: steering column flexible coupling separated; break-away mirror came off from driver contact. VDI:02-FDEW-2.

* American Medical Association Abbreviated Injury Scale (AIS).

Vehicle 2, 1971 Chevrolet Camaro, 2-door hardtop, dark metallic blue exterior, black vinyl top, blue vinyl interior, odometer reading 25,171 miles. No indication of vehicle inspection (periodic vehicle inspection not mandatory in Michigan). Power steering and power brakes with front discs; automatic transmission. Padded upper instrument panel, armrests, and sunvisors; lightly padded steering wheel spokes. Lap belts, upper torso belts in front. No vehicle defects. Maintenance on August 19, 1972 at 23,617 miles included lubrication, oil, filter, air filter, brake fluid, and four new tires; transmission, differential, cooling system, power steering, and battery were checked. Damage was to the left side from front wheel to quarter panel, with maximum 10 inches of crush. Left upper and lower A-pillars and B-pillars damaged, left roof side rails buckled at both B-pillars. Upper right B-pillar shifted somewhat, gap between pillar and door larger than usual. Floorpan deformed, windshield cracked. Of special interest is performance of the side guard door beam which minimized intrusion of Vehicle 1 into passenger compartment. VDI:10-LYNN-2.

Occupants

Driver 1, 17-year-old Caucasian, male, 71 inches, 170 pounds. Driving one year, accumulated 7,000 miles. En route from school to home of right front passenger; accident occurred about two miles from origin, half mile from destination. Familiar with case vehicle having driven 4,000 miles with it; lived in area so familiar with route and traveled it average of twice a week. Completed two-phase driver education course in high school, classroom and on-road training. Good physical and mental condition. No alcohol or drugs involved. Driver unrestrained. Complained of pain and muscle soreness to lower back, and had small laceration on bridge of nose. Injury Severity AIS code 01, minor.

Right front passenger, Vehicle 1, 17-year-old male, Caucasian, 71 inches, and 165 pounds. Unrestrained. Swelling of right temporal lobe and superficial laceration of right cheek. Injury Severity AIS code 01, minor.

Driver 2, 18 years old, Caucasian, female, 66 inches and 118 pounds. Had been driving two years, averaging 15,000 miles per year. En route from home to work, taking sister's two children to work with her where they would meet their mother. Accident site about one mile from origin, four miles from destination. Adequately familiar with vehicle; had owned it three weeks and accumulated 1,000 miles. Very familiar with route having driven it daily for several years. Completed two-phase driver education course in high school, classroom and on-road training. Mild symptoms of hypoglycemia. Had been having fainting spells for two weeks, and on day of accident felt "queasy," otherwise health good. Mental health good, enjoys driving. Unrestrained. Suffered laceration to left cheek; was dazed and may have momentarily lost consciousness at impact. Injury Severity AIS code 01, minor.

Left rear passenger, Vehicle 2, 10 years old, female, Caucasian, 56 inches and 75 pounds. Unrestrained. Lacerated inside lower lip by biting with teeth. Injury Severity AIS code 01, minor.

Right rear passenger, Vehicle 2, 9 years old, female, Caucasian, 52 inches and 72 pounds. Unrestrained. Received abrasion over left eye. Injury Severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) are particularly relevant to this case:

- MVPS #201 Occupant Protection in Interior Impact--Passenger Cars. Injuries minor to occupants of Vehicle 1--break-away mirror broke off windshield when hit by Driver 1; padded instrument panel offered protection; convenience tray broke leaving sharp edges, but caused no injury; plastic molding on right A-pillar cracked, cutting passenger.
- MVPS #205 Glazing Materials--Passenger Cars, Multipurpose Passenger Vehicles, Motorcycles, Trucks, and Buses. Windshield on Vehicle 1 cracked when struck by Driver 1 but did not shatter.
- MVPS #206 Door Locks and Door Retention Components--Passenger Cars and Multipurpose Vehicles. Left door latch released on Vehicle 2, but door remained closed because of sheet metal damage.
- MVPS #208 Seat Belt Installation--Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. No restraints worn by occupants of both Vehicle 1 and Vehicle 2; neither car had seat belt warning system.
- MVPS #214 Side Door Strength--Passenger Cars. Vehicle 2 had side guard door beam which minimized crush and intrusion of Vehicle 1 into passenger compartment.
- TSPS #4 Driver Education. Driver education courses should include: a) information on debilitating characteristics of various diseases, such as diabetes (hypoglycemia), and on how to control effects of such diseases; b) emphasis on need for caution when driving in rural areas; and c) warnings against negligence in very familiar areas since statistics show most accidents occur within 25 miles of driver's home.

Description

Pre-crash: Vehicle 1, eastbound on Talladay Road and Vehicle 2 northbound on Tuttle Hill Road, both cars in correct lanes and close to center of roadway. Driver 2 was traveling at 55 mph, slowed to 40 mph before intersection, then speeded up, entered intersection at 50-55 mph. Driver 2 did not remember seeing Vehicle 1 prior to impact. Driver 1, at estimated 45 mph, planned to go straight through intersection and was looking directly ahead. Just before entering intersection, Driver 1 saw Vehicle 2 and braked. Driver 2 committed two violations: failed to yield right-of-way despite clearly legible signs, and entered intersection too fast.

Crash: Vehicle 2 struck on left side, rotated counterclockwise 170°; after impact, Vehicle 1 rotated counterclockwise 585° (radiator fluid from

Vehicle 1 spilled in a 360° circle denoting spin). Both vehicles came to final rest northeast from point of impact; Vehicle 1 on edge of roadway facing southwest. Vehicle 2 rolled 110 feet onto lawn and into lamp post, bending it slightly but doing no damage to car, and ended facing south. Driver 1 was thrown forward and to the right as car rotated, struck rearview mirror and windshield, received small laceration on bridge of nose and complained of pain and muscle soreness to lower back from forward flexion at impact. Right front passenger in Vehicle 1, who was turning radio just prior to impact, was thrown forward and right and struck right A-pillar causing swelling of right temporal lobe and superficial laceration of right cheek. Driver 2 was thrown left and struck door, sustaining laceration to left cheek from broken window glass; may have momentarily lost consciousness. Passenger pitched forward and left; left rear passenger's teeth lacerated inside lower lip, right rear passenger received abrasion over left eye probably from seat back. Frontal damage to Vehicle 1; sheet metal wiped to the left; rear edge of hood elevated; left engine mount separated and right mount twisted; left front door shifted but still operable; steering wheel rim slightly deformed and plastic cracked; steering column flexible coupling separated; and break-away mirror detached. Left side of Vehicle 2 smashed from front wheel to quarter panel, with maximum crush 10 inches; upper and lower left A-pillars and B-pillars damaged, left roof side rails buckled at both pillars; upper right B-pillar shifted; floorpan deformed; windshield cracked. Directions of force 2:00 o'clock to Vehicle 1, 10:00 o'clock to Vehicle 2.

Postcrash: Vehicle 1 occupants exited themselves. Occupants of Vehicle 2 assisted from car by neighbors. Driver 2 dazed and suffered dizziness probably due to reactive hypoglycemia and taken to nearby house. Ambulance attendants applied bandages to lacerations and abrasions of Vehicle 2 occupants; then transported them to hospital. Driver 2 seen but not treated; asked by doctor to return in a week for tests for diabetes. No fire or explosion or environmental problems; only debris was 360° circle of spilled radiator fluid. Washtenaw County Sheriff's were in area, so they arrived on-scene in minutes; ambulance response was poor as it took them nearly 25 minutes to arrive, but this was unavoidable given the distance they had to travel from Ann Arbor and poor roads which prevented high speed. No traffic control needed as one car off road and the other on road edge, and there was no traffic.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

1 Driver 2 approached intersection at excessive speed and without adequately surveilling roadway. (Definite)

Relevant Conditions

1 Driver 2 had mild symptoms of hypoglycemia which may have impaired her thought processes. (Definite)

1 Driver 2's familiarity with road and knowledge of low traffic volume contributed to her carelessness in checking for clearance too far in advance of intersection. (Possible)

*1 Driver 1's braking action lessened severity of accident. (Probable)

Injury Causation

2 Injuries to occupants of Vehicle 1 and rear passengers of Vehicle 2 would have been minimized had they been restrained. (Definite)

*5 Vehicle 2 had pre-standard side door beam which prevented severe passenger compartment intrusion. (Definite)

*5 Light padding on doors in Vehicle 2 minimized injury to Driver 2. (Possible)

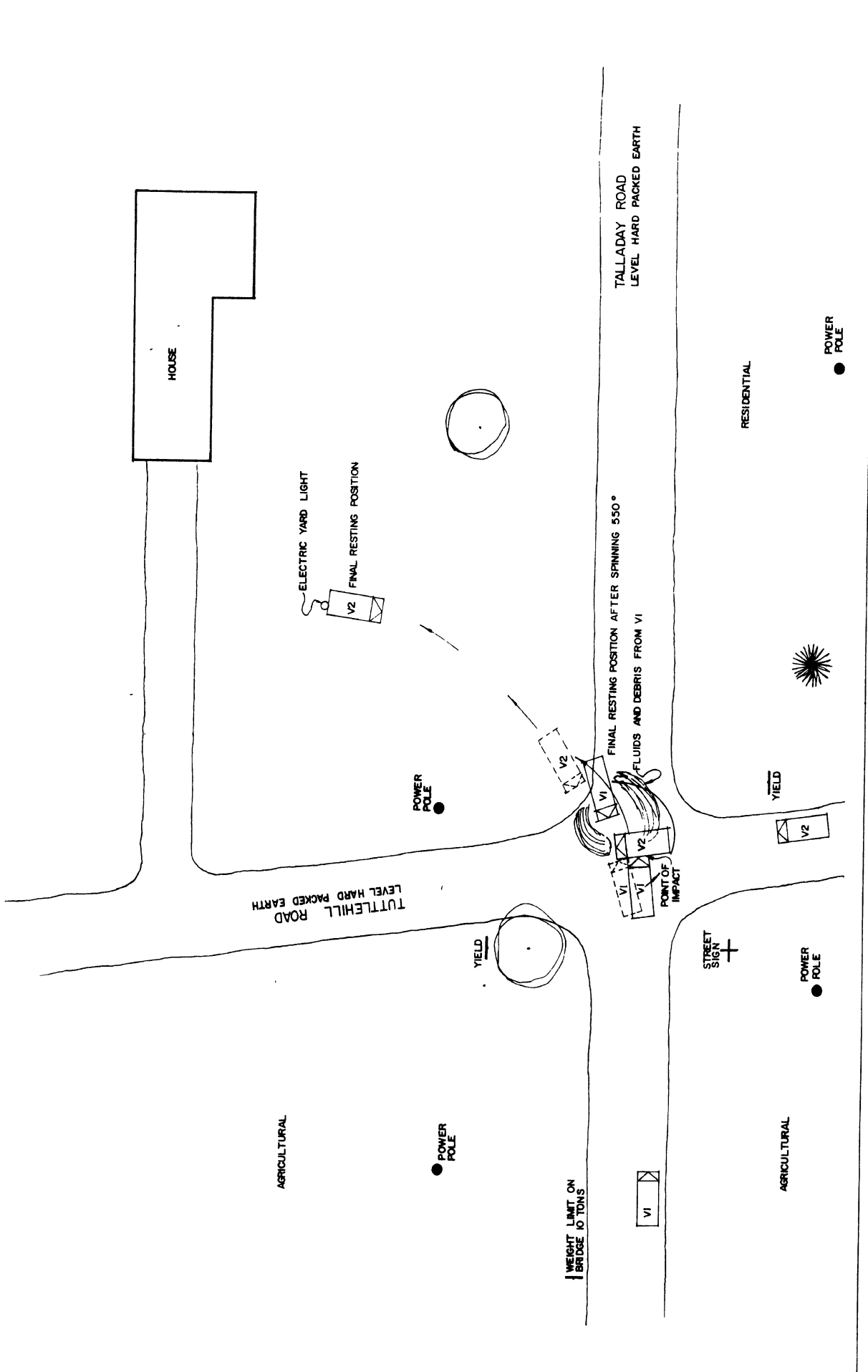
Postcrash Factor

*3 First aid administered on-scene by ambulance attendants. (Definite)

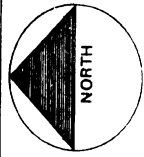
Recommendations

1 Driver education courses should include information on debilitating diseases such as diabetes (hypoglycemia) which may affect driving ability.

1 Driver education courses should emphasize need for caution, particularly in rural areas and in familiar areas close to home.



AA 319



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-320
CASE SUMMARY

Identification

Accident occurred on US-23, a 4-lane divided expressway in an agricultural area of Northfield Township, Washtenaw County, Michigan, on Monday, October 23, 1972, at 1340 hours. Single vehicle out of control, left roadway, rolled over crossing median, entering opposing traffic lanes. First accident precipitated second accident in which single vehicle left roadway and impacted a tree. Injury Severity AIS* code 01, minor.

Ambience

Bright sunny day, temperature 64⁰, relative humidity 72%, wind 16 mph from the southwest. Roadway dry.

Highway

US-23, 4-lane divided expressway, open roadway. Each lane 12 feet wide, grassy median 40 feet wide. Well-traveled and well-maintained concrete. Asphalt shoulders: exterior 10 feet wide, interior 3 feet wide. Shoulders heavily covered with loose gravel. No guardrails. Roadway straight and level: crowned +1 $\frac{1}{2}$ ⁰ from center of roadway to outside. No lighting at accident site. Two accesses per quarter mile, including one rest area. No poles, but 50 trees per quarter mile. Accident history of site indicates three single-vehicle accidents in 1968, all out of control.

Traffic Controls

Posted speed limit 70 mph maximum. 45 mph minimum. Pavement markings: solid white line at edge of roadway, intermittent white center line; visibility of markings good. No symbols or words on roadway. Legible sign indicaring "Rest Area." No traffic signals.

Vehicles

Vehicle 1, a 1971 Plymouth Duster, 2-door coupe, lime green exterior with black vinyl top, black interior. Odometer 22,735 miles. No previous vehicle inspection (periodic vehicle inspection not mandatory in Michigan). Power brakes and power steering, automatic transmission. Padded sunvisors, upper instrument panel, and arm rests. Lap and upper torso seat belts available; lap belt buckled behind seat. No defects; new tires, front shocks, and ball joints; right front brake lining good. No sticker to indicate maintenance; friend had installed shocks and ball joints. Damage was to left front fender and left front corner of roof which sustained eight inches of crush; upper left A-pillar damaged and separated, small cracks at belt line; upper left B-pillar and upper right

* American Medical Association Abbreviated Injury Scale (AIS).

A-pillar damaged; upper left C-pillar dented at top; right roof side rail damaged and left one buckled at front door; and windshield header bent.
VDI:00-TPGW-3.

Vehicle 2, a 1968 Chevrolet Van/90; bright yellow exterior, yellow interior with green seats; 90-inch wheel base. Odometer 55,802 miles. No previous vehicle inspection (periodic vehicle inspection not mandatory in Michigan). No power accessories, manual transmission. Padded sunvisors, upper instrument panel, and armrests. Tab part of seat belt there, but buckle half could not be found; no upper torso restraints. Tires very worn (front 0/32 inch and 1/32 inch; both rear 2/32 inch), rear tires oversized. No tailpipe, front end needed alignment; air shocks on rear end. No sticker to indicate maintenance. Vehicle 2 sustained 26 inches of crush; sheet metal damage to right bumper and grill; windshield smashed, windshield header damaged; upper left A-pillar twisted to right and separated, upper right A-pillar damaged and separated, lower right A-pillar and upper and lower right B-pillars damaged; right front door smashed and jammed closed, latch and hinges broken; right rear door hinges broken and separated; right roof side rails buckled.
VDI:12-FREW-7.

Occupants

Driver 1, 39 years, female, Caucasian, 65½ inches, 125 pounds. Fourteen years driving experience, approximately 14,000 miles per year. Driving from home 15 miles north of Ann Arbor to Ypsilanti to visit family; no planned time of arrival. Accident occurred about eight miles from origin; six miles from destination. Vehicle familiarity good; had accumulated all mileage on car. Very familiar with route since drove it twice daily to and from work. No driver education, self-taught driver. Physical condition good, vision normal. Four-month separation from husband possible stress factor; mental condition appeared stable and mature to interviewer. No alcohol involved. Driver 1 unrestrained. Injuries: minor lacerations on both hands, right arm contused over deltoid process, contusions on lateral surface of both thighs, and lower back pain; momentarily stunned, but did not lose consciousness. Injury Severity AIS code 01, minor.

Right front passenger, Vehicle 1, 10-year-old female, Caucasian, 59 inches, 85 pounds. Unrestrained. Injuries: swelling on right temporal lobe, pain in right upper arm. She did not lose consciousness. Injury Severity AIS code 01, minor.

Driver 2, 23 years, male, Caucasian, 68 inches, 140 pounds. Seven years driving experience, approximately 15,000 miles per year. Driving from Ann Arbor delivery route to home in suburb of Detroit. Accident occurred four miles from origin and forty miles from destination. Vehicle familiarity good; accumulated 9,000 miles in 8 months. High school driver education including on-road and classroom training. Physical and mental condition good. No alcohol involved. Available lap restraint not worn. Injuries: abrasions both knees, abrasion lateral aspect left arm, complaint of pain left thorax and neck. Injury Severity AIS code 01, minor.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were specifically relevant to this case.

- TSPS #1 Periodic Motor Vehicle Inspection. Tires on Vehicle 2 badly worn and would not have passed a vehicle inspection had one been conducted.
- TSPS #4 Driver Education. Had Driver 1 completed a driver education course, perhaps she would have better understood the proper precautions in aassing
- MVPS #201 Occupant Protection in Interior Impacts--Passenger Cars. Occupants of Vehicle 1 received only minor injuries during rollover because of interior design which included padded components and flat instrument knobs.
- MVPS #205 Glazing Materials--Passenger Cars, Multipurpose Passenger Vehicles, Motorcycles, Trucks, and Buses. Although windshield on Vehicle 1 had 15-inch rip, it did not shatter into dagger-like pieces.
- MVPS #216 Roof Crush Resistance--Passenger Cars. Had Vehicle 1 complied to this standard (which will not be in effect until August of 1973), it would not have sustained the severe (8 inches) crush to roof.

Description (Vehicle 1)

Precrash: Vehicle 1 southbound on inside lane, passing a tractor-trailer truck. Nearly past truck when left front wheel apparently straddled roadway and shoulder, causing steering difficulty. Investigators theorize Driver 1 panicked, overcorrected by steering hard right, lost control, rotated clockwise about 35-40 degrees, and slid into slopped median. Driver 1's failure to have her vehicle under control was a violation. Short, very dark tire marks on edge of inside southbound lane where Vehicle 1 left roadway.

Crash: Vehicle 1 overturned, first on left side, to left front fender and left front corner of top, then to right side completing a full 360° roll. Sliding and rotating on right side, Vehicle 1 became slightly airborne as it approached opposing lane, entered northbound lane rotating 170° clockwise, and came to final rest on all four wheels on outside shoulder facing northbound. Physical evidence of the rollover included glass in median from broken left side door window, sod gouged out of median, and scuffs from contact of rolling vehicle. Driver 1 and right front passenger thrown left initially, toward the roof as car rolled onto top, then to right side against door. Front right passenger on seat against right door. Driver 1 slid off seat under instrument panel with upper torso against seat and passenger. Driver 1 sustained minor lacerations to both hands from flying glass from left door; bruises on right arm over deltoid process from contacting roof; bruises on lateral surface of both thighs, left from driver's door, right from under side of instrument panel; lower back pain from contacting roof. Driver 1 momentarily stunned, but did not lose consciousness. Passenger bumped right temporal lobe on right door window, and had pain in upper right arm from striking right door. Vehicle 1 damage primarily to left front fender and left front corner of roof which had eight inches of crush; upper left A-pillar damaged and separated, small cracks at belt

line; upper right A-pillar and upper left B-pillar damaged; upper left C-pillar dented at top; right roof side rail damaged, and left one buckled at front door; and windshield header bent.

Postcrash: Passerby helped Driver 1 out of driver's door and advised her to sit down; passenger exited unassisted. Driver 1 refused treatment; no first aid was required on-scene. No fire or explosion; no environmental problems; only debris was a little broken glass in median. Police and ambulance response prompt; occupants of Vehicle 1 not taken to hospital. Vehicle 1 off roadway, so no need for traffic controls.

Description (Vehicle 2)

Precrash: Chevrolet Van, northbound on outside lane, being passed by high stake truck. Saw Vehicle 1 upside down in median, view momentarily blocked by truck, then saw Vehicle 1 entering northbound lane. Swerved left to avoid collision with Vehicle 1; then, to stabilize the van, steered hard right, lost control of vehicle, and left roadway. Wheel marks in soft earth showed path of van off roadway, and tree scraped at point of impact.

Crash: Vehicle 2 continued approximately 100 feet off roadway and impacted tree. Driver 2 leaped from vehicle before collision, suffering abrasions and contusions on both knees from contacting door and steering column, and abrasions on lateral aspect of left arm and soreness to left thorax from door contact, soreness to neck from jolt sustained, all while exiting vehicle. Vehicle 2 had 26 inches of frontal crush; sheet metal damage to right bumper and grill; windshield fractured, windshield header damaged; upper left A-pillar twisted to right and separated, upper right A-pillar damaged and separated, lower right A-pillar and upper and lower right B-pillars damaged; right front door smashed and jammed closed, latch and hinges broken; right rear door hinges broken and separated; right roof side rails buckled. Direction of force to Vehicle 2 12:00.

Postcrash: Driver 2 out of vehicle before crash. No first aid required on-scene; Driver 2 transported by ambulance to St. Joseph's Mercy Hospital in Ann Arbor. No fire or explosions, environmental problems, or debris. Police and emergency response good; no traffic controls because vehicle off roadway.

Causal Factors & Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environment	7	8	9

Accident Causation

Matrix Cell

Explanation

Primary or Principle Causes

- 1 Driver 1 inattentive and did not exercise proper care in passing truck - crowded side of road so left front wheel straddled roadway and shoulder making steering difficult. (Probable)
- 1 Driver 1 made improper corrective maneuver in steering hard right to regain roadway. (Definite)
- 7 Roadway shoulders improperly maintained, thus preventing safe transition from roadway to shoulder. (Definite)

Severity Increasing Factors

- 5 Structured reinforcement of roof on Vehicle 1 would have reduced crush (Standard 216 regarding roof reinforcement to be effective in August of 1973). (Definite)
- 4 Instability of Chevrolet Van, Model 90, exaggerated by after-market addition of over-sized rear tires which were bald, contributed to Vehicle 2 going off roadway. (Probable)
- 1 Driver 2's improper overcorrection maneuver to right caused Vehicle 2 to leave roadway. (Possible)

Relevant Conditions

- 1 Driver 1's stress from recent life change was distracting factor. (Possible)
- *1 Driver 2's maneuver to inside lane may have prevented collision with Vehicle 1. (Probable)
- 4 Air shocks on back of Vehicle 2 elevated it and raised center of gravity, further increasing vehicle's instability. (Definite)
- 7 Transient view obstruction by truck limited the time Driver 2 had to make evasive maneuvers. (Probable)

Injury Causation

- 2 Driver 1 and passenger unrestrained. (Definite)
- *5 Interior padding and flat control knob design minimized injuries to occupants of Vehicle 1. (Definite)
- 2 Driver 2 jumped from moving vehicle. (Definite)

Matrix Cell

Explanation

Recommendations

- | | |
|---|---|
| 1 | Driver education courses should emphasize: (a) defensive driving and crisis maneuvers, and (b) that wearing restraints and remaining in vehicle safer than jumping out. |
| 4 | Information should be made available on the possible hazards of vehicle modification and after-market additions. |

THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-321
CASE SUMMARY

Identification

Accident occurred on open roadway section of South Main Street, a major arterial in city of Ann Arbor, Washtenaw County, Michigan, on Thursday, November 2, 1972, at 0900 o'clock. Area is commercial-residential. Single vehicle, primary and secondary collisions with fixed objects. Injury Severity AIS code 02, moderate.*

Ambience

Daytime, light rain. Temperature 69^oF, relative humidity 88%, wind 18 mph from the southwest. Roadway wet, but not considered a factor in this case.

Highway

South Main Street is four-lane major arterial, 46 feet wide, no divider. Surface well-traveled and well-maintained asphalt. Standard six-inch curb. Roadway straight, crowned for drainage, and graded from crest -1^o south and -2 1/2^o north. One mercury vapor luminaire. Within a quarter-mile radius of accident site are 8 driveways, 3 intersections, 10 poles, and 10 trees. Accident history shows 11 accidents up to one-half mile north of site.

Traffic Controls

Speed limit 25 mph by state statute. Pavement markings were solid white lane lines, yellow double solid center lines, turn arrows, and word "ONLY"; visibility good. Legible "No Parking" sign. Traffic signals at adjacent intersection not involved in accident.

Vehicle

Passenger car, 1972 Mercury Monterey Custom, 4-door sedan, dark brown exterior and vinyl top, light brown interior, odometer 2,984 miles. No indication of vehicle inspection (periodic vehicle inspection not mandatory in Michigan). Power steering and power brakes; automatic transmission; air conditioned. Padded upper instrument panel, armrests, sunvisors, and steering wheel spokes. Three-point lap belt and upper torso restraint system with locking retractor and buzzer system; belts fastened over seat. No vehicle defects, and no maintenance because of very low accumulated mileage. Slight sideswipe damage from utility pole to left front corner and left side; left rear fender skirt knocked off, left front wheel lip very slightly bent. Frontal damage from tree, with 11 inches of crush to hood, grill, and bumper; rear edge of hood elevated but did not move rearward; hood latch bent slightly and partially jammed by sheet metal damage; steering wheel rim slightly deformed. Scuffs on

*American Medical Association Abbreviated Injury Scale (AIS).

glove compartment and on area left of steering column; damage to lower instrument panel to right of radio, all from occupant contact. Significant finding: hood latch released. VDI*:12-FCEN-2 (primary impact with tree); 11-FLES-1 (secondary impact with pole).

Occupants

Driver, 62 years old, female, Caucasian, 59 inches and 105 pounds. Driving 30 years, averaging 9,000 miles per year. Was en route from home to work, planned to drop off passenger on University of Michigan campus; 1½ miles from origin, 5 miles from destination. Had owned case vehicle four months, had accumulated all miles on it. Familiar with route; usually went another way to work, but in past four years had driven this route once a week to get gas at filling station. Taught to drive by relatives; no formal driver education course. General overall physical condition good; had severe scoliosis of the spine; near-sighted and wore corrective lenses. Overall mental condition good; possibly distracted just prior to accident. No blood alcohol involved. Driver unrestrained. Injuries: simple fracture of left patella; small superficial abrasion to right knee; fractured right 6, 7, and 8 ribs at costa chondral junction; and had pain in low center chest. Injury Severity AIS code 02, moderate.

Right front passenger, 74 years old, female, Caucasian, 60 inches, and 110 pounds. Unrestrained. Injuries: lacerated right jaw from protuberance of cheek rearward along zygomatic bone (four inches); one-inch vertical laceration on left side of lower lip; small abrasion to center forehead. Complaint of pain to chest area, leg abrasion. Injury Severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|-----------|---|
| MVPS #201 | Occupant Protection in Interior Impact--Passenger Cars. Right front passenger thrown left during pole sideswipe and U-turn, ducked down prior to impact with tree, and hit head on unpadded lower instrument panel, sustaining moderate cheek laceration from fractured hard plastic. |
| TSPS #4 | Driver Education. Driver education courses should emphasize proper crisis maneuvers. |
| TSPS #5 | Driver Licensing. The driver's license expired one month before the accident. |
| TSPS #15 | Police Traffic Services. No enforcement action was taken on the driver's expired license. |

Description

Preocrash: Driver had stopped for gas and was parked at filling station between building and gas pumps, westernmost from street, facing

* VDI = Vehicle Deformation Index.

northward. While talking to station attendant, she turned key in ignition, put the car in gear, accidentally depressed the accelerator pedal instead of applying the brake pedal, and accelerated rapidly. Driver thinks she tried to steer prior to first impact. Not having car under control was a violation. No physical evidence or tire marks to indicate precrash maneuvers.

Crash: Vehicle struck utility pole with left front corner, continued to sideswipe left side, glanced off pole, crossed South Main Street in a U-turn, and impacted tree on east side of street with front end. Came to final rest facing south. Occupants thrown to the left at pole impact and held to the left during U-turn; passenger ducked down under instrument panel near radio area prior to impact with tree. On colliding with tree, Driver 1 was thrown forward; she sustained fractured 6, 7, and 8 right ribs at costa chondral junction and pain to low center chest from impacting steering wheel, and simple fracture to left patella and small superficial abrasion to right knee from striking instrument panel. Right front passenger's whole body thrown against instrument panel; from shattered plastic on unpadded lower panel she received four-inch laceration to right jaw from protuberance of cheek rearward along zygomatic bone, one-inch vertical laceration to left lower lip, and small abrasion to center forehead.

Vehicle sustained slight sideswipe damage to left front corner and left side from utility pole; left rear fender skirt knocked off and left front wheel lip slightly bent. Impact with tree caused frontal sheet metal damage to hood, grill, and bumper, with 11 inches of crush; rear edge of hood elevated but did not move rearward; hood latch bent slightly and partially jammed; steering wheel rim slightly deformed; glove compartment and panel left of steering column scuffed; and lower instrument panel fractured. Hood latch released on impact with tree. Direction of force to vehicle was 12:00 o'clock for both pole and tree.

Postcrash: Filling station attendant rushed immediately to car but did not remove occupants; witness at station called police and ambulance. Occupants remained in car until ambulance arrived; first aid applied to lacerations on-scene; both extricated on backboards. Transported to St. Joseph's Mercy Hospital in Ann Arbor; passenger's chest x-rayed then released her; driver's chest and lower spine x-rayed, driver admitted and hospitalized two days. No fire or explosion and no environmental problems. Debris included lost left fender skirt and small grill pieces, utility pole scraped, tree scraped and had pain transfers. Police and ambulance response prompt. Car far enough to edge of roadway to make traffic controls unnecessary.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environment	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver distracted and inattentive to driving task. (Definite)
- 1 Because of her height and severe scoliosis of the spine, driver had difficulty in reaching pedals on this model vehicle. (Definite)
- 1 Driver evidenced panic behavior and information processing error in failing to make any corrective maneuvers. (Definite)
- 4 Driver incompatible with vehicle controls due to her height and scoliosis. (Definite)

Severity Increasing Factor

- 5 Lack of padding on lower instrument panel increased injury severity. (Definite)

Relevant Condition or Modifying Factor

- 1 Driver's physical characteristics were poorly matched with this vehicle, resulting in limited ability of driver to control car. (Definite)

Injury Causation

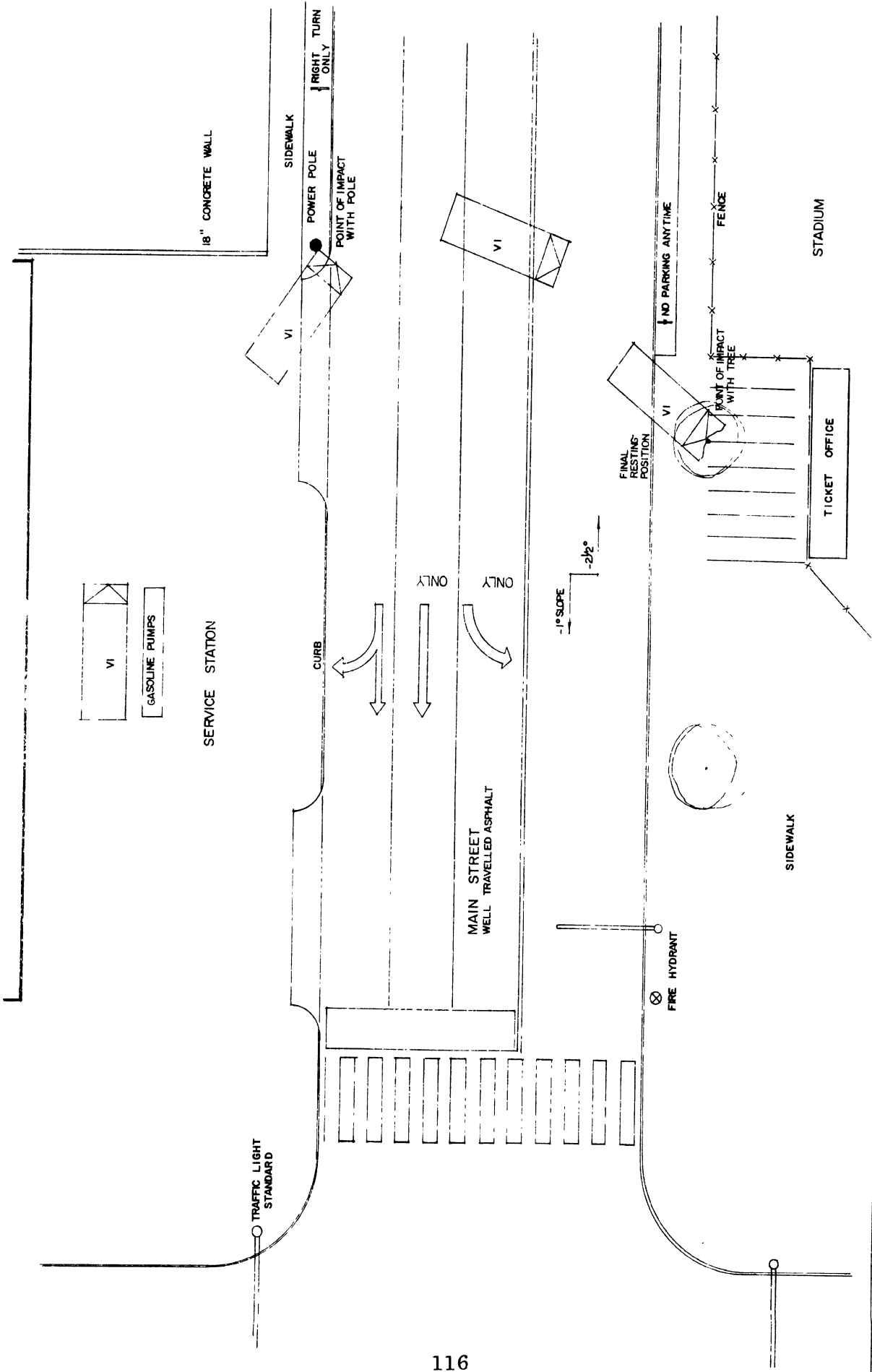
- 2 Occupants unrestrained. (Definite)
- 2 Passenger ducked under instrument panel, striking unpadded hard plastic. (Definite)
- *2 Driver braced herself on steering wheel, minimizing injury. (Possible)

Postcrash Factor

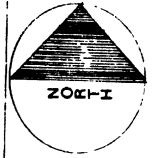
- *3 Extricating occupants on backboards proper precautionary measure. (Definite)

Recommendations

- 1 Driver education courses should emphasize inherent danger in choosing vehicle with controls incompatible with driver's physical characteristics; this is especially critical in emergency maneuvers.



AA321



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-322
CASE SUMMARY

Identification

Accident occurred on Washtenaw Avenue at intersection with Cambridge Avenue, in city of Ann Arbor, Washtenaw County, Michigan, on Thursday, November 2, 1972 at 1230 o'clock. Area is residential. Two passenger cars, rear-end impact. Injury Severity AIS* code 02, moderate.

Ambience

Partially overcast day, temperature 52^oF, humidity 53%, wind from the west up to 18 mph. Roadway dry.

Highway

Washtenaw Avenue, a 4-lane major arterial, 38 feet wide, no divider. Well-traveled, well-maintained asphalt, 6-inch high curb. Roadway straight, crowned for drainage, +1 $\frac{1}{2}$ ^o grade to the south. Three mercury vapor luminaires. In quarter mile radius of accident site: 1 driveway, 4 intersections, 15 utility poles, 25 trees. Accident history shows 12 accidents in past three years; 10 at intersection, one 50 feet southeast and one 150 feet north of intersection; 10 on clear days; six rear-end impacts.

Traffic Controls

Posted speed limit 30 mph. Intermittent white lane delineators, double yellow center line; visibility good. No pavement words or symbols. Legible No Parking and 30 mph speed limit signs, all legible. No signals.

Vehicles

Vehicle 1, passenger car, 1962 Ford Falcon 2-door sedan, light blue exterior and dark blue interior; odometer 98,315 miles. Inspected by State Police of Virginia, December 6, 1970. Automatic transmission, no power accessories. Padded upper instrument panel, sunvisors, and armrests. Lap belts available in front seat only, very dirty and rusty; use in past few years unlikely. All brake linings and drums scored. Last maintenance at 95,575 miles on August 5, 1972; service unknown. Frontal sheet metal damage to bumper, grill, hood, and both fenders; hood latch released; steering wheel rim cracked and very slightly deformed. Vehicle 1 old, economy car in fairly good condition. VDI*: 12-FDEW-1.

Vehicle 2, passenger car, 1971 Ford Mustang Mach I, 2-door hardtop, red exterior and black interior, odometer 20,687 miles. No indication of inspection (periodic vehicle inspection not mandatory in Michigan). Power steering, power brakes, automatic transmission; padded upper instrument panel, sunvisors, armrests, and steering wheel spokes. Lap belts and

* American Medical Association Abbreviated Injury Scale (AIS).

* Vehicle Deformation Index (VDI).

upper torso restraints available. No vehicle defects; last maintenance at 18,982 miles on October 1, 1972 included oil change, oil filter, and air filter. Sheet metal damage to rear bumper and trunk lid; quarter panels buckled; upper and lower right and left C-pillars damaged; lower left B-pillar damaged; left side of windshield cracked; front seat adjusters jammed rearward. Significant finding was plate with rubber seal around fuel filler pipe, held to floor by four sheet metal screws. Fuel tank struck those screws during impact, resulting in four puncture holes in tank. VDI:06-BDEW-1.

Occupants

Driver 1, a 23-year-old female, Caucasian, 68 inches, and 145 pounds. Five years of driving experience, averaging 30,000 to 35,000 miles per year. Going from home of friends in Ypsilanti, Michigan to work in Ann Arbor; seven miles from origin, one mile from destination. Very familiar with vehicle having owned it two years. Drove route twice daily so very familiar with area and roadway. Completed two-phase driver education course, including on-road and classroom training. In excellent physical condition. Mental condition worried and disturbed. No blood alcohol involved. Injuries: 5 cm laceration to lower lip, 4 cm laceration to chin; lost three front teeth, fractured one front tooth; contusions to both knees. Injury Severity AIS code 02, moderate.

Driver 2, 20 years old, male, Caucasian, 67 inches, and 163 pounds. Had been driving four years, averaging 16,000 miles per year. Driving from classes at Washtenaw Community College in Ann Arbor to home; three miles from origin, one mile from destination. Owned vehicle 13 months and accumulated most of mileage, very familiar with it. Traveled route daily as it was main thoroughfare near his home. Completed two-phase, on-road and classroom, driver education course. Excellent physical condition, good mental condition. No blood alcohol involved. Injuries: neck stiff on left side; contusion inside left leg above ankle. Injury Severity AIS code 01, minor.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were specifically relevant to this case.

- | | |
|-----------|---|
| TSPS #1 | Periodic Motor Vehicle Inspection. A vehicle inspection would have found Vehicle 1's scored brake linings and drums. |
| TSPS #4 | Driver Education. Driver education courses should emphasize hazards of driving while preoccupied and prudence of wearing seat belts to minimize injuries. |
| TSPS #9 | Identification and Surveillance of Accident Locations. Accident site high accident location and area of flagrant abuse of posted speed limit. |
| MVPS #201 | Occupant Protection in Interior Impact--Passenger Cars. Protruding choke knob and lights knob caused injury to Driver 1. |
| MVPS #202 | Head Restraints--Passenger Cars. Head restraints in Vehicle 2 probably prevented whiplash to Driver 2. |

- MVPS #207 Anchorage of Seats--Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. Front seat back in Vehicle 2 deformed but remained anchored, thus decreasing whiplash potential.
- MVPS #301 Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. Vehicle 2's fuel tank deformed and punctured causing gas leakage.

Description

Preocrash: Both Vehicle 1 and Vehicle 2 headed northwest on Washtenaw Avenue. Vehicle 2 stopped in inside lane waiting to turn left; wheels forward, turn signal on. Vehicle 1 came over brow of hill 300 feet from accident site at 40 mph (30 mph zone); Driver 1 noticed she was speeding. Driver 1 saw Vehicle 2 about 160 feet before impact, slammed on brakes; Driver 2 saw Vehicle 1 just before impact, no evasive action. Driver 2's speeding and failing to allow assured distance to stop violation of law. Brake skid marks left by Vehicle 1: left wheels, 62 feet; right wheels, 60 feet.

Crash: Direct front of Vehicle 1 impacted direct rear end of Vehicle 2. Vehicle 2 pushed forward 25 to 30 feet from point of impact, still facing straight ahead in same inside lane. Vehicle 1 moved forward a couple of feet in same lane. At impact, Driver 1 was thrown forward; impacted upper rim of steering wheel, bit through lower lip and chin causing 5 cm laceration to lip, 4 cm laceration to chin, three lost teeth, and one fractured tooth: struck lower instrument panel suffering contusions to both knees from choke knob on right and lights knob on left. Driver 2 thrown backwards, rebounded forward; left side of neck stiff from being jarred at impact; contusion to inside left leg above ankle, probably from brake pedal. Vehicle 1 sustained frontal sheet metal damage to bumper, hood, grill, and both fenders; hood latch released; steering wheel rim cracked and very slightly deformed. Vehicle 2 had sheet metal damage to rear bumper and trunk; quarter panels buckled; upper and lower right and left C-pillars damaged; lower left B-pillar damaged; left side of windshield cracked; front seat adjusters jammed rearward; fuel tank deformed and punctured. Directions of force 12:00 to Vehicle 1, 6:00 to Vehicle 2.

Postcrash: Driver 2 sat in car a few moments to gain composure, then went back to check on Driver 1. Driver 1 remained in car until ambulance arrived; attendants lifted her out on backboard. Driver 2 gave kleenex to Driver 1, police administered first aid to her lacerations, and ambulance transported her to hospital. No fire, explosions or environmental problems. Gas leaked from Vehicle 2 and radiator fluid leaked from Vehicle 1. Police arrived on-scene in two to three minutes, ambulance in about five minutes. No traffic controls necessary because Driver 2 drove Vehicle 2 onto side street, and even with Vehicle 1 still on roadway, three out of four lanes were open and traffic wasn't heavy.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver 1 exceeding speed limit. (Definite)
- 1 Driver 1 observation of Vehicle 2 delayed. (Definite)

Severity Increasing Factor

- 4 Brake linings and drums were scored on Vehicle 1, decreasing braking ability. (Definite)

Relevant Conditions

- 1 Driver 1's fatigue and preoccupation with problems distracted her attention from roadway. (Definite)
- 7 Incline on roadway 300 feet before impact limited Driver 1's sight distance. (Definite)
- 7 Wet leaves on dry roadway decreased coefficient of friction. (Definite)

Injury Causation

- 2 Driver 1's injuries would have been minimized had she been restrained (lap belt available, but part under seat cover). (Definite)
- 5 Upper torso restraints not available in Vehicle 1. (Definite)
- 5 Protruding control knobs in Vehicle 1 injury-producing. (Definite)
- *5 Head restraints in Vehicle 2 prevented whiplash injury to Driver 2. (Probable)

Postcrash Factors

- *3 Ambulance response prompt and use of backboard appropriate. (Definite)

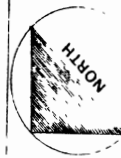
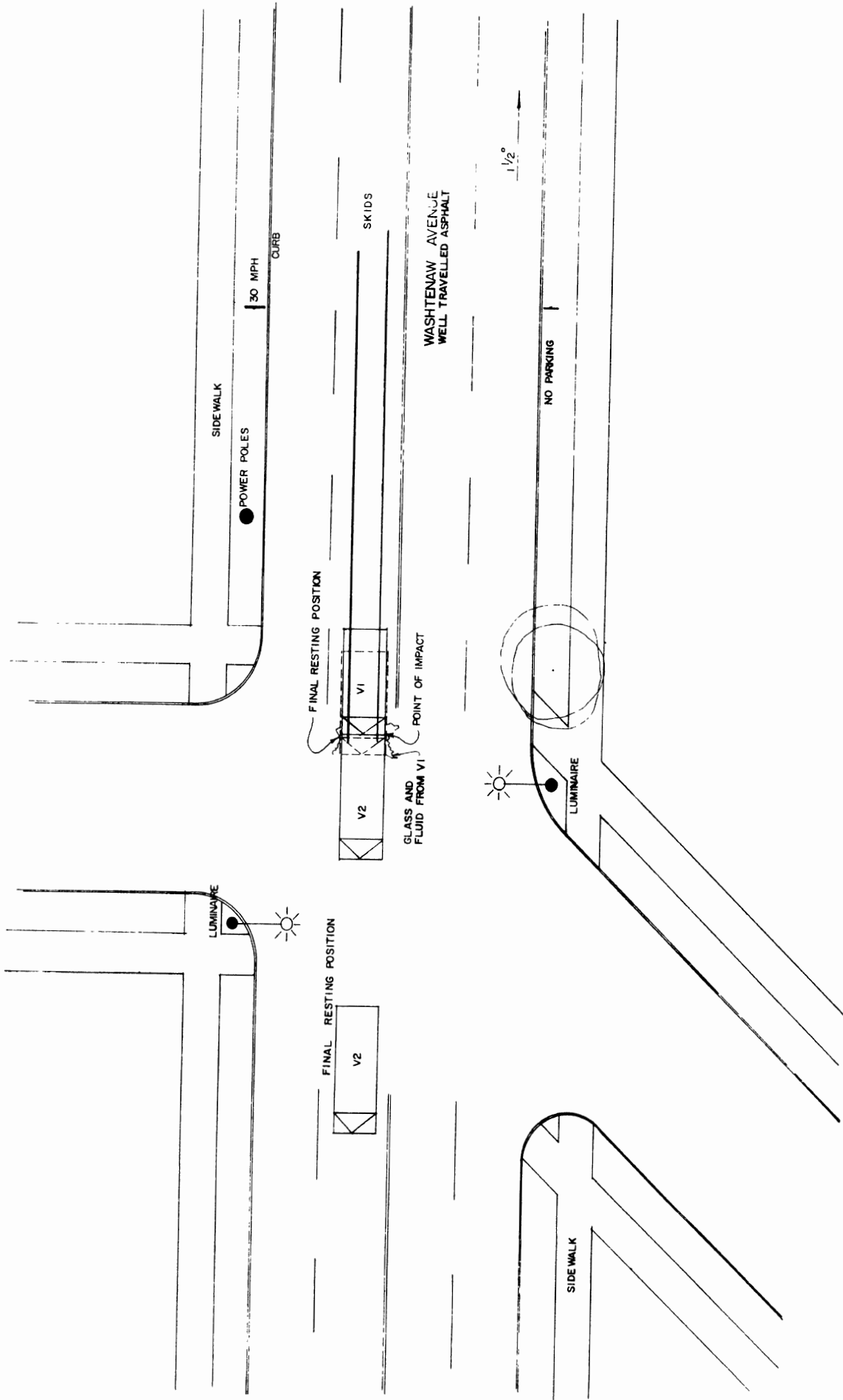
Matrix Cell Explanation

Postcrash Factors continued

- 6 Gas leaked from Vehicle 2 and Vehicle 1 causing potential fire hazard; radiator fluid leaked from Vehicle 1. (Definite)

Recommendation

- 1 Driver education courses should emphasize: (a) danger of speeding; (b) potential hazards of driving while preoccupied; and (c) prudence of wearing seat belts to minimize injury.
- 7 Accident site should have police surveillance because motorists constantly violate the speed limit in this area, and 12 accidents have happened there in three years.
- 4 Mandatory periodic motor vehicle inspection would have revealed Vehicle 1's scored brake linings and drums.



AA 322



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-323
CASE SUMMARY

Identification

Accident occurred on US-12 (Michigan Avenue), Pittsfield Township, Washtenaw County, Michigan on Monday, November 6, 1972, at 1815 hours. Area is agricultural. Two passenger cars, head-on collision. Injury severity AIS* code 10, unknown, fatal.

Ambience

It was already dark, sky clear. Temperature 51^oF, relative humidity 62%, wind 7 mph from the southeast. Roadway dry.

Highway

US-12 (Michigan Avenue) at accident site 2-lane major arterial, 22 feet wide, no divider. Well-traveled, well-maintained asphalt; 11 foot wide gravel shoulders. Roadway straight, crowned for drainage, - $\frac{1}{2}$ ^o grade to the east. No lighting in area. Within a quarter mile radius of accident site: one driveway, no intersections or interchanges, seven utility poles, no trees. Accident history for 1968-1971 shows no accidents in area.

Traffic Controls

Speed limit 65 mph daytime, 55 mph nighttime by state statute. Intermittent yellow center line; solid white edge delineation. "Traffic Island Ahead" and "45 mph Ahead" signs, legibility good. No signals.

Vehicles

Vehicle 1, passenger car, 1967 Chevelle Concours station wagon; white exterior, blue interior; odometer 65,832 miles. No indication of vehicle inspection (vehicle inspection not mandatory in Michigan). Power brakes, power steering, automatic transmission. Padded upper instrument panel, and armrests. Lap restraints only. Defects: tread on right rear tire 3/32 inch; right rear shock absorber leaking fluid; brake fluid low. No recorded maintenance. Frontal damage to hood, grill, bumper, fenders, and front doors; 27 inches of crush to right front corner; tailgate electric window broken out; upper left A- and B-pillars, upper and lower right A-pillar, and upper right B-pillar separated; lower left and right B-pillars damaged; rear seat bent and dented. Significant findings included engine compartment telescoping unit compressed 4.4 inches; energy-absorbing steering device compressed 3.7 inches; shear capsule separated 3.5 inches. VDI:**12-FDEW-4.

* American Medical Association Abbreviated Injury Scale (AIS).

** Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J221a.

Vehicle 2, passenger car, 1970 Mercury Monterey, 4-door sedan; green exterior, black vinyl top, green interior; odometer 51,902 miles. No indication of vehicle inspection (periodic inspection not mandatory in Michigan). Automatic transmission; power brakes and power steering; padded upper instrument panel, sunvisors, and arm-rests. Lap belts with locking retractors and upper torso restraints available. No vehicle defects; last maintenance at 49,225 miles on September 27, 1972 included oil, lubrication and new oil filter and air filter. Thirty-five inches frontal crush; right and left rear quarter panels dented, damage to hood, grill, fenders, and right doors; left body mount separated near wheel well; upper and lower right A-pillars and B-pillars damaged (upper right B-pillar partially separated); right roof side rails buckled; right door window frame bent outward; right front and rear doors jammed closed; steering wheel spokes severely bent. Significant findings included shear capsule separated 1.0 inches; energy-absorbing steering device compressed 1.3 inches. VDI:12-FDEW-4.

Occupants

Driver 1, 59 years, male, Caucasian, 73 inches and 185 pounds. Forty years driving experience; had usually averaged 12,000 miles per year, but had been driving less since he quit his job following a heart attack in February, 1972. Driver 1 allegedly driving from home in Belleville, Michigan, 13 miles from accident site, to visit his sister in Hillsdale, Michigan, 60 miles from site. Accompanied by small dog who was uninjured in crash. Familiar with vehicle having driven it for three years. Had driven route several times recently. No driver education. In poor health, had heart condition; was fatigued; recently maintained irregular eating habits. Suffered intermittent psychosis (was discharged from a mental hospital in 1960 after a two-year stay); under recent life stress from illness and financial and marital insecurity. Driver unrestrained. No alcohol or drugs involved in accident. Injuries: facial lacerations; fractured nasal bone; probable concussion; avulsion and contusion over sternum; flail chest, possible associated internal injuries; abrasions and lacerations to anterior surface of both shins; fractured left tibia; fractured right metatarsals and heel bone. Cause of death concussion or internal injuries. Injury severity AIS code 10, fatal, details unknown.

Driver 2, 63-year-old male, Caucasian, 68 inches and 165 pounds. Had been driving 40 years, averaging 20,000 miles per year. Returning to home in Detroit from business trip to Hillsdale, Michigan; 60 miles from origin, 50 miles from destination. Had put 40,000 miles on Vehicle 2 in two years of ownership. Adequately familiar with area, had driven route recently. No driver education. General state of physical and mental health good. No alcohol or drugs involved. Driver unrestrained. Injuries: concussion, facial lacerations, fractured nasal bone, multiple abrasions and lacerations to limbs, flail chest, lacerated thoracic aorta, fractured right radius and ulna, fractured middle and distal right femur. Driver died five days after accident; cause of death dissecting aneurism in thoracic aorta. Injury severity AIS code 05, critical, survival uncertain.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) are specifically relevant to this case.

- MVPS #111 Rearview Mirrors--Passenger Cars and Multipurpose Passenger Vehicles. The multiview rearview mirror in Vehicle 2 was injury-producing.
- MVPS #203 Impact Protection for the Driver from the Steering Control System--Passenger Cars. Vehicle 1's energy-absorbing device compressed only 1.3 inches.
- MVPS #212 Windshield Mounting--Passenger Cars. Vehicle 1 had 100% windshield bond separation; however, crash exceeded standard's test requirement of a 30 mph barrier impact.
- TSPS #5 Driver Licensing. Driver 1 was mentally unfit to drive a car.

Description

Pre-crash: Vehicle 1 traveling approximately 50 mph westbound in eastbound lane, without lights despite darkness. Vehicle 2 eastbound in eastbound lane also at approximately 50 mph. One westbound witness stated that he saw Vehicle 1 in the wrong lane seven miles before the accident site, and gave Driver 1 room to get into correct lane but Driver 1 continued in wrong lane. This witness had shortwave radio in car and tried to call police but got no response. He turned car around and followed behind Vehicle 1 in eastbound lane. Several other cars swerved off road to avoid a collision. According to witnesses, as Driver 1 approached oncoming westbound traffic, he made no attempt at evasive maneuvers, but just drove straight ahead in wrong lane. Driver 2 took no evasive action, apparently because he didn't see Vehicle 1 until impact. Driver 1's driving left of center and not having his lights on both violations of traffic laws. No pre-crash physical evidence, skids, or scuffs.

Crash: Vehicle 1 and Vehicle 2 collided head on with a force vector of 12:00 o'clock to both cars, then rebounded back about one foot, coming to final rest in roadway facing east and west respectively. Vehicle 1 had frontal damage to hood, grill, bumper, fenders, and front doors and 27 inches of crush to right front corner. The tailgate electric window was broken out; upper left A- and B-pillars, upper and lower right A-pillar, and upper right B-pillar separated; lower left and right B-pillars damaged; rear seat bent and dented. Engine compartment telescoping unit compressed 4.4 inches; energy-absorbing steering device compressed 3.7 inches; and shear capsule separated 3.5 inches.

Vehicle 2 sustained 35 inches of frontal crush with damage to hood, grill, fenders, and doors. The right and left rear quarter panels were dented, left body mount separated near wheel well, upper and lower right and left A- and B-pillars damaged (upper right B-pillar partially separated), right roof side rails buckled, right front and rear doors jammed closed, and steering wheel spokes severely bent. Shear capsule separated 1.0 inches and energy-absorbing steering device compressed 1.8 inches.

Both drivers unrestrained. Driver 1 thrown forward heavily into steering column as vehicle front end rearward crush significantly reduced occupant compartment. Driver 1 suffered probable concussion, 3-inch laceration on bridge of nose, and fractured nasal bones from striking windshield with head; had one-inch-deep avulsion two inches below top of sternum, bilateral rib fractures, flail chest, possible sternal fractures and mid-chest imprint of steering wheel all from impacting the steering wheel; sustained deep abrasion and laceration on bone of upper third of right shin from ashtray and abrasion to right knee, abrasion to lower right leg, abrasions over left knee, closed fracture of upper third of left tibia, and laceration to lower left leg from instrument panel. Driver 1's right foot contacted accelerator with enough force to leave an imprint of the pedal on his slipper; this and contact with transmission hump resulted in fractured right 3, 4, and 5 metatarsals and right heel bone.

Driver 2 was thrown forward and suffered a concussion, extensive facial lacerations, and fractured nasal bones from striking the windshield and multiview rearview mirror with his head, was comatose post-crash, and never fully regained consciousness. Impact with the steering wheel (energy-absorbing device collapsed only 1.8 inches) resulted in a bilateral mid-clavicular fracture, large hematoma over right clavicle, flailed chest, widening of mediastinum, small laceration on thoracic aorta, spot mid-chest abrasions, and possible spleen rupture. Driver 2 also sustained abrasions to right arm and fracture to right distal radius and ulna from upper instrument panel; open fracture to right femur midshaft, comminuted fracture to right distal femur, and linear abrasion outside right knee from instrument panel and steering column; and abrasions to left leg four inches below knee from lower instrument panel. Expired five days after the crash.

Postcrash: Witness stopped immediately at nearby farm house and called police. First ambulance arrived in five minutes; extricated Driver 2 on backboard out driver door, splinted his fractured femur, and administered first aid to lacerations, transported Driver 2 to hospital. Second ambulance extricated Driver 1 through left rear door. Ambulance service vehicle* used for transporting bodies also arrived and Driver 1 could be removed from scene. Fire department sprayed dry chemical fire extinguisher on both engines to prevent fire or explosion. No environmental problems. It was approximately one hour and 15 minutes before scene cleared of wrecked vehicles. Police response prompt; officers routed traffic around accident into open lane.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

* This vehicle has no equipment and is used to transport bodies so that equipped ambulances won't be held up waiting for medical examiner to arrive on-scene to pronounce victims dead.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

1 Driver 1 traveling westbound in eastbound lane of traffic at night without headlights, took no action to avoid collision. (Definite)

1 Driver 2 took no evasive action. (Definite)

Relevant Factors

1 Driver 1 attempting suicide/homicide while in psychotic state. (Possible)

1 Driver 2 had difficulty seeing Driver 1 because of darkness and no headlights on Vehicle 1. (Definite)

1 Driver 2 inattentive. (Probable)

7 Transition from area of roadway adjacent to brightly lit parking lot 400 feet from accident to roadway with no artificial lighting made it difficult for Driver 2, an older man, to adjust his eyes, and increased Driver 2's inability to see Vehicle 1. (Probable)

*7 Wide, level shoulders of packed dirt covered with gravel gave motorists safe area to pull off roadway in evasive maneuvers to avoid colliding with Driver 1. (Definite)

Injury Causation

2 Both drivers unrestrained. (Definite)

2 Driver 2's advanced age increased severity of chest injury and lessened his potential for survival. (Probable)

5 Neither energy-absorbing columns on Vehicle 1 and Vehicle 2 compressed fully as they should have considering the severity of impact; this increased chest injuries to both drivers. (Definite)

Matrix Cell Explanation

Injury Causation (continued)

- 5 Lack of padding on lower instrument panels in both vehicles increased injury severity to lower extremities of Driver 1 and Driver 2. (Definite)

- 5 Aftermarket multiview rearview mirror in Vehicle 2 caused head injury to Driver 2. (Definite)

Postcrash Factors

- *3 Extrication of Driver 2 on backboard appropriate. (Definite)

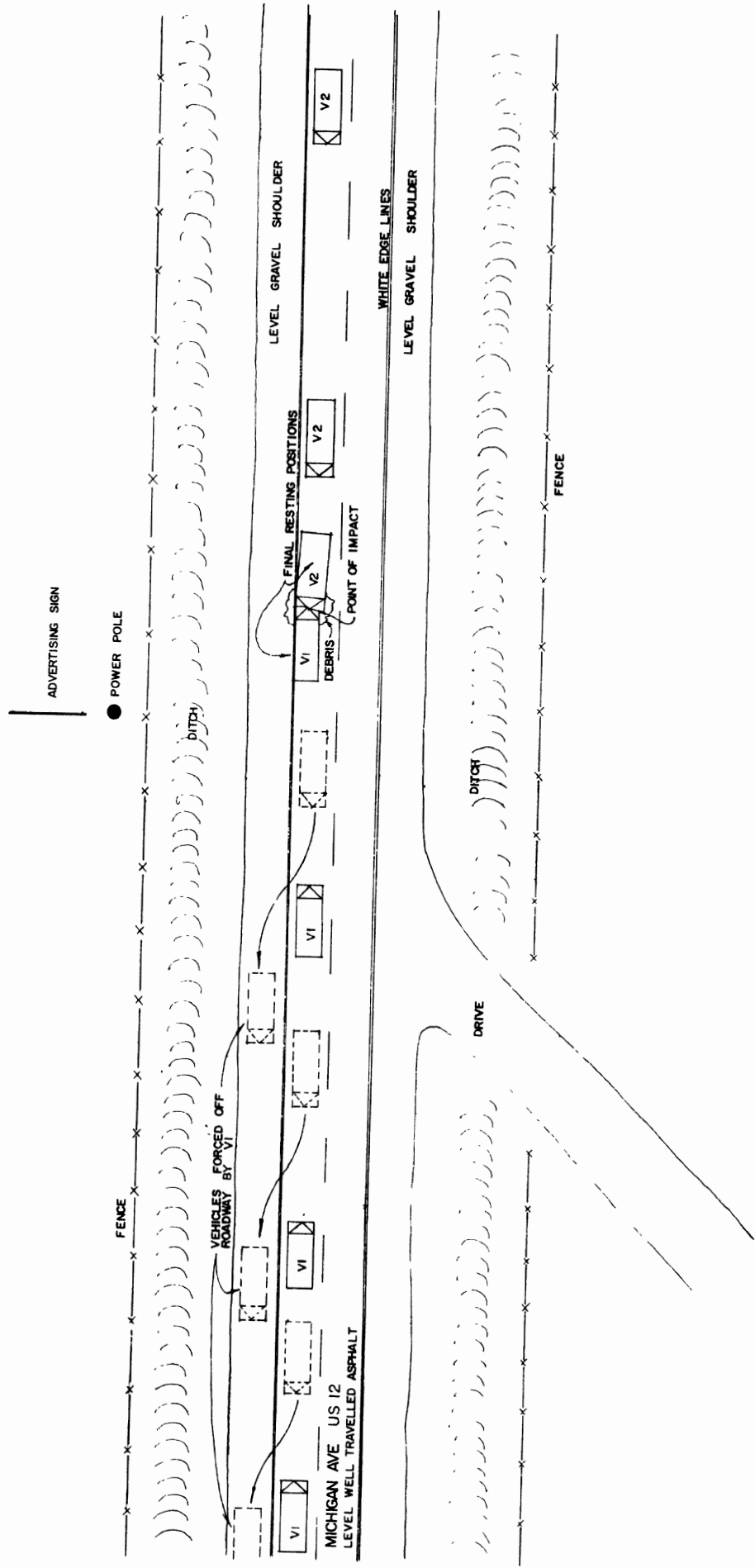
- *6 Fire department sprayed dry chemical fire extinguisher on both engines to prevent fire and explosion. (Definite)

- 9 Considering the long wait for the medical examiner, police officers excellently equipped to control traffic--had lighted arrow on top of squad car to route cars into open lane. (Definite)

Recommendations

- 4 Reevaluate MVPS #203 (Protection from Steering Control). With both drivers unrestrained in this head-on collision, accident is classic case of when energy-absorbing device should operate to maximum effectiveness, but they did not fully compress.

- 4 Investigate use of aftermarket multiview rearview mirror mounted along windshield header--device confusing and potentially injury-producing.



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AA 323



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-324
CASE SUMMARY

Identification

Accident occurred on Dexter Road, an open roadway, in a residential-commercial area in the city of Ann Arbor, Washtenaw County, Michigan, on Thursday, November 9, 1972 at 1600 hours. Single passenger car struck a pedestrian. Injury severity AIS* code 06, fatal.

Ambience

Daylight, overcast sky. Temperature 43^oF, relative humidity 70%, wind 5 mph from southeast. Roadway dry.

Highway

Dexter Road, 3-lane, 34-foot-wide collector, no divider. Well-traveled polished asphalt; 6-inch-high curbs.** Roadway straight, crowned for drainage, +1 $\frac{1}{2}$ ^o grade to the northwest. There are three mercury vapor luminaires in the area. Within a quarter-mile radius, 15 driveways, one major intersection, 10 utility poles and 20 trees.

Traffic Controls

Posted speed limit 30 mph. Intermittent white lane delineators; solid, yellow, double center line; visibility of pavement markings good. One speed limit and one "No Parking Anytime" signs; good legibility. No signals at accident site; however, at intersection 195 feet from accident, continuous green arrow for northwestbound traffic allows a continuous traffic flow without interruption for pedestrian crossing. Accident history for 1968 through 1970 indicates four two-vehicle intersection collisions at the intersection; however, there were no accidents on Dexter Road at point where this accident occurred.

Vehicle

Passenger car, 1967 Pontiac Firebird, 2-door hardtop, light green exterior, black interior; odometer 35,005 miles. No indication of vehicle inspection (periodic inspection not mandatory in Michigan). Automatic transmission, power brakes, power steering, and drum brakes. Padded instrument panel, sunvisors, armrests. Lap belts available, not worn. No vehicle defects; all tires had 9/32-inch tread. No recorded maintenance. Left front turn indicator broken. VDI:+12-FLEN-0 (at location of occupant contact). Pedestrian struck by relatively blunt portion of vehicle's front end.

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs are standard in city of Ann Arbor, MI.

+ Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Occupants/Pedestrian

Driver 1, 22 years, male, Black, 71 inches and 160 pounds. Five years driving experience; averaged 8,000 miles per year. Driving from downtown Ann Arbor to Maple Village Shopping Center; accident occurred one mile and a half from origin of trip, three-quarters of a mile from destination. Had owned vehicle two years, drove it regularly. Traveled Dexter Road daily. Completed high school two-phase driver education course. Good physical and mental condition. No alcohol or drugs involved. Driver unrestrained. Injury severity AIS code 00, no injuries.

Right front passenger, 20-year-old female, Black, 66 inches and 110 pounds. Passenger unrestrained. Injury severity AIS code 00, no injuries.

Pedestrian, 47-year-old female, Caucasian, 60 inches and 135 pounds, an immigrant to the U.S. Walking home from babysitting; third of a mile from origin, two and a half miles from destination. Familiar with area, had walked back and forth from home to babysitting job once weekly for two months. No history or illness, was having difficulty with menopause; autopsy indicated probable carcinoma of sigmoid colon, unknown by pedestrian. Was in good mood; her family stated she tended to be nervous, intense person. She was overly cautious as a rule when crossing streets. Injuries: multiple skull fractures, severe concussion, face and scalp lacerations, abrasions to lateral aspect right thigh. Injury severity AIS code 06, fatal.

Standards

The following Traffic Safety Program Standards were specifically relevant to this case.

- | | |
|----------|--|
| TSPS #12 | Highway Design, Construction, Maintenance. Green straight-through arrow at intersection permits constant flow of northwestbound traffic, making it difficult for pedestrians to cross. |
| TSPS #14 | Pedestrian Safety. Pedestrians should more effectively be warned about the hazards of jaywalking. |

Description

Pre-crash: Vehicle 1 traveling northwest at approximately 38 mph* in center of traffic lane; pedestrian crossing from south to north side of street. After traveling 50 feet past intersection, driver saw pedestrian, went another 150 feet during perception-reaction time, braked, hit pedestrian approximately 27 feet into skid. Pedestrian jaywalking a violation of traffic law. Pre-crash skid marks: 55.1 feet right tire; 54.3 feet left tire.

* Driver speed estimated at 32 mph according to coefficient of friction obtained from established tables of roadway friction measurements; 38 mph from actual tests with HSRI mobile tire test system.

Crash: Vehicle hit pedestrian at impact speed of 23 mph. Vehicle came to final rest in same lane, angled slightly toward north curb. Pedestrian hit on right side by front of car near left headlight; pedestrian put out right hand--imprint of hand on hood. Carried by car 27 feet, then whipped to ground 30 feet from impact, coming to rest with head pointed northeast, three feet in front of final rest of Vehicle 1. Vehicle's unrestrained occupants jarred forward on seat a little from braking; no injuries. Pedestrian unconscious and sustained multiple comminuted fractures of skull with associated cerebral contusions; lacerations of scalp and face; abrasions lateral aspect right thigh. Concussion cause of death. No vehicle damage; direction of force of impact 12:00 o'clock.

Postcrash: Nearby resident telephoned police and ambulance. Vehicle occupants exited themselves. Police squad car about one-quarter mile away, arrived on-scene in few seconds. Fire department rescue truck arrived in about three minutes, ambulance in about five minutes. No first aid administered on-scene. Pedestrian transported on a backboard to the hospital and died 2½ hours later. No fire, explosions, or environmental problems. Debris included blood, pedestrian's tennis shoe, and helmet she was carrying. Scene held because of severity of accident for thorough police investigation; three police officers rerouted all northwestbound traffic away from Dexter Road until investigation completed.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell Explanation

Accident Causation

Primary or Principle Causes

- 1 Pedestrian jaywalking. (Definite)
- 1 Pedestrian did not check for clearance before entering traffic lane. (Definite)

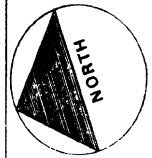
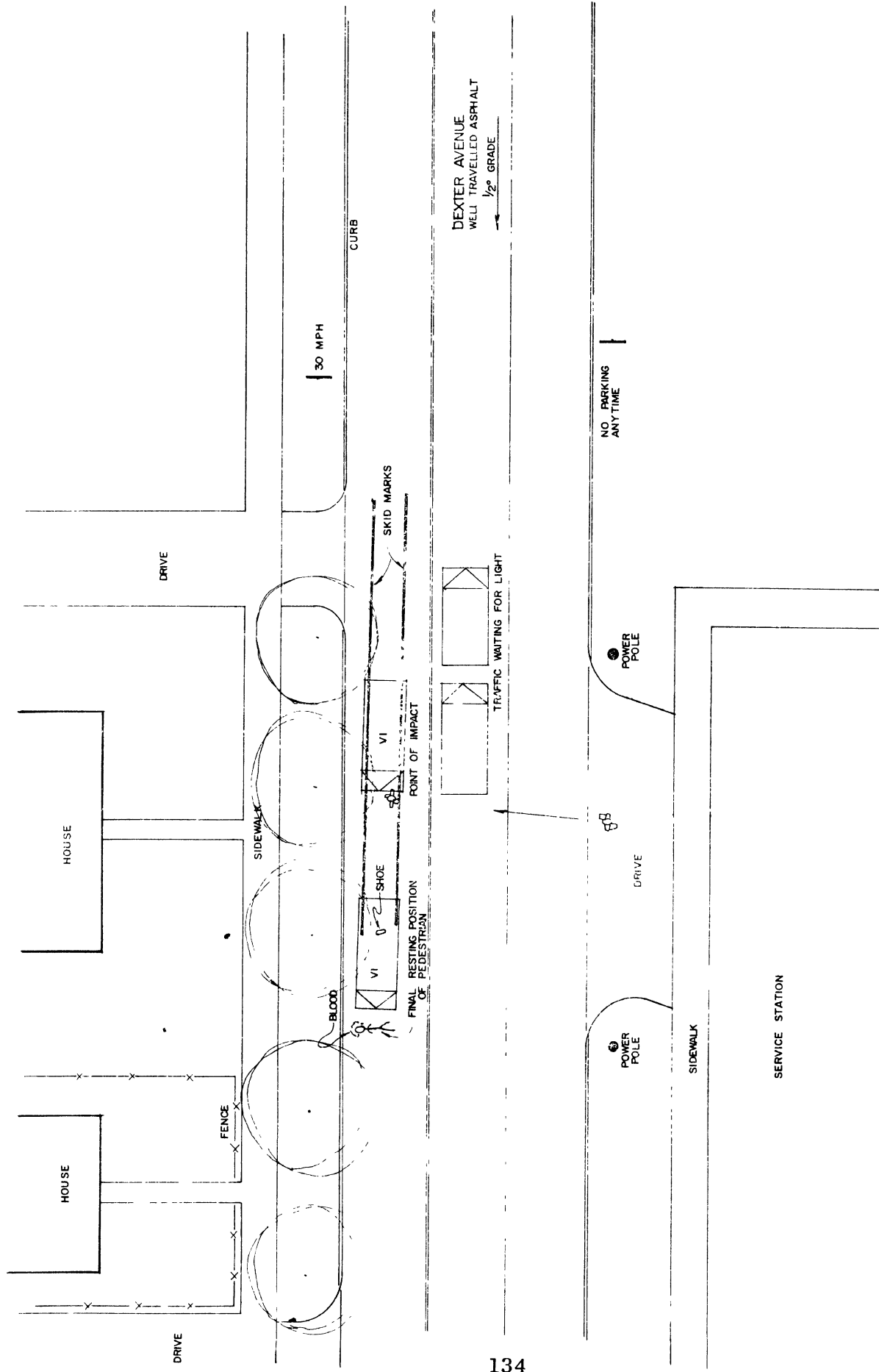
Severity Increasing Factors

- 1 Driver of striking vehicle going 8 mph over posted speed limit according to speed calculations based on coefficient of friction measurements with HSRI mobile tire test system.

<u>Matrix Cell</u>	<u>Explanation</u>
	<u>Relevant Factors</u>
1	Pedestrian inattentive. (Definite)
1	Pedestrian misjudged traffic situation because two lanes of traffic stopped for red light, traffic moving in third lane. (Probable)
7	Green straight-through arrow at intersection prevents pedestrians from ever crossing safely due to uninterrupted traffic flow into one leg of intersection. (Definite)
7	Two lanes of stopped traffic were transient view obstruction for driver of Vehicle 1 and pedestrian. (Definite)

Recommendations

- 7 Install pedestrian actuated traffic signal on Dexter Road to interrupt traffic into intersection for safe pedestrian crossing.
- 7 Discontinue green straight-through arrow on curb lane of westbound Huron Street traffic.
- 7 Establish pedestrian crosswalk markings on pavement which are distinctive and of sufficient contrast.
- 1 Improve public education beginning with small children, on the safety rules for pedestrians, and emphasize on hazards of jaywalking.



AA 324



SERVICE STATION

SIDEWALK

DRIVE

POWER POLE

NO PARKING ANYTIME

DEXTER AVENUE
WELL TRAVELLED ASPHALT
1/2° GRADE

CURB

30 MPH

SIDEWALK

DRIVE

HOUSE

HOUSE

FENCE

DRIVE

BLOOD

SHOE

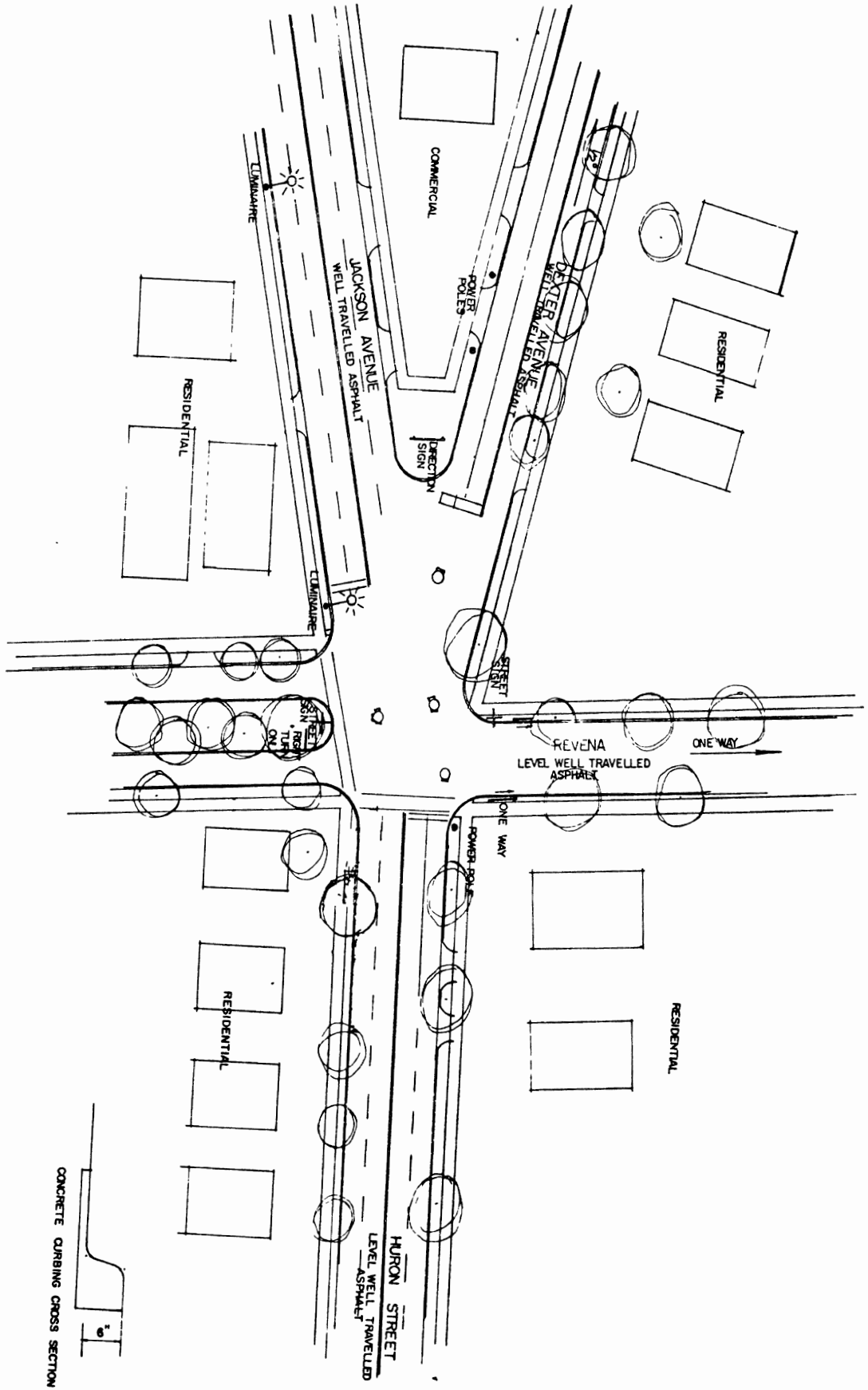
VI

POINT OF IMPACT

SKID MARKS

TRAFFIC WAITING FOR LIGHT

POWER POLE



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-325
CASE SUMMARY

Identification

Accident occurred on Huron Street, just east of Dexter Avenue-Jackson Avenue-South Revena Street-Huron Street intersection, in the city of Ann Arbor, Washtenaw County, Michigan. on Friday, November 10, 1972, at 2158 o'clock. Area is commercial-residential. Passenger car impacted fixed object; driver had been drinking (0.09 BAC). Injury Severity AIS* code 01, minor.

Ambience

Nighttime, heavy rain. Temperature 33^o, humidity 100%, wind speed at 7 mph from southeast. Roadway wet.

Highway

Jackson Avenue and Huron Street both 44-foot-wide, 4-lane major collectors; Dexter Avenue, 34-foot-wide, 3-lane collector; South Revena Street, 34-foot-wide, 2-lane local street. Grass median only on South Revena. All streets well-traveled asphalt with standard 6-inch-high curbs. Intersection Y-type, with Huron branching into Jackson and Dexter and Revena intersecting at junction of Jackson and Dexter. Westward $\pm 1^{\circ}$ grade on Dexter, all other streets level. Six mercury vapor luminaires. Within quarter-mile radius of intersection, 20 driveways, six intersections, 25 poles, and 55 trees. Accident history for 1968 through 1970 indicated four two-vehicle intersection collisions; three clear weather, one rainy conditions.

Traffic Controls

Speed limit posted 30 mph. Intermittent white lane delineators; double solid yellow center lines; no words or symbols on pavement. No Parking and 30 mph speed limit signs, both legible. One green arrow turn signal for traffic westbound on Huron to turn right on Dexter or North Revena; two three-color traffic signals (one for Huron-Dexter, one for Huron-Jackson) with fixed time as follows: green 31 seconds, yellow 4 seconds, red 35 seconds.

Vehicle

Passenger car. Ford Capri 2000, 2-door sedan, red exterior and black interior, odometer 11,052 miles. No vehicle inspection (periodic vehicle inspection not mandatory in Michigan). Power brakes, manual steering and transmission. Padded upper instrument panel, sunvisors, armrests and steering wheel spokes. Three-point restraint system with lap belt inertia reel. No vehicle defects except for right front passenger's lap belt--half was missing having been worn away by being buckled across seat which moved to let rear seat passengers in or out. Last recorded maintenance at 4,891 miles on July 23, 1972 including oil,

* American Medical Association Abbreviated Injury Scale (AIS).

lubrication and brake fluid. Frontal sheet metal damage to hood, bumper, and grill (16 inches of crush); damage to front seat backrest and left corner of driver's seat cushion. Significant findings were 100 percent separation of windshield bond, and bent steering wheel with little energy-absorbing compression. VDI*:12-FCEN-2.

Occupants

Driver, 18-year-old male, Caucasian, 71 inches and 175 pounds. Two years driving experience, averaging 7,500 miles per year; had driven 11,000 miles since June 1972 commuting during summer between Gaylord and Okemos, Michigan. Driver and center rear passenger had driven from Okemos to Ann Arbor, a distance of 65 miles, to attend a birthday party at a University of Michigan dormitory. On the way to a restaurant in Ypsilanti; accident occurred after they had driven nine miles from dormitory, 10 miles from Ypsilanti. Had owned car for five months and had accumulated 10,800 miles on it. Unfamiliar with area, having never driven there before. Completed two-phase driver education course, including on-road and classroom training. Overall physical and mental condition good; fatigued at time of accident. Had been drinking. Injuries: simple fracture to nasal bones, ecchymosis to both eyes, minor lacerations to both knees. Unrestrained. Injury Severity AIS code 01, minor.

Right front passenger, 18-year-old female, Caucasian, 63 inches and 98 pounds. Injuries: 2 cm laceration to right frontal lobe; mild neurological involvement, dazed, consciousness level varied; complained of headache and tightness to chest; amnesia for accident. Unrestrained. Injury Severity AIS code 01, minor.

Left rear passenger, 18-year-old female, Caucasian, 65 inches and 125 pounds. Injury: muscle strain to left ankle. Unrestrained. Injury Severity AIS code 01, minor.

Center rear passenger, 18-year-old male, Caucasian, 67 inches and 155 pounds. Injuries: mild neurological involvement, severe headache, blurred vision; one-inch laceration over right periorbital bone. Unrestrained. Injury Severity AIS code 01, minor.

Right rear passenger, 18-year-old female, Caucasian, 60 inches and 98 pounds. Uninjured, unrestrained. Injury Severity AIS code 00, no injury.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were specifically relevant to this case:

TSPS #4	Driver Education. Driver was driving while drinking, was unrestrained, and was inattentive in unfamiliar surroundings, all of which indicate need for remedial training, directed toward evoking attitude change toward driving.
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* Vehicle Deformation Index (VDI).

- TSPS #5 Driver Licensing. Driver had accumulated six points in a two-year period and was issued a warning letter.
- TSPS #8 Alcohol in Relation to Highway Safety. Police gave driver breathalyzer test so there would be a record of his alcohol level; driver not considered a problem drinker, but at time of accident had a 0.09 BAC.
- TSPS #12 Highway Design, Construction, and Maintenance. Lighting at intersection seemed inadequate.
- MVPS #103 Windshield Defrosting and Defogging Systems-- Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. Fogged windshield lowered driver's visual ability.
- MVPS #201 Occupant Protection in Interior Impact--Passenger Cars. Instrument panel padding and flat design of control knobs minimized injury to front seat occupants.
- MVPS #203 Impact Protection for the Driver from the Steering Control System--Passenger Cars. Steering system collapsed only one-half inch; steering wheel severely bent from driver impact.
- MVPS #205 Glazing Materials--Passenger Cars, Multipurpose Vehicles, Motorcycles, Trucks, and Buses. Driver and right front passenger struck windshield; glazing material prevented the glass from shattering into jagged pieces.
- MVPS #207 Anchorage of Seats--Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Buses. Front seat back locks held and prevented rear seat passengers from being thrown into front which would have increased the injury potential of the front seat occupants.
- MVPS #212 Windshield Mounting--Passenger Cars. There was 100% windshield bond detachment.

Description

Precrash: Driver headed southeast in outside lane of Dexter Avenue. Stopped at red light, sat through one full sequence of light change, then accelerated across intersection when light turned green, looking for on-coming traffic. Was confused by intersection and suddenly started climbing curb across intersection on south side of Huron Street. Right front passenger, facing backwards, saw vehicle start off roadway and covered face with right arm. Driver saw No Parking sign on lawn extension and drove over it, probably intending to continue back onto roadway. Did not see tree behind sign until impact. Tire marks up onto curb and along

grass to tree, and bent "No Parking" sign indicated path of vehicle. Driving under the influence of alcohol and failing to have vehicle under control violation of traffic laws.

Crash: Vehicle impacted tree head-on and came to final rest against tree facing east. Driver thrown forward, no bracing; upper torso impacted steering wheel, compressing steering column one-half inch; head struck windshield causing simple fracture of nasal bones and ecchymosis to both eyes, and knees sustained minor lacerations from striking lower instrument panel; no loss of consciousness. Right front passenger thrown forward; torso impacted upper instrument panel and head hit windshield resulting in 2 cm laceration to right frontal lobe and mild neurological involvement. Dazed, level of consciousness varied, amnesia for accident; complained of headache and tightness in chest. Left rear passenger thrown forward and impacted front seat back; strained muscle in left ankle. Center rear passenger went forward and hit front seat back with head; had laceration over right periorbital bone, severe headache, mild neurological involvement, blurred vision. Right rear passenger also thrown forward into front seat back, but was not injured. Vehicle sustained frontal sheet metal damage to hood, bumper, and grill; 100% separation of windshield bond causing it to fall out onto hood; severe deformation of steering wheel with little energy-absorbing compression; damage to front seat backrests and to left corner of driver's seat cushion. Direction of force to vehicle 12:00 o'clock.

Postcrash: Rear seat passengers exited themselves out driver door; center rear passenger ran to nearby house and called for help. Driver remained in vehicle and held head of right front passenger until ambulance arrived. Driver exited himself out driver's door, was transported to police station in patrolcar and given BAC test, then taken to hospital emergency room for treatment and released. Right front passenger extricated on backboard and checked for consciousness by ambulance attendant; transported to hospital where chest, skull, and cervical spine x-rayed; released. Center rear passenger taken to hospital, skull and cervical spine x-rayed; released. Right rear and left rear passengers also went to hospital but were not treated. No fire or explosions, environmental problems, or debris. Police and ambulance response prompt. No traffic control necessary as vehicle was off roadway.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

/

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver, while not observing roadway and vehicle direction, left roadway and impacted tree. (Definite)
- 4 Defroster setting was "low" and windows fogged causing vision obstruction. (Definite)

Severity Increasing Factor

- 1 Driver did not brake or take any evasive action. (Definite)

Relevant Conditions

- 1 Driver's ability to operate vehicle impaired by alcohol. (Definite)
- 1 Young driver unfamiliar with area. (Definite)
- 1 Driver fatigued. (Definite)
- 5 Windshield bond separation 100%. (Definite)
- 7 Lighting seemed inadequate at intersection. (Probable)
- 7 Darkness and heavy rain limited driver's visual ability. (Definite)

Injury Causation

- 2 Occupants unrestrained. (Definite)
- 5 Half of lap belts for right front passenger missing; no belts available for center rear passenger. Belts under cushion for other rear passengers. (Definite)
- *5 Deformation and light spoke padding of steering wheel minimized injury to driver. (Probable)
- *5 Front seat back locks functioned properly, and prevented rear seat passengers from invading front seat area which would have increased injury potential to front seat occupants. (Definite)
- 5 Total separation of windshield increased potential for occupant injury--they could have been ejected. (Definite)

Matrix Cell

Explanation

Postcrash Factor

3

Ambulance response prompt and emergency medical treatment appropriate; attendants extricated right front passenger on backboard and were alert to possible neurological damage. (Definite)

Recommendations

7

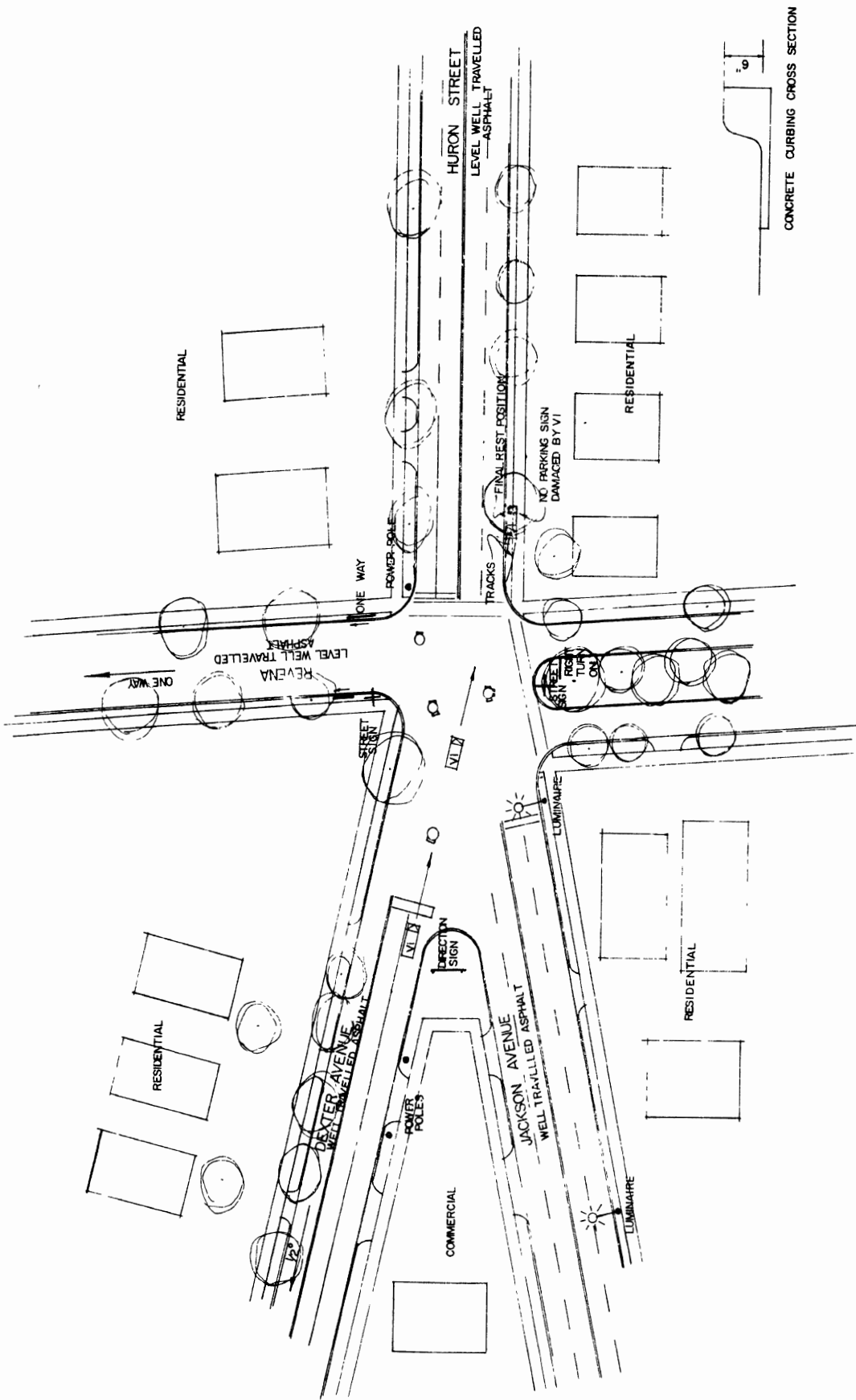
Increase lighting at intersection, and erect target sign on south side of Huron Street, visible from Dexter Avenue, to indicate change in horizontal alignment of roadway.

1

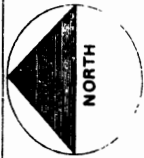
Driver education courses should emphasize inherent danger in driving under the influence of alcohol.

3

Police officers should issue citations for violations in accident cases where appropriate, so that points will be accumulated toward license reexamination and/or remedial driver education.



AA 325



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-326
CASE SUMMARY

Identification

Accident occurred on westbound I-94 just east of the State Road overpass in an open commercial area in the city of Ann Arbor, Washtenaw County, Michigan, on Wednesday, November 15, 1972, at 0935 hours. Unloaded tractor truck-semitrailer, attempted to pass on the left of a wide-load tractor truck-semitrailer steel hauler which suddenly swerved into the passing lane. The passing vehicle went out of control to the right, impacted a guardrail, a drain culvert, and then the overpass embankment, and at the same time jackknifed to the right. Injury severity AIS* code 03, severe.

Ambience

Daylight, clear, temperature 30^oF, relative humidity 70%, winds 8 mph from the northwest. Roadway dry.

Highway

An Interstate Highway, 4 lanes, 2 eastbound and 2 westbound, each lane 12 feet wide. Each pair of lanes bordered on outside by 10-foot-wide asphalt shoulder and on inside by 3-foot-wide asphalt shoulder. A 21-foot-wide grass median divider separated each pair of lanes and shoulders. The driving surface well-traveled, well-maintained concrete. Highway straight and level and crowned for drainage. No artificial lighting. One utility pole 75 feet off highway, otherwise, no poles or trees within the quarter mile. Only access within a quarter mile is State Road which overpasses I-94 in the immediate vicinity. Westbound I-94 exit and entrance ramps are about 100 feet east of accident site. Guardrails extend through the I-94 overpass on both the inside and outside of each pair of lanes. Accident history indicates this section of I-94 is hazardous. For the years of 1968-1971, a total of 65 accidents occurred along I-94 within one-half mile of the State Road overpass. Of these, 24 were single vehicle, three fatal, and 23 injury-producing accidents. Two of these accidents were similar to this case in that they involved tractor truck-semi trailers, single vehicle, going off road to the right out of control. The Michigan Department of State Highways has the intersection and the immediate vicinity programmed for modification during the year 1973.

Traffic Controls

Posted speed limit 70 mph maximum and 45 mph minimum. Pavement markings consist of intermittent white line lane delineators and solid white line edge delineators on both pair of lanes, all plainly visible. In the area, one clearly visible Interstate route marker sign about 50 feet east of accident site. No traffic signals.

* American Medical Association Abbreviated Injury Scale (AIS).

Vehicles

Vehicle 1, 1965 GMC tractor truck and 1965 Keystone semitrailer livestock carrier. One of company-owned fleet, odometer 822,911 miles. Had Illinois inspection sticker for both tractor and trailer with April 30, 1973 expiration date. Also had DOT sticker indicating passing inspection in Michigan in October 1972. No power accessories, no padded components. Equipped with driver lap belts. No defects noted. No maintenance stickers. Damage to Vehicle 1 mid-center twist to frame, dented left roof side rail on outside, broken tilt cab latch which also was released, broken right front leaf spring and case, broken left rear spring rear mount, disengaged front strap on left fuel tank which itself was loose, broken transmission case, steering box shifted to right, broken steering wheel, load plate separated from trailer at rear even though king pin remained attached to load plate, broken battery box, deformed front bumper, severed left front fender. During postcrash removal, leading trailer axle separated. Left fuel tank cap had fallen off and fuel tank had struck the ground. VDI*: 10-LYAW-1

Occupant

Driver 1, 40-year-old Caucasian male, 70 inches, and 187 pounds. Had driven for 25 years, mostly as a truck driver, averaging 100,000 miles per year plus additional mileage driving passenger cars. Was en route from Detroit, 60 miles east, where he had delivered a cargo of hogs back to his base in South Springfield, Illinois, 386 miles away. Had left Detroit at about 0730 hours and had no specified deadline for arriving at destination. Was very familiar with roadway, having driven it twice weekly in past 3 months. Had driven Vehicle 1 for 3 months for total of 24,000 miles. Had taken no driver education courses, was self-taught. Physical and mental condition good. No alcohol involvement. Slept 7½ hours the night before. Stopped for a snack just eight miles east of accident site. Driver 1 wearing lap belt, but loosely strapped. Injuries: swelling and abrasions to the frontal lobe just above the hairline and a subsequently diagnosed concussion to the head. Injury severity AIS code 03, severe.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were relevant to this case study.

- | | |
|---------|--|
| TSPS #1 | Emergency Medical Services. Although adequate emergency medical services were en route, they were turned back by police radio on the assumption that injuries were minor. Driver 1 left the accident site unaware of the seriousness of his head injuries. |
| TSPS #5 | Driver Licensing. Driver 1, a licensed commercial driver got himself trapped into an emergency situation and then failed to keep his vehicle under control. |

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

- TSPS #12 Highway Construction, Design, and Maintenance. The length and height of the guardrail extending through the underpass on the right side was not sufficient to prevent Vehicle 1 from running off the road and impacting a concrete drain culvert and overpass embankment.
- TSPS #15 Police Traffic Services. The initiating causal factor in this accident was the wide-load steel hauler swerving into the passing lane just when Vehicle 1 was about to pass it. No attempt was made by investigating police to pursue or trace the steel hauler.
- MVPS #208 Seat Belt Installations, Multipurpose Passenger Vehicles, Trucks, and Buses. Although this standard did not apply to Vehicle 1 because of its vintage, Vehicle 1 was in fact equipped with a lap belt. Driver 1 wore belt, loosely buckled, which resulted in his being thrown upward and to the left, receiving a severe head injury and being partially ejected.

Description

Precrash: At about 0930 hours, Driver 1, proceeding westbound at 55 mph in the inside (#2) lane, was about 7 feet to left rear of an unidentified wide-load steel hauler which was proceeding at about 35 mph. As Driver 1 prepared to pass, the steel hauler swerved suddenly into the path of Vehicle 1. Driver 1 braked, realized he was heading toward the left guardrail which lead into the underpass, so he cut right to get into the right lane, overcorrected, lost control, and went off roadway to the right. On the pavement were two skid marks left by right rear tractor wheels and scuff marks made by the left side wheels.

Crash: Vehicle 1, upon leaving roadway, caught the unanchored end of the right guardrail with the tractor's right rear wheels and then struck a concrete culvert with the under side of the tractor and the left front wheels. Then, as the trailer jackknifed to the right, the cab impacted the underpass dirt embankment at a force vector of 10:00 o'clock and nosed over on the left side, and the vehicle came to rest. Driver 1 thrown upward against left door, head struck and broke door glass, and upper torso partly ejected. Driver 1 wearing lap belt loosely strapped. The major damage to Vehicle 1 mid-center twist to frame, dented left roof side rail on outside, disengaged front strap on left fuel tank causing fuel to become loose and touch ground, separation of load plate from trailer at rear even though king pin remained attached to load plate, broken tilt cab latch which also released, and sheet metal damage to left side. Left fuel tank cap had fallen off. VDI:10-LYAW-1.

Postcrash: Driver 1, whose outward injuries consisted only of swelling and abrasion to frontal lobe just above hairline, refused medical treatment, so the ambulance which was then en route to the accident site was turned back by police radio. After investigation

was completed, Driver 1 left accident site with a fellow driver from the same trucking firm and rode with him to Springfield, Illinois. En route, he developed a severe headache and vision problems and was hospitalized for two weeks with severe head concussion. There were no postcrash fires, explosions, environmental problems, or debris. Investigating police responded promptly and directed the relatively light traffic into left lane.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 7 Wide-load steel hauler blocked passing lane to Vehicle 1. (Definite)
- 1 Driver 1 overcorrected to right. (Definite)

Severity Increasing Factors

- 4 Vehicle 1 trailer was empty contributing to instability and jackknifing. (Definite)

Relevant Conditions

- 1 Driver 1 used poor judgement in choosing the time to pass. (Definite)

Injury Causation

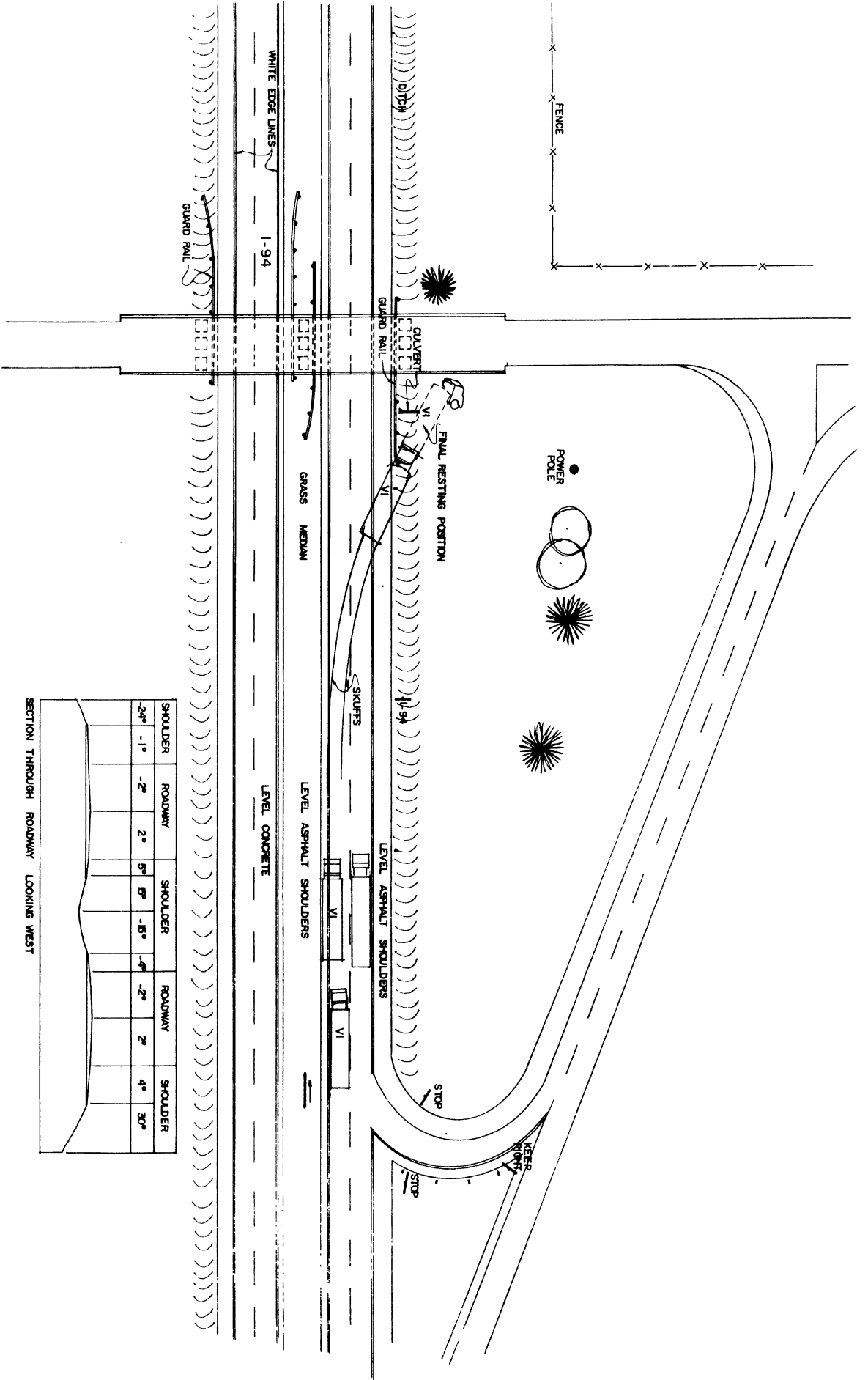
- *2 Driver 1 used seat belts even though loosely strapped. (Definite)
- 5 Truck cab tilt latch broke, increasing injury potential. (Definite)
- 8 Guardrail extending back from overpass embankment did not extend far enough out and was not high enough to prevent vehicle contact with culvert. (Definite)

Postcrash Factors

- 3 Driver 1 and investigating police failed to recognize Driver 1 had head concussion and emergency service vehicle was turned back, increasing injury potential for Driver 1. (Definite)
- 6 Fuel tank cap fell off allowing fuel spillage (diesel) and increasing injury and severity potential. (Definite)
- 6 During the removal operations, trailer axle became disconnected from trailer, complicating removal. (Definite)

Recommendations

- 8 Guardrail at the accident site should be extended and increased in height to insure no vehicle contact with culvert.
- 1 Truck driver training should emphasize hazards of passing other trucks, especially wide-load vehicles, at approaches to underpasses.
- 2 Truck driver training should emphasize need for proper adjustment of installed lap belts.
- 9 Police services training should include follow-up of drivers suspected of hauling illegal wide loads or driving so as to endanger other motorists.
- 9 Police services training should emphasize that external injuries to the head and vital parts of the body may indicate hidden critical internal injuries and that under such conditions emergency vehicle services should not be turned back.



SECTION THROUGH ROADWAY LOOKING WEST

SHOULDER	ROADWAY	SHOULDER	ROADWAY	SHOULDER
-24°	-1°	-2°	2°	9"
				5"
				-15°
				-4"
				-2°
				2°
				4"
				30°



AA 326



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-327
CASE SUMMARY

Identification

Accident occurred at the crossing of South Main Street and Ann Arbor Railroad tracks in a commercial area of city of Ann Arbor, Washtenaw County, Michigan, on Thursday, November 30, 1972, at 2145 hours. Train impacted passenger car. Injury severity AIS* code 01, minor.

Ambience

Nighttime, sky clear. Temperature 31⁰, relative humidity 85%, no wind. Roadway dry.

Highway

South Main Street at railroad crossing 45-foot-wide, 4-lane, collector; no divider. Surface new, well-maintained asphalt. Six-inch high concrete curbing.** Roadway level, slightly curved and crowned for drainage. No lighting. Within quarter-mile radius: 15 driveways, one intersection, 20 utility poles, and 12 trees. No previous accidents at this railroad crossing.

Traffic Controls

Speed limit 25 mph by statute. Yellow double center line, good visibility. Legible "No Parking Any Time" sign. Railroad signals: two flashing red lights, one located northwest side of tracks, the other southeast side; cross sign indicating "Railroad Crossing" in reflector lights over red lights; "Stop on Red Signal" sign in reflector lights under red lights. Warning bells also used.

Vehicles

Vehicle 1, train, 410 tons total weight; composed of two diesel engines, three box cars, one empty tank car, and a caboose. No damage to train.

Vehicle 2, passenger car, 1972 Ford Maverick, 2-door sedan; chocolate brown exterior, lighter brown interior; odometer 5,717 miles. No indication of vehicle inspection (periodic vehicle inspection not required in Michigan). Automatic transmission; power steering; padded upper instrument panel, armrests, sunvisors. Lap belts with automatic locking retractor and upper torso restraints; buzzer system. No vehicle defects; no record of maintenance. Vehicle had side guard door beams. Damage to left front fender

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch high curbing standard throughout city of Ann Arbor, Michigan.

and to left A-, B-, and C-pillars, with upper B-pillar separating at roof; left side driver window broken out; left door jammed; eight inches of crush to quarter panel; left roof rail bent; right side sheet metal damage and two inches of crush to door; right roof rail bent; right lower A-frame bent; front splash pan and bumper damaged; induced damage to instrument panel. VDI*:10-LDAW-2 (primary); 00-RDHO-1 (secondary).

Occupant

Driver of Vehicle 2, 50-year-old, female, Caucasian, 68 inches, and 132 pounds. Thirty-two years driving experience, averaged 10,000 miles per year. Driving from work to downtown Ann Arbor to see Christmas lights, then planned to go home. Accident occurred four miles from trip origin, five miles from destination (home). Owned car one year, had accumulated all 5,717 miles on odometer. Familiar with area, drove there once a month. No formal driver education. Good physical and mental condition. No alcohol or drugs involved. Injuries: swelling to left side of head, contusion on left shoulder, contusion on lateral left thigh. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standard (TSPS) have specific relevance to this case.

- | | |
|-----------|---|
| MVPS #201 | Occupant Protection in Interior Impact-Passenger Cars. Only light padding on door, but seemed to minimize severity of injuries. |
| MVPS #214 | Side Door Strength--Passenger Cars. Vehicle 2 had side guard door beams. |
| TSPS #4 | Driver Education. Need to caution drivers to be more alert when driving in urban areas and near railroad tracks. |

Description

Pre-crash: Train (Vehicle 1) traveling southeast at 10 mph; car (Vehicle 2) northbound in outside lane at a speed of 30 mph estimated by witness. Engineer saw Vehicle 2 when car was about 100 feet from railroad crossing and train was 50 feet from point of impact. Threw on train's emergency braking system; takes a few seconds for air brakes to go into effect and all wheels on all cars to lock. Air brakes not on by time of impact. Driver 2 saw train approximately 75 feet before impact; first braked hard to about 19 mph, then accelerated to try to beat train but gained no appreciable speed. Front wheels of car on railroad ties before impact. Failing to obey railroad stop signals a violation; driver cited by police for hazardous action. Vehicle 2 left 25 feet of skid marks with left wheels, 27 feet with right wheels.

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J221a.

Crash: Vehicle 2 struck by train on left front corner, swiped to rear, spun nearly parallel with tracks, overturned 90° onto right side. Came to final rest on right side, partially over curb on right side of road, facing northwest. Driver 2 thrown left and slightly forward on impact, and suffered swelling to left side of head from hitting window frame on door, and contusions to left shoulder and lateral left thigh from striking door. Upper torso impacted steering wheel, slightly deforming it. No damage to train. Vehicle 2 sustained damage to left front fender, and to left A-, B-, and C-pillars, with upper B-pillar separating at roof; left door jammed; left side driver window broken out; eight inches of crush to quarter panel; left roof rail bent; right side sheet metal damage and two inches of crush to door; right roof rail bent; right lower A-frame bent; front splash pan and bumper damaged; instrument panel had induced damage due to A-pillar moving inward and buckling instrument panel. Direction of force to car 10:00 o'clock.

Postcrash: Man who witnessed accident went over to see how driver was; helped her climb out left front window. Police and ambulance response prompt. No first aid administered; Driver 2 got into ambulance and had to be urged to lie down. Driver 2 transported by ambulance to hospital; seen in emergency room and released. No fires, explosions, or environmental problems. Hubcap knocked off Vehicle 2. First engine of train on track crossing roadway, second engine just to west edge of roadway; engines blocked traffic. Police officer south of railroad tracks stopped northbound traffic and re-routed it on Madison Street 150 feet from tracks; police officer just north of tracks made southbound traffic turn around and go north on Main Street to find an alternate route. Very little traffic.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environment	7	8	9

Matrix Cell Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver 2 did not observe railroad signals and did not see train in time to avoid accident. (Definite)
- 1 Driver 2's evasive maneuvers ineffective. (Definite)

Matrix Cell

Explanation

Relevant Factors

- | | |
|----|---|
| 1 | Driver 2 traveling approximately 5 miles over 25 mph speed limit. (Definite) |
| 1 | Driver 2 inattentive to driving task. (Definite) |
| 1 | Driver 2 unaccustomed to meeting trains at this intersection. (Definite) |
| *1 | Driver 2 usually did not wear seat belts, was restrained at time of accident because buzzer warning device for restraint system annoyed her; she was going to have buzzer removed. (Definite) |
| *7 | Railroad crossing lights at accident site conform to Michigan Public Service Commission (MPSC) Standards; crossing reviewed and approved in 1966 by city of Ann Arbor and MPSC. (Definite) |

Injury Causation

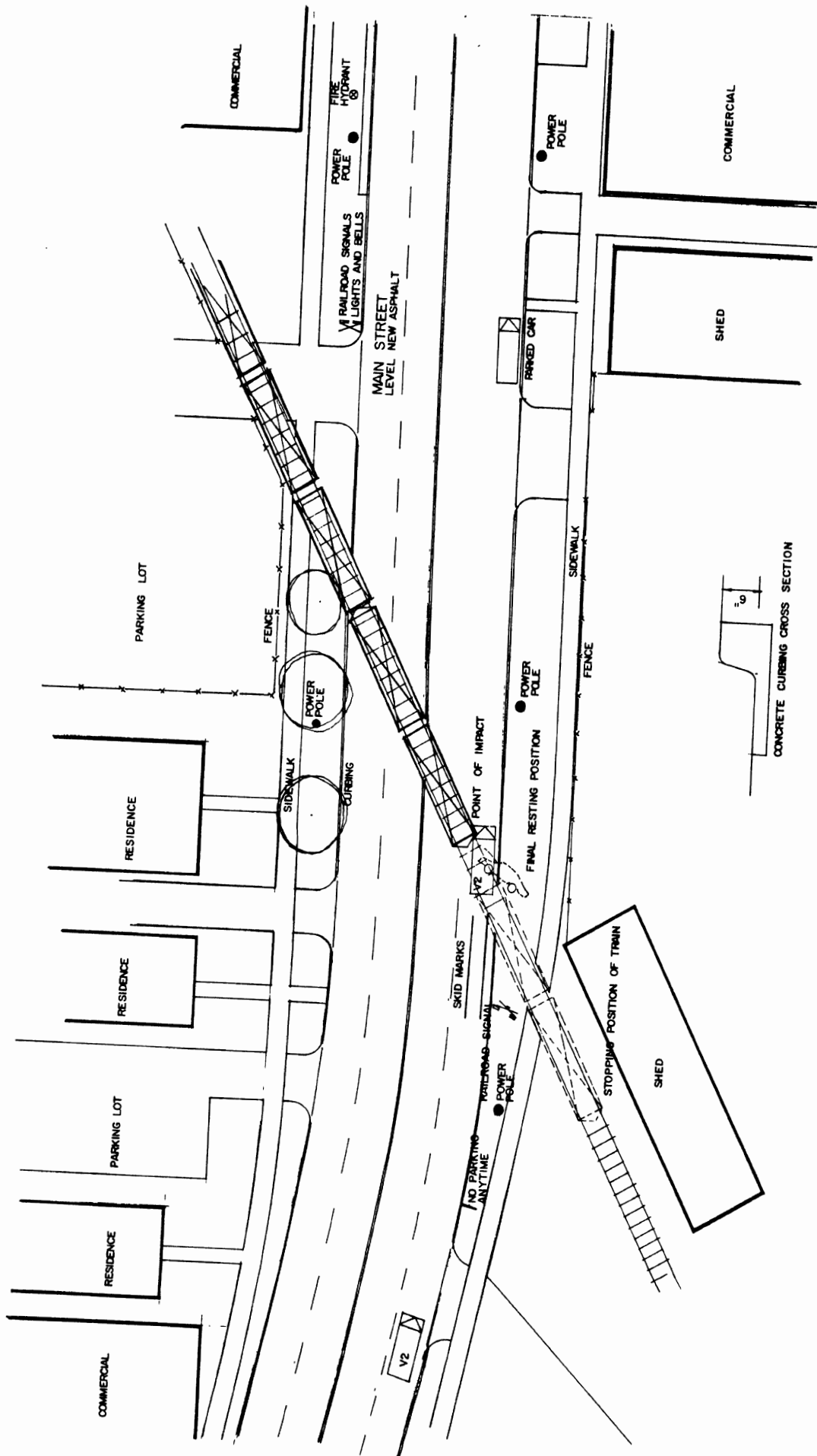
- | | |
|----|---|
| *5 | Vehicle 2 had side guard door beams which minimized intrusion into occupant space. (Definite) |
| *5 | Light door padding prevented more serious injury to Driver 2. (Probable) |

Postcrash Factors

- | | |
|---|--|
| 3 | Police and ambulance response prompt. (Definite) |
|---|--|

Recommendations

- | | |
|---|---|
| 1 | Driver education courses should stress the need to pay attention while driving in urban areas and the need to be alert at railroad crossings. |
|---|---|



AA 327



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-328
CASE SUMMARY

Identification

Accident occurred on open roadway section of US-23 in a commercial area of Pittsfield Township, Washtenaw County, Michigan, on Monday, December 11, 1972. Exact time of accident unknown, estimated at 0100 hours. Single passenger car rollover. Injury severity AIS* code 10, fatal.

Ambience

Nighttime, clear with occasional snow squall. Temperature 18⁰F, relative humidity 50-60%, no wind. Heavy frost following extended cold period. Roadway dry and clear up to traveled roadway edge.

Highway

US-23, 4-lane divided expressway; each set of lanes 24-feet-wide. Grass median, 62-feet-wide. Roadway well-traveled, well-maintained concrete. Asphalt shoulders: 10-feet-wide outside, 3-feet-wide inside; frozen and snow-covered. Washtenaw County maintains a "white shoulder" policy--roadway is cleared but the snow is left on the shoulders. Guardrail is a singles "W"-section, 22 inches high, mounted on steel and wooden posts. The end is designed to be buried in concrete. Roadway curved, crowned for drainage, + $\frac{1}{2}$ ⁰ grade south to north. No lighting. No accesses, utility poles, or trees within a quarter-mile radius.

Traffic Controls

Speed limit posted at 70 mph maximum, 45 mph minimum. Intermittent white lane delineators, solid-white edge delineator; good visibility, not worn. Two signs, both conformed to standards. "Gas Food Lodging Next Exit" and "Emergency and Authorized Vehicles Only." No signals. Three years of data showed 13 accidents at accident site. Nine were out of control accidents, ten involved single vehicle, 12 involved straight ahead movement, and six incurred in the winter.

Vehicle

Passenger car, 1972 Ford Maverick Grabber, 2-door sedan; red exterior, black rally markings on hood and sides, black interior; odometer 24,946 miles. No indication of vehicle inspection (periodic vehicle inspection not required in Michigan). Automatic transmission, no power accessories. Padded upper instrument panel and armrests; sunvisors unpadded. Lap and shoulder belts available; only lap belt worn. No vehicle defects; no sticker showing record of maintenance. Extensive unclassifiable damage to entire car

* American Medical Association Abbreviated Injury Scale (AIS).

including sheet metal damage to all body panels and supporting pillars. Occupant compartment volume was not compromised, but rear seat expelled through rear trunk opening. VDI*:00-XDAO-4.

Occupant

Driver, 25 years, male, Caucasian, 72 inches and 200 pounds. Nine years driving experience, averaged 20,000 miles per year. Traveling from Detroit to Ann Arbor to visit girlfriend; accident occurred 30 miles from origin, one mile from destination. Owned vehicle one year, had driven it nearly 25,000 miles. Traveled route regularly. Two-phase driver education course in high school. Good overall physical and mental condition; accumulated fatigue and stress. Blood alcohol concentration (BAC) 0.09 (by Michigan statute: 0.07 BAC is legally impaired, 0.10 is legally intoxicated). Restrained by lap belt. Injuries: facial lacerations, fractured mandible, probable concussion, fractured left humerus, abrasions on left leg. Cause of death: asphyxiation from airway blockage or concussion. Injury severity AIS code 10, fatal. An autopsy was not performed.

Standards

The following Motor Vehicle Program Standards (MVSP) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|-----------|--|
| MVPS #205 | Glazing Materials--Passenger Cars, Multi-purpose Passenger Vehicles, Motorcycles, Trucks, and Buses. Windshield was pocketed and cracked from driver's head impacting it, but glass did not break. |
| MVPS #206 | Door Locks and Door Retention Components--Passenger Cars and Multipurpose Passenger Vehicles. Despite severe damage to left door, latch remained fastened. |
| MVPS #209 | Seat Belt Assemblies - locking retractor for driver's lap belt slipped allowing full extension of belt and, the driver to be partially ejected out left front sideglass. |
| MVPS #216 | Roof Crush Resistance--Passenger Cars. (To be effective August 15, 1973.) Roof sheet metal damage was significant, but there was no inward crush. |
| TSPS #4 | Driver Education. Driver was driving while under stress with accumulated fatigue and after excess alcohol injection. |

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Description

Preocrash: Vehicle northbound on US-23 in outside lane. Entered gradual curve westward from tangent section of roadway; went onto shoulder and traveled 390 feet on shoulder; yawed to the left at Point A (see Accident Schematic on page 7). Not having vehicle under control at all times is a violation of law. Physical evidence of accident included two broken guardrail posts, gouges in earth, strewn pieces of the vehicle. Vehicle tracks on snowy shoulders, scuffs and marks on guardrail.

Crash: Vehicle impacted guardrail and rode on top of it with left front wheel on inside of guardrail; vehicle released from left off top of guardrail onto two right wheels (Points B and C). At Point D, vehicle tripped into violent movement, spun counterclockwise and rolled clockwise; final contact with front of car at Point E; spun 180° counterclockwise to left rear quarter panel (Point F), (driver probably partially ejected out left sideglass here). At Point G, car vaulted front-around-rear, still rolling slightly, and subsequently contacted ground with rear of vehicle at Points H and I. There was heavy ground contact with right rear quarter panel at Point I, the car continued to roll; and trunk lid came off at Point J. Vehicle on left wheels at Point K; bounced and rocked with primary contact to undercarriage, to final resting point facing northeast. Driver thrown forward on impact; left side of face into windshield, pocketing and cracking but not penetrating glazing. During rollover, contacted left door interior heavily. Head and upper torso ejected through left window and contacted A-pillar and exterior surface of windshield. Final resting position in driver's seat with right foot folded under leg; left arm, shoulder, and head extended through left front window. Suffered a possible concussion from windshield contact at initial impact; blood on protruding heater knobs to left of steering wheel indicate knobs may have caused lacerations to ventral surface of left wrists. Moderate abrasions and hematoma on lateral surface of left leg from contacting left door; fractured midshaft left humerus either from door or ground contact. During partial ejection, sustained facial injuries from striking A-pillar, left window frame, and exterior windshield; fracture of bilateral mandibular rami from hitting car exterior or possibly was an indirect fracture resulting from initial windshield contact. Abrasions to left axilla from lower window frame. Seat belt abrasions across groin; scrotal abrasion from seat. Cause of death either asphyxiation from blockage of airway or possible concussion or from local tissue injury, though no such injury was observed.

Damage to the left side of the vehicle included 12 inches of sheet metal crush at quarter panel, door buckled outward 24 inches, and the wheelbase shortened 3 inches; A-pillar partially separated at belt line, B-pillar totally separated at roof rail and partially separated at belt line, upper C-pillar totally separated and lower C-pillar damaged; roof rail buckled upward just to rear of A-pillar;

door latch jammed closed; rear wheel bent out. There was 6 inches of sheet metal crush at both corners of the rear of the vehicle; trunk lid latch broke allowing trunk lid to open; trunk lid and trunk-passenger-compartment partition torn from vehicle as single unit; trunk lid hinges bent and torsional springs separated; back-light header bent slightly; and fuel tank had 1-inch long scrape (with dent), but no fuel leakage. Right side of vehicle had 11 inches of sheet metal crush at quarter panel; rear edge of front fender pulled away 27 inches from body; A-pillar damage, no separation; B-pillar damaged and partially separated at roof rail and belt line; C-pillar damaged; roof rail damaged and buckled; door latch damaged and door would not close after once opened. The front of the vehicle sustained 8 inches of crush; the hood latch bent and jammed, but didn't release; hinges on hood appeared to be undamaged, but hinge anchoring bolts were pulled through body holes; rear edge of hood elevated, no rearward movement. In the interior, roof structure and lining damaged; rear seat cushion out and backrest twisted; windshield top molding bent in left corner due to exterior damage; left A-pillar twisted (no evidence of contact), left and right B- and C-pillars damaged; front seat adjuster jammed; right headrest came out during collision; backlight and backlight header damaged; all side panels and both roof side rails damaged; no energy-absorbing steering device compression, shear capsule separated 0.2 inches.

Postcrash: Accident discovered at 8:30 a.m. by soft drink delivery man who saw car from store parking lot; called Washtenaw County sheriff's who arrived on-scene in five minutes. Ambulance arrived within next five minutes. Driver had partial rigor mortis in all of body except right leg which was bent under him and was frozen. Extricated out passenger door onto litter; process methodical and unhurried as death was established. Medical examiner called, on-scene at 9:30 a.m. No first aid necessary. No fires or explosions, or environmental problems. Debris included kleenex box, right headrest, window scraper, battery jumper cables, trunk lid, and cardboard box, grill pieces, pieces of glass. Wrecker arrived at 9:50 a.m., took half hour to remove car; highway right-of-way fence knocked down and car winched into store parking lot. No traffic control necessary as area isolated between highway right-of-way and store parking lot.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver inattentive to vehicle drift and left roadway to the right. (Definite)
- 1 Driver became aware of danger too late to regain roadway without loss of control. (Definite)

Severity Increasing Factors

- 8 Guardrail did not extend far enough to prevent vehicle from dropping down steep embankment. (Definite)
- 8 Guardrail end should have been angled or "flaired" away from roadway so as to catch deviant vehicles. (Definite)

Relevant Factors

- 1 Driver's ability to drive impaired by alcohol consumption (BAC 0.09). (Definite)
- 1 Driver's physical and mental condition below optimum because of longstanding fatigue and stress. (Definite)
- *5 Left door latch remained fastened despite severe damage to door. (Definite)

Injury Causation

- *2 Use of lap belt prevented total ejection. (Definite)
- 2 Lack of use of upper torso restraints increased severity of injuries. (Definite)
- 5 Locking retractor on seat belt slipped, allowing driver to be partially ejected to the extent that he struck the exterior surface of the windshield. (Probable)

Postcrash Factors

- 9 Discovery of accident delayed because steep embankment obscured vehicle from roadway. (Definite)
- 3 Had driver received immediate first aid, his injuries may not have been fatal. (Possible)

Matrix Cell

Explanation

Recommendations

- | | |
|---|--|
| 1 | Continue attempts to educate the public on the danger of drinking and driving. |
| 4 | Reevaluate the design and performance of the seat belt locking retractor found in the crash vehicle so as to prohibit slipping in all angles of orientation with forces incurred in a severe rollover type accident. |
| 3 | Educate the public to report accidents to the police, even if they don't stop at the scene. |
| 7 | Extend guardrail 200 feet further down the roadway from accident site, flair, so as to lead vehicles leaving the roadway into a safe recovery area. |

THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-329
CASE SUMMARY

Identification

Accident occurred on Huron Street in a residential section of the city of Ann Arbor, Washtenaw County, Michigan, on Thursday, December 21, 1972 at 1315 hours. Single passenger car struck elderly pedestrian. Injury severity AIS* code 06, fatal within 24 hours.

Ambience

Daylight, misty and overcast. Temperature 35⁰F, relative humidity 100%, no wind. Sight distance 500-750 feet, limited by fog. Roadway wet.

Highway

Huron Street, 4-lane major arterial, 42 feet wide; no divider. New surface, well-maintained asphalt; 6-inch concrete curbing.** Open roadway, straight, crowned for drainage, +1 $\frac{1}{2}$ ⁰ grade to the west. No artificial lighting. Per quarter mile radius of accident site: 25 driveways, 3 intersections, 15 utility poles, and 50 trees. Four accidents in three years to one-half mile west of Huron-Arbana intersection. Two accidents rear end, one right angle, and one out-of-control. Considered low ranking accident site as compared to other sites in mass data file.

Traffic Controls

Posted speed limit 30 mph. Intermittent white lane delineators; double yellow center line. Signs: "Speed Limit 30," "No Parking Anytime"; good legibility. No signals.

Vehicle

Passenger car, 1964 Plymouth Valiant, 2-door sedan; light greenish-blue exterior, tan interior; odometer mileage unknown. No indication of vehicle inspection (periodic motor vehicle inspection not mandatory in Michigan). Automatic transmission (push button on left half of instrument panel); no power accessories; lightly padded armrests, no padding on instrument panel and sunvisors. Front seat lap belts only. No vehicle defects observed. No recorded maintenance; driver stated car had new shock absorbers and brakes. Damage: dent on right front corner of hood and dent on top of right front fender. VDI+:12-FRMN-1.

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch high curbing standard in city of Ann Arbor, Michigan.

+ Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Occupants and Pedestrian

Driver, 33-year-old Caucasian male, 68 inches and 175 pounds. Information about driver limited due to possible legal action. Driving experience and driver education unknown. Day off from work, going from shopping trip in downtown Ann Arbor to Maple Village Shopping Center; half mile from origin, three-quarters of a mile from destination. Familiar with car, drove it frequently; lived in area and traveled route often. Mental and physical condition unknown; wore corrective lens. No alcohol involved. Restraint use unknown. No injury. Injury severity AIS code 00, no injury.

Left rear passenger, 5-year-old Caucasian female, height and weight unknown. Unrestrained. No injury.

Right rear passenger, 3-year-old Caucasian male, height and weight unknown. Unrestrained. No injury.

Pedestrian, 84-year-old Caucasian male, 66 inches and 135 pounds. Had been shopping at Westgate Shopping Center; took bus to Huron Street, was walking home from bus stop; three-quarters of a mile from origin, one block from destination. Had not driven since he lost sight in one eye three years earlier due to glaucoma. An experienced and cautious pedestrian, very familiar with area, lived nearby and made same trip three or four times a week. General state of physical health good, no sight in right eye from glaucoma, farsighted in left eye, but corrected with eyeglasses. Mental condition generally good, concerned about wife's health. No alcohol involved. Injuries: multiple facial and skull fractures, severe concussion, fractured right ulna and radius, fractured right femur, multiple fractures to left tibia and fibula, small abrasion to posterior left elbow, 10 x 1 cm laceration over left foot. Injury severity AIS code 06, fatal within 24 hours.

Standards

The following Traffic Safety Program Standards are specifically relevant to this case.

- | | |
|----------|---|
| TSPS #4 | Driver Education. Need to caution drivers to watch out for pedestrians and to warn drivers about the dangers of speeding on a busy street. |
| TSPS #12 | Highway Design. Area of significant pedestrian circulation lacked a designated and marked pedestrian crosswalk; pedestrians crossed at various locations with greater hazard to their safety. |
| TSPS #14 | Pedestrian Safety. Pedestrian was jaywalking; however, provisions for safe crossing in area were lacking. |

Description

Preocrash: Vehicle westbound in outside lane of Huron Street, traveling at an estimated 35 mph. Saw pedestrian in middle of street and braked slightly. As pedestrian continued to traverse the roadway, driver moved to inside lane anticipating passing behind the pedestrian, then slowed again, moving back to curb lane when believing the pedestrian was hesitating to let him pass. The elderly pedestrian then suddenly ran directly in front of the car, perhaps still believing the car was still maneuvering to pass behind him. Pedestrian crossing at location was jaywalking and in violation of traffic law. Driver first attempting to pass behind the elderly crossing pedestrian was poor judgement. No preocrash physical evidence, skids, or scuffs.

Crash: Right front corner of car contacted right side of pedestrian. Initial impact resulted in fracture of pedestrian's right femur and most probably fractures in lower left leg. Pedestrian elevated up onto fender where sheet metal dent indicated spot he possibly impacted with back of head. Body bounded off the car 12 feet into a guy wire, then airborne approximately 22 feet landing on sidewalk; came to final rest on sidewalk with head oriented eastward. Impact with sidewalk resulted in scalp lacerations, depressed skull fracture of the left temporal parietal lobe, and fractured facial bones. No injury to vehicle driver or passengers. Only vehicle damage was sheet metal dent on right front hood corner, and dent on upper surface of right front fender. Direction of impact force to vehicle 12:00 o'clock.

Preocrash: Driver stopped and backed into nearest driveway on north side of street. Nearby resident called police; three squad cars on-scene within five minutes. Lady resident nearby brought blanket to cover pedestrian; retired policeman in car following striking vehicle stopped and made sure no one moved pedestrian. Ambulance called at 1:17 p.m.; ambulance arrived 1:26 p.m., transported pedestrian on backboard to hospital where he was dead on arrival. No first aid administered on-scene or in ambulance. No postocrash environmental problems resulted, as injured pedestrian was off roadway. Scuff on guy wire from pedestrian contact; large blood pool necessitated the dispatching of a fire department vehicle to hose down street. Westbound curb lane closed to preserve accident evidence; police directed traffic into three remaining open lanes.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Preocrash	Crash	Postocrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Pedestrian crossed at a non-designated pedestrian crossing. (Definite)
- 1 Driver did not anticipate response of pedestrian to vehicle lane change. (Definite)
- 1 Of various alternatives, driver should have slowed down and given pedestrian right-of-way, rather than attempting lane-changing maneuvers, anticipating passing behind the pedestrian. (Definite)
- 1 Pedestrian confused by maneuvers of driver. (Probable)

Severity Increasing Factor

- 7 Utility pole and guy wire 2½ feet from roadway. (Definite)

Relevant Factors

- 1 Pedestrian had no sight in right eye. (Definite)
- 1 Elderly pedestrian's reaction slowed due to advanced age. (Probable)
- 7 No designated pedestrian crosswalk at accident site despite bus stop; no crosswalks on Huron for distance of two miles. (Definite)

Postcrash Factor

- *3 Police concerned about driver's ability to drive after the accident; police followed behind driver's car to police station. (Definite)

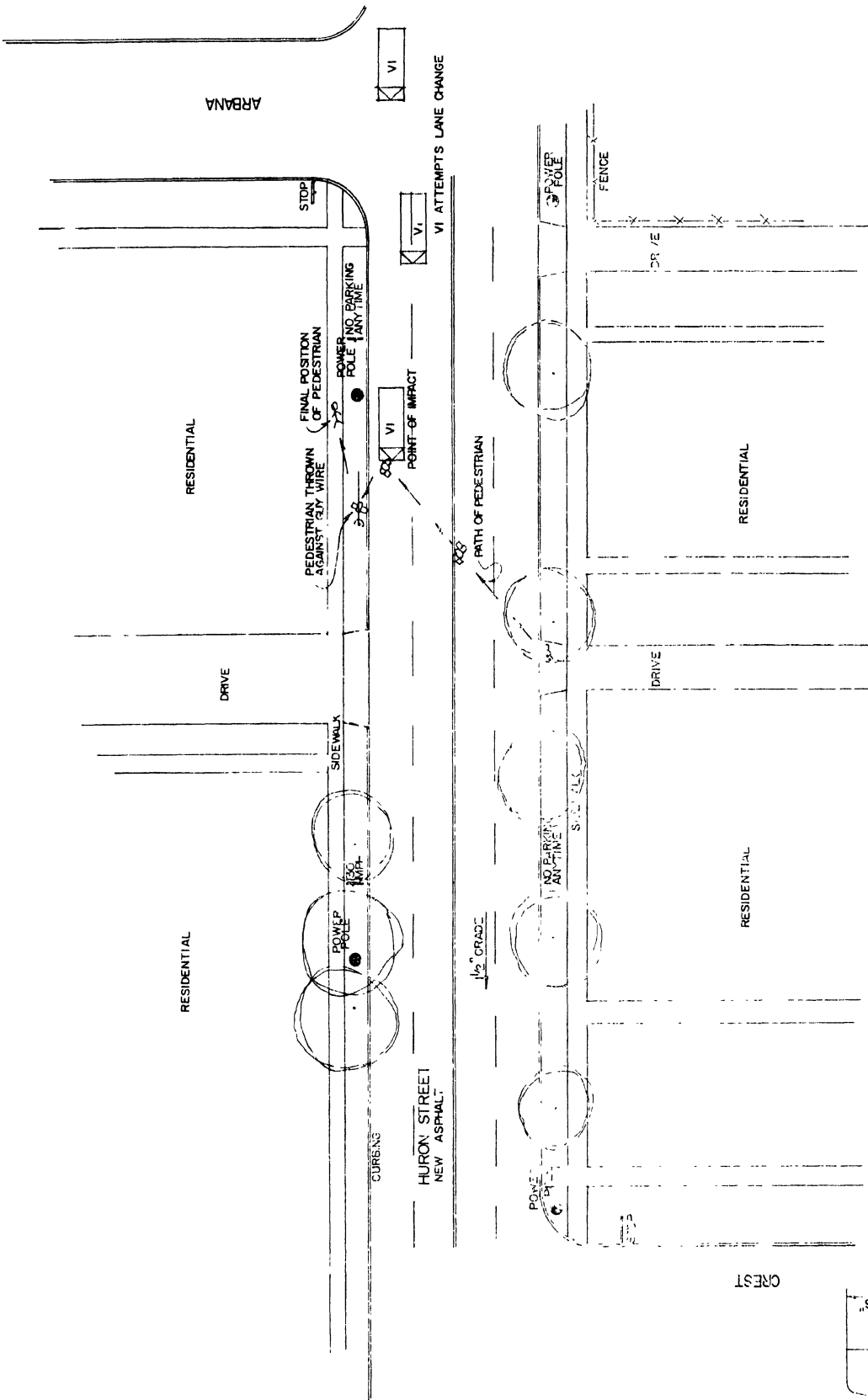
Recommendations

- 1 Pedestrian problems should be brought more effectively to the public's attention; drivers should be cautioned to look out for pedestrians, especially elderly ones; pedestrians and drivers should be made aware of the differential between vehicle and pedestrian speeds.

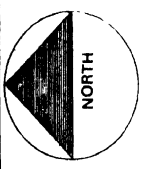
Matrix Cell Explanation

Recommendations (continued)

7	Area should be reevaluated based on pedestrian flow and lack of designated crossing areas, and more adequate pedestrian protection implemented on Huron Street.
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CONCRETE CURBING CROSS SECTION



AA 329



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-330
CASE SUMMARY

Identification

Accident occurred on open roadway section of I-94 expressway, residential area of Pittsfield Township, Washtenaw County, Michigan, on Friday, December 29, 1972 at 1905 hours. Single passenger car and army truck, rear-end impact. Injury severity AIS* code 06, fatal.

Ambience

Nighttime, mist, periods of heavy rain, limited visibility. Temperature 35^o, relative humidity 90%, no wind. Roadway wet.

Highway

I-94, 4-lane divided expressway; each set of lanes 24 feet wide. Grass median 19 feet wide. Roadway well-traveled, well-maintained concrete. Exterior shoulder asphalt, 10 feet wide; interior shoulder asphalt, 3 feet wide. Highway straight and level, crowned for drainage. No lighting. Within a quarter mile radius, no accesses, one utility pole, and 25 trees.

Traffic Controls

Posted speed limit 70 mph maximum, 45 mph minimum. Solid white road edge delineation, intermittent white center line; markings worn. "Exit Ahead" sign which conformed to standards, not involved in this case. No signals.

Vehicles

Vehicle 1, 1971 Cadillac Coupe de Ville, 2-door coupe; odometer reading 7,216 miles; deep red exterior with white vinyl top, black interior. No indication of vehicle inspection (periodic vehicle inspection not required in Michigan). Automatic transmission; power accessories included brakes, steering, seats, windows, and door locks. Instrument panel, doors, sunvisors, armrests, and front seat backs all padded. Lap belts with locking retractors and upper torso restraints were available. No vehicle defects were observed. Last recorded maintenance at 5,775 miles on November 9, 1972 included oil and lubrication. Damage: 28 inches of frontal sheet metal crush primarily to right front corner including hood, grill, bumper, and fender, and slight damage to right door. Of particular significance was right hood hinge separation and hood's

* American Medical Association Abbreviated Injury Scale (AIS).

rearward movement into windshield killing right front occupant who was belted. Energy-absorbing steering column compressed 3.75 inches. VDI*:12-FREA-3.

Vehicle 2, 1952 GMC M135, 2 $\frac{1}{2}$ ton 6 x 6 army truck; army green exterior, light army green interior; odometer reading 9,674 miles. No indication of inspection. Automatic transmission, no power accessories, no padded components, no restraints. Vehicle equipped with only one small taillight mounted on left side; rear window badly weathered isinglass. Maintenance performed by city airport. Damage to left rear mud flap; trailing axle housing twisted clockwise; leaf springs came out of both mountings. VDI:06-BLLW-2.

Occupants

Driver 1, 64 years, male, Black, 69 inches and 160 pounds. Fifty years driving experience; in recent years averaged 27,000 miles per year. Traveling from visiting relatives in South Haven, Michigan to home in Inkster, Michigan; accident occurred 150 miles from origin, 30 miles from destination. Had owned vehicle one year; familiar with route and had traveled it recently. No driver education. Physical and mental condition good. No alcohol involved. Snugly restrained by lap belt. Injuries: facial injuries, knee contusions, contusion inside left leg four inches below kneecap, left hand sore and swollen. Injury severity AIS code 02, moderate.

Vehicle 1, right front passenger, 55-year-old Black female, 66 inches and 152 pounds. Snugly restrained by lap belt. Injuries: hemorrhage and concussion resulting from severe facial injuries; fracture of right orbit and severe laceration and avulsion of its contents; bilateral subarachnoid hemorrhage and extensive comminuted fracture to base of skull; superficial lacerations to ventral surface of right upper arm and to right index finger. Injury severity AIS code 06, fatal.

Driver 2, 18-year-old Caucasian male. No injury. Further information unknown due to pending legal action.

Vehicle 2, right front passenger, 55-year-old male Caucasian. Uninjured. Further information unknown due to pending legal action.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

MVPS #203	Impact Protection for the Driver from the Steering Control System--Passenger Cars. Vehicle 1's energy-absorbing (e-a) steering system depressed 3.75 inches (perfect loading for optimum e-a effectiveness).
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* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

MVPS #208	Seat Belt Installations--Passenger Cars, Multipurpose Vehicles, Trucks, and Buses. Lap belts worn by Vehicle 1's driver and passenger proved to be inadequate protection; shoulder harness would have reduced injury to passenger.
TSPS #1	Periodic Motor Vehicle Inspection. Truck's equipment met old standards, but not new standards for highway travel.
TSPS #4	Driver Education. Under no circumstances should unauthorized vehicles attempt to cross median, especially vehicle with substandard equipment.
TSPS #15	Police Traffic Services. Although accident was severe, there was no thorough investigation and sheriff deputy did not request help to expedite traffic control; sheriff deputy had opportunity to prevent accident had he provided army truck safe escort and recommended Driver 2 not travel on highway at night.
Proposed MVPS	Windshield Zone Intrusion. Would establish protected zone in front of windshield which would protect passengers from occupant compartment intrusion by hood, for example.

Description

Pre-crash: Vehicle 1 eastbound in inside lane of I-94 at impact speed of 50-60 mph; Vehicle 2 eastbound in outside lane at impact speed of 30-35 mph. Vehicle 2 pulled into passing lane and partially onto shoulder with left wheels. Driver 1 passing stream of vehicles; has passed two cars, truck was third vehicle; Driver 1 60 feet from truck when he first observed it; swerved onto median to avoid truck. Passenger in Vehicle 1 apparently shielded face with right arm. Traffic violations committed by Driver 2: improper lane usage, attempting median crossover with unauthorized vehicle, driving vehicle with substandard lighting on highway. Undercarriage metal gouge marks from Vehicle 1 on asphalt shoulder indicated point of impact; left wheel marks of Vehicle 1 in median showed pre-crash maneuvers.

Crash: Right front headlight area of Vehicle 1 impacted left rear corner of Vehicle 2; there was 22 inches of vehicle overlap. Vehicle 1 spun clockwise 135°, came to final rest in median oriented southwest. Vehicle 2 continued about 30 feet into median, made 90° turn northward, and continued across median, stopping with front half of truck in westbound inside lane. Passenger of Vehicle 2 backed truck onto median off roadway. Kinematics of truck driver and passenger unknown; they were uninjured. At moment of impact, Driver 1 gripped steering wheel firmly, braked hard with one foot and braced other foot on floorboard. Driver 1 thrown forward, striking face on steering wheel; knees contused from being thrust into instrument panel and lower left leg had contusion four inches

below kneecap from being thrust upwards against steering wheel. Contact with steering wheel caused compound, undisplaced fracture to nose, superficial laceration on right side of nose, ecchymosis to right eye. Right front passenger in Vehicle 1 thrown forward into windshield where hood was protruding inward and sustained fracture of right orbit and severe laceration and avulsion of its contents; bilateral subarachnoid hemorrhage and an extensive comminuted fracture to base of skull; superficial lacerations to ventral surface of upper right arm and to right index finger. She had a superficial abrasion over left hip from seatbelt, and chest contusions over heart from resuscitative efforts. Cause of her death, hemorrhage with concussion resulting from severe facial injuries. Vehicle 1 sustained 28 inches of frontal sheet metal crush primarily to right front corner including hood, grill, bumper, and fender; right hood hinge separated and hood moved rearward into windshield; small dent on right door. Energy-absorbing steering column compressed 3.75 inches. Vehicle 2 had damage to left rear mud flap; trailing axle housing twisted clockwise; and leaf springs came out of both mountings. Directions of impact force 12:00 o'clock to Vehicle 1 and 6:00 o'clock to Vehicle 2.

Postcrash: Sheriff's deputy driving in front of Vehicle 2 circled back and called for an ambulance. Driver 1 wanted to get right front door open which was locked and which he apparently feared would not open because it had power locks and the battery was damaged. He opened glove compartment with ignition key, removed a screw driver, and he and a passerby pried open the right front door. Nurse who stopped on-scene tried to stop Passenger 1's bleeding; sheriff's deputy brought out first-aid kit and attempted to assist passenger. Ambulance arrived in 10 minutes, extricated passenger on backboard, transported her to hospital; en route to hospital Driver 1 applied bandages to wife's face and attendant attempted cardiopulmonary resuscitation. At hospital, Driver 1's nose x-rayed, but his hand wasn't x-rayed until two days later. Unsuccessful attempt made to revive wife. Only debris was grill pieces and pieces of cast metal from Vehicle 1's headlight area found in median. No traffic controls necessary as both vehicles were off roadway.

Causal Factors and Recommendations

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- | | |
|---|--|
| 1 | Driver 2 attempted illegal turnaround on expressway median. (Definite) |
| 1 | Driver 2 changed lanes without ascertaining right-of-way. (Definite) |
| 1 | Driver 2 traveling in passing lane too slow for traffic conditions. (Definite) |

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 4 Due to poor design of truck which created large blind spot, coupled with poor maintenance of back window, Driver 2 unable to see Vehicle 1 (truck used in airport only, moved only occasionally for intensive maintenance). (Definite)

Relevant Factors

- 1 Sheriff's deputy did not get inadequately lighted army truck off highway; he should have trailed truck. (Definite)
- 1 Driver 2 did not take into account truck's limitations (blind spot, lighting) while driving and maneuvering on public highway. (Definite)
- *1 As Driver 2 entered passing lane, Driver 1 braked and swerved into median. (Definite)
- 4 Lack of adequate lighting on Vehicle 2 a hazard. (Definite)
- 5 Vehicle 2 did not have override/underride protection to decrease vehicle damage to impacting vehicle. (Definite)
- 7 Bad weather and poor visibility a factor in accident. (Definite)
- 7 Narrow flat design of median encouraged illegal crossovers as evidenced by numerous tracks across median. (Definite)
- 9 Officer showed poor judgement in trying to handle accident situation alone in midst of heavy Friday traffic. (Definite)

Injury Causation

- *2 Use of lap restraints minimized injuries to Driver 1. (Definite)
- 2 Use of shoulder harness would have minimized injury and prevented fatal injury to right front passenger in Vehicle 1. (Definite)
- *5 Energy-absorbing steering device effective (compressed 3.75 inches). (Definite)

Matrix Cell

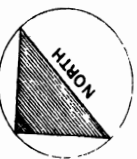
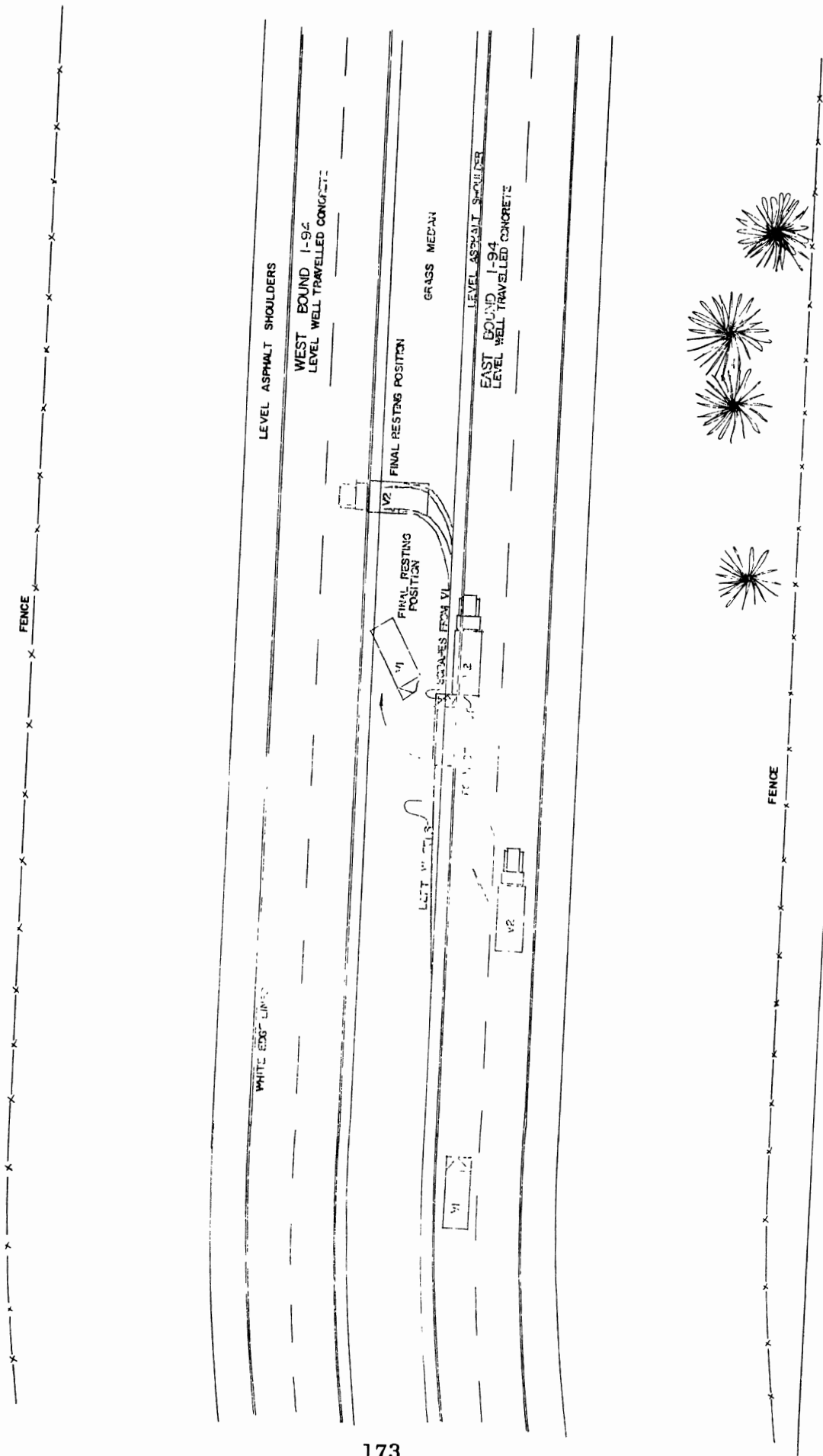
Explanation

Postcrash Factor

- *3 Emergency first aid rendered immediately on-scene by passing registered nurse. (Definite)

Recommendations

- 4 Encourage adoption of TSPS #1, Periodic Motor Vehicle Inspection, which provides that vehicles must meet standards endorsed by the National Highway Traffic Safety Administration.
- 4 Reevaluate postwar use of army vehicles on public highways.
- 3 Emphasize police traffic services.. On-scene police should understand good accident procedure--thorough accident investigation, traffic control, first aid, and preventing further accidents; police responsible for safe transport of substandard vehicles on public highway.
- 1 Driver education courses should emphasize the dangers of unauthorized vehicles using expressway medians for turnarounds; such courses should also stress that the driver is the one responsible for a vehicle and should not rely on the advice of passengers in making decisions regarding vehicle maneuvers.
- 4 Trucks should have override/underride protection to decrease vehicle damage severity to vehicles striking the truck.



AA 330



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-331
CASE SUMMARY

Identification

Accident occurred on Ann Arbor-Dexter Road, an open roadway in suburban/residential area in Scio Township, Washtenaw County, Michigan, on Thursday, January 4, 1973 at 0833 hours. Single vehicle, out of control to the left, impacted tree. Driver sole occupant. Injury severity AIS code 02, moderate, non-dangerous.

Ambience

Early daylight, clear, temperature 34^oF, relative humidity 62%, wind velocity 27 mph, from due west. Roadway generally dry with sporadic icy patches.

Highway

Rural collector roadway, 22 feet wide, 2-lanes, 2-way, undivided. Road surface well-travelled asphalt, normally well-maintained but showing ravages of winter weather; shoulders of packed fill. Straight, crowned for drainage, with $+\frac{1}{2}$ grade westward. No roadway lighting. Three intersections, 10 driveways, and 50 trees within a quarter mile radius. At a dip in the roadway about 250 feet southeast of the accident site, a blocked drainage culvert had caused some water to run downhill onto roadway surface. Traffic had spread water but not near accident site. Accident history over 4 $\frac{1}{2}$ year period in this vicinity includes 2 two-vehicle PDO accidents and 1 single-vehicle injury-producing accident. The single-vehicle case involved collision with a fixed object under clear, daylight, dry surface conditions. Accident rate considered non significant.

Traffic Controls

Posted speed limit 35 mph. Pavement markings consisted of center yellow intermittent lines painted during prior summer but very worn by winter traffic. No control symbols or signals. Standard 35 mph speed signs of good legibility along route. Standard "No Passing" signs of good legibility to right of roadway about 100 feet before accident site and Michigan yellow and black "No Passing" pennant sign on left side opposite. Warning arrow sign 8 feet short of accident site and on right side of road indicating left turn curve in roadway ahead.

Vehicle

A 1970 Chevrolet Nova, 2-door sedan, light green exterior, black interior. Odometer 30,475 miles. No previous inspection (vehicle in-

spection not required in MI). No power accessories, automatic transmission; padded upper instrument panels, armrests, and sunvisors. Lap belts and shoulder harness installed. Studded snow tires were mounted on rear wheels. No vehicle defects. Last indicated vehicle maintenance at 25,297 miles with oil and filter change plus lubrication on June 8, 1972. Damage to vehicle: 8 inches of sheet metal crush to right front fender, hood crushed and both hinges damaged, engine and transmission mount separated, right side upper and lower A frame dented. King pin separated from A frame, lower shock absorber mount broken, front cross member of chassis broken and stub frame bent. VDI:03-RFEW-3. Interior damage from driver contact included bent accelerator pedal, broken heater ducts, broken lower instrument panel near radio, and loosened heater controls.

Occupant

Driver, 38 year-old Caucasian female, 63 inches, and 125 pounds. Had driven 5 years, averaging 10,000 miles a year. Occupation: school-teacher. Was enroute from her apartment residence in Ann Arbor about 3 miles east and was proceeding northwest on Ann Arbor-Dexter Road to her school 12 miles away in Dexter. Owned vehicle 3 years and had driven it approximately 30,000 miles. Was very familiar with roadway having driven it each school day for past three years. Had completed a driver education course and had a valid driver's license with no restrictions. Except for limited experience in urban rush hour traffic, had driven in all traffic situations and in all kinds of weather. Driving record contains only one violation for failure to stop for school bus which was stopped off roadway to left (See Driver Record, Appendix B). Vision and general health normal. Had 8 hours sleep the night before, was under no mental stress, had usual breakfast of coffee only. No alcohol or drug involvement. Was wearing seat belt snugly fastened over several layers of clothing and thick fur coat, but was not wearing shoulder harness. Injuries: both ankles sprained, lacerations to right foot, muscle soreness in knees, soreness to neck and right side of torso, stiffness of spine, seat belt abrasions on right hip. Injury severity AIS code 02, moderate, non-dangerous.

Standards

The following Traffic Safety Program Standards (TSPS) and Motor Vehicle Program Standards (MVPS) were relevant to this case study.

- TSPS 4 Driver Education. Driver was proceeding at the legal speed limit, which was too fast for existing road conditions, and was unprepared for sudden icy spots.
- TSPS 12 Highway Design, Construction, and Maintenance. The well-travelled collector roadway contained ice spots which had not been salted or sanded.
- MVPS 201 Occupant Protection in Interior Impact--Passenger Cars. Driver 1 sustained injury from jagged edges of heater ducts which broke upon occupant contact.

MVPS 208 Seat Belt Installations--Passenger Cars. Vehicle had properly installed seat belts and shoulder harness which met the standard. Driver was wearing seat belt properly buckled which prevented her from being thrown about the car. She was not wearing the shoulder harness so her upper torso pitched rightward and forward against the seat belt which caused abrasions to right hip. She also suffered side whiplash to back and neck.

Description

Preocrash: At about 0830 hours, Driver alone was proceeding north-westbound at legal speed limit of 35 mph in right lane of Ann Arbor-Dexter Road. She had just come over crest of $+1/2^{\circ}$ northwestbound rise, at which point she apparently lost some traction, then suddenly came upon icy patch on roadway. Vehicle started to skid left. Driver unsuccessfully attempted to correct and lost control. Vehicle skidded across roadway onto soft left shoulder, spun about 90° counterclockwise, and continued sideways toward row of trees. Tire marks and scuffs on roadway and shoulder clearly indicate direction of movement. No indication of braking.

Crash: Vehicle, upon leaving roadway, crashed into one of a row of pine trees with a force vector of 3:00 o'clock, the point of contact being the right front wheel and fender. Driver had taken no action and apparently froze behind wheel. After impact, the vehicle pivoted slightly around tree and then slid rearward out onto road and came to rest astride the left eastbound lane. At impact, the belted driver was thrown forward and to the right, straining against the seat belt, striking her feet on the gas pedal, her right leg against the plastic heat ducts which broke, and her left knee against the radio instrument panel. Her right hip was bruised by the seat belt, despite several layers of clothing and a heavy fur coat. Sideward whiplash caused soreness to neck and back. Vehicle damage was confined mainly to the right front area and included 8 inches of sheet metal crush to right front fender, crushed hood and damaged hinges, separated engine and transmission mounts, dented upper and lower A frame, king pin separation from A frame, broken lower shock absorber mount, broken front chassis member, and bent stub frame. VDI: 03-RFEW-3. Interior damage included bent accelerator pedal, broken heater ducts, broken lower instrument panel near radio, and loosened heater controls.

Postcrash: After vehicle came to rest, driver sat and screamed, "because it felt good and helped relieve tension", then honked her horn to summon help, and unbuckled her seat belt. When nearby residents responded she asked them to call an ambulance, notify police and her school, and help her out of the car because she was afraid of being hit by other cars. They instructed her to remain in the vehicle and notified ambulance service and police. Driver through her legs were broken but she sat up to turn off lights. Ambulance and police arrived shortly. Attendants checked her for fractures, and transported her to hospital. She was x-rayed, treated and released that day. There were no postcrash fires, explosions, or environmental degris, or traffic control problems.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

1 Driver lost control on icy road. (Definite)

Severity Increasing Factors

*2 Driver's use of seat belt minimized injury by preventing her from striking right A-pillar area. (Probable)

2 Driver's failure to use installed shoulder harness resulted in her upper torso being thrown forward and to the right with whiplash effects to back and neck. (Definite)

Relevant Conditions

7 Roadway pavement, shaded by trees, had not been salted or sanded to eliminate ice hazard. (Definite)

1 Driver did not watch for icy conditions and was not prepared to take corrective actions. (Definite)

Injury Causation

2 Seat belts caused abrasions to driver's right hip. (Definite)

5 Hard, sharp-edged material and plastic shroud on heater duct caused lacerations to driver's right foot. (Definite)

Postcrash Factors

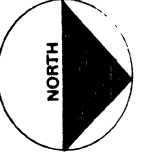
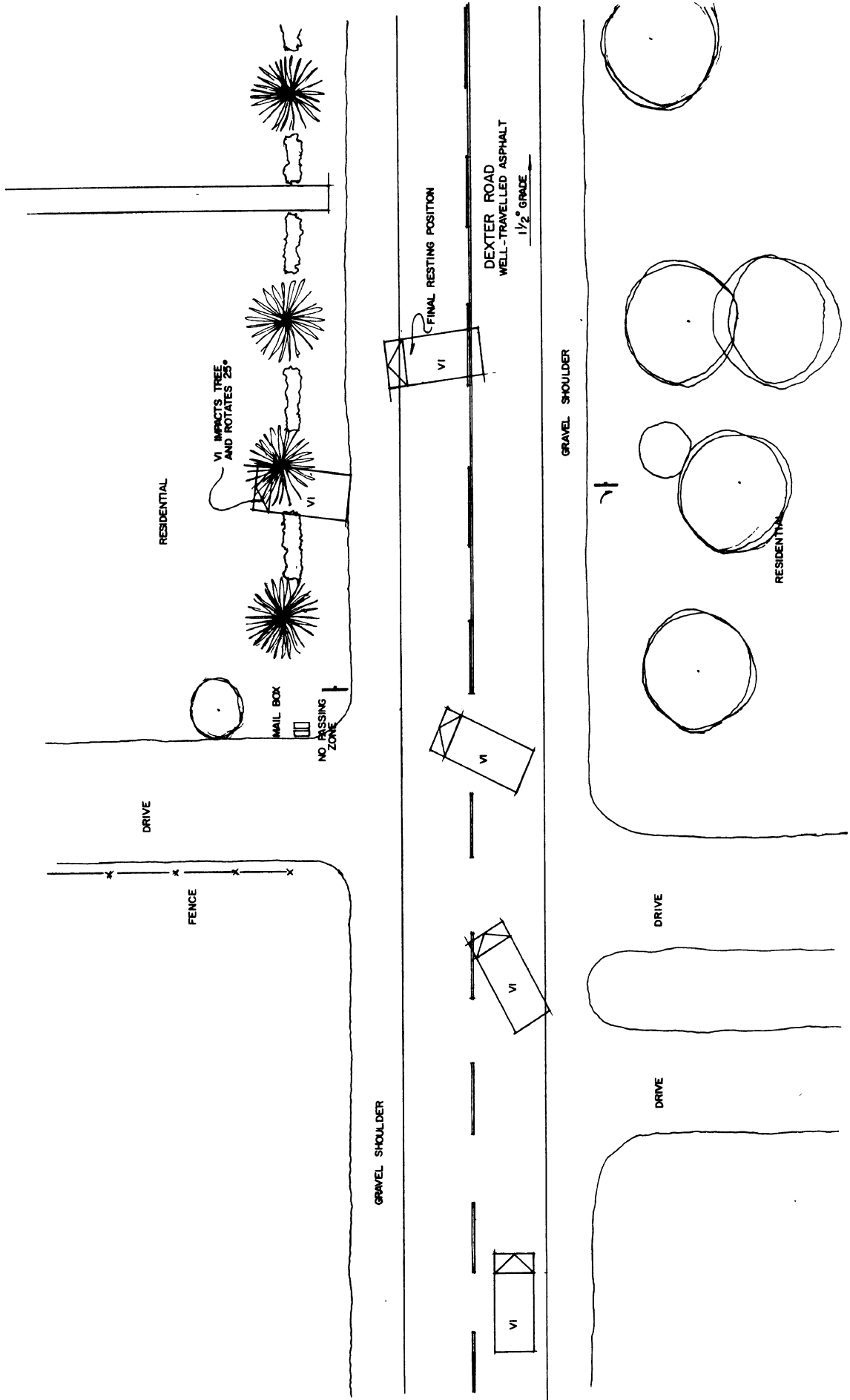
*3 Insistence of persons on-scene that driver remain in vehicle prevented additional injury. (Possible)

Matrix Cell

Explanation

Recommendations

- | | |
|---|--|
| 1 | Driver education should emphasize that during winter driving conditions one must be alert for sudden appearance of ice on tree-shaded roads and be prepared to take corrective action. |
| 2 | Driver education should better emphasize the purpose of and desirability of wearing the shoulder harness. |
| 5 | Heater ducts should be made of soft yielding, non-injury producing material. |
| 8 | Highway sections which are tree-shaded should be monitored for icy conditions and sanded or salted. |



THE UNIVERSITY OF MICHIGAN
TRAFFIC SAFETY RESEARCH INSTITUTE
CASE #AA-032
CASE SUMMARY

Identification

Accident occurred on expressway M-14 Bypass in Ann Arbor Township, Washtenaw County, Michigan, on Monday, January 8, 1973 at 0939 hours. Open road by in commercial-residential area. Single full-sized vehicle involved. Driver ejected. Injury severity AIS* code 10, fatal, severity unknown.

Ambience

Daylight; cold, cloudy and overcast. Roadway dry (Police Accident Report, Appendix A, erroneously states that the roadway was snowy and icy). Temperature 15^o, relative humidity 53%, wind 4 mph from northeast.

Highway

Expressway M-14 Bypass, 4 lanes, each set of lanes 24 feet wide. Divided by median barrier, which was a 28-inch guardrail installed on top of 6-inch curb 5 feet in from edge. 6-foot wide interior asphalt shoulders. Surface well-traveled concrete. Outside shoulders asphalt, 10 feet wide. Roadway curved, crowned for drainage, 4 1/2" grade to the south. No artificial lighting; within quarter mile radius 5 trees, no driveways, intersections, interchanges, or utility poles. Three-year history of accidents indicated eight accidents; five loss of control, three sideswipe. Five accidents involved single vehicles, two were two-vehicle accidents, and one involved three vehicles. This is not considered a particularly significant accident location.

Traffic Controls

Posted speed limit 70 mph maximum, 45 mph minimum. Solid white edge delineators, intermittent white center line. No other pavement markings. Direction signs which conformed to standards. No signals.

Vehicle

1972 Ford Bronco. 4-wheel drive recreation vehicle; exterior cinnamon brown bottom and white top, white interior; odometer 18,637 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Three-speed manual transmission; no power accessories; padded upper instrument panel, sunvisors, and armrests. Lap belts only available. No vehicle defects observed. No maintenance recorded. Damage: 16 inches crush to right side, damage to right hood hinge and right A-, B-, and C-pillars; 6 inches of frontal sheet metal crush, hood latch damaged and released; door latch and A-, B-, and C-pillars damaged on left side, left hood hinge

* American Medical Association Abbreviated Injury Scale (AIS).

partially separated from firewall; 7 inches of crush to top, left and right roof side rails and windshield header damaged. VDI*: 00-XDAO-3. Vehicle's high center of gravity, coupled with catapulting effect of striking sloping median, allowed vehicle to vault guardrail.

Occupant

Driver, 58-year-old Caucasian male, 65 inches and 160 pounds. Forty years driving experience, averaged 35,000 miles per year. Traveling from work in Flint, Michigan to home in Jackson, Michigan; 45 miles from origin, 25 miles from destination. Fairly familiar with vehicle; had owned it one week and had driven it 600-700 miles. Traveled route twice weekly. No driver education. Physical condition unknown, possible heart attack; mental condition good. No alcohol involved. Unrestrained. Injuries: 3-inch forehead laceration, multiple fractures to mandible, possible concussion, abrasions right side of chest 3 inches below axilla, multiple right rib fractures, simple sternal fracture, abrasion and laceration over left hand, multiple fractures left carpal and metacarpal. Injury severity AIS code 10, fatal, severity unknown.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|-----------|--|
| MVPS #201 | Occupant Protection in Interior Impact-- Passenger Cars. Padded sunvisor hit by driver decreased injury potential (padded sunvisors not required for multipurpose vehicles). |
| MVPS #212 | Windshield Mounting--Passenger Cars. One hundred percent windshield mounting separation increased ejection potential (MVPS #212 does not apply to multipurpose vehicles). |
| MVPS #216 | Roof Crush Resistance--Passenger Cars. There was significant roof crush at windshield header (MVPS #216 does not apply to multipurpose vehicles). |
| TSPS #12 | Highway Design, Construction, and Maintenance. Height of guardrail serving as median barrier met current standards; however, with slope of median, effective height of guardrail was nearly four inches shorter than required. |
| TSPS #15 | Police Traffic Services. Police officer attempted cardiopulmonary resuscitation on-scene. |

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Incident

Pre-crash: Vehicle 1 westbound on M-14 Bypass, passed semi-trailer truck at 60 mph (moved from outside lane to inside lane back to outside lane). Right wheels went three feet off roadway onto shoulder, veered sharply to left about 90 feet crossing both lanes, started to cut right again. Not having vehicle under control in violation of traffic law. Physical evidence included 30 foot critical scuff with right wheels on outside shoulder of eastbound lane as driver attempted to regain roadway; 28 feet of critical scuff with left wheel and 80 feet with right wheels on roadway as driver attempted to recenter before hitting guardrail.

Crash: Vehicle hit median curb with left front wheel, impacted top of median guardrail with left front end, momentum carried vehicle along and over guardrail. Traveled 40 feet in air crossing inside eastbound lane, hit center line area with left front end, started to rotate clockwise. Went onto outside asphalt shoulder, was "tripped" by damaged left front wheel and suspension, made a 1 1/4 roll in fill section, and came to rest on left side. Driver partially ejected at three-quarter roll out closed right door window, car rolled over him, completely ejected at 1 1/4 roll. Driver scraped on right side of chest 3 inches below axilla from door; injuries from being crushed included three-inch forehead laceration, multiple fractures to mandible, possible concussion, multiple right rib fractures, simple sternal fracture, abrasions and lacerations over left hand, multiple fractures left carpal and metacarpal. Right side vehicle damage: 16 inches of crush, right hood hinge and A-, B-, and C-pillar damage; frontal damage: 6 inches sheet metal crush, hood latch damaged and released; left side: hood hinge partially separated from firewall, door latch and A-, B-, and C-pillar damage; top: seven inches of crush, left and right roof side rails buckled and damaged, windshield header damaged. Directions of force unclassifiable.

Post-crash: Washtenaw County sheriff's deputy happened by immediately on-scene, tried cardiopulmonary resuscitation; ambulance arrived in 5 minutes and attempted to revive him on way to hospital. Driver dead on arrival at hospital. No fires, explosions, or environmental problems. Only debris glass from side windows and windshield. No traffic controls necessary as vehicle came to final rest off roadway.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Pre-crash	Crash	Post-crash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Cause

1 Driver overcorrected to left after drifting off roadway onto righthand shoulder. (Definite)

Severity Increasing Factors

4 Because of its design use, vehicle had high center of gravity and high body structure which allowed it to vault guardrail after striking curb. (Definite)

7 Guardrails were not adequate for protecting multipurpose vehicles. (Definite)

7 Curb placed close to guardrail serves as "launching pad" for vehicles which impact it. (Definite)

Relevant Conditions

1 Driver may have had physical disability. (Possible)

1 Driver inattentive to driving task. (Probable)

Injury Causation

1 Driver unrestrained, which allowed total ejection. (Definite)

1 Driver probably would not have received fatal injuries had he been restrained and remained in vehicle. (Probable)

Recommendations

7 Guardrails should be designed to serve total vehicle population.

THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-333
CASE SUMMARY

Identification

Accident occurred on expressway US-23 in Northfield Township, Washtenaw County, Michigan, on Wednesday, January 17, 1973 at 1020 hours. Open roadway in residential/industrial area. Single vehicle impacted guardrail and bridge. Injury severity AIS* code 01, minor.

Ambience

Daylight; windy, warm, and sunny; scattered hazy clouds. Temperature 44^o, relative humidity 56%, wind 14 mph from southwest. Roadway dry.

Highway

US-23 4-lane divided expressway, each set of lanes 24-feet wide. Grass median 46-feet wide. Roadway surface well-traveled concrete; shoulders asphalt, outside 10-feet wide, inside 3-feet wide. Eight-inch high curb on either side of bridge leading into bridge base of the same height. Standard 22-inch single guardrail extended away from bridge on both sides (not connected to parapet). Bridge rail was formed by 12" x 14" concrete piers, 10 feet on center. They were 48" high from surface of roadway mounted on an 8" high curb. The railing was cast aluminum. Roadway superelevated at curve, crowned for drainage, graded 1 $\frac{1}{2}$ ^o to the south. No artificial lighting; within a quarter-mile radius one interchange, no driveways, intersections, utility poles, or trees. Search of accident data for January 1968-June 1972 showed 20 cases within quarter-mile radius of accident site (average number for single site in 4 $\frac{1}{2}$ -year period). Eleven were single-vehicle accidents, six two-vehicle, two three-vehicle, and one four-vehicle. Six cases were out of control, four rear end, four right angle, three head-on, two fixed object, and one collision with debris.

Traffic Controls

Speed limit posted 70 mph maximum, 45 mph minimum. Solid white edge delineators, intermittent white center line; pavement markings worn. No signs or signals.

Vehicle

Passenger car, 1973 Chevrolet Vega Kammback (station wagon); medium blue exterior, black interior, odometer 4,232 miles. No indication of vehicle inspection (periodic vehicle inspection not

* American Medical Association Abbreviated Injury Scale (AIS).

required in Michigan). Automatic transmission, no power accessories, upper instrument panel and armrests padded (sunvisors not padded). Upper torso and lap belt restraints available. No vehicle defects observed. No recorded maintenance. Sideswipe damage to lower right side, heavy damage to right rear corner, left rear axle shaft broke, fuel tank leakage. Primary VDI*:06-BRAW-4, secondary VDI:12-RDMS-1.

Occupant

Driver, 23-year-old female Caucasian, 68 inches and 170 pounds. Had been driving 5 years, averaging 8,000 miles per year. Traveling from appointment with social worker in Howell, Michigan to mother's home in Ann Arbor; 19 miles from origin, 10 miles from destination. Vehicle belonged to sister, driver had only driven it 25 miles so unfamiliar with it. Familiar with area, drove route several times weekly in last three months. No driver education. Physical condition good; mentally under stress. No alcohol involved. Restrained by lap belt. Injuries: contusions lateral aspect both upper arms, contusions lateral aspect left thigh, contusions both knees, soreness to right side and back, soreness left side of face. Injury severity: AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|-----------|---|
| MVPS #101 | Control Location, Identification, and Identification--Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. Driver was unfamiliar with controls and accident vehicle. |
| MVPS #202 | Head Restraints--Passenger Cars. Integral head restraint built into seat, coupled with seat back deformation, helped reduce possibility of whiplash injury. |
| MVPS #207 | Anchorage of Seats--Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. Driver's seat remained anchored to floor despite severe seat back deformation. |
| MVPS #301 | Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. Fuel leaked from float assembly for fuel gauge because of severe tank deformation. |
| TSPS #4 | Driver Education. Crash shows inherent danger of driving while under stress and also the prudence of acquainting oneself with the controls when driving a strange car. |

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

- TSPS #12 Highway Design, Construction, and Maintenance. Guardrail of substandard design and was not attached to bridge (however, did not increase severity of accident); frozen mound of dirt in front of guardrail could have launched vehicle; bridge mounted on curb dangerous.
- TSPS #15 Police Traffic Services. State policeman, who was stopping traffic from driving in inside lane, left as soon as vehicle was removed from roadway but before danger to people and vehicles close to road was over; wrecker with car pulled onto roadway without safeguards.

Description

Preocrash: 1973 Vega southbound in outside lane of expressway US-23, traveling at 60 mph. Driver leaned down to adjust air vent, vehicle drifted off roadway onto right shoulder. Not having vehicle under control in violation of traffic law.

Crash: Vehicle struck guardrail and traveled along it six feet before being deflected back onto roadway. Vehicle rotated clockwise 150°, crossed both lanes of traffic, impacted bridge parapet with right rear corner. Came to final rest in westward orientation in middle of roadway. Driver moved right at initial impact with guardrail and again to the right during vehicle rotation. Right rear impact to bridge caused seat back lock to break loose and driver fell back, up, and to the right with her head lightly impacting roof rail; she then rebounded forward and to left. Injuries incurred on bridge impact during driver's rearward motion and rebound. Right arm bruised on side of right seat back; right side and back sore from impact force; right side of face sore, probably from impacting right seat back; knees contused from striking instrument panel; left arm and thigh bruised on left door at rebound. Vehicle damage: on left side, B-pillar partially separated at roof and at belt line, D-pillar partially separated at roof, door latch inoperable because striker moved rearward with B-pillar, rear wheel bent; rear axle shaft broke; fuel tank severely deformed, fuel leaked from float assembly for fuel gauge; right side, upper A-pillar dented, upper and lower B-pillar and upper D-pillar partially separated, lower D-pillar totally separated, roof side rails buckled at B- and D-pillars, door jammed closed, rear wheel bent. Directions of force 6:00 o'clock to rear of vehicle, 12:00 o'clock from sideswipe to guardrail.

Postcrash: Passerby opened driver's door and helped her to exit the vehicle. Both state and county police arrived in about eight minutes, ambulance called but turned back, no first aid given. Policeman drove driver to her mother's home in Ann Arbor. No fires, explosions, or environmental problems. Fuel leakage on roadway created possible fire hazard, fire department not summoned to hose it away. One state policeman stopped traffic in inside lane until damaged vehicle moved off roadway.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Cause

1 Driver drifted off roadway to right while adjusting air vent. (Definite)

Relevant Factors

1 Driver unfamiliar with vehicle. (Definite)

1 Driver under stress over financial difficulties and inability to find job. (Definite)

5 Location of fuel tank near rear bumper allowed for little sheet metal damage before tank was damaged. (Definite)

Injury Causation

*2 Use of lap belt minimized injury to driver. (Definite)

*5 Integral headrest, combined with seat back deformation, reduced whiplash danger. (Definite)

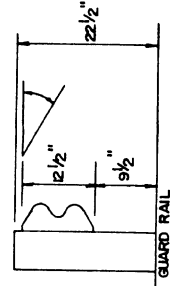
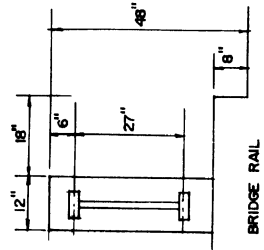
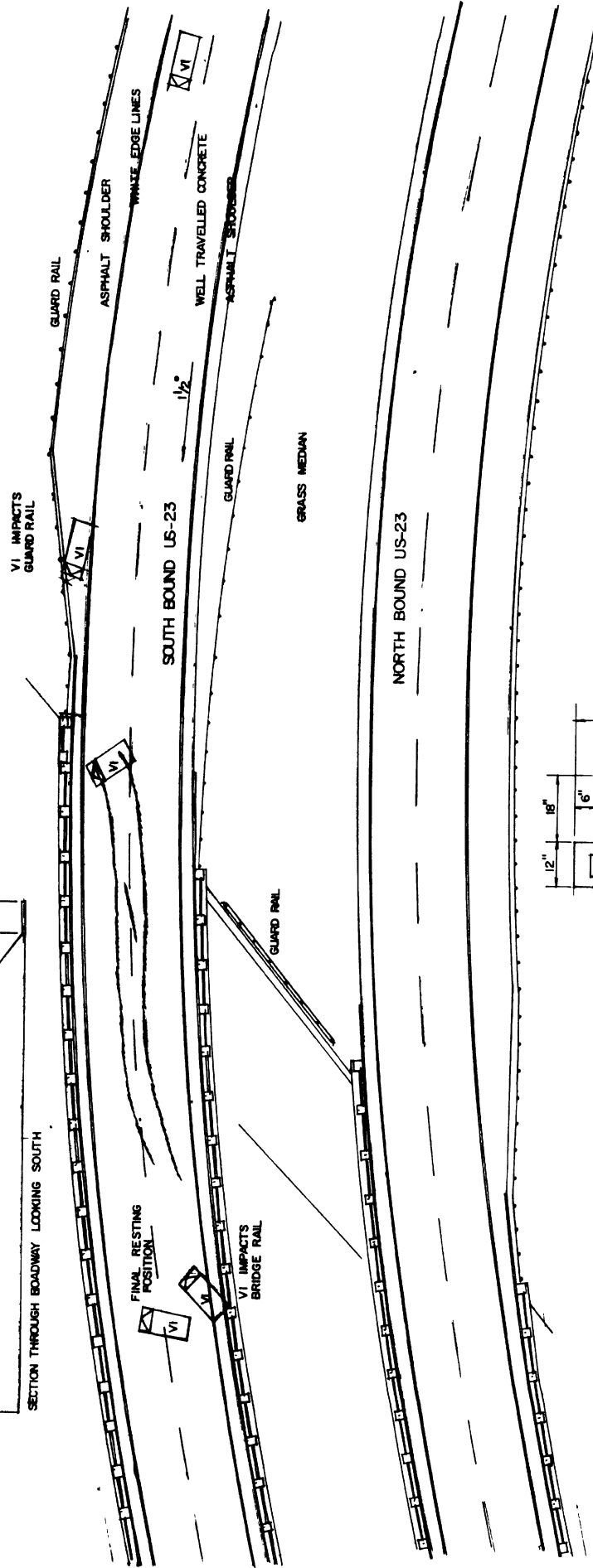
Postcrash Factors

6 Fuel tank leaked due to severe deformation which loosened float. (Definite)

9 After damaged vehicle removed from roadway, inadequate warning to approaching traffic that vehicle and people still near accident. (Definite)

ROADWAY			
8°	4°	3°	0°
		-1°	0°
			-40°
			0°

SECTION THROUGH ROADWAY LOOKING SOUTH



ACCIDENT SCHEMATIC AA 333



UNIVERSITY OF MICHIGAN HSR

THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-334
CASE SUMMARY

Identification

Accident occurred on Geddes Road in Superior Township, Washtenaw County, Michigan on Friday, January 26, 1973 at 0915 hours. Open roadway section in residential area. Single vehicle, loss of control. Injury severity AIS* code 01, minor.

Ambience

Bright, sunny day; temperature 40^o, relative humidity 84%, wind 4 mph from southwest. Roadway icy.

Highway

Geddes Road is two-lane major arterial; each lane 11.5 feet wide. No divider. Surface well-traveled asphalt. Gravel shoulders; eastbound shoulder three feet wide, westbound shoulder 3.5 feet wide. Roadway straight, level, graded 1 $\frac{1}{2}$ ^o to west. No artificial lighting. Within quarter mile area: 15 driveways, no intersections or interchanges, 10 utility poles, heavily wooded. Data covering 4 $\frac{1}{2}$ years showed 15 accidents on Geddes Road in area of this accident site. Six of accidents were right angle, four head-on, three rear-end, and two out of control. All but three took place in the intersection with US-23; therefore, there is no significant accident data at the exact location of this case.

Traffic Controls

Speed limit posted 40 mph. Worn yellow double center line; no other pavement markings. "Speed Limit 40" and "Do Not Pass" signs, all conform to standard. No signals.

Vehicle

Passenger car, 1971 Pontiac Tempest T-37, 2-door hardtop; avocado green exterior, black vinyl top, light green interior; odometer 14,055 miles. No indication of inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission; power steering; padded instrument panel, sunvisors, and armrests; very light padding on doors. Lap belts and upper torso restraints available. Last recorded maintenance at 13,035 miles on December 30, 1972; included oil and oil filter. Vehicle had never had tune-up; driver claimed car stalled occasionally. When started in towing yard, vehicle idled fairly well. Damage: 1-inch sheet metal crush on left front corner, 10 inches of crush to right front fender,

* American Medical Association Abbreviated Injury Scale (AIS).

2 inches of crush to left quarter panel; vinyl top ripped by cyclone fence. VDI :02-KLN-2 (primary); 06-IDMS-1 (secondary); 11-IBM-1 (tertiary).

Occupant

Driver, 37 years old, female, Black, 65 inches and 160 pounds. Seventeen years driving experience averaging 7,000 miles per year. Traveling from home in Detroit suburb to work in Ann Arbor; 16 miles from origin, 6 miles from destination. Had owned vehicle 2 years, driven it 14,055 miles. Had traveled route daily for eight years. No driver education. Physical and mental condition good. No alcohol involvement. Unrestrained. Injuries: soreness to head, spine, arms, left leg. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standard (TSPS) were specifically relevant to this case.

MVPS #201	Occupant Protection in Interior Impact--Passenger Cars. Light padding on door perhaps minimized injury.
MVPS #202	Head Restraints--Passenger Cars. Head restraints in vehicle perhaps minimized injury.
TSPS #4	Driver Education. Driver education courses should include information on basic vehicle maintenance and principles of operation.

Description

Pre-crash: Vehicle westbound on Geddes Road at 40 mph. Engine stalled, and without power steering driver had difficulty steering. Vehicle then skidded on patch of ice and went off roadway onto right shoulder. Driver steered hard back onto roadway, crossed both traffic lanes, went into eastbound ditch. Driving at a speed too fast for conditions violation of traffic laws. Tire marks from right front and rear tires on right shoulder for distance of 140 feet. Twenty-six-foot critical speed scuff made by right front wheel in westbound lane ending at center line.

Crash: Vehicle clipped tree with left front corner at impact speed of 10 mph. Struck second tree with right front corner, pivoted around second tree, backed into ditch and sideswiped left side of car with third tree. Came to final rest in cyclone fence. Driver gripped steering wheel until hit first tree; was thrown forward and left at initial impact, forward and right as car pivoted around tree, impelled rearward and rebounded off seat back as car impacted fence. Injuries: pain to right side and back of head resulting from whiplash and striking head restraint (headaches persisted beyond one week);

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J221a.

pain over both shoulders up and down spinal column from impact force; arms sore gripping steering wheel; left leg sore from either steering column or door impact. Vehicle had one inch of sheet metal damage to left front corner, 10 inches of crush to right front fender, and 2 inches of crush to left quarter panel; rips in vinyl top from cyclone fence. Directions of force: primary (second tree) 2:00 o'clock, secondary (third tree) 6:00 o'clock, tertiary (first tree) 11:00 o'clock.

Postcrash: Driver exited unassisted out driver door. Passing truck driver stopped to see if she was all right, put out flares and called police. Ambulance not called, no first aid administered on scene. No fires, explosions, or environmental problems; no debris. Traffic controls not needed as vehicle off roadway. Friend of driver gave her ride home.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Pre-crash	Crash	Post-crash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver lost control when vehicle stalled on icy road. (Definite)

Relevant Factors

- 1 Driver knew something was wrong with car because it had stalled before; lacked knowledge of auto mechanics and unaware car needed tune-up. (Definite)
- 2 Driver over-steered to regain roadway. (Definite)

Injury Causation

- *5 Head restraints and light padding on doors minimized injury. (Probable)

Postcrash Factors

- *3 Passing truck driver stopped to see how driver was and put out flares.

Recommendations

- 4 Reinstate use of secondary hydraulic pump on transmission so power steering will not be lost when engine fails.
- 1 Driver education courses should include information on basic auto mechanics and vehicle maintenance, and effective maneuvers in emergency situations.

THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-335
CASE SUMMARY

Identification

Accident occurred at intersection of US-12 (Michigan Avenue) and Allen Street in a commercial area of Ypsilanti; Washtenaw County, Michigan, at 1100 hours on Tuesday, January 30, 1973. Passenger car rear impacted passenger car. Injury severity AIS* code 02, moderate, non-dangerous.

Ambience

Cloudy day, temperature 26⁰, relative humidity 69%, wind 13 mph from the southwest. Roadway dry.

Highway

US-12 (Michigan Avenue) is 4-lane major arterial, each lane 10 feet wide. No divider. Surface well-traveled asphalt. Earth shoulders; eastbound shoulder 12 feet wide, westbound shoulder 16 feet wide. Roadway straight, level, and crowned for drainage. Within quarter-mile radius, 20 mercury vapor lights, 50 driveways, two intersections. No significant accident history.

Traffic Controls

Speed limit posted 50 mph. Intermittent white lane delineators, yellow double center line; pavement markings worn. Speed limit and no parking signs, legibility good. No signals.

Vehicles

Vehicle 1, 1966 Chevelle 2-door hardtop; royal blue exterior and interior; odometer 65,216 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in California where vehicle was registered). Automatic transmission; power steering; upper instrument panel, sunvisors, and armrests padded. Lap restraints only available. No vehicle defects observed. Last recorded maintenance at 61,897 miles on January 15, 1973, included oil change and oil filter. Vehicle sustained frontal damage to hood, fenders, and grill area; 10 inches of crush. VDI*:12-FDEW-2. Vehicle purchased by driver at 61,450 miles.

Vehicle 2, 1970 Ford LTD, 2-door hardtop; red exterior with black vinyl top, black interior; exact mileage unknown, at least 33,000 miles judging by mileage at last recorded maintenance. No

*American Medical Association Abbreviated Injury Scale (AIS).

**Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

indication of vehicle inspection. Automatic transmission; power brakes and power steering; padding on upper instrument panel, sunvisors, armrests, and seat backs. Lap belts and upper torso restraints available in front seat; lap belts only in rear seat. No vehicle defects observed. Last recorded maintenance at 32,545 miles on December 27, 1972, oil change and new air filter. Damage to both quarter panels and trunk area, 30 inches sheet metal crush to rear end, fuel tank ruptured, car burned. VDI:06-BDEW-4. Fuel tank mounted directly behind differential pushed forward into differential and deformed.

Occupants

Driver 1, 34-year-old male, Caucasian, 69 inches and 160 pounds. Driving for 16 years, averaging 10,000 miles per year. Going from brother's home in Ypsilanti to another brother's home outside Ypsilanti; half-mile from origin, two miles from destination. Had owned vehicle 25 days and had driven it 4,000 miles (including trip from California to Michigan). Familiar with area because he was previous resident of Ypsilanti. No driver education. Physical condition poor, had pacemaker; mental condition also poor; probable alcoholic. Blood alcohol concentration 0.254. Driver unrestrained. Injuries: 5 cm laceration to left side of forehead, ecchymosis left eye, abrasion right cheek, fractured sternum, several one- to two-inch lacerations to center chest, multiple superficial lacerations to extremities, contusions to both knees. Injury severity AIS code 02, moderate, non-dangerous.

Driver 2, 41-year-old male, Caucasian, 70 inches and 180 pounds. Twenty-four years driving experience averaging 20,000 miles per year. Driving from downtown Ypsilanti to home; three miles from origin, one mile from destination. Familiar with car, and familiar with route because drove it twice weekly. No driver education. Good mental and physical condition. No alcohol involved. Driver unrestrained. Injuries: "whiplash," neck sore on both sides, pain left side of chest and upper back. Injury severity AIS code 01, minor.

Vehicle 2, right front passenger, 44-year-old female, Caucasian, 66 inches and 145 pounds. Unrestrained. Injuries: back pain. Injury severity AIS code 01, minor.

Vehicle 2, left rear passenger, 39-year-old male, Caucasian, 71 inches and 195 pounds. Unrestrained. Injuries: pain lower thoracic spine, abrasion lateral aspect left leg, two-inch laceration center forehead. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

MVPS #202

Head Restraints Passenger Cars. Head restraints in Vehicle 2, coupled with the seat back yielding rearward, perhaps minimized severe injury to front seat occupants.

- MVPS #203 Impact Protection for the Driver from the Steering Control System--Passenger Cars. Driver 1 had pacemaker; injuries to chest from impacting steering wheel; steering device did not collapse (Vehicle 1 pre-standard).
- MVPS #301 Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. Poor location of fuel tank in Vehicle 2 allowed it to be moved forward into differential on impact and to rupture.
- MVPS #302 Flammability of Interior Materials--Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. Interior materials in Vehicle 2 not fire retardant. (Vehicle 2 pre-standard).
- TSPS #5 Driver Licensing. Driver 1 had history of reckless and irresponsible driving; Driver License Bureau made frequent requests for reexamination; Driver 1's Michigan driver's license revoked and financial responsibility invoked.
- TSPS #8 Alcohol in Relation to Highway Safety. Driver 1 was driving under the influence of liquor (BAC 0.254).

Description

Pre-crash: Vehicle 1 eastbound in inside lane of US-12 (Michigan Avenue) at 50-70 mph according to witnesses; Vehicle 2 eastbound in inside lane, slowed to 10-15 mph and signalled to make lefthand turn. Driver 1 braked just prior to impact; Driver 2 didn't see Vehicle 1 before crash. Driver 1 speeding and driving under the influence of liquor (DUIL), both violations of traffic law. Vehicle 1 left 17 feet of skid marks with right wheels prior to impact, and 6 feet with left wheels.

Crash: Front end of Vehicle 1 struck rear end of Vehicle 2 at impact speed of 45 mph. Vehicle 1 continued forward, angled left, went onto westbound shoulder, and came to final rest on shoulder headed northeast. Vehicle 1 traveled 186 feet after impact, leaving 6 feet of skid marks with right wheels and 15 feet with left wheels. Vehicle 2 spun 90° counterclockwise and came to final rest on the westbound road edge, traveling a total of 110 feet. On impact, Driver 1 thrown forward, head into windshield, chest into steering wheel breaking rim, and knees into instrument panel. Suffered 5 cm laceration left side of forehead at hairline, ecchymosis left eye, abrasion right cheek, fractured sternum, several one- to two-inch lacerations to center chest, multiple superficial extremity lacerations, and contusions to both knees. Driver 2 impelled rearward and rebounded forward on impact, sustained whiplash and back pain from force of impact, chest pain from steering wheel. Right front passenger thrown rearward and rebounded forward; had back pain from

impact force. Left rear passenger went rearward and rebounded forward and left, 2-inch laceration to center forehead from seat back, back pain from impact force, and abrasion lateral aspect left leg from rear seat. Vehicle 1 had 10 inches of frontal sheet metal crush with damage to hood, fenders, and grill area. Vehicle 2 sustained damage to both quarter panels and trunk area with 30 inches rear sheet metal crush, fuel tank ruptured, car destroyed by fire. Directions of force 12:00 o'clock to Vehicle 1, 6:00 o'clock to Vehicle 2.

Postcrash: Vehicle 2 was on fire upon coming to rest. Driver 2 yelled at wife, front passenger to get out; she couldn't find door handle so Driver 2 reached across seat, opened door, and nudged wife out. Driver 2 exited out driver door. Observer helped get left rear passenger out and called police. Driver 1 remained in car until ambulance arrived. No first aid administered on-scene. First ambulance arrived in two minutes and transported Driver 1 to University Hospital in Ann Arbor; second ambulance dispatched, arrived in 6 to 7 minutes and transported occupants of Vehicle 2 to Beyer Hospital in Ypsilanti. Fuel tank on Vehicle 2 ruptured on impact, leaked fuel; dragging back framework caused sparks, and as car rotated counterclockwise it vent over sparks and fuel spillage and caught fire. Fire truck dispatched to put out fire. Most of radiator fluid drained out of Vehicle 1; Vehicle 1 tire tracks in snow on westbound shoulder; scuff marks on roadway from Vehicle 2's spin. Police officers stopped traffic and rerouted it around accident until site cleared.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Cause

- 1 Driver 1 rear-ended Vehicle 2 which had slowed to make left-hand turn. (Definite)

Matrix Cell

Explanation

Severity Increasing Factor

5 Design location of fuel tank in Vehicle 2 makes it vulnerable to deformation in impact situation; fuel tank ruptured and Vehicle 2 caught fire. (Definite)

Relevant Conditions

1 Driver 1 DWIL. (Definite)

1 Driver 1's physical and mental condition poor. (Definite)

1 Driver 1 driving in excess of speed limit. (Definite)

Injury Causation

5 Injuries to Driver 1 increased because steering column did not compress (Vehicle 1 pre-standard for energy-absorbing steering devices). (Definite)

2 Injuries to Driver 1 increased because he was unrestrained. (Definite)

Postcrash Factor

*3 Driver 2 alert in getting everyone out of burning Vehicle 2 quickly. (Definite)

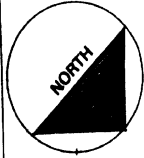
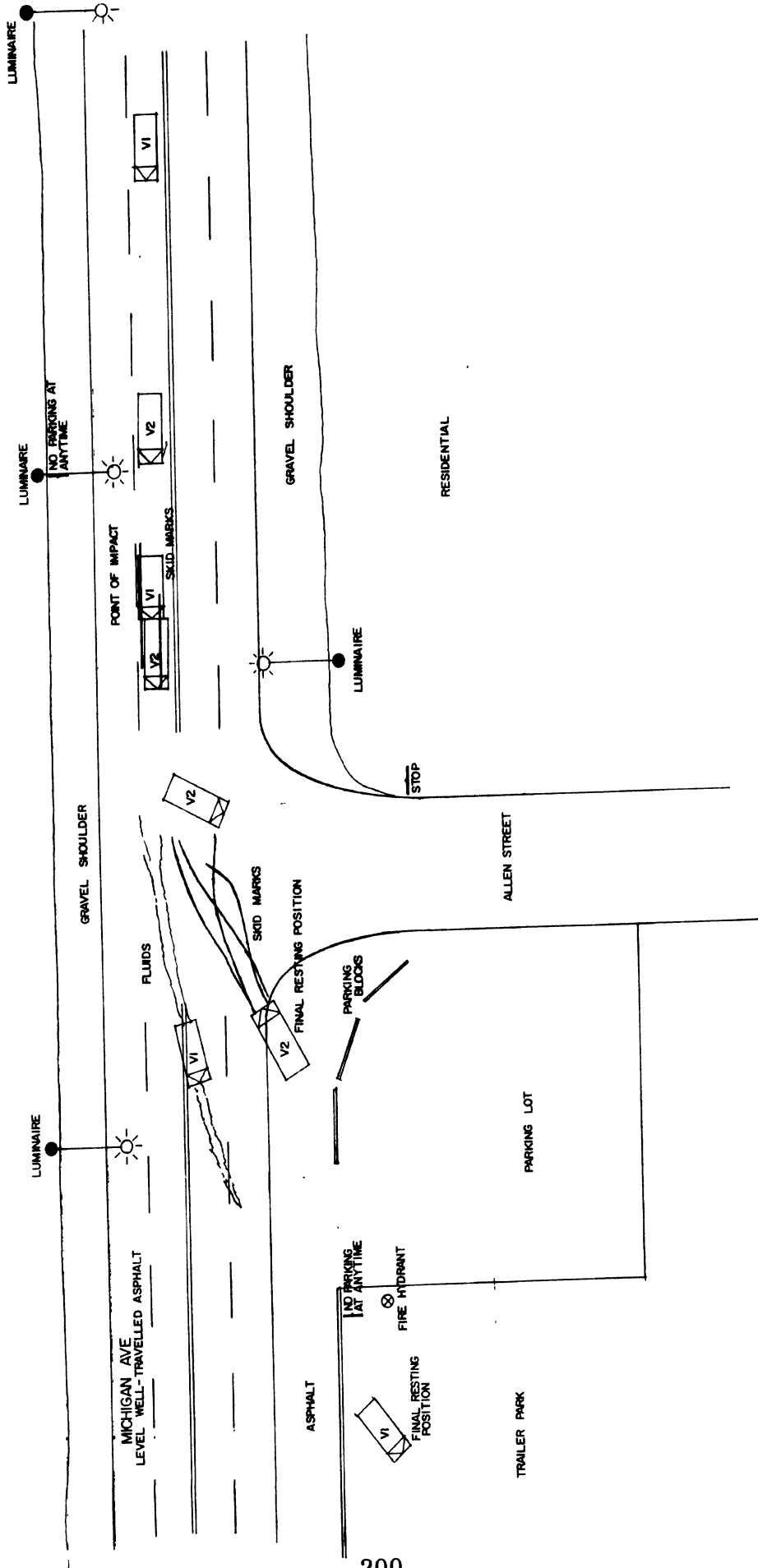
Recommendations

4 Reevaluate location of fuel tank in vehicles manufactured by Ford.

1 Intensify efforts to remove incompetent drivers from the road (Driver 1 had poor driving record, see Appendix B).

1 Review legal system which makes it possible for drivers to drive with a revoked license.

FIELD



UNIVERSITY OF MICHIGAN HSRI

ACCIDENT SCHEMATIC AA 335



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-336
CASE SUMMARY

Identification

Accident occurred where US-12 Bypass joins with M-17 (Ecorse Road) in industrial area of Ypsilanti Township, Washtenaw County, Michigan at 1515 hours on Monday, February 5, 1973. Passenger car/passenger car, rear corner impact. Injury severity AIS* code 01, minor.

Ambience

Clear afternoon, temperature 34^o, relative humidity 62%, wind 18 mph from northeast. Roadway dry.

Highway

US-12 Bypass, 2-lane concrete major arterial, joins at accident site with M-17 (Ecorse Road), 2-lane asphalt major arterial. US-12 Bypass lanes and M-17 lanes each 12 feet wide. No divider. Gore area grass covered. Roadway surface well-traveled and poorly maintained. Asphalt shoulders on US-12 11 feet on outside, 8 feet on inside; asphalt shoulders on M-17 11 feet on inside, three feet on outside. M-17 (Ecorse Road) curved, crowned for drainage, -1^o to west; US-12 straight, crowned for drainage, 1^o grade to west. No artificial lighting. Within quarter-mile radius: no accesses or utility poles, 20 trees. Survey of 4½ years of accident history data showed nine accidents on US-12 at M-17 and three accidents on M-17 at US-12, for a total of 12 accidents which is considered average for a Washtenaw County intersection site. Nearly all movement of involved vehicles straight ahead.

Traffic Controls

Speed limit 65 mph daytime, 55 mph nighttime, posted. Solid white edge delineators; intermittent white lane lines, visibility good. Directions signs, conformed to standards. No signals.

Vehicles

Vehicle 1, passenger car, 1966 Pontiac Ventura, 2-door hardtop; bronze exterior, black vinyl top, light bronze interior; odometer 71,912 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission; power brakes and power steering; padding on upper instrument panel, sunvisors and armrests. Lap belts only available. Only 1/32-inch tread on left front tire; no other vehicle defects observed. Record of maintenance unknown, very old sticker unreadable; Driver 1 thought car serviced about two months ago. Frontal damage including fenders, hood, bumper, and grill; 06 inches of frontal sheet metal crush;

* American Medical Association Abbreviated Injury Scale (AIS).

damage to rear bumper; vinyl top cut by fence. Primary VDI*:12-FDEW-1; secondary VDI:12-UDLW-1.

Vehicle 2, passenger car, 1971 Ford Galaxy 500, 2-door hardtop; red exterior, black vinyl top, black interior; odometer 43,347. No indication of motor vehicle inspection. Automatic transmission; power brakes and power steering; padding on upper instrument panel, sunvisors, and armrests. Lap belts and upper torso restraints available. No vehicle defects observed; no recorded maintenance, Driver 2 said oil change and lubrication one to two months earlier; new brakes and new tires this year. Heavy damage to left rear corner including trunk lid and left quarter panel; 24 inches of sheet metal crush; left C-pillar damaged. VDI:07-BYEW-5.

Occupants

Driver 1, 33 years old, male, Black, 70 inches and 200 pounds. Seventeen years driving experience. Returning home from cousin's house; one mile from origin, $1\frac{1}{4}$ mile from destination. Familiar with vehicle, owned two months; drove route several times a week. No driver education. Physical and mental condition poor. Blood alcohol concentration (BAC) 0.19. Available lap restraint not worn. Injuries: minor laceration and swelling on top of head, light abrasion on top of nose, bruise on lateral aspect right leg, soreness to back. Injury severity AIS code 01, minor.

Driver 2, 40 years old, male, Caucasian, 70 inches and 195 pounds. Driving from home in Detroit suburb to work; 30 miles from origin, $1\frac{1}{2}$ mile from destination. Had driven vehicle two years; traveled route daily. No driver education. Physical and mental condition good. No alcohol involved. Available lap belt not worn. Injury severity AIS code 00, no injury.

Vehicle 2, right front passenger, 56 years old, female, Caucasian, 66 inches and 150 pounds. Unrestrained. Injuries: "whiplash," soreness to neck and back. Injury severity AIS code 01, minor.

Standards

The following Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|----------|--|
| TSPS #8 | Alcohol in Relation to Highway Safety.
Driver 1 driving under the influence of liquor (BAC 0.19). |
| TSPS #12 | Highway Design, Construction, and Maintenance.
Guardrail was needed in gore area. |

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Description

Precrash: Vehicle 1 westbound in outside lane of M-17 (Ecorse Road) at a driver-estimated speed of 60 mph. Vehicle 2 westbound in inside lane of US-12 at 45 mph. Vehicle 1 left roadway to right, crossed gore area, entered traffic lanes of westbound US-12. Driver 1 tried to brake in gore area and attempted to steer back onto roadway. Driver 1 driving under influence of liquor (BAC 0. 9) violation of traffic law. Vehicle 1 left precrash wheel tracks along outside shoulder and through gore area.

Crash: Front end of Vehicle 1 struck Vehicle 2 in left rear corner; Vehicle 1 rotated counterclockwise very slightly, went off right side of roadway. Shoulder dropped away, Vehicle 1 remained level and was airborne 45 feet, bounced down and continued across field 125 feet, coming to final rest oriented westward on far side of cyclone fence. Vehicle 2 rotated counterclockwise 360° and came to final rest partially off right side of roadway facing westward. Driver 1 sustained a minor laceration and swelling to top of head from contacting roof and bruise on lateral aspect right leg from striking instrument panel when vehicle bottomed out in ditch; light abrasion to top of nose from moving forward into steering wheel; and soreness to back from impact force. Driver 2 thrown right on rotation, gripped steering wheel, uninjured. Vehicle 2 spun counterclockwise out from under unrestrained right front passenger, forcing her to left; she came to final rest with back against instrument panel and suffered "whiplash" and a sore back. Vehicle 1 had six inches of frontal sheet metal crush and damage to fenders, hood, bumper, and grill from impact with Vehicle 2, minor damage to rear bumper from bottoming out in ditch, and vinyl top ripped by fence. Vehicle 2 sustained heavy damage to left rear corner including trunk lid and quarter panel; 24 inches of sheet metal crush; left C-pillar damaged. Directions of force 12:00 o'clock to Vehicle 1; 7:00 o'clock to Vehicle 2.

Postcrash: Driver 1 exited himself and walked through field to roadway. Right front passenger got out of Vehicle 2, Driver 1 told her to get back into car. Driver 2 stayed in car until police arrived. Co-worker of Vehicle 2 occupants passed accident and called police; ambulance arrived in eight minutes. No first aid administered on-scene. Driver 1 and Vehicle 2's right front passenger transported to hospital by ambulance, Driver 2 taken to hospital in police car. Vehicle 1 left large scuff and torn sod where it bottomed out after being airborne (trailer hitch broke off at this time), and 125 feet of tire tracks in field from scuff to final resting place. Scuff marks from Vehicle 2's right tires on roadway marking rotation. Traffic flow was light so no traffic controls were needed.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Preocrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Cause

1 Driver 1 left curved section of roadway.
(Definite)

Severity Increasing Factor

3 There should have been a guardrail in
gore area to protect motorists from out-of-
control drivers leaving roadway where M-17
(Ecorse Road) curves and slopes. (Definite)

Relevant Conditions

1 Driver 1 driving while intoxicated (0.19 BAC).
(Definite)

1 Driver 1's physical health and mental condition
below optimum. (Definite)

1 Driver 1 stated he looked away from roadway
(M-17) to check traffic on US-12 where the two
roadways join. (Probable)

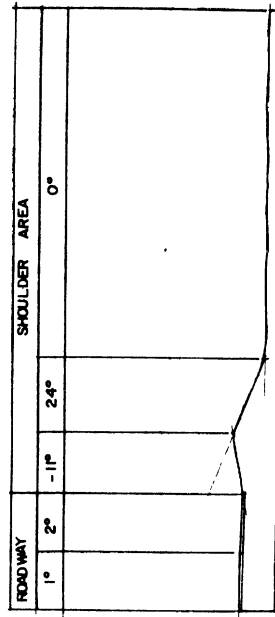
Injury Causation

2 Injury severity to Driver 1 and Vehicle 2's
right front passenger increased because they
were unrestrained. (Definite)

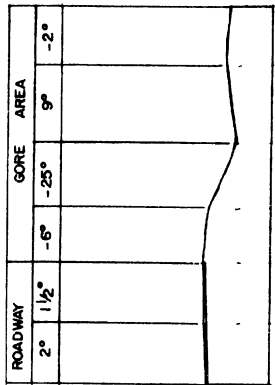
Recommendations

9 Need for guardrail should be investigated.

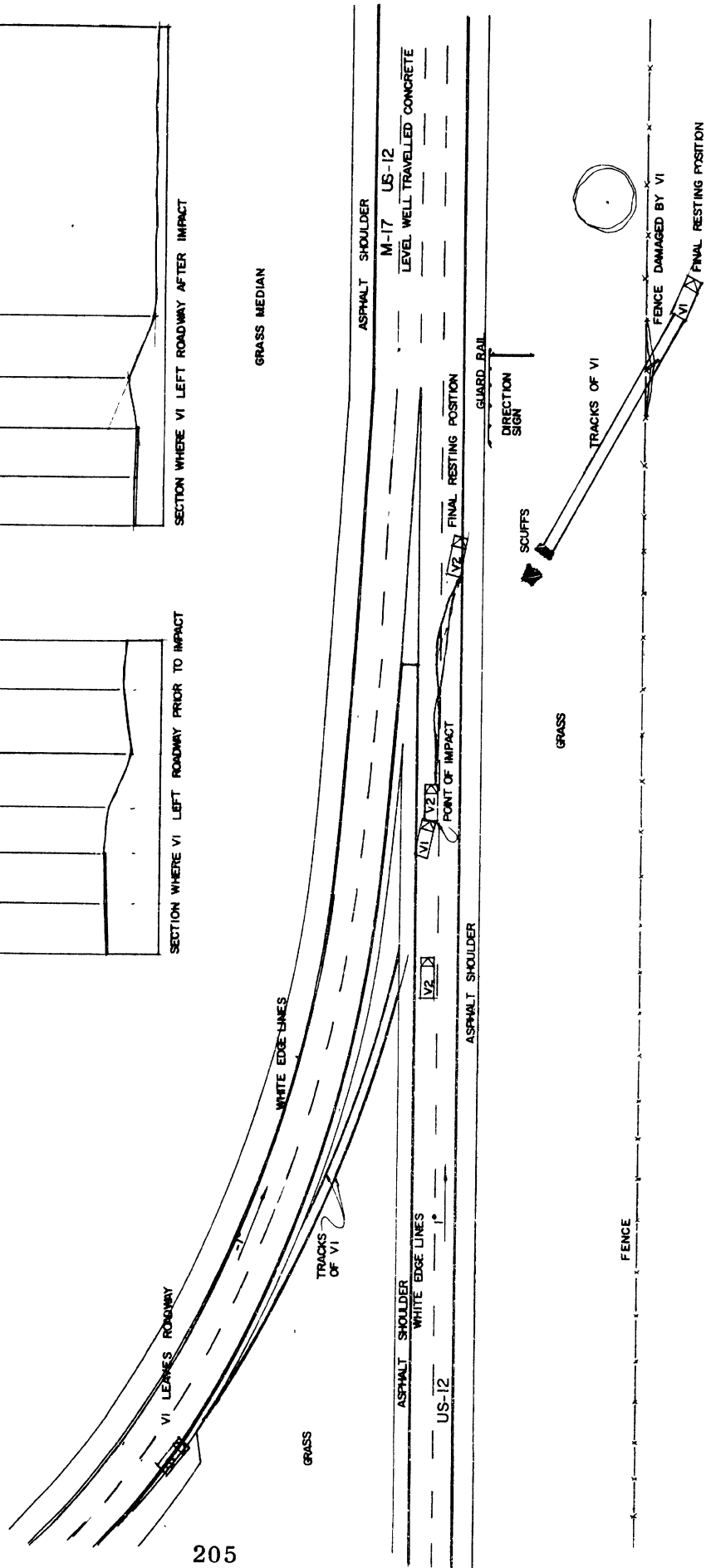
1 Direct efforts toward removing hazardous,
drinking drivers from the road and toward
implementing driver reeducation programs to
which individuals respond effectively.



SECTION WHERE VI LEFT ROADWAY AFTER IMPACT



SECTION WHERE VI LEFT ROADWAY PRIOR TO IMPACT

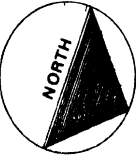


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ACCIDENT SCHEMATIC AA 336



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-337
CASE SUMMARY

Identification

Accident occurred on Barton Drive in residential section of the city of Ann Arbor, Washtenaw County, Michigan, at 0800 hours on Friday, February 9, 1973. Passenger car impacted school bus head-on. Injury severity AIS* code 01, minor.

Ambience

Bright, sunny morning; temperature 70^o, relative humidity 87%, wind 8 mph from northwest. Roadway snow-covered, and icy.

Highway

Barton Drive is two-lane collector, 19 feet wide, no divider. Surface is well-traveled asphalt. Road edge shoulders were dirt fill, each six feet wide. Between roadway and embankment sloping to adjacent river only protection wooden posts 10 feet apart (on-center measurement). Roadway curved, was not crowned for drainage, no grade. Mercury vapor lights every 175 feet. Within quarter mile radius: 20 driveways, one intersection, 15 utility poles, and 150 trees (approximately). No history of prior accidents at this location.

Traffic Controls

Speed limit 25 mph by statute. No pavement markings. Two directional arrow signs and a "No Parking Anytime" sign, all conformed to standards.

Vehicles

Vehicle 1, passenger car, 1967 Pontiac Tempest, 2-door hardtop, dark blue exterior, black interior; odometer 72,836 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission; no power accessories; upper instrument panel, sunvisors, and armrests padded. Lap belt only available. Left rear tire 1/32-inch tread, right rear tire 4/32-inch tread. No recently recorded maintenance. Fifteen inches of frontal sheet metal crush with damage to bumper, grill, hood, and fenders; 65% windshield bond separation; dents on instrument panel from occupant contact. VDI** :12-FDEW-2.

* American Medical Association Abbreviated Injury Scale (AIS).

** Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Vehicle 2, 1971 Ford school bus with Wayne body; chrome yellow exterior with black stripes and lettering; approximately 18,000 miles on bus (old odometer broken, new odometer showed 9,319 miles). State Police inspected bus in December 1972. Five-speed manual transmission, power steering, air brakes, no padded components. Lap belt available for driver only. No vehicle defects detected. Had undergone regularly scheduled maintenance. Frontal damage including bumper and grill, front fenders bowed out slightly, 4 inches of sheet metal crush. VDI:12-FDEW-1.

Occupants

Driver 1, 22 years old, male, Caucasian, 70 inches and 160 pounds. Six years driving experience, averaging 20,000 to 25,000 miles per year. Going from home to work in Detroit, 1½ miles from origin, 60 miles from destination. Unfamiliar with vehicle which was owned by residence roommate, had driven it only 25 miles. Traveled route daily. Completed high school two-phase driver education course. Physical condition good; overall mental condition good, but hurried at time of accident. No alcohol involved. Available lap belt not worn. Injuries: 1½-inch laceration center chin, front teeth loose, left side of head sore, slight lacerations both legs mid-shin. Injury severity AIS code 01, minor.

Vehicle 1, right front passenger, 21 years old, male, Caucasian, 70 inches and 130 pounds. Unrestrained. Injuries: 1½-inch laceration over right eye. Injury severity AIS code 01, minor.

Driver 2, 29 years old, Caucasian, female, 66 inches and 230 pounds. Driving 12 years averaging 30,000 miles per year. Traveling from bus parking lot to school in Ypsilanti; route included five stops. Route was 20 miles, driver on schedule. Accident site seven miles from origin, 13 miles from destination. Familiar with bus having driven it 12,000 miles in five months; drove route daily on weekdays. No driver education. Overweight, corrective lens for astigmatism; overall mental condition good. No alcohol involved. Not wearing lap belt. No injury.

Vehicle 2 passengers:

Second seat from front, left side: 6-year-old Caucasian female, 46 inches and 48 pounds. Unrestrained. No injury.

Third seat from front, left side: 10-year-old Caucasian male, 54 inches and 75 pounds. Unrestrained. No injury.

Third seat from front, right side: 9-year-old Caucasian male, 52 inches and 70 pounds. Unrestrained. No injury.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) are specifically relevant to this case.

- MVPS #201 Occupant Protection in Interior Impact-- Passenger Cars. Padded sunvisors and blunt design of instrument panel minimized injury to occupants of Vehicle 1 (pre-standard).
- MVPS #212 Windshield Mounting--Passenger Cars. Vehicle 1 had 65% windshield bond separation (pre-standard).
- TSPS #4 Driver Education. Driver education courses must caution drivers to drive at speeds safe for road conditions; also alert drivers to learn unfamiliar vehicle's handling characteristics.
- TSPS #12 Roadway Design, Construction, and Maintenance. Roadway narrow; guardrails were needed to prevent vehicles from going down embankment into adjacent river; also the snow-covered road had not been treated (sand) to reduce icy surface.
- TSPS #17
(Proposed) Pupil Transportation Safety. Driver 2 had had no driver education. Michigan law requires school bus drivers to complete school bus driver safety course every two years; Driver 2 unrestrained though lap belt available.

Description

Pre-crash: Vehicle 1 headed northwest at a driver-estimated speed of 40 mph, Vehicle 2 going southeast at 20 mph; each in their respective traffic lane. Vehicle 1 entered roadway curve to the right, crossed center of road into opposing traffic lane. Driver 1 pumped brakes, steered to right. Just prior to impact, Driver 2 saw Driver 1 enter curve at a speed too fast for conditions, realized crash imminent, steered to right and applied brakes and clutch. Driver 1's driving too fast for conditions violation of traffic law. Because roadway was sanded immediately post-crash and scene not investigated until 1 $\frac{1}{4}$ hour after accident, pre-crash skids and scuffs are, if any, were not evident.

Crash: Front end of car struck front end of bus head-on; Vehicle 1's impact speed 20 mph, Vehicle 2's 10 mph. Driver 1 thrown forward and sustained 1 $\frac{1}{2}$ -inch laceration center chin and loose front teeth from striking steering wheel, sore left side of head from windshield, and slight lacerations both legs mid-shin from instrument panel. Right front passenger went forward into windshield and received 1 $\frac{1}{2}$ -inch laceration over right eye. Neither of Vehicle 1 occupants lost consciousness. Occupants of Vehicle 2 uninjured. Vehicle 1 had frontal damage to bumper, grill, hood, and fenders with 15 inches of sheet metal crush; 65% windshield bond separation; dents on instrument panel from occupant contact. Vehicle 2 had four inches of frontal sheet metal crush with damage to bumper and grill, front fenders bowed out slightly. Directions of force 12:00 to both vehicles.

Postcrash: Vehicle 2 passengers remained in bus; Driver 2 exited, went to Vehicle 1, and suggested Driver 1 and right front passenger stay in car, which they did. Driver 2 went to nearby house and phoned police who arrived in three minutes. Ambulance arrived in four minutes; checked condition and bandaged lacerations of Driver 1 and Vehicle 1's right front passenger; transported them on full backboards to hospital. Driver 2's school transportation supervisor took her and children to school. No fires, explosions, or environmental problems. Pieces of grill and glass from Vehicle 1 on roadway. City maintenance truck sanded roadway immediately post-crash. Scene held for HSRI crash investigation team; light traffic diverted into unobstructed traffic lane.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver 1 crossed into opposing lane of travel while rounding curve. (Definite)
- 1 Driver 1 traveled too fast for conditions. (Definite)

Relevant Conditions

- 1 Driver 1 was in hurry and did not exercise proper care. (Definite)
- 1 Driver 1 unfamiliar with full-sized vehicle. (Definite)
- 4 Tires on Vehicle 1 had 1/32-inch tread on left rear, 4/32-inch on right rear. (Definite)
- 7 Roadway too narrow at curve for two vehicles to safely pass. (Definite)
- 7 Roadway snow-covered which reduced coefficient of friction. (Definite)

Matrix Cell

Explanation

Injury Causation

2 Failure to use lap restraints increased injury to Driver 1 and his right front passenger. (Definite)

Postcrash Factors

*3 Emergency Medical Service response prompt and treatment appropriate. (Definite)

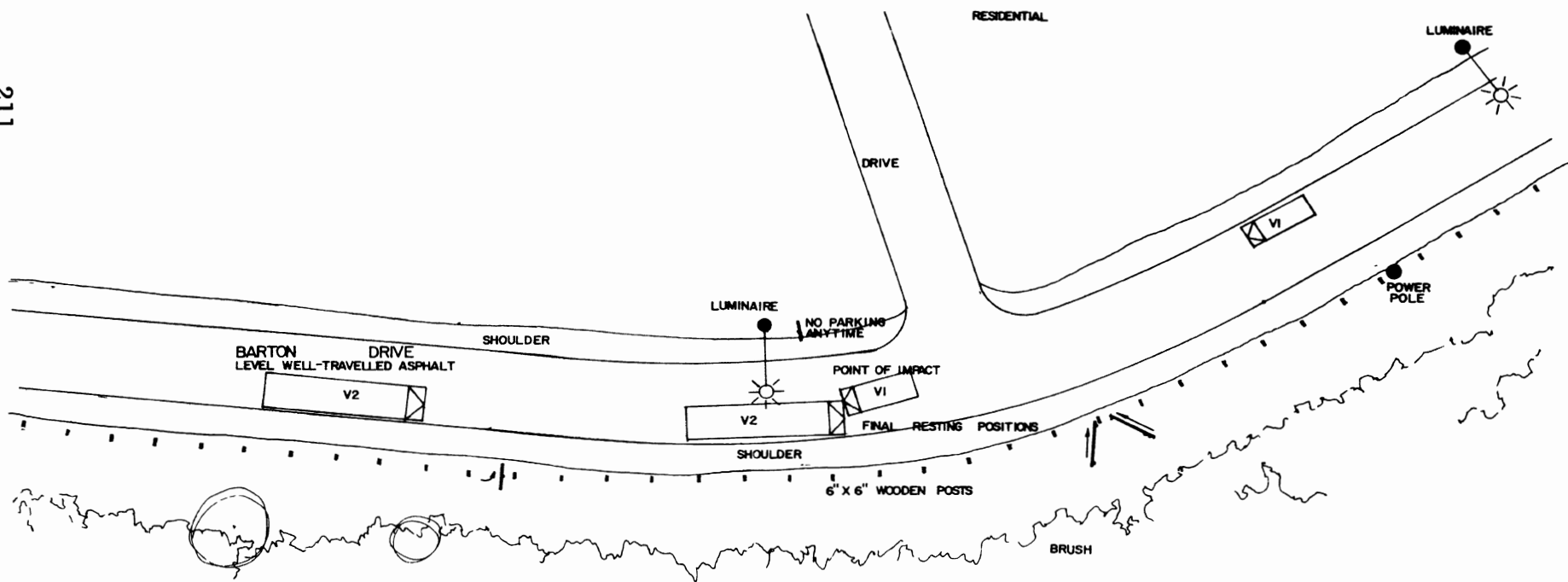
*9 Maintenance truck from city of Ann Arbor sanded road immediately postcrash. (Definite)

Recommendations

7 Widen road at curve and install guardrail to protect motorists who leave road from going down steep embankment and into river.

1 Driver education courses should warn drivers against driving too fast for conditions, and emphasize the need to familiarize oneself with a vehicle before driving it.

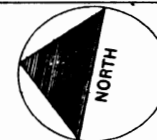
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ACCIDENT SCHEMATIC AA 337



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-338
CASE SUMMARY

Identification

Accident occurred on eastbound expressway I-94, open roadway in agricultural area of Sylvan Township, Washtenaw County, Michigan, on Thursday, February 8, 1973 at 1414 hours. Mobile home, loss of control, fire. Injury severity AIS* code 00, no injury.

Ambience

Daylight, sunny and windy; temperature 20^o, relative humidity 42%, wind 13 mph from northwest. Roadway dry, occasional ice patches, shoulders snow-covered.

Highway

I-94, 4-lane divided expressway, each set of lanes 24 feet wide. Grass median quarter-mile wide. Roadway surface well-traveled and well-maintained concrete. Exterior asphalt shoulder 10 feet wide, interior asphalt shoulder 3 feet wide; no guardrail. Roadway straight, level, crowned for drainage. No artificial lighting, accesses or utility poles per quarter-mile radius; many trees. A total of 26 accidents in a 5-year period was found in a search of the Washtenaw County data for the intersection of I-94 with Pierce Road (overpass) to one-half mile east of Pierce Road on I-94. In general, this is a below average yearly total. The most common category of accident configuration was out-of-control (8), followed by rear end (5), sideswipe (4), right angle (3), rollover (2), hit animal (2), and one each for head on and fixed object. There were 15 single-vehicle accidents, nine two-vehicle, and two three-vehicle. Fifteen of the accidents occurred in potentially wintry months (November-March).

Traffic Controls

Speed limit posted 70 mph maximum, 45 mph minimum; these speeds also apply to motor homes in Michigan. Intermittent white center line, solid white edge delineators; visibility good. No signs or signals.

Vehicle

Vehicle 1, mobile home, 1973 28-foot Swinger Statesman; exterior lime green with black accent stripes, white top and bottom; odometer approximately 350 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in state of Michigan). Automatic transmission, power brakes and power

* American Medical Association Abbreviated Injury Scale (AIS).

steering, padded instrument panel. Lap belts only available. No vehicle defects reported, no record of maintenance. Fire completely destroyed vehicle. VDI:*00-RDMO-1.

Occupant**

Driver 1, 23-year-old Caucasian male, 70 inches and 180 pounds. Seven years driving experience with passenger cars, averaging 15,000 miles per year; one-year experience driving Swingers, averaged 50,000 miles in past year driving around United States as an awning salesman. On business trip from Jackson, Michigan to Detroit; 15 miles from origin, 45 miles from destination. Very familiar with vehicle, fairly familiar with route. Completed high school driver education course. Overall physical and mental condition good. No alcohol involved. Driver unrestrained. Injury severity AIS code 00, no injury.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standard (TSPS) were specifically relevant to this case.

- | | |
|-----------|---|
| MVPS #301 | Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. The rubber junction connecting the fuel filler pipe to the fuel tank separated allowing fuel leakage, but the fuel tank did not rupture. (MVPS #301 does not apply to mobile homes.) |
| MVPS #302 | Flammability of Interior Materials--Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses. The vehicle and many of its components were flammable to extent that mobile home was completely destroyed by fire. |
| TSPS #4 | Driver Education. Driver 1 oversteered in attempts to regain roadway. |

Description

Pre-crash: Vehicle 1 eastbound in outside lane of I-94 expressway at 60-65 mph. Hit patch of ice, driver overcorrected and fishtailed into inside lane then back to outside lane and onto snow-covered shoulder. Oversteered back onto roadway, then steered right to straighten out vehicle. Vehicle rotated clockwise across roadway onto median, skidded 105 feet. Driving too fast for conditions violation of traffic law. One hundred and thirty feet

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

** Case interviewer unable to talk to Driver 1 because of his job as a traveling salesman; therefore, she interviewed his family and company employer.

of critical speed scuffs on roadway; tire tracks in snow; skid marks on roadway, 65 feet from rear wheels, 85 feet from front wheels; scuffs down fill section into median.

Crash: Vehicle overturned on median and made a three-quarter roll to final resting place. Unrestrained driver rolled with vehicle, received no injuries. Vehicle totally destroyed by fire. Because of rollover, no directions of force available.

Postcrash: Driver heard explosion of propane gas tank and fuel tank, saw fire in back of mobile home, crawled out skylight roof vent. Passing motorist called police who arrived promptly. Fire truck also dispatched. Great amount of non-combustible debris (vehicle side structure, appliances, etc.) in median necessitated time-consuming clean-up. No traffic controls necessary as vehicle was off roadway.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Cause

1 Driver 1 lost control and vehicle left roadway. (Definite)

Relevant Conditions

1 Driver 1 overcorrected to regain roadway which caused vehicle loss of control. (Definite)

4 Vehicle had very high center of gravity. (Definite)

7 Patch of ice on roadway initiated vehicle loss of control. (Probable)

7 Snow on shoulder further contributed to vehicle loss of control. (Definite)

Matrix Cell

Explanation

Injury Causation

- *5 Presence of skylight roof vent enabled Driver 1 to safely exit burning vehicle. (Definite)

Postcrash Factors

- *3 Driver exhibited alert behavior in extri-
cating himself out skylight roof vent when
he saw vehicle on fire. (Definite)
- 9 Debris clean-up was time-consuming because
of large amount of loose pieces scattered
about median. (Definite)

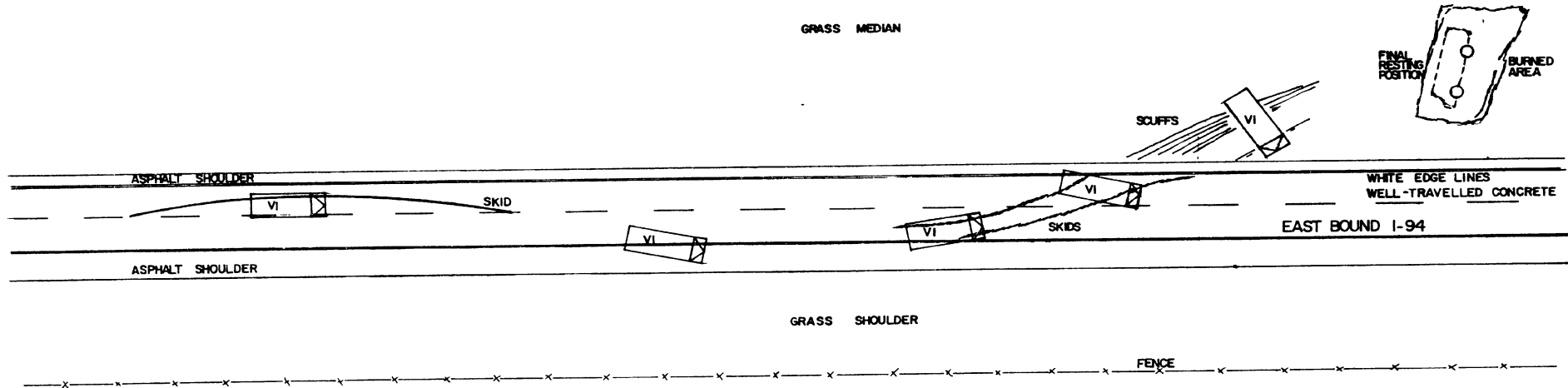
Recommendations

- 7 Reevaluate speed limit for mobile home
vehicles because of handling and stability
problems due to high center of gravity.
- 4 Study should be made of mobile home
flammability.
- 1 Driver education courses should teach
defensive driving and emphasize danger of
overcorrecting as evidenced in Driver 1's
rapid and critical steering maneuvers in
an attempt to regain roadway. Overcorrecting
is frequent cause of accidents.

MEDIAN		ROADWAY			SHOULDER	
12°	4°	2 1/2°	-1 1/2°	-4°	-8°	-2°

SECTION THROUGH ROADWAY LOOKING EAST

216

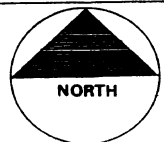


ACCIDENT SCHEMATIC

AA 338



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-339
CASE SUMMARY

Identification

Accident occurred on open roadway section of Platt Road in residential area of city of Ann Arbor, Washtenaw County, Michigan, on Saturday, February 10, 1973, at 1110 hours. Pedestrian struck by stake truck. Injury severity AIS* code 04, serious, life-threatening, survival probable.

Ambience

Bright, sunny morning; temperature 22^o, relative humidity 79%, wind 12 mph from due north. Roadway dry.

Highway

Platt Road, 4-lane major arterial; each lane 11 feet wide. No divider. Surface well-traveled asphalt; road edge 6-inch-high concrete curbing.** Roadway straight, crowned for drainage, no grade. Twenty mercury vapor lights every half mile. Accesses per quarter mile: 10 driveways, 2 intersections, 15 utility poles, and 40 trees. No accident history according to 4½-year Washtenaw County data base.

Traffic Controls

Speed limit 35 mph, posted. Worn pavement markings; intermittent white lane delineators, double yellow center line. Standard "No Parking" and speed limit signs. No signals.

Vehicle

1969 Chevrolet C/50 stake truck owned by Michigan Consolidated Gas Company; odometer 33,180 miles; dark blue-grey exterior and interior. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Manual transmission, power steering, and power brakes, padding on upper instrument panel and armrests. Lap belt only available. No vehicle defects observed. Regular maintenance done by Michigan Consolidated Gas Company's own garage; driver indicates when truck needs more than regular maintenance. VDI+: 12-FRNM-0 (area of pedestrian contact).

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs standard in city of Ann Arbor, Michigan.

+ Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Occupant/Pedestrian

Driver 1, 30 years old, male, Caucasian, 66 inches and 200 pounds. Thirteen years driving experience; averaged 34,000 miles per year, 500 miles per week for the Gas Company, 155 miles per week for personal driving. Making third trip of the day from Gas Company to Ann Arbor Dump; nine miles from origin, one mile from destination. Drove truck and route frequently. Completed driver education course in high school, army, and Gas Company. Good physical condition, wore corrective lenses. Mental condition possibly somewhat agitated as he had just witnessed a near ambulance-passenger car intersection accident; then as he continued on Platt Road, a passenger car pulled out from a side street directly in front of him. No alcohol involved. Restrained by lap belt. No injury.

Pedestrian, 8-year-old male Caucasian, height and weight unknown. Walking with a friend from home to Mary D. Mitchell School for a Cub Scout hike; half mile from origin; half mile from destination. Familiar with area, lived nearby. Injuries: closed head injury, semi-conscious on-scene; comatose to semi-conscious for 12 hours after accident; groggy, some amnesia second day; alert, normal functioning apparently restored third day; 2-inch anterior midline scalp laceration; complaint of pain in neck, contusion lateral aspect left thigh, stiffness in left thigh and leg, abrasions and contusions to knees and ankles. Injury severity AIS code 04, serious, life-threatening, survival probable.

Standards

The following Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|----------|---|
| TSPS #11 | Emergency Medical Service. It took 20 minutes for ambulance to arrive. |
| TSPS #14 | Pedestrian Safety. Need to intensify pedestrian safety education in elementary schools. |

Description

Pre-crash: Vehicle 1 southbound in outside lane of Platt Road at 30-35 mph. Pedestrian darted into street, Driver 1 slammed on brakes, down-shifted, and swerved to left. No violations. Skid marks: 42 feet with right front and left front tires, 65 feet with right back dual tires, 60 feet with left back dual tires.

Crash: Right front corner of truck struck pedestrian. Pedestrian fell to pavement between wheels and truck passed over him. Driver 1 pulled into outside lane and stopped, put the truck in neutral, put on emergency brake and emergency flashers. No driver kinematics, driver uninjured.

Pedestrian sustained contusions to lateral aspect of left thigh, stiffness to left thigh and leg from bumper impact. Further injuries sustained as the pedestrian fell to the pavement and passed under the bumper and undercarriage were complaint of pain in neck, contusions and abrasions to knees and ankles, 2-inch anterior midline scalp lacerations, and serious closed head injuries. He was semi-conscious on-scene and comatose to semi-comatose in the hospital 12 hours after accident. The day following the accident, he regained consciousness, was groggy and suffered amnesia. The following day normal functioning was apparently restored. Injury severity AIS code 04, serious, life-threatening, survival probable. No vehicle damage. Direction of force 12:00 o'clock.

Postcrash: Driver got out of truck and asked pedestrian's friend to go for help. Nearby resident brought blanket for pedestrian. Pedestrian started to get up, driver laid him back down. The boy started vomiting and lost consciousness and the driver, trained in first aid, checked for airway clearance, vital signs, and broken bones in neck and extremities. Police and fire truck arrived in four minutes, fire rescue truck in eight minutes. Pedestrian placed on backboard, check on vital signs maintained until ambulance arrival twenty minutes postcrash. Pedestrian transported in ambulance, semi-conscious, vital signs stable on hospital arrival. While southbound lanes blocked by truck and pedestrian, traffic rerouted by police into northbound lanes. No fires, explosions, environmental problems, or debris.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell Explanation

Accident Causation

Primary or Principle Cause

1 Young pedestrian darted into street in front of truck. (Definite)

Relevant Conditions

1 Pedestrian hurrying to Cub Scout Hike, inattentive to traffic when crossing road. (Definite)

Matrix Cell

Explanation

Relevant Conditions (continued)

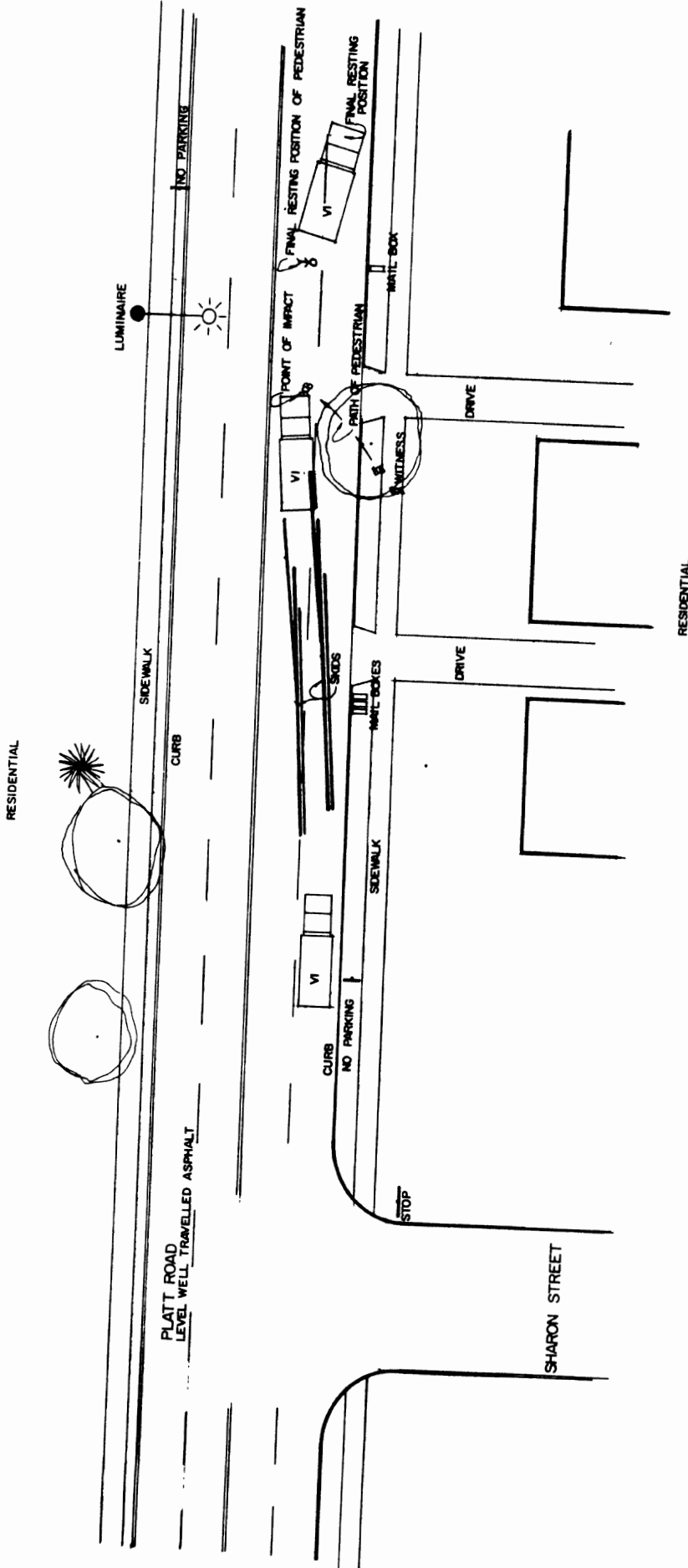
- | | |
|---|--|
| 1 | Driver possibly shaken having just witnessed a near intersection accident and experienced a near collision when passenger car pulled out of side street directly in front of him. (Possible) |
| 7 | Neighborhood, united into one school district, divided by major roadway; this is incompatible with pedestrian traffic. (Definite) |

Postcrash Factors

- | | |
|----|--|
| *3 | Appropriate treatment given on-scene. (Definite) |
| 3 | Ambulance didn't arrive for 20 minutes. (Definite) |

Recommendations

- | | |
|---|---|
| 1 | Intensify pedestrian safety education in elementary schools. |
| 9 | City of Ann Arbor should implement study of major roadways dividing residential areas; split neighborhoods and school districts encourage pedestrian crossing, marked cross-walk areas impede traffic flow as does double loading (houses and/or commercial areas along major thoroughfares). |



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ACCIDENT SCHEMATIC

AA 339



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-340
CASE SUMMARY

Identification

Accident occurred on Huron Parkway which runs through golf course in residential area of city of Ann Arbor, Washtenaw County, Michigan, on Monday, February 12, 1973 at 1535 hours. Intersection collision involving two passenger cars. Injury severity AIS* code 01, minor.

Ambience

Sunny day; temperature 28^o, relative humidity 69%, wind 12 mph from northeast. Roadway dry.

Highway

Huron Parkway, 5-lane major arterial; each lane 12 feet wide (60-foot roadway); center lane left turn only. No divider. Surface well-traveled asphalt. Road edge 6-inch concrete curbing.** Roadway curved, crowned for drainage, graded +2 $\frac{1}{2}$ ^c to south. No artificial lighting. In quarter-mile radius: one driveway, two intersections, 50 trees. Washtenaw County accident data indicated an above average total of 35 accidents at or within six-tenths of a mile of this accident site over a 4 $\frac{1}{2}$ -year period--seven accidents on East Huron River Drive at Huron Parkway, and 28 accidents on Huron Parkway at East Huron River Drive. Twenty-three accidents involved two vehicles, 10 a single vehicle, and two three vehicles. The most frequent configurations are rear end (13) and out-of-control (9) collisions, but there were also four right angle, four sideswipe, three head-on, one rollover, and one fixed-object collisions.

Traffic Controls

Speed limit posted 35 mph. Intermittent white lane delineators, solid yellow left turn lane delineation; visibility good. No parking on parkway sign, conformed to standard. No signals at this intersection.

Vehicles

Vehicle 1, passenger car, 1970 Ford Maverick 2-door sedan; odometer 27,073; red exterior, black interior. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission; no power accessories; padding on upper instrument panel, sunvisors, armrests. Lap belts and upper

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch high curbs standard in city of Ann Arbor, Michigan.

torso restraints available. No vehicle defects observed. Maintenance at 26,114 miles on December 19, 1972, included oil change, lubrication, oil filter, air filter, positive crank case ventilation valve; differential, battery, and master cylinder checked. Damage: 14 inches of sheet metal, crush, damage to right front corner including fender, hood, grill, and bumper. VDI*:01-FZEW-2.

Vehicle 2, passenger car. 1972 Buick Le Sabre, 4-door hardtop; odometer 10,284 miles; seafoam green exterior and interior, darker green vinyl top. No indication of vehicle inspection. Automatic transmission; power brakes and power steering; padded components included upper instrument panel, sunvisors, and armrests, very light padding on doors. Lap belts and upper torso restraints available. No vehicle defects observed. Maintenance on October 11, 1972 at 7,613 miles included oil change, lubrication, oil filter and check on transmission, differential and air filter. Damage to left front fender near wheel, 10 inches of sheet metal crush. VDI:10-LFMW-2.

Occupants

Driver 1, female, Caucasian, 22 years old, 63 inches and 123 pounds. Driving 6 years averaging 13,000 miles yearly. Driving home from classes at The University of Michigan, $4\frac{1}{2}$ miles from origin, 1 mile from destination. Vehicle 1 owned by father, Driver 1 had driven it 27,000 miles in two years. Familiar with area, traveled weekly. Completed high school driver education course. Physical and mental condition good. No blood alcohol. Available lap and upper torso restraints not worn. Injuries: small laceration left side of chin, contusions both knees. Injury severity AIS code 01, minor.

Driver 2, 58 years old, female, Caucasian, 64 inches and 165 pounds. Forty years driving experience, averaged 5,000 miles yearly. Driving to car wash from bridge game in Ypsilanti; 7 miles from origin, 1 mile from destination. Familiar with vehicle, had driven it one year; familiar with area, drove it regularly. Completed commercial driver education course. Physical and mental condition good. No alcohol involved. Available lap belt and upper torso restraint not worn. Injuries: chest pain, lateral pain across shoulders, swelling left side of head, pain back of left calf. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standard (MVPS) was specifically relevant to this case study.

MVPS #201	Occupant Protection in Interior Impact-- Passenger Cars. Light padding on door in Vehicle 2 slightly minimized injuries to Driver 2; Vehicle 1 had hard plastic tray under instrument panel which is potentially injury-producing when struck in a collision.
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* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Description

Precrash: Vehicle 1 northbound in inside lane of Huron Parkway at maximum possible speed of 36 mph as indicated by skid marks. Driver 2 entered northbound lane from eastbound Huron River Drive, intending to turn left onto southbound Huron Parkway. Driver 2 came to rolling stop according to Driver 1, and although she saw Vehicle 1 approaching, failed to yield right-of-way. Driver 1 saw Vehicle 2 entering her lane and braked hard. Driver 2's failing to yield violation of traffic law. Vehicle 1 left 62 feet of skid marks with right and left front wheels.

Crash: Impact speed for Vehicle 1 was 10 mph; for Vehicle 2, 5 mph. Right front fender area of Vehicle 1 struck left front side of Vehicle 2; Vehicle 1 rotated counterclockwise about 10° and went forward about 7 feet after impact; Vehicle 2 rotated clockwise 10-15° and went forward 3 feet. Driver 1 thrown forward, received small laceration left side of chin from steering wheel and contusions to both knees from striking instrument panel. Driver 2 went forward and to the left, sustained chest pain from steering wheel, bump left side of head from hitting window or A-pillar, and lateral pain across shoulders and pain back of left calf from impacting door. Vehicle 1 had damage to right front corner including fender, hood, grill, and bumper, and 14 inches of sheet metal crush. Vehicle 2 sustained damage to left front fender near wheel and had 10 inches of sheet metal crush. Directions of force 1:00 o'clock to Vehicle 1, 10:00 o'clock to Vehicle 2.

Postcrash Witness to accident telephoned police. Driver 1 sat in car couple of minutes, then exited unassisted. Police, ambulance, and fire truck arrived on-scene from 5 to 10 minutes postcrash. Driver 2 was described as hysterical postcrash. She remained in the vehicle, thrashed about, and resisted assistance of medical personnel attempting to place her on backboard. Twenty minutes postcrash Driver 2 was transported to the hospital on a backboard. Driver 1 refused medical assistance for her minor injuries. No fire, explosions, or environmental problems. Only debris little plastic grillwork and pieces of headlight glass from Vehicle 1. Traffic stopped for 25 minutes, backed up to crest of hill creating potentially hazardous situation. Witness directed traffic. Scene cleared five minutes after Driver 2 removed from her car.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- | | |
|---|--|
| 1 | Driver 2 entered thoroughfare without yielding right-of-way. (Definite) |
| 1 | Driver 2 did not come to complete stop at stop sign, which reduced information-processing and decision-making time. (Probable) |

Relevant Condition

- | | |
|---|--|
| 1 | Driver 2 under stress which affected driving judgement. (Possible) |
|---|--|

Injury Causation

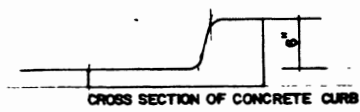
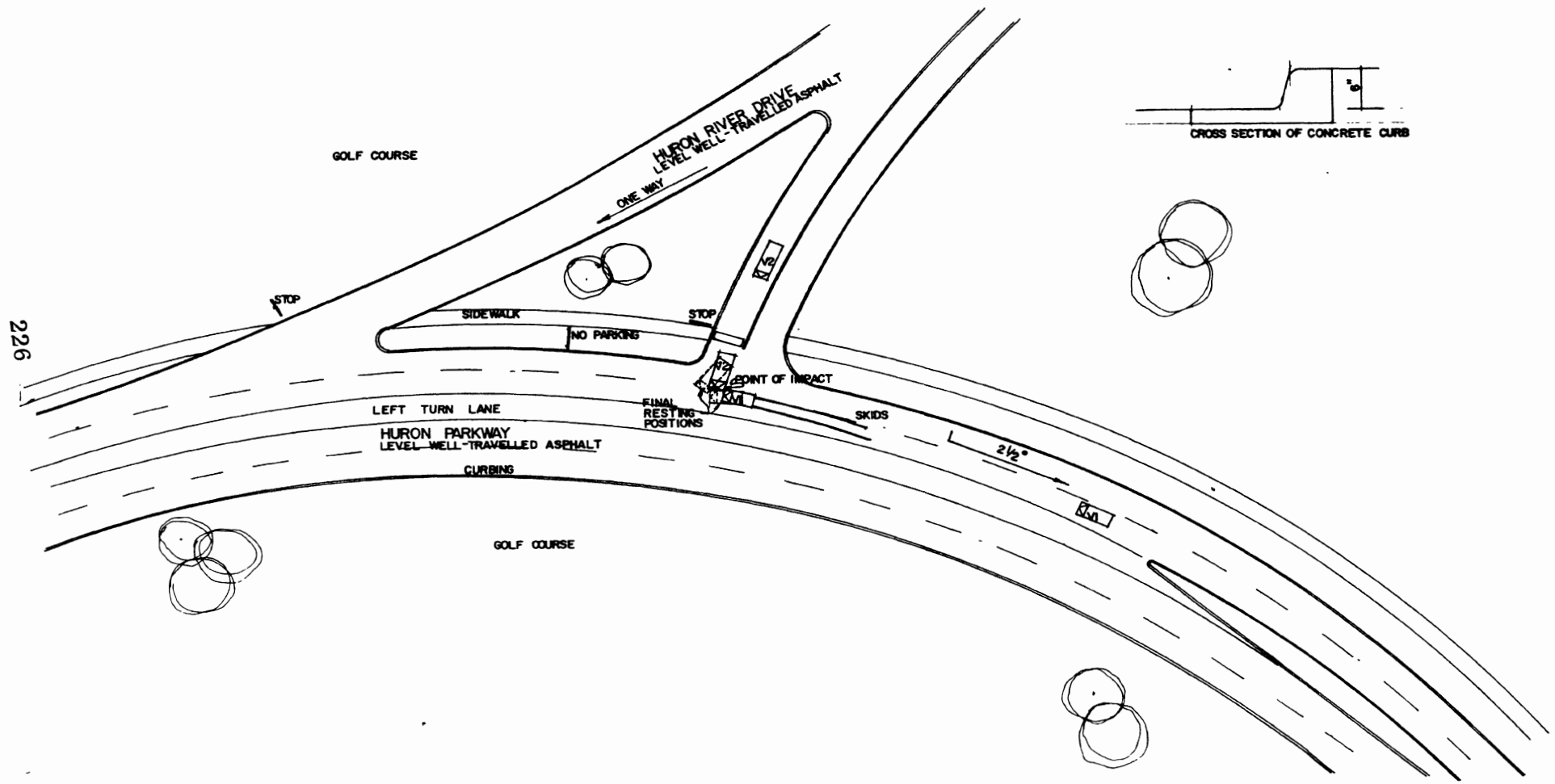
- | | |
|----|---|
| *5 | Padding on door of Venicle 2 minimized injury to Driver 2. (Probable) |
|----|---|

Postcrash Factors

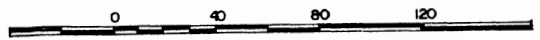
- | | |
|----|---|
| 3 | Hysteria of Driver 2 delayed postcrash scene clearance. (Definite) |
| *3 | Ambulance attendants and others trying to assist remained calm in face of Driver 2's panic behavior. (Definite) |

Recommendations

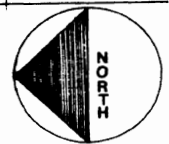
- | | |
|---|--|
| 1 | Drivers should be made aware of danger of making rolling stops at intersections as this decreases information-processing and decision-making time. |
|---|--|



ACCIDENT SCHEMATIC AA 340



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-341
CASE SUMMARY

Identification

Accident occurred on Prairie Street at intersection with Renfrew Street in residential/school zone area in city of Ann Arbor, Washtenaw County, Michigan on Tuesday, February 13, 1973 at 1534 hours. Passenger car struck young pedestrian. Injury severity AIS* code 03, severe, not life-threatening.

Ambience

Clear and sunny afternoon; temperature 35^o, relative humidity 50%, wind 11 mph from northeast. Roadway dry.

Highway

Prairie Street is local roadway, 33 feet wide, two lanes, no divider. Surface well-traveled asphalt. Road edge six-inch concrete curbing.** Roadway straight, crowned for drainage, graded -1^o to the north. Intersects with Renfrew Street at accident site. One mercury vapor luminaire over intersection. Within quarter mile radius: 15 driveways, 2 intersections, 10 utility poles and 10 trees on both Prairie Street and Renfrew Street. Only one accident at the intersection of Renfrew Street with Prairie Street was found in the 4½-year Washtenaw County accident data base. This was a single vehicle, property damage accident which occurred on Renfrew Street 600 feet west of the intersection. The car was moving backwards and had a right-angle collision with a fixed object.

Traffic Controls

Speed limit posted 25 mph. No pavement markings or signals at intersection. "Slow Children" sign on Prairie Street, "Yield" signs on Renfrew Street of new design, no longer black lettering on a yellow background; changed to reflective red lettering with a red border on a white background.

Vehicle

Passenger car, 1971 Buick Electra 225, 4-door hardtop; metallic brown exterior, white vinyl top, tan interior; odometer 19,425 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission; power brakes and power steering; padding on upper instrument panel, armrests, sunvisors, and seat backs. No vehicle defects observed. No recorded

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch high curbs are standard in city of Ann Arbor, Michigan.

maintenance. No vehicle damage. Fairly blunt design of vehicle prevented piercing wound to pedestrian. VDI*:12-FRMN-0.

Occupants/Pedestrian

Driver, 48 years old, female, Caucasian, 67 inches and 150 pounds. Driving for 20 years, averaged 4,000 miles per year. Traveling from picking up carload of children at elementary school to home; two blocks from origin, one mile from destination. Familiar with vehicle; familiar with area because picked up children twice a week. No driver education. Physical condition good; overall mental condition good, hurried on day of accident. Breathalyzer test administered, negative BAC. Driver unrestrained. No injury.

Center front passenger, 6 years old, female, Caucasian, 48 inches and 60 pounds. Unrestrained. No injury.

Right front passenger, 6 years old, female, Caucasian, 47 inches and 50 pounds. Unrestrained. No injury.

Right rear passenger, 7 years old, female, Caucasian, 47 inches and 55 pounds. Unrestrained. No injury.

Left center rear passenger, 8 years old, female, Caucasian, 50 inches and 62 pounds. Unrestrained. No injury.

Right center rear passenger, 6 years old, male, Caucasian; 42 inches and 50 pounds. Unrestrained. No injury.

Right rear passenger, 9 years old, female, Caucasian, 52 inches and 65 pounds. Unrestrained. No injury.

Pedestrian, 6 years old, male, Caucasian, 48 inches and 55 pounds. Walking from school to home; 2 blocks from origin, 3 blocks from destination. Familiar with area as walked to and from school daily. Injuries: displaced fracture midshaft left femur, contusions and abrasions to face and upper lip, abrasions right knee, pain left hip and pelvis. Injury severity AIS code 03, severe, not life-threatening.

Standards

The following Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|----------|--|
| TSPS #4 | Driver Education. Driver education courses should caution drivers to be especially alert in school zones where child pedestrians are crossing streets. |
| TSPS #14 | Pedestrian Safety. Safe pedestrian behavior should be emphasized, beginning with small children and continuing in elementary school safety programs. |

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Description

Precrash: Vehicle 1 northbound on Prairie Street at 20 mph. Driver saw group of school children standing on northeast corner of Prairie-Renfrew intersection. Some standing in street so driver steered to left and slowed to about 5 mph. Young pedestrian suddenly darted into street in front of car. No violations; no skids or scuffs.

Crash: Right front corner of vehicle hit pedestrian and knocked him down. Vehicle 1 came to a final rest three feet from point of impact. Occupants of vehicle uninjured. Pedestrian sustained displaced fracture midshaft left femur and pain left hip and pelvis from vehicle impact; contusions and abrasions face and upper lip, and abrasions right knee from contact with pavement. Injury severity AIS code 03, severe, not life-threatening. No vehicle damage. Direction of force to vehicle 12:00 o'clock.

Postcrash: Passerby stopped and covered up pedestrian while Driver 1 called police. Second passerby stopped and tried to calm down pedestrian. Children in case vehicle taken home by another mother. Fire rescue truck, police, and ambulance arrived within five minutes; applied air splint to pedestrian's fractured leg and transported him to hospital on backboard. Driver 1 nervous and upset on-scene. Little traffic so no traffic controls needed. Driver 1 taken to police station for breathalyzer test; results negative (.00 BAC).

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Pedestrian darted into street without observing car. (Definite)
- 1 Driver 1 did not observe pedestrian's sudden movements in time to avoid hitting him. (Definite)

Matrix Cell

Explanation

Relevant Conditions

- | | |
|---|---|
| 1 | Driver 1 distracted by six young passengers.
(Possible) |
| 1 | Driver 1 less attentive than usual to driving task because hurried and under stress.
(Possible) |
| 7 | No sidewalk at northeast corner of intersection of Prairie Street and Renfrew Street.
(Definite) |

Injury Causation

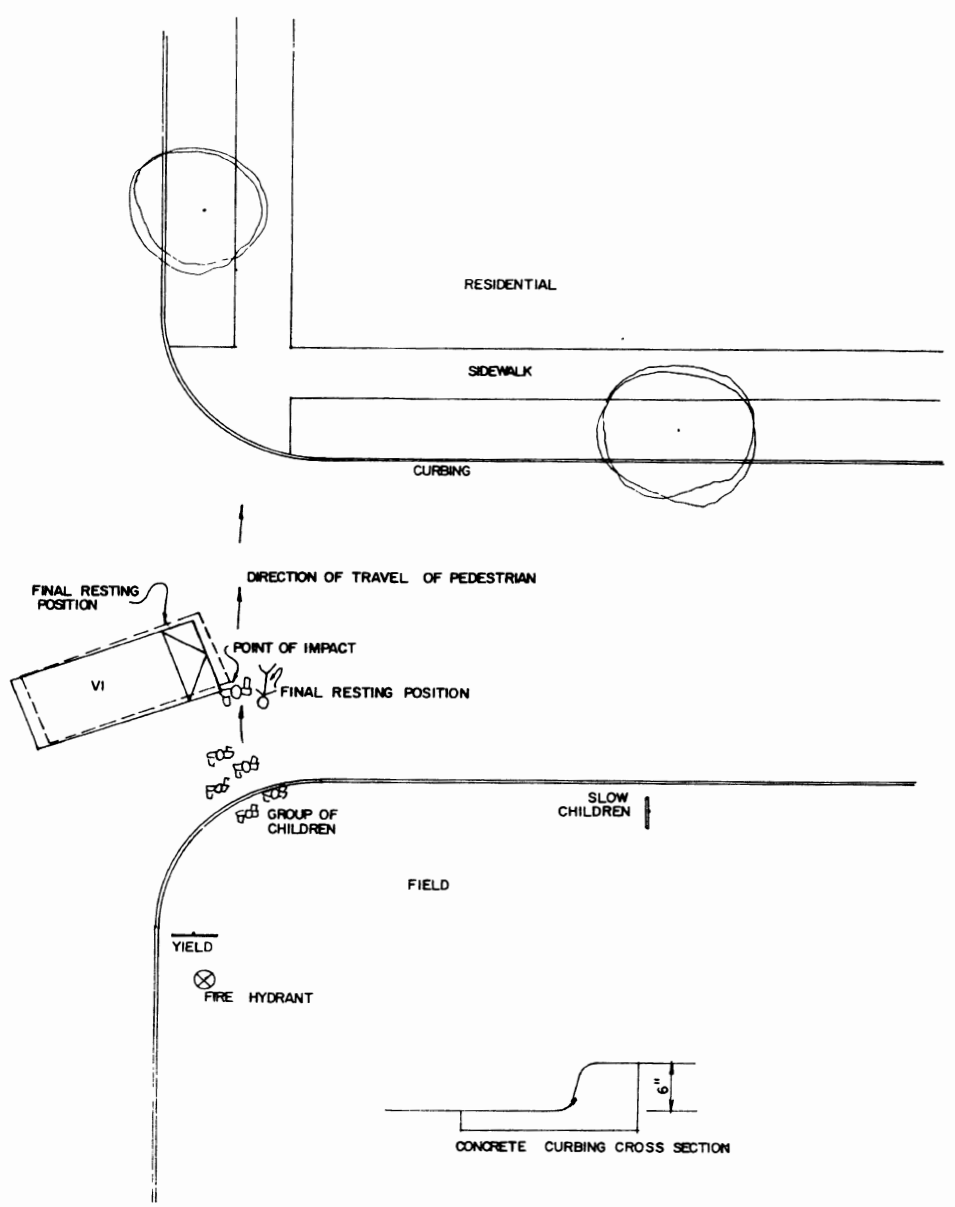
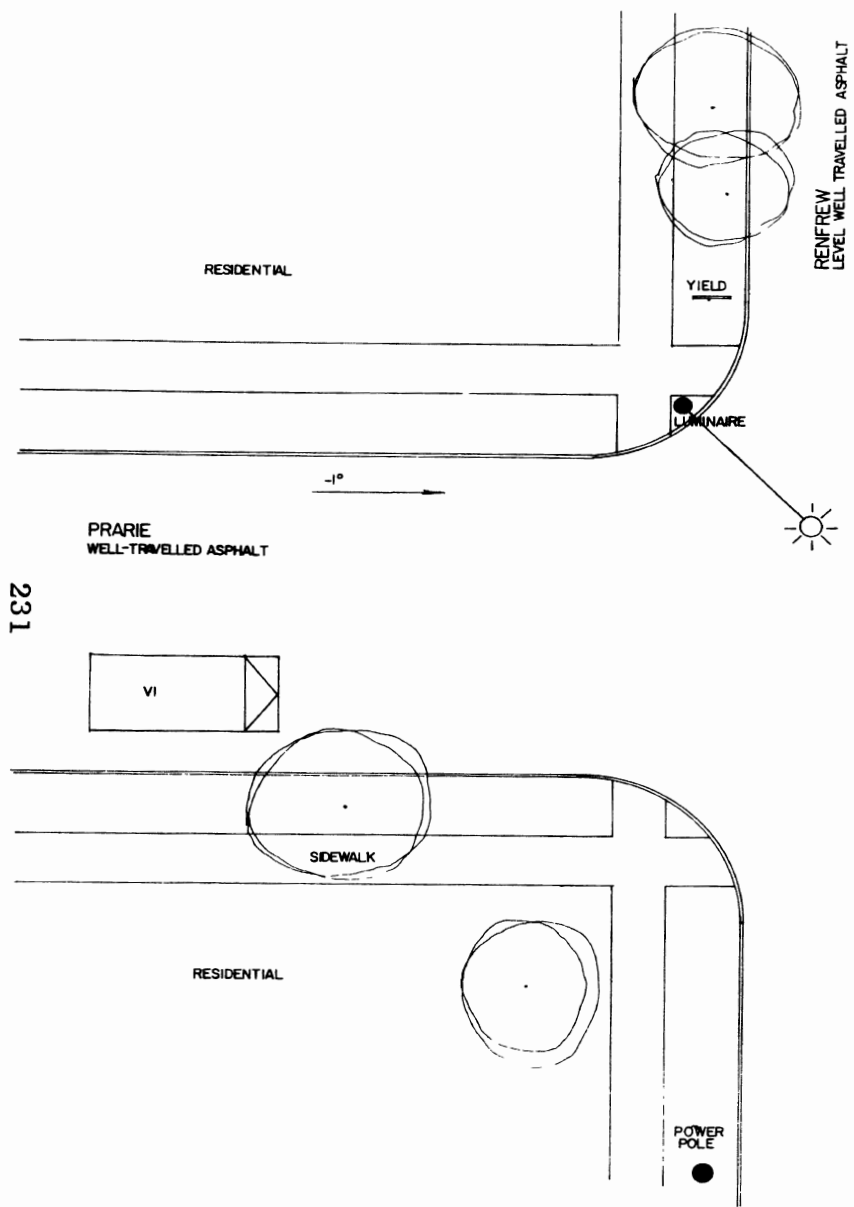
- | | |
|----|--|
| *5 | Blunt vehicle design prevented piercing injury to pedestrian. (Definite) |
|----|--|

Postcrash Factor

- | | |
|----|---|
| *3 | Appropriate assistance by passerby (covered pedestrian, talked to him, tried to calm him). (Definite) |
|----|---|

Recommendations

- | | |
|---|--|
| 1 | Drivers should be reminded that, when driving in school zone, they must anticipate sudden movements of children into street. |
| 1 | Safe pedestrian behavior should be emphasized, beginning with small children and continued in elementary school safety programs. |



ACCIDENT SCHEMATIC AA341

0 10 20 30

UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-342
CASE SUMMARY

Identification

Accident occurred on Plymouth Road at intersection with restaurant-motel driveway in commercial area of city of Ann Arbor, Washtenaw County, Michigan on Friday, February 16, 1973 at 1245 hours. Passenger car side impacted passenger car. Injury severity AIS* code 01, minor.

Ambience

Daytime, clear; temperature 14^o, relative humidity 56%, wind 11 mph from north-northwest. Roadway wet and snowy; inside lanes snow-covered.

Highway

Plymouth Road 61-foot-wide major arterial; five lanes at point of impact--four lanes plus eastbound right turn lane, just changed from four lanes with center lane for left turn only. No divider. Surface well-traveled asphalt. North road edge 8-foot-wide gravel shoulder; south edge 6-inch-high concrete curbs.** Roadway straight, level, and crowned for drainage. No artificial lighting. Within quarter mile radius: 5 driveways, one intersection, one interchange, 5 utility poles, and 15 trees. The Plymouth Road/Green Road intersection has a history of 53 accidents in a 4½-year period. Ten of these accidents occurred on Plymouth Road 75 feet to seven-tenths of a mile east of the Green Road intersection, the area which includes the location of this case accident. Nine of the ten accidents were two-vehicle collisions, one involved four vehicles. The configuration categories were: five rear-end, four right angle, and one head-on.

Traffic Controls

Speed limit posted at 45 mph. Intermittent white lane delineators, solid yellow channeling lines; visibility worn. Direction signs. "Begin Center Lane For Left Turn Only." "Stop," "One Way." No signals involved.

Vehicles

Vehicle 1, station wagon, 1972 Chevrolet Vega Kamback; odometer 15,209 miles; cinnamon brown exterior, saddle brown interior. No indication of vehicle inspection (periodic motor vehicle inspection

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs standard in city of Ann Arbor, Michigan.

not required in Michigan). Manual transmission, no power accessories. Padding on upper instrument panel and armrests; sunvisors vinyl-covered cardboard. No vehicle defects observed. Last maintenance, at 14,772 miles on February 2, 1973, included oil change, lubrication, and oil filter. Frontal damage to bumper, fenders, and grill; seven inches of sheet metal crush. VDI*:12-FDEW-01.

Vehicle 2, passenger car, 1971 Ford Maverick, 2-door sedan; bronze exterior with black vinyl top, black interior; odometer 36,296 miles. No indication of vehicle inspection. Automatic transmission; power steering; padded upper instrument panel, armrests, and sunvisors. Uneven tire pressure; left rear wheel was 13 inches, all others were 14 inches. Car didn't appear to be well-maintained; last recorded maintenance, at 17,292 miles on February 16, 1972, included oil change, oil and air filters, power steering and battery checked, wheel bearings greased. Damage to left side included front fender, door, and A-pillar; nine inches of sheet metal crush. VDI:09-LYMW-02.

Occupants

Driver 1, 29 years old, female, Caucasian, 65½ inches and 116 pounds. Driving 14 years, averaging 15,000 miles per year. Going home after classes at The University of Michigan; 3 miles from origin, 12 miles from destination. Had accumulated 15,000 miles on car; familiar with roadway which she traveled about once a week. High school driver education course. Good physical and mental condition. No alcohol involved. Unrestrained. Injuries: soreness on either side of neck running vertically down shoulders, soreness to both legs, contusions on both knees. Injury severity AIS code 01, minor.

Driver 2, 21 years old, female, Black, 65 inches and 125 pounds. Four-years driving experience averaging 15,000 miles per year. Driving home after job interview at Win Schuler's Restaurant; 1/8 mile from origin, 3 miles from destination. Familiar with car having driven it 36,000 miles in two years; not very familiar with roadway, last traveled two weeks earlier. Driver education course in high school. Good physical and mental condition; no blood alcohol. Unrestrained. Injuries: pain upper left area of thorax, contusion left hip, pain left pelvic area, left upper arm sore, pinched nerve above left elbow, pain medial aspect left ankle, slight whiplash, pain left side of head. Injury severity AIS code 01, minor.

Vehicle 2, right front passenger, 19 years old, female, Black, 66 inches and 125 pounds. Unrestrained. Injuries: pain lateral aspect left upper arm, pain and contusions left upper area of thorax and left hip. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were especially relevant to this case.

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

- MVPS #201 Occupant Protection in Interior Impact-- Passenger Cars. Driver 1 sustained knee contusions from unpadding lower instrument panel; Driver 2 had contusions from unpadding door.
- MVPS #205 Glazing Materials--Passenger Cars, Multipurpose Passenger Vehicles, Motorcycles, Trucks, and Buses. Driver 1 struck and cracked windshield; glazing material prevented glass from breaking into jagged pieces.
- TSPS #4 Driver Education. Driver 2 did not check for clearance before entering roadway. Driver 1 made improper evasive maneuver. Use of seat belts would have minimized injury to occupants of Vehicle 1 and Vehicle 2.
- TSPS #12 Highway Design, Construction, and Maintenance. Improperly placed freeway direction sign obstructed Driver 2's vision; geometry of roadway design confusing.

Description

Pre-crash: Vehicle 1 eastbound in inside lane of Plymouth Road at 25 mph; Vehicle 2 northwestbound, stopped to make left-hand turn, straddling inside east and westbound lanes. When Driver 1 saw Driver 2 pull out of driveway, she changed to inside lane, braked, and skidded on snow-covered roadway. Driver 2 did not see Vehicle 1 pre-crash so made no evasive maneuvers. Driver 2's failure to yield right of way violation of traffic law, no citation issued. No pre-crash skids or scuffs.

Crash: At impact speed of 10 mph, front end of Vehicle 1 struck left side of Vehicle 2. Vehicle 2 rotated clockwise 110°, striking right front of Vehicle 1 and coming to final rest oriented toward northeast. Vehicle 1 moved forward about 5 feet, came to final rest oriented eastward. Vehicle 1 sustained frontal damage to bumper, fenders, and grill, and seven inches of sheet metal crush. Vehicle 2 had left side damage to front fender, door, and A-pillar, and had nine inches of sheet metal crush. Driver 1 was thrown forward and hit the windshield with the top of her head; she was wearing a wig which may have reduced head injury. She stiffened her legs on the brake and clutch, and impacted the instrument panel with her knees. She had soreness on either side of her neck running vertically down shoulders, soreness to both legs, and contusions on both knees. Driver 2 thrown left and forward, impacted door and window frame or A-pillar, and sustained pain in upper left area of thorax, contusion left hip, pain left pelvic area, soreness left upper arm, pinched nerve above left elbow, pain medial aspect left ankle, slight whiplash, and pain left side of head. Vehicle 2 right front passenger thrown left against driver, steering wheel, and instrument panel, and suffered pain lateral aspect of left upper arm, and pain and contusions upper left area of thorax and left hip. Directions of force 12:00 o'clock to Vehicle 1, 9:00 o'clock to Vehicle 2.

Postcrash: Passerby stopped, checked on vehicle occupants and told them to stay in their cars, then called police and ambulance. Passing nurse also stopped and checked vehicle occupants. Police and ambulance arrived in 3-5 minutes; occupants checked, backboarded, and transported to hospital. No fires, explosions, or environmental problems. Only debris grill pieces from Vehicle 1. No traffic controls needed as sufficient lanes open for traffic flow.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver 2 pulled onto roadway to make left-hand turn when vehicle approaching. (Definite)
- 1 Driver 1 chose to pull left into inside lane when she saw Vehicle 2 pull out. (Definite)

Relevant Conditions

- 1 Driver 1 assumed snow-covered inside lane was center left turn lane rather than a traffic lane. (Definite)
- 1 Driver 1 locked brakes, causing loss of control, and skidded. (Definite)
- 1 Driver 2 unfamiliar with roadway. (Definite)
- 7 Confusing geometry of roadway caused Driver 1 to assume inside lane was center left turn lane. (Definite)
- 7 Snow covering inside lane reduced coefficient of friction. (Definite)

Injury Causation

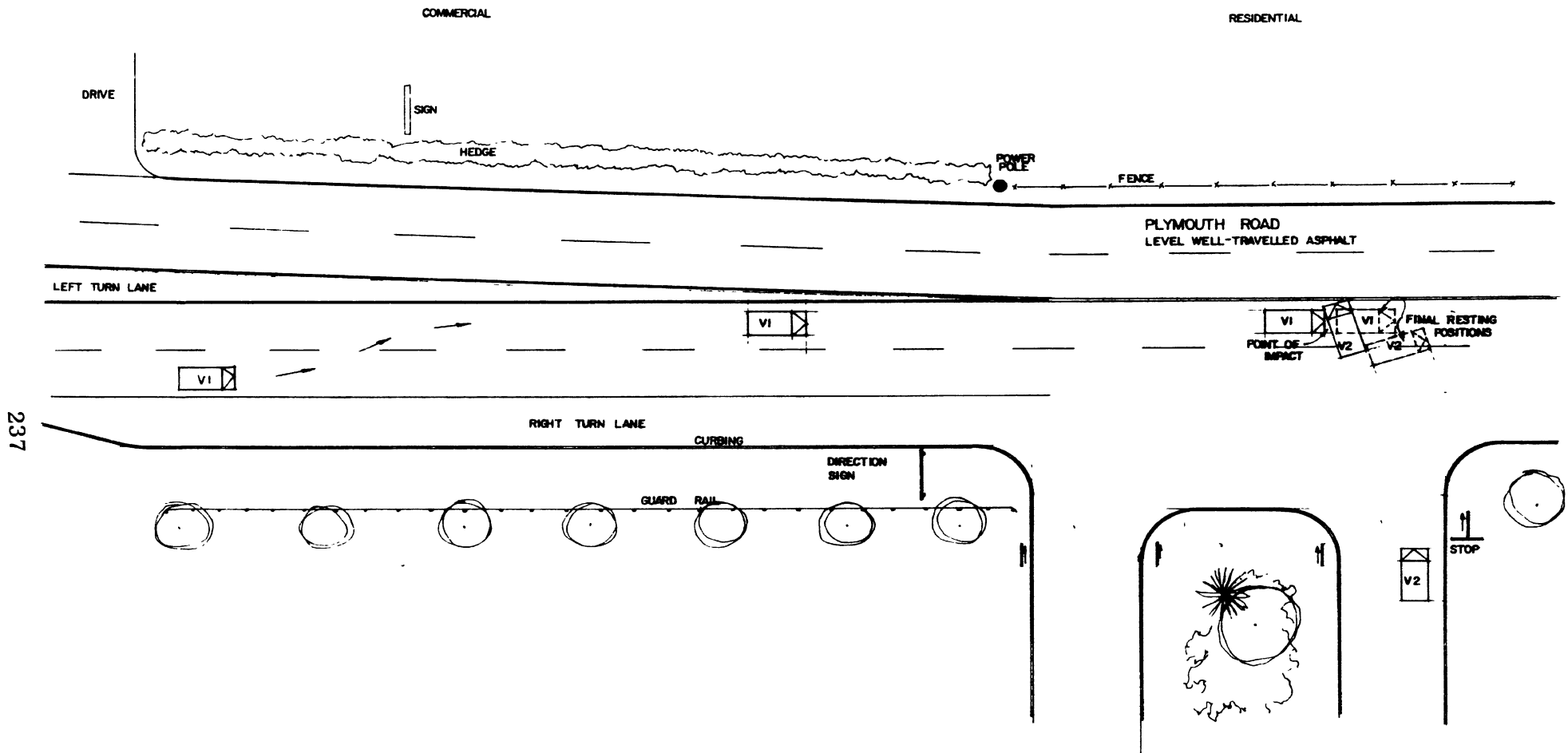
- 2 Injuries to Vehicle 1 and Vehicle 2 occupants would have been minimized had they been restrained. (Definite)

Matrix Cell

Explanation

Recommendations

- | | |
|---|--|
| 9 | Reevaluate roadway design; extend center left turn lane further eastward. |
| 1 | Driver education courses should instruct students that it is wrong to pull into center left turn lane and try to merge; also should emphasize defensive driving. Motorists should use restraint systems. |

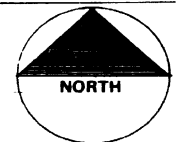


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ACCIDENT SCHEMATIC AA 342



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-343
CASE SUMMARY

Identification

Accident occurred on West Liberty Street in commercial area of city of Ann Arbor, Washtenaw County, Michigan, on Monday, February 26, 1973, at 1000 hours. Passenger car/freight train, side impact. Injury severity AIS*code 01, minor.

Ambience

Overcast morning; temperature 22^o, relative humidity 59%, wind 20 mph from the east. Roadway wet.

Highway

West Liberty Street, 2-lane major arterial; each lane 15 feet wide; no divider. Surface well-traveled, poorly-maintained asphalt. Road edge 6-inch-high concrete curbing.** Roadway at accident site straight level, +2^o grade to the west. One mercury vapor luminaire. Within a quarter-mile radius: two driveways, one intersection, five utility poles, no trees. A 4½-year survey of the Washtenaw County data file indicated no previous accidents at the intersection of West Liberty Street and the Ann Arbor railroad tracks.

Traffic Controls

Speed limit is 25 mph by city ordinance. Solid white center line, visibility worn. "Do Not Stop on Tracks" sign on south side of West Liberty about 35 feet from railroad tracks; "One Way" arrow on southwest corner of intersection with First Street. Two railroad signals composed of crossbuck with "Railroad Crossing" in reflector lights, large, round, flashing red lights, and square sign that reads "Stop on Red Signal"; one located on southwest side of tracks, one on northeast side. At intersection of West Liberty Street with First Street: three-color traffic signals--one which has lights pointing east, west, and north; one which points east only, and one which points north only; hanging "No Right Turn" sign for West Liberty traffic; and hanging luminaire (see Figure 1).

Vehicles

Vehicle 1, train engine, 1970 GM electro-motive drive engine; black exterior. Freight train composed of two engines and 110 cars.

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs standard in city of Ann Arbor, Michigan.

Traveling from Owasso, Michigan to Toledo, Ohio. Handrail on front of engine bent. VDI*:12-FDMW-0.

Vehicle 2, passenger car, 1972 Plymouth Duster, 2-door sedan; butterscotch exterior, green interior with plaid seats; odometer 23,665 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission; power brakes and power steering; padding on upper instrument panel, armrests, and sunvisors. Lap belts and upper torso restraints available. No vehicle defects observed; maintenance unknown. Extensive damage; left side: left hood hinge bent; upper and lower A-pillar damaged, upper partially separated; upper and lower B-pillar and C-pillar totally separated; door latch damaged, striker pulled from latch because of B-pillar damage; lower door hinge separated; rear: fuel leakage present because filler neck pulled from junction with fuel tank; both trunk hinges bent; trunk passenger compartment partition bent; right side: upper A-pillar damaged and totally separated; upper B-pillar damaged and partially separated, lower B-pillar damaged; upper and lower C-pillar damaged; door latch damaged and non-functional; roof: right and left roof side rails buckled; backlight header bent slightly; windshield header severely buckled up near driver area; interior: steering wheel severely bent (induced from exterior damage); steering wheel spoke broken; 3/4-inch shear capsule separation; floorpan deformed; upper instrument panel damaged by right A-pillar; roof right A-pillar, and sunvisor damage induced from exterior damage; rear seat backrest and cushion damaged and loosened; left side interior damaged. VDI: primary 9-LDAW 3, secondary, 03-LFEN-2

Occupants

Vehicle 1, two occupants in locomotive, one an experienced engineer.

Driver 2, 17-year-old Caucasian female, 61 inches and 95 pounds. One year driving experience, accumulated 5,000 miles. Traveling from home to school; 3 miles from origin, 4 miles from destination. Familiar with vehicle; traveled area daily. Completed high school driver education course. Physical and mental condition good. No alcohol involved. Restraints not worn. Injuries: 1/2-inch laceration left side of chin; abrasion and contusion left elbow; abrasion left knee; lacerations backs of hands, especially right hand; low back pain; momentary loss of consciousness. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standard (TSPS) are specifically relevant to this case.

* Vehicle Deformation Index (VDI). in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

- MVPS #206 Door Locks and Door Retention Components-- Passenger Cars and Multipurpose Passenger Vehicles. Left door of Vehicle 2 opened as result of crash, allowing potential for driver ejection; however, forces of crash far exceeded those of standard's compliance tests.
- MVPS #214 Side Door Strength--Passenger Cars. Vehicle 2 prestandard and not equipped with side guard door beam; presence of side guard door beam may have lessened vehicle deformation.
- MVPS #301 Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. Fuel leakage present because filler neck pulled from junction with fuel tank.
- TSPS #4 Driver Education. Drivers should be cautioned about need to be extra careful at train crossings; should be educated to wear restraint systems.
- TSPS #12 Highway Design, Construction, and Maintenance. Railroad crossing in busy urban area and adjacent to intersection of two major arterials.

Description

Pre-crash: Vehicle 1 southeastbound on train tracks at 10 mph; Vehicle 2 eastbound on West Liberty Street at 30 mph. Engineer saw Vehicle 2, blew whistle, and braked moments prior to impact. Driver 2 did not see train. Driver 2 violated traffic law by disregarding railroad signals. No skids or scuffs.

Crash: Front of Vehicle 1 struck left side of Vehicle 2, Vehicle 2 dragged 165 feet down tracks by train; right front corner of Vehicle 2 struck railroad signal pole erected for traffic southbound on First Street. Vehicle 2 came to final rest heading east on First Street on north side of tracks. Driver 2 thrown left against door on initial impact with train, struck roof headlining with head. She was jolted to the right with pole impact. Sustained ½-inch laceration on left side of chin from either glass or window frame, abrasion and contusion left elbow from interior surface of door, abrasion left knee from instrument panel, superficial lacerations on back of hands from broken side window glass, and low back pain from impact force. Handrail on front of engine bent. Vehicle 2 extensively damaged; left side: left hood hinge bent; upper and lower A-pillar damaged, upper partially separated; upper and lower B-pillar and C-pillar totally separated; door latch damaged; striker pulled from latch because of B-pillar damage; lower door hinge separated; rear: fuel leakage present because filler neck pulled from junction with fuel tank; both trunk hinges bent; trunk passenger compartment partition bent; right side: upper A-pillar damaged and totally separated; upper B-pillar damaged and partially separated; lower B-pillar damaged; upper and lower C-pillar damaged; door

latch damaged and nonfunctional; roof: right and left roof side rails buckled; backlight header bent slightly; windshield header severely buckled up near driver area; interior: steering wheel severely bent (induced from exterior damage); steering wheel spoke broken; 3/4-inch shear capsule separation; floorpan deformed; upper instrument panel damaged by right A-pillar; roof, right A-pillar, and sunvisor damage induced from exterior damage; rear seat backrest and cushion damaged and loosened; left side interior damaged. Directions of force 9:00 o'clock for Vehicle 1, 3:00 o'clock for Vehicle 2.

Postcrash; Observer helped Driver 2 out of car because he smelled gas and feared fire. Driver 2 remained standing with support of bystanders. felt dizzy and faint. Observer called police who arrived in three minutes. ambulance arrived in five minutes. Driver 2 placed on backboard. check for vital signs and neurological damage made in ambulance en route to hospital. No fire, explosions, or environmental problems. Only debris some trim pieces from Vehicle 2. Train blocked roadway so traffic prevented from going west on Liberty Street beyond First Street intersection, and from going south on First Street.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Pre-crash	Crash	Post-crash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell Explanation

Accident Causation

Primary or Principle Cause

1 Driver 2 did not perceive railroad signal's warning of approaching train. (Definite)

Relevant Conditions

1 Driver 1 distracted by traffic signal at intersection and by surrounding traffic. (Probable)

1 Radio in Vehicle 2 masked sound of warning bell and possibly distracted driver. (Definite)

Matrix Cell

Explanation

Relevant Conditions (continued)

- 7 Environmental overload--railroad crossing, near city central business district, only 65 feet from busy intersection. (Definite)
- 5 Left door of Vehicle 2 opened as result of crash and allowed potential for driver ejection. (Definite)

Injury Causation

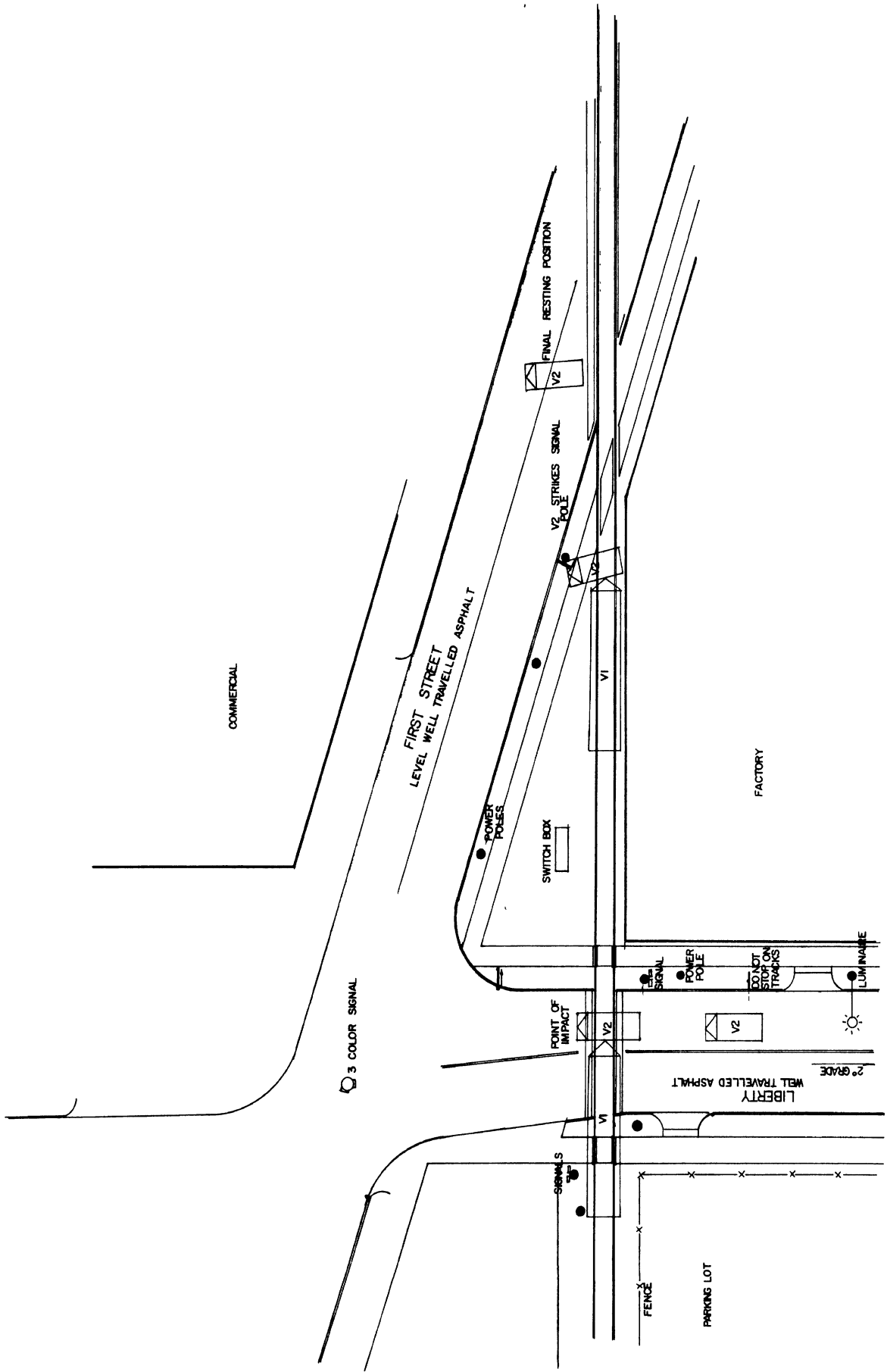
- 2 Driver 2 unrestrained; restraint system would have decreased possibility of being ejected out open door, but would not have influenced injuries. (Probable)

Postcrash Factors

- *3 Driver 2 removed from vehicle because of fire danger. (Definite)
- 3 Proper precautions not taken in extricating driver; bystanders should have had her lie down. (Definite)
- 6 Left quarter panel damage precipitated fuel filler pipe being separated from fuel tank. (Definite)

Recommendations

- 7 Railroad warning signing should be increased when close to signalized intersection and in other areas that place heavy demands on driver attention.
- 1 Driver education courses should emphasize the need to be alert at railroad crossings, and should encourage practice of using restraint systems.
- 7 Possibility of adding railroad gates should be considered.



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UNIVERSITY OF MICHIGAN HSRI

ACCIDENT SCHEMATIC AA 343



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-344
CASE SUMMARY

Identification

Accident occurred on southbound Huron Parkway, an open undeveloped area of Ann Arbor, Washtenaw County, Michigan, on Monday, March 26, 1973 at 1300 hours. Sub-compact passenger car, out of control, left roadway. Injury severity AIS* code 01, minor.

Ambience

Daylight, partly sunny, overcast; temperature 22^o, relative humidity 59%, wind 20 mph from east. Roadway dry and cleared of snow.

Highway

Huron Parkway is a major arterial city parkway; four lanes, two northbound and two southbound, each lane 12 feet wide. Each pair of lanes separated by grass median divider, which is 58 feet wide at accident site. Surface well-traveled, well-maintained asphalt, bordered by 6-inch-high curbing**, crowned for drainage, and contour curved into landscape. Section at accident site is straight, $-\frac{1}{2}^{\circ}$ slope to south. No artificial lighting, no driveways, and only one intersection within a quarter mile radius. No poles and no trees within right-of-way, but heavily wooded just beyond right-of-way. Parkway average daily traffic (ADT) 7,700 vehicles. A 4 $\frac{1}{2}$ year data base revealed no prior accidents along this stretch of Huron Parkway.

Traffic Controls

Posted speed limit 35 mph. Pavement markings confined to intermittent white line lane delineators. No signals in vicinity. Only traffic sign at accident site is located 25 feet off roadway to right and designates the bicycle path which parallels the roadway on the right (west) side.

Vehicle

1971 Ford Pinto, passenger car, 2-door sub-compact sedan; exterior green. Odometer 26,874 miles. No inspection sticker (vehicle inspection not mandatory in Michigan). No power accessories, automatic transmission. Padded instrument panel, sunvisors, and armrests. Equipped with both lap and upper torso restraints. No defects. Last maintenance at 22,600 miles included lubrication, oil change, filter change, transmission check. Damage to vehicle:

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs standard for city of Ann Arbor, Michigan.

right rear wheel bent, two inches metal crush and dent on left rear side. dent on interior surface of right front door. No significant findings. VDI*:03-UBLN-1 and 06-LBMW-1.

Occupants

Driver 1, 16 years old, Caucasian, female, 67 inches and 135 pounds. High school student. Completed driver education course which included both classroom work and road driving and obtained her driver's license in June 1972. In Michigan, this license is probationary for one year. Driver 1's experience was limited to daily trips to and from high school, shopping trips, and local Ann Arbor driving, except for several trips via expressway to Grand Rapids, about 130 miles to the west. Driver 1 was en route back to high school one mile south of the accident site after having spent lunch hour at home 1½ miles north of the accident site. Familiar with the vehicle which she shared with her brother. Traveled same route daily and was very familiar with it and the surrounding road network. Driver 1 was a normal, healthy, 16 year old, with no known problems, but was in a mild state of anxiety as she drove back to school because she already was late for a 12:58 p.m. class and was speeding an estimated 15 mph over the posted 35 mph speed limit. No alcohol or drug involvement. Her brief driving history reveals no prior accidents or traffic violations. Wearing installed lap belt but not upper torso belt. Injuries: cut on left side of head above hairline, soreness to neck and back muscles, slight dizziness after accident. Injury severity AIS code 01, minor.

Passenger in right front seat, 16 years old, Caucasian, female, 64 inches and 120 pounds. High school student returning to school with driver. Was wearing lap belt but not upper torso restraint. Injuries: contusion on right knee, bruised right elbow, bruise on right side of head, soreness of neck and lower back muscles. Injury severity AIS code 01, minor.

Standards

The following Traffic Safety Program Standard (TSPS) and Motor Vehicle Program Standards (MVPS) were relevant to this case study.

- | | |
|-----------|---|
| TSPS #4 | Driver Education. Driver unconsciously turned left or allowed vehicle to wander left when she looked to right rear in order to see whether she had cleared the car she was passing. |
| MVPS #201 | Occupant Protection in Interior Impact-- Passenger Cars. Vehicle had smooth interior design with appropriately padded surfaces and no projecting appurtenances. |

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

MVPS #208

Seat Belt Installations--Passenger Cars.
Both occupants were wearing the installed
lap belts but not the installed upper
torso restraints.

Description

Pre-crash: At about 1300 hours, Driver 1 speeding southbound on Huron Parkway at about 50 mph in the inside lane, passed an unidentified passenger vehicle which presumably was proceeding at about 35 mph (the posted speed limit) in the outside lane. Driver 1 looked to her right rear to see if she had cleared unidentified vehicle. In so doing, she inadvertently turned her vehicle left or allowed it to wander left off roadway onto grass median divider. Passenger in right front seat shouted a warning. Driver 1 saw Vehicle 1 was heading for a fire hydrant in the center of the median and turned Vehicle 1 to the right, over correcting. Vehicle 1 went out of control, crossed both lanes of traffic while spinning clockwise about 185°, then continued sideways and backwards toward the right curbing. Scuff marks on left side curbing and wheel tracks in snow on median made by left side wheels.

Crash: Vehicle 1 struck right curbing while moving sideways and backwards, left roadway in same manner, crossed a 10 foot snow-covered shoulder and a 6-foot asphalt bicycle path which paralleled roadway, continued up snow-covered grass slope about 45 feet. Then, with left rear wheels and undercarriage, struck and was redirected by large rock, slid rearward down embankment about 10 feet, and finally came to rest 25 feet from roadway. Scuff marks on right side curbing, tracks in snow on right shoulder, and scuffs and scrapings on bicycle path caused by all four tires and studs on rear snow tires. Tracks made by all four wheels in snow, extending up right embankment.

When Vehicle 1 struck right curbing, Driver 1 thrown to left and upward and struck her head against roof rail. Passenger initially thrown to left while restrained by lap belt, then was snapped back to the right whereupon she contacted right door with right elbow, and right roof rail with head. Driver 1 received cut on left side of head above hairline upon impact with roof rail, and neck and back muscle sprain as a result of side whiplash. Passenger received contusion on right knee from right door window crank, bruise on right side of head from right roof rail, bruised elbow from right door sill, neck and lower back muscle sprain from side whiplash. Damage to Vehicle 1: right rear wheel bent, two inches sheet metal crush and dent on rear leftside, dent in right rear door interior surface. Force vector upon impact with curbing 8:00 o'clock, and upon impact with rock 6:00 o'clock.

Post-crash: Both Driver 1 and passenger extricated themselves. Police and ambulance were at accident site in short time in response to call by passing motorist. Driver 1 was taken to hospital, treated for minor injuries, and released. Passenger remained on-scene and described accident to police and investigators. There were no fires, explosions, traffic or environmental problems.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Cause

- 1 Driver 1 lost control of the vehicle resulting in Vehicle 1 leaving roadway to left, returning to roadway, and impacting right side curbing and then impacting a rock up on a slope off the right shoulder. (Definite)

Severity Increasing Factor

- 1 Driver 1 was proceeding at excess rate of speed for roadway. (Definite)

Relevant Conditions

- 1 Driver 1 was inexperienced and lacking in driver skills. (Definite)
- 1 Driver 1 was in a mild state of anxiety because she was late for school, was hurrying, and was not adequately attentive to her driving. (Definite)
- 7 Driver 1 upon seeing the hydrant in the median, assumed she had inadequate recovery area, unaware that the hydrant had a break-away base and was designed to yield upon impact. (Probable)

Injury Causation

- *2 The use of installed lap belt by both Driver 1 and passenger minimized injuries. (Probable)

Matrix Cell

Explanation

2

Failure to use installed upper torso restraints by both Driver 1 and passenger increased injury potential. (Probable)

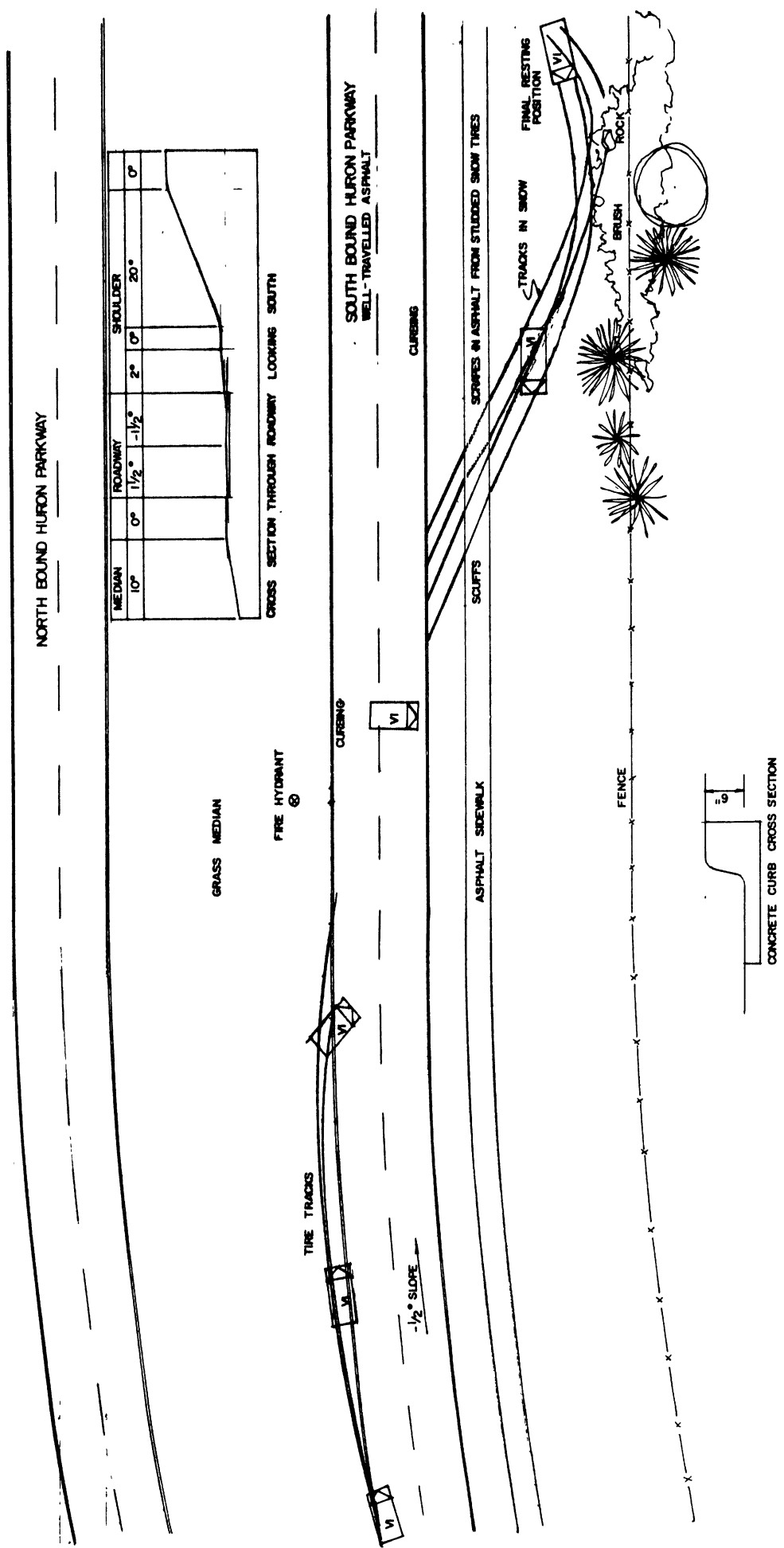
Recommendations

1

Driver education should stress maintaining control of the vehicle when glancing to the right or left rear.

1

Driver education should include practice in maintaining vehicle control in the recovery areas on medians and shoulders.



ACCIDENT SCHEMATIC AA 344



UNIVERSITY OF MICHIGAN HSRI



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-345
CASE SUMMARY

Identification

Accident occurred on Prospect Road, 150 feet from intersection with Cherry Hill Road, in rural residential area of Superior Township, Washtenaw County, Michigan, on Saturday, March 10, 1973 at 0050 hours. Single vehicle forced off roadway. Injury severity AIS* code 02, moderate.

Ambience

Dark; temperature 40⁰, relative humidity 68%, wind 7 mph from the east. Roadway wet.

Highway

Prospect Road 2-lane collector, 24 feet wide, no divider. Surface well-traveled, poorly maintained asphalt; 4-foot-wide gravel shoulders. Roadway level, straight, and crowned for drainage. No artificial lighting. Within quarter mile radius: 1 intersection, 4 driveways, 6 utility poles, 150 trees. In prior 4½ years, only one accident occurred on Prospect Road in the area of the case accident. It involved a single vehicle collision with a fixed object on a rainy day with icy road conditions.

Traffic Controls

Speed limit 50 mph, posted. Intermittent yellow center line. Speed limit sign which conformed to standard; no signals at intersection.

Vehicle

Passenger car, 1972 AMC Gremlin X, 2-door sedan; exterior Chinese red with gold accent stripes, interior black, odometer 15,139. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Manual transmission, no power accessories; padded components included upper instrument panel, sunvisors, and armrests. Lap belts and upper torso restraints available; lap belts in front seat knotted to inhibit restraint buzzer warning system. No vehicle defects observed. Last maintenance, February 10, 1973 at 14,015 miles, included oil change, lubrication, new oil and fuel filters, transmission and differential checked. Frontal damage to hood, grill, bumper, splash pan, and left front fender, seven inches of sheet metal crush; right side

* American Medical Association Abbreviated Injury Scale (AIS).

sideswipe damage to right front fender and right door, four inches of sheet metal crush; interior damage included cracked windshield, bent steering wheel, broken steering wheel spokes, and broken instrument panel tray. Primary VDI*:12-FYEW-1, secondary VDI: 12-RYMS-1.

Occupants

Driver, 29-year-old male, Caucasian, 70 inches and 170 pounds. Twelve years driving experience; averaged 25,000 miles per year including both personal driving and driving in connection with job as County sheriff's deputy. Traveling from work to home, had just stopped at babysitters to pick up daughter; 5 miles from origin, 9 miles from destination. Had owned vehicle one year accumulating 15,000 miles. Familiar with area, traveled route daily. Completed driver education course with Washtenaw County Sheriff's Patrol. Good physical and mental condition. No alcohol involved. Driver unrestrained. Injuries: $\frac{1}{2}$ -inch laceration over right eye, 1-inch laceration over nose, soreness to chest, compressive fracture of right knee cap, ligament torn from right knee joint. Injury severity AIS code 02, moderate.

Right front passenger, 5-year-old female, Caucasian, 43 inches and 42 pounds. Lying on seat asleep; unrestrained. Injuries: $\frac{1}{2}$ -inch laceration to bridge of nose, ecchymosis to both eyes. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were especially relevant to this case.

- | | |
|-----------|--|
| MVPS #201 | Occupant Protection in Interior Impact-- Passenger Cars. Driver struck radio and cigarette lighter knobs on instrument panel and fractured kneecap. |
| MVPS #203 | Impact Protection for the Driver from the Steering Control System--Passenger Cars. Driver's forward motion compressed energy-absorbing steering column one inch, bent steering wheel, and broke one spoke in steering wheel. |
| MVPS #205 | Glazing Materials--Passenger Cars, Multipurpose Passenger Vehicles, Motorcycles, Trucks, and Buses. Driver's head struck and cracked windshield, glass did not fracture. |

* Vehicle Deformation Index (VDI). in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

- MVPS #301 Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. Fuel tank scratched and dented, but did not rupture; however, rubber junction on filler pipe separated causing fuel spillage.
- TSPS #4 Driver Education. Driver 1 passing at intersection, not seen by Driver A.* Driver 1 and right front passenger unrestrained.
- TSPS #12 Highway Design, Construction, and Maintenance. Roadway was built on inadequate base and breaks up each year; surface was in poor repair with many chuck holes; badly placed guardrail which was poorly maintained and missing one wooden support post at the south end.

Description

Pre-crash: Vehicle 1 northbound on Prospect Road at 55 mph. Driver A, also traveling northward at driver-estimated speed of 45 mph, saw Vehicle 1 in rearview mirror quite far back. As Driver 1 started to pass Vehicle A just before intersection, Driver A, unaware he was being passed, swerved left to avoid large chuck holes. Driver 1 went off west shoulder to avoid colliding with Vehicle A. Passing at an intersection violation of traffic law. No skids or scuffs.

Crash: Vehicle 1 went behind guardrail, struck several small trees, vaulted ditch, bottomed out on embankment on far side of ditch, and came to final rest on all four wheels in ditch. Driver 1 moved upward and forward; sustained $\frac{1}{2}$ -inch laceration over right eye and 1-inch laceration over nose from striking face on windshield, soreness to chest from impacting steering wheel, and compressive fracture to right knee cap and ligaments torn from right knee joint from hitting radio and cigarette lighter knobs on instrument panel. Right front passenger lying on seat, thrown to floor, and received $\frac{1}{2}$ -inch laceration to bridge of nose and ecchymosis to both eyes. Damage to vehicle frontal area including hood, grill, bumper, splash pan, and left front fender, seven inches of sheet metal crush; right side sideswipe damage to right front fender and right door, four inches of sheet metal crush; interior damage included cracked windshield, bent steering wheel, broken steering wheel spoke, and broken instrument panel tray. Direction of force to vehicle 12:00 o'clock.

*Driver of the car being passed by Driver 1 in the 1972 AMC Gremlin X will be referred to as Driver A and his car as Vehicle A. While a contributing factor in the accident, Driver A was not involved in the actual collision of Vehicle 1 with the trees, so he was not interviewed in depth.

Postcrash: Driver 1 remained in car until ambulance arrived. Driver A stopped, checked on Driver 1 and put the right front passenger from Vehicle 1 into his car. Police arrived on-scene in five minutes, ambulance in 15 minutes. Driver 1 placed on backboard and air splint applied to right leg; both Vehicle 1 occupants transported to hospital. No debris or environmental problems; no traffic controls needed as vehicle off roadway. When front of vehicle lifted up to remove car from ditch, large volume of fuel spilled out where rubber junction on filler pipe had separated. No fire or explosion resulted.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Causes

- 1 Driver 1 swerved off roadway to avoid colliding with Vehicle A. (Definite)
- 1 Driver A swerved left to avoid hitting large chuck holes. (Definite)
- 7 Roadway poorly maintained. (Definite)

Severity Increasing Factor

- 7 Poorly placed guardrail, which affords no protection for motorists, is more dangerous as is than having no guardrail. (Definite)

Injury Causation

- 2 Use of safety restraints and child restraint system would have minimized injury to Driver 1 and the right front passenger. (Definite)

Postcrash Factors

- *3 Driver A assisted right front passenger (small child) out of Vehicle 1 and put her in his car. (Definite)

Matrix Cell

Explanation

Postcrash Factors (continued)

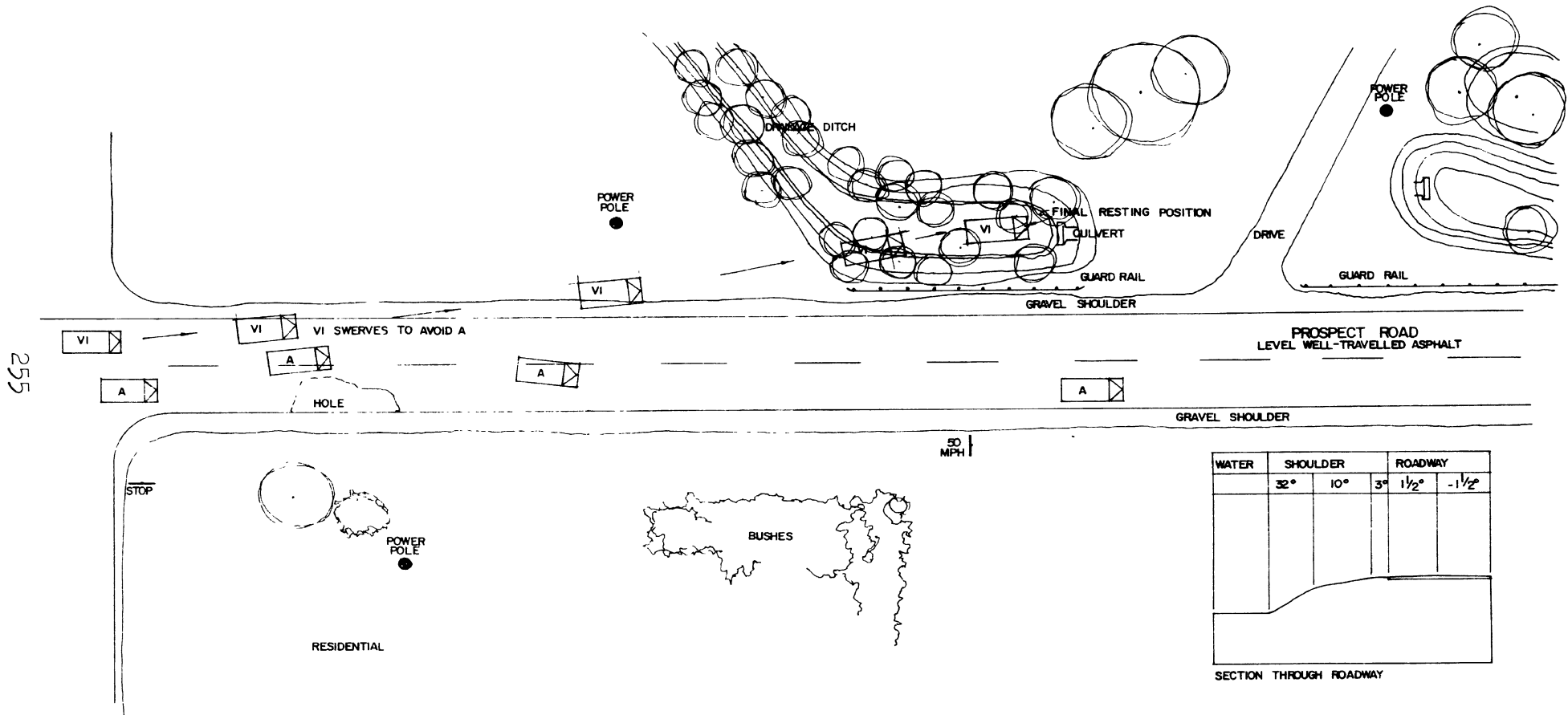
6 When front of vehicle lifted up to remove car from ditch, fuel spilled out where rubber junction on filler pipe separated.

Recommendations

7 Reevaluate positioning of guardrails to insure adequate effectiveness for errant cars, not just conform to letter of hand-book-type design specifications.

7 Improve roadway maintenance on Prospect Rd.

1 Warn drivers more effectively of danger in abruptly changing lanes without checking for clearance in all directions. Better educate drivers as to the injury-reducing effectiveness of lap and upper torso restraints, as well as child restraint systems.

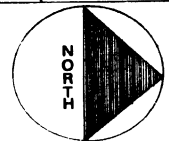


ACCIDENT SCHEMATIC

AA 345



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-346
CASE SUMMARY

Identification

Accident occurred on Washtenaw Avenue at intersection with Golfside Drive in commercial area of Ypsilanti Township, Washtenaw County, Michigan, on Wednesday, March 14, 1973 at 1349 hours. Two passenger cars collided at oblique right angles. Injury severity AIS* code 03, severe, not life-threatening.

Ambience

Grey, rainy day. Temperature 49^o, relative humidity 94%, wind 11 mph from southeast. Roadway wet.

Highway

Washtenaw Avenue is a 60-foot-wide major arterial; five lanes including center lane for left turn only. No divider. Surface well-travelled asphalt. North Golfside Drive 4 lane collector, well-travelled asphalt; South Golfside 2-lane gravel roadway. Road edge 6-inch-high concrete curbing except for South Golfside. Both streets straight and crowned for drainage: Washtenaw level; North Golfside graded +1 $\frac{1}{2}$ ^o to north, South Golfside +2 $\frac{1}{2}$ ^o to south. No artificial lighting. Within quarter mile radius of Washtenaw: 20 driveways, no intersections or interchanges, 25 utility poles, no trees; of Golfside: 8 driveways, no intersections or interchanges, 15 utility poles, no trees. This intersection has one of the highest accident rates in Washtenaw County, having had 266 accidents in a 4 $\frac{1}{2}$ -year period (235 on Washtenaw, 31 on Golfside). The most frequent configurations were right angle (116) and rear end (102). Two hundred and eighteen collisions involved two vehicles, 22 were single vehicle accidents, 22 involved three vehicles, and four were 4-vehicle accidents. Failure to yield right of way or stop was the most frequent violation (50 cases each for D 1 [Driver 1] and D 2 [Driver 2]). The accident activity pattern showed heavy activity Friday through Sunday and a peak again on Wednesdays.

Traffic Controls

Speed limit is posted at 45 mph on Washtenaw and 30 mph on Golfside. No pavement markings on Golfside. On Washtenaw, intermittent white lane delineators; left turn lane designated by intermittent yellow line with solid yellow line. "No Parking"

* American Medical Association Abbreviated Injury Scale (AIS).

and 45 mph speed limit sign on Washtenaw; visibility good. Two three-color fixed-time traffic signal lights: red, 35 seconds; green, 31 seconds; yellow, 4 seconds.

Vehicles

Vehicle 1, passenger car, 1973 Oldsmobile Omega 2-door sedan; dark green exterior, seagreen interior; odometer, 5067 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission, power steering, padding on upper instrument panel, sunvisors, and armrests. Lap and upper torso restraints available. No vehicle defects observed. Oil and lubrication at 3,700 miles on January 31, 1973. Damage sustained included 15 inches of frontal sheet metal crush and 4 inches of left quarter panel crush; hood latch damaged and released, left hood hinge damaged, right hood hinge separated, spring came off; right fender moved rearward partially jamming door shut; steering wheel rim bent and spokes deformed, energy-absorbing steering device compressed 2 inches; floorpan deformed in front of driver; windshield cracked; instrument panel and assorted hardware damaged. VDI:* 12 FYEW-3 (primary); 09 LEMW-1 (secondary).

Vehicle 2, passenger car, 1966 Ford Calaxie 500, 4-door sedan; red exterior, black interior; odometer, 79,576 miles. No indication of vehicle inspection. Automatic transmission, no power accessories, padding on armrests, sunvisors, and upper instrument panel. Lap belts only available. No vehicle defects observed. Last maintenance at 75,190 miles, included oil, lubrication, and oil and air filters. Damage: 28 inches sheet metal crush to front right corner; left wheelbase shortened six inches, right wheelbase four inches; hood latch bent and released, both hood hinges bent, steering column flexible coupling separated; right A-pillar bent rearward slightly; body mount separated at fender; right side firewall and floorpan deformed; windshield cracked; foot controls bent; rearview mirror crushed; right front window broken; right front door panel damaged. VDI: 01-FREW-3.

Occupants

Driver 1, 19-year-old Black male, 68 inches and 160 pounds. Had been driving only five months, had accumulated 6,000 miles. Trip plan unknown. Familiar with vehicle, driven it 5,000 miles; familiar with area, drove route five to seven times a week. High school 2-phase driver education course. Physical and mental condition good. No blood alcohol. Restrained by lap belt. Injuries: headache, slight whiplash, soreness to upper arms, sprained right thumb, low back pain, abrasion upper left hip, 2-cm laceration below right patella, contusion left knee. Injury severity AIS code 01, minor.

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAW Technical Report J224a.

Vehicle 1, center front passenger, 16 years old, female, Caucasian, 64 inches and 130 pounds, unrestrained. Injuries: left ear sore, both elbows sore, contusion and scrape top of right knee, contusion and abrasion to medial left leg, bruise below left knee, one-inch laceration outside left calf, contusions and small laceration left shin. Injury severity AIS code 01, minor.

Vehicle 1, right front passenger, 28-year-old Caucasian female, 65 inches and 140 pounds. Unrestrained. Injuries: bump on center forehead, chipped front teeth, tongue bitten, contusion right elbow, abrasion right knee, fracture and dislocation left ankle, 3-cm laceration to chin, unconscious briefly. Injury severity AIS code 03, severe, not life-threatening.

Driver 2, 26-year-old Caucasian female, 65 inches and 112 pounds. Nine years driving experience; averaged 6,000 miles per year. Driving from Arborland Shopping Center in Ann Arbor to K-Mart in Ypsilanti; $\frac{1}{2}$ mile from origin, $\frac{1}{8}$ mile destination. Car belonged to her father, but D 2 drove it frequently and was familiar with it. Drove in area once or twice a month, familiar with roadway. No driver education. Physical and mental condition good. No blood alcohol. Unrestrained. Light forehead abrasions, fractured right clavicle, fractured C7 vertebrae, abrasions right side of neck and shoulder over clavicle, low back pain, fractured fifth right rib. Injury severity AIS code 03, severe, not life-threatening.

Vehicle 2, right front passenger, 63 years old, Caucasian female, 64 inches and 128 pounds. Unrestrained. Injuries: right temporal abrasion and contusion, abrasion and circular laceration lateral aspect right knee, open comminuted fracture proximal end of fibula, contusion lateral aspect right thigh, contusions over knuckles left hand. Injury severity AIS code 03, severe, not life-threatening.

Vehicle 2, right front passenger, 11-month-old female Caucasian baby held by adult right front passenger; 28 inches and 24 pounds. Injury: soreness inside of mouth. Injury severity AIS code 01, minor.

Vehicle 2, center rear passenger, 5 years old, male, Caucasian, 45 inches and 45 pounds. Unrestrained. Injuries: 2 1-cm lacerations occipital lobe, 1-cm laceration chin, contusion right elbow. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were especially relevant to this case.

MVPS 201

Occupant Protection in Interior Impact-- Passenger Cars. Padding in V1 (Vehicle 1) and V2 (Vehicle 2) minimized injuries;

control knobs in Vehicle 1 met standard, but were still injury-producing right front adult passenger in V 2 fractured leg on window crank.

- MVPS 203 Impact Protection for the Driver from the Steering Control System--Passenger Cars. Energy-absorbing steering device on V 1 compressed 2.0 inches.
- MVPS 205 Glazing Materials--Passenger Cars, Multipurpose Passenger Vehicles, Motorcycles, Trucks, and Buses. Windshield on V1 and V2 didn't fracture, prevented major facial lacerations.
- TSPS 4 Driver Education. Both drivers showed poor judgement--D 1 for accelerating through amber light at busy intersection; D 2 for making left turn before oncoming traffic stopped. Passengers in V 1 and occupants in V 2 unrestrained.
- TSPS 5 Driver Licensing. D 2 had four accidents and two moving violations in six years.
- TSPS 12 Highway Design, Construction, and Maintenance. Intersection at Washtenaw and Golfside suffers from urban build-up, accompanied by no access control.

Description

Precrash. V 1 westbound in inside lane at 45 mph, slowed to 20 mph at intersection as Vehicle A* turned left, then accelerated to 25 mph into intersection through amber light. Vehicle 2 eastbound in center lane at 15 mph; after Vehicle A turned, V 2 accelerated to make lefthand turn. No evidence of braking by either D 1 or D 2. D 2's failure to yield, right-of-way violation of traffic law. No physical evidence, skids, or scuffs.

Crash. Front end of V 1 impacted right front fender of V 2; V 1 deflected into signpost on northwest corner of intersection (sign 10 feet off roadway) and came to final rest facing west-northwest. V 2 rotated counterclockwise 285°, came to final rest west of intersection facing southward. D 1 braced himself on steering wheel which caused sore upper arms and sprained right thumb, thrown forward and left, struck head on steering wheel and sustained headache, suffered slight whiplash and low

* Vehicle A refers to eastbound passenger car which was a contributing factor, but not directly involved in this accident.

back pain from flexion, abrasion upper left hip from seat belt, 2-cm laceration below right patella from hitting steering column, contusion left knee from lower instrument panel. Center front passenger in V 1 sitting with legs on transmission hump, went forward and left, hit upper instrument panel with head and elbows causing soreness to left ear and to both elbows, sustained contusion and scrape on top of right knee from mid-instrument panel, and lower left leg struck radio knob and lower instrument panel which caused contusion and abrasion medial left leg, bruise below left knee, one-inch laceration outside left calf, contusion and small laceration left shin. Vehicle 1 right front passenger was seated with foot on transmission hump; thrown forward, bumped center forehead on windshield; struck chin on upper instrument panel resulting in her chipping front teeth, biting tongue, and biting a 3-cm laceration in chin; contused right elbow on upper instrument panel, knees impacted instrument panel, abrasion to right knee possibly from glove compartment door latch; suffered fracture and dislocation of left ankle as left leg flexed over foot between transmission hump and instrument panel. Driver 2 thrown forward and her head impacted the rearview mirror and right center windshield. She sustained light forehead abrasions from each of these contacts. Right shoulder struck instrument panel resulting in fractured right clavicle, abrasions right side of neck and shoulder over clavicle, and fractured fifth right rib; fractured C7 vertebrae and had low back pain from forward and lateral flexion and windshield impact; brief amnesia for accident. Vehicle 2 right front passenger was holding sleeping baby, thrown heavily to right against door and moved forward into instrument panel; sustained right temporal abrasion and contusion from right side window or A-pillar, abrasion and circular laceration lateral aspect right knee and an open comminuted fracture proximal end of right fibula from window crank, and contusion lateral aspect right thigh from door, and contusions over knuckles on left hand from instrument panel. Infant held by right front passenger throughout collision suffered only soreness inside mouth from biting with teeth. Vehicle 2 center rear passenger impacted right rear door causing two 1-cm lacerations to occipital lobe and contusion right elbow, and had 1-cm laceration to chin from hitting front seat back. Vehicle 1's damage included 15 inches of frontal sheet metal crush and 4 inches of left quarter panel crush; hood latch damaged and released, left hood hinge damaged, right hood hinge separated, spring came off; right fender moved rearward partially jamming door shut; steering wheel rim bent and spokes deformed, energy-absorbing steering device compressed 2 inches; floorpan deformed in front of driver; windshield cracked; instrument panel and assorted hardware damaged. V 2 had 28 inches sheet metal crush to front right corner; left wheelbase shortened six inches, right wheelbase four inches; hood latch bent and released, both hood hinges bent; steering column flexible coupling separated; right A-pillar bent rearward slightly; body mount separated at fender; right side firewall and floorpan

deformed; windshield cracked; foot controls bent; rearview mirror crushed; right front window broken; right front door panel damaged. Directions of force 12:00 o'clock to V 1 and 1:00 o'clock to V 2.

Postcrash. Witness in gas station called police; all occupants of both vehicles remained in cars. Sheriff's deputies arrived in three minutes, ambulance in five minutes. Right front passenger in V 2 had right leg bandaged and splinted. All occupants except D1 placed on backboards and transported to hospital. No fires or explosions. Trim pieces and glass in roadway. Accident caused traffic tie-up because both westbound lanes were closed; traffic routed around crashed cars. Minor property-damage accident occurred before scene was cleared. Scene was cleared in approximately 15 minutes.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary/Principle Causes

- 1 D 2 made left turn in front of V 1. (Definite)
- 1 D 1 slowed while Vehicle A turned left, then accelerated through amber light. (Definite)

Relevant Conditions

- 1 D 2 had a poor driver record. (Definite)
- 1 D 1 was inexperienced driver which possibly contributed to accident. (Definite)
- * 5 Energy-absorbing device on V 1 compressed 2.0 inches. (Definite)
- 7 Urban build-up along Washtenaw Avenue in area of accident intersection resulted in many accesses onto roadway which is a major arterial. (Definite)

Matrix Cell

Explanation

Injury Causation

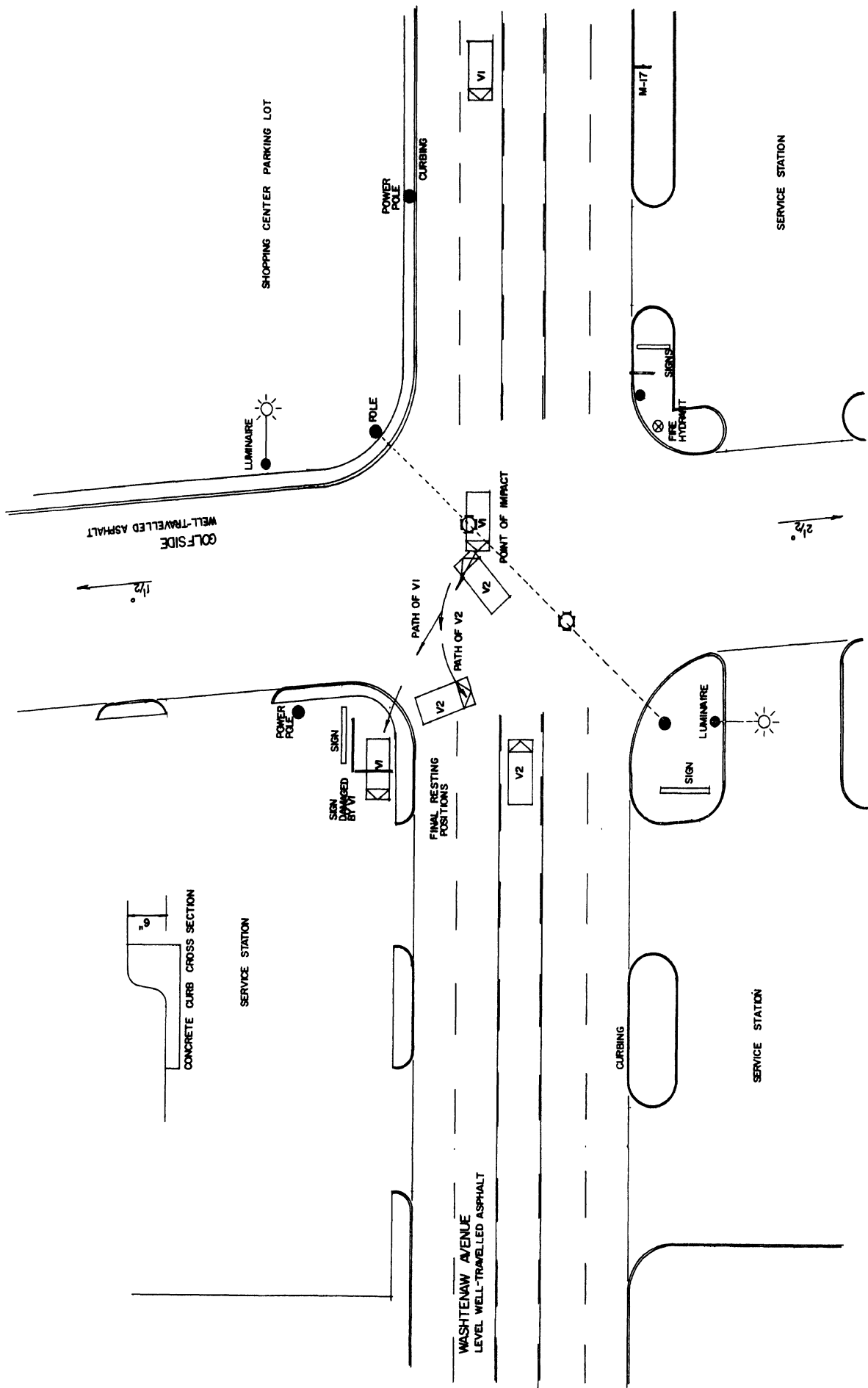
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|---|--|
| 2 | Restraint usage would have lessened injury to D 2 and occupants in V 1. (Definite) |
| 2 | Child restraint would have mitigated injury to rear passenger in Vehicle 2. (Definite) |
| 5 | Window crank in V 2 had sharp, protruding knob which caused injury to leg of right front passenger. (Definite) |
| 5 | Radio knobs on V1 instrument panel were injury-producing. (Definite) |

Postcrash Factors

- | | |
|---|---|
| 9 | Minor property-damage accident occurred as result of scene tie-up. (Definite) |
|---|---|

Recommendations

- | | |
|---|---|
| 1 | Driver education courses should emphasize need for caution at busy intersections, and warn against accelerating through amber traffic lights. |
| 1 | Educate public to use safety restraint systems and to place child passengers in child restraint systems. |
| 7 | Reevaluate existing 45 mph speed limit on Washtenaw. |
| 7 | Install three- or four-phase traffic signal lights with a left turn arrow. |
| 7 | Implement a study of the intersection and surrounding area in order to initiate greater traffic control. |



UNIVERSITY OF MICHIGAN HSRI

ACCIDENT SCHEMATIC AA 346



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-347
CASE SUMMARY

Identification

Accident occurred in residential area on Washtenaw Avenue in city of Ann Arbor, Washtenaw County, Michigan, on Thursday, March 15, 1973 at 1057 hours. Motorcycle and two passenger cars, sideswipe accident. Injury severity AIS* code 06, fatal within 24 hours.

Ambience

Daylight, partly cloudy; temperature 65^o, relative humidity 46%, wind 20 mph from north/northwest. Roadway dry.

Highway

Washtenaw Avenue 38-foot-wide, 4-lane, major arterial, westbound lanes each 9 feet 6 inches, eastbound lanes 10 feet and 9 feet. No divider; surface well-travelled asphalt. At road edge, 6-inch-high concrete curbing.** Roadway straight, crowned for drainage, graded -1 $\frac{1}{2}$ ^o to southeast. Five mercury vapor luminaires. Within quarter-mile radius: one intersection, 9 driveways, 20 utility poles, and 50 trees. A 4 $\frac{1}{2}$ -year search of the Washtenaw County accident data file indicated no previous accidents at the point of impact. However, there were 42 accidents shown at the Washtenaw Avenue-Hill Street intersection, 150 feet northwest of the point of impact, and on Washtenaw 100 feet northwest of Hill Street.

Traffic Controls

Posted 25 mph speed limit. Double yellow center line, intermittent white lane delineators. Two "No Parking" signs. Two three-color traffic signal lights; fixed time: 35 seconds red, 4 seconds yellow, 31 seconds green.

Vehicles

Vehicle 1, 1972 Suzuki GT 750 motorcycle, metallic blue-green with white accent stripes; odometer, 12,866.1 miles. No indication of vehicle inspection; maintenance unknown; no defects observed. Damage to headlamp housing, tachometer, speedometer, and handlebars; dented fuel tank; radiator housing scraped; forks bent; front wheel badly bent; engine plates on right and left sides scraped. No VDI + for motorcycles.

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs standard for city of Ann Arbor, Michigan.

+ Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Report J224a.

Vehicle 2, passenger car, 1967 Ford Custom 2-door sedan, white exterior, blue interior; odometer 92,015 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission, power brakes; padded components included sunvisors, upper instrument panel, and armrests. Lap belt only available, no locking retractor. No vehicle defects observed. Maintenance unknown, last sticker indicated service at 67,815 miles. Sideswipe damage to left front fender including five inches of sheet metal crush; headlamp area damaged, left front tire scraped by damaged fender. VDI: 11-LFES-1.

Vehicle 3, passenger car, 1971 Buick Skylark 2-door hardtop; dark green exterior with matching vinyl top, dark green cloth interior; odometer, 24,912 miles. Vehicle inspected by Michigan State Police in October 1972. Automatic transmission; power brakes and power steering; padded upper instrument panel, sunvisors, and armrests. Lap belts with locking retractors and upper torso restraints available. No vehicle defects observed; last maintenance on March 7, 1973 at 22,935 miles included oil change, new oil filter, lubrication, and transmission checked. Left quarter panel sustained 5 inches of sheet metal crush. VDI: 07-LBMW-1.

Occupants

Driver 1, 28-year-old Caucasian male, 70 inches and 145 pounds. One-year experience driving motorcycles; had been driving passenger cars 12 years averaging 15,000 miles per year. Travelling from home to Credit Union on Packard Road; three miles from origin, two miles from destination. Had owned case motorcycle month and a half, familiar with it; familiar with area. Completed high school driver education course. Good overall physical condition; mental overall poor; history of irresponsible driving. Blood alcohol concentration 0.02. Injuries: 8 x 4 x 1.5-cm. puncture wound into thoracic space, fractured 3-5 left ribs, laceration left ventricle of heart, laceration left lung, laceration liver and spleen, 5 cm laceration above right ear, 5 cm laceration and evulsion left knee. Injury severity AIS code 06, fatal lesions in one area.

Driver 2, 28 years old, female, native of Thailand, 61 inches and 95 pounds. Four-years driving experience in United States, averaged 4,000 miles per year. Driving from Washtenaw Community College to downtown Ann Arbor for errands and shopping; six miles from origin, three miles from destination. Had owned V2 (Vehicle 2) for three years and drove it daily, also travelled route daily. Took driver education course at the Michigan Driver License Bureau. Physical and mental condition good. No alcohol involved. Driver unrestrained. Injury: pain in upper right thigh. Injury severity AIS code 01, minor.

Driver 3, 68-year-old Caucasian female, 68 inches and

158 pounds. Fifty-six years driving experience, averaged 15,000 miles per year. Going from home to gas station and shopping; 4½ miles from origin, distance to destination unknown. Had owned V3 (Vehicle 3) for two years and familiar with it, also familiar with area. No driver education. Good physical and mental condition, likes to drive. No alcohol involved. Driver unrestrained. No Injury.

Standards

The following Motor Vehicle Program Standard (MVPS) and Traffic Safety Program Standard (TSPS) were specifically relevant to this case.

- | | |
|----------|--|
| MVPS 122 | Motorcycle Brake Systems--Motorcycles. V1 had independently accuated brakes as required by this Standard, but D1 used only the rear brake. |
| TSPS 3 | Motorcycle Safety. D1 was speeding on motorcycle. |
| TSPS 4 | Driver Licensing. D1 had no motorcycle permit, and had been reexamined by continued driving irresponsibly. |

Description

Preocrash. V1 travelling southeast in outside lane at approximately 50 mph; V2 northwestbound in inside lane; V3 southeastbound in inside lane. Traffic on Washtenaw Avenue stopped for traffic signal light at intersection 80 feet from point of impact. D1 came over crest of hill too fast, applied back brake hard, lost vehicle stability, crossed inside southeast lane and crossed center line. V2 had just started northwestbound as light turned green. V3 had braked and come to a rolling stop at red light, then released brake and continued forward with traffic as light turned green. D1's excess speed violation of traffic law. V1 left 212 feet of skid marks.

Crash. At 20 mph impact speed, V1 struck left front corner of V2, bounced off car, recrossed center line and struck left quarter panel of V3. D1 went forward into handlebars as motorcycle hit V2 and he landed on pavement 11 feet southeast of point of impact, slightly southwest of center line. The left handlebar of the cycle penetrated D1's chest, resulting in an 8 x 4 x 1.5-cm puncture wound and fatal laceration of the left ventricle of the heart. Other internal injuries from this contact were small lacerations of the left lung, liver and spleen and fracture of left 3-5 ribs. A 5 cm laceration above the right ear resulted from helmet contact. The driver's head probably contacted V2 or impacted the pavement. A 5x3.5 cm laceration and evulsion of the left knee possibly resulted from contact with the left side of the cycle or from pavement contact. Injury severity AIS code 06, fatal lesions in one region. Vehicle 1 came to final rest 36 feet southeast of point of impact straddling center line. Vehicle 2 stopped in its lane 40 feet from point of impact, then pulled into outside lane. Driver 3 steered to outside lane

and backed up to point of impact. Driver 2's right leg impacted the instrument panel causing pain to upper thigh; D3 uninjured. V1 had damage to headlight housing, tachometer, speedometer, and handlebars; dented fuel tank, scraped radiator housing, bent forks, badly bent front wheel, scraped engine plates on right and left sides. V2 sustained sideswipe damage to left front fender and 5 inches of sheet metal crush, damaged headlight area, and scraped left tire from damaged fender. V3 had dented left quarter panel and 5 inches of sheet metal crush. Directions of force 11:00 o'clock to V2, 7:00 o'clock to V3.

Postcrash. Off-duty police officer happened on scene two to three minutes after accident and summoned help. D2 remained in car; D3 started walking toward friend's house, then turned and returned to car when police arrived. Police attempted cardiopulmonary resuscitation on D1 on scene. Ambulance arrived in five minutes, placed D1 on backboard, and tried cardiopulmonary resuscitation en route to hospital; D1 dead on arrival. Police moved motorcycle from middle of roadway; electrical system shorted out. Fire truck dispatched and firemen stood prepared with chemical fire extinguishers while electrical system was disconnected. No fire or explosion. Small amount of blood on pavement, and trim pieces from three vehicles. Accident area blocked off; northwest traffic had to turn right, westbound traffic could cross Washtenaw Avenue or turn left, and southeast traffic was routed around adjacent island.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principle Cause

1

Vehicle 1 crossed double yellow center line and struck Vehicle 2. (Definite)

Relevant Conditions

- 1 D1 approached intersection area at excess speed. (Definite)
- 1 D1 applied rear brakes only, minimizing total braking efficiency. (Definite)
- 1 D1 had poor driving record and history of irresponsible driving. (Definite)

Injury Causation

- 5 Handlebars on V1 fatal injury-producing agent. (Definite)
- *3 Helmet prevented concussion. (Possible)

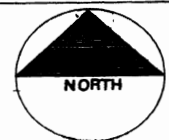
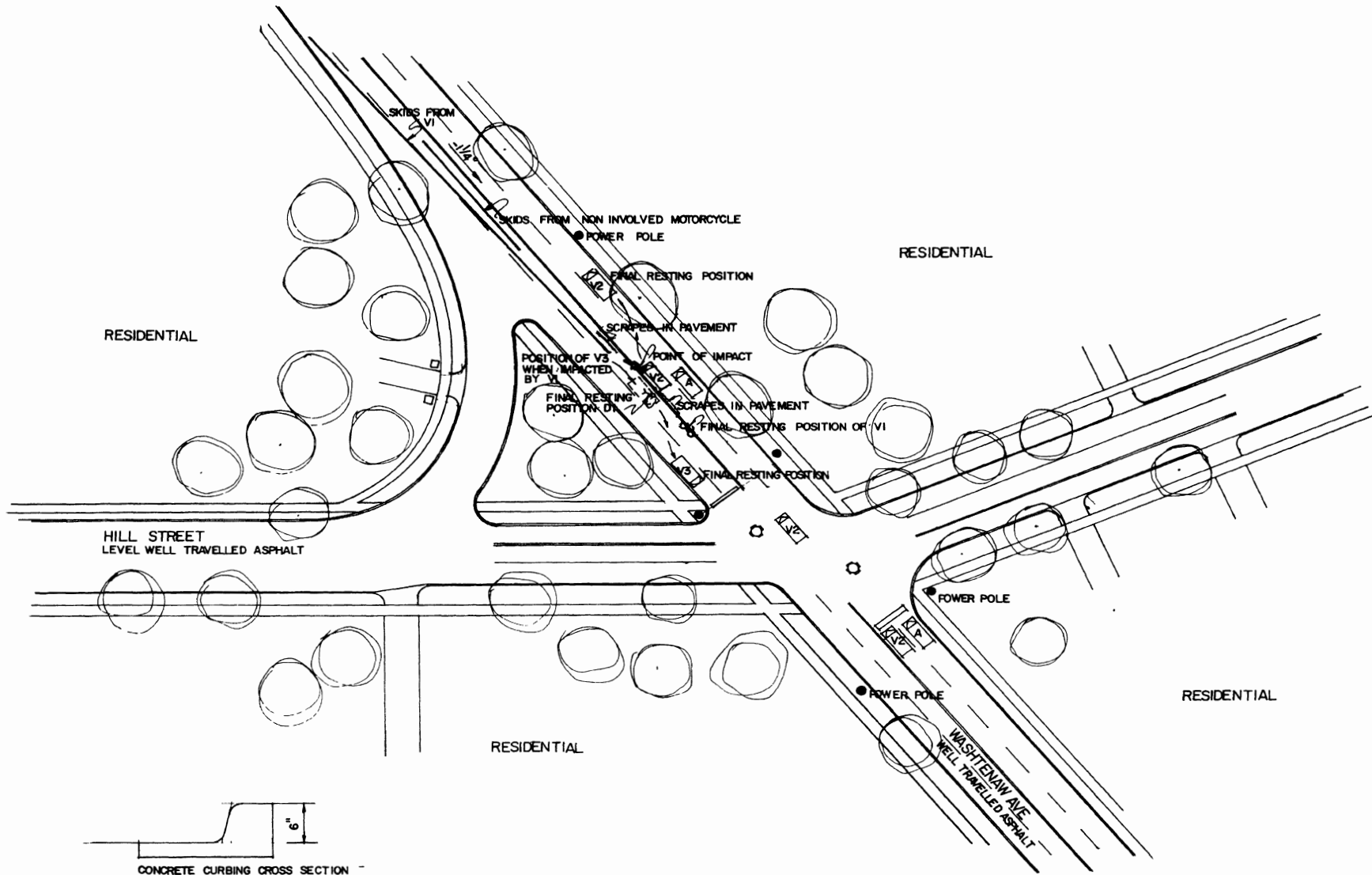
Postcrash Factor

- *3 Police and ambulance responded rapidly and performed cardiopulmonary resuscitation. (Definite)
- 6 Vulnerability of V1's electrical system created potential fire hazard. (Definite)
- *9 Firemen handled potential fire hazard with expertise. (Definite)
- 9 Minor accident occurred when accident sightseers collided. (Definite)

Recommendations

Develop effective program for identifying hazardous drivers and removing them from the road.

Make available an effective program for rehabilitating irresponsible drivers.



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-348
CASE SUMMARY

Identification

Accident occurred on open roadway section of Ann Arbor-Saline Road in an undeveloped residential area in Lodi Township, Washtenaw County, Michigan on Saturday, March 24, 1973 at 1317 hours. Truck and motorcycle, side impact. Injury severity AIS* code 10, fatal, details unknown.

Ambience

Bright, sunny day. Temperature 43^o, relative humidity 56%, wind 10 mph from the north. Roadway dry.

Highway

Ann Arbor-Saline Road 2-lane collector, no divider. Surface well-traveled, well-maintained asphalt. Road edge 6-foot wide packed earth shoulders. Roadway straight, level, crowned for drainage. No artificial lighting. In a quarter-mile radius: 8 driveways, one intersection, 15 utility poles, many trees. A search of the 1 $\frac{1}{2}$ -year data base for Washtenaw County accidents occurring on Ann Arbor-Saline Road from the intersection with Textile Road to one-half mile south of intersection, the area including accident site, revealed six accidents. Three involved two vehicles, three involved a single vehicle. Accident configurations included out-of-control (2), right angle (2), rear end (1), and rollover (1).

Traffic Controls

Speed limit† posted 45 mph. Intermittent yellow center line for northbound traffic; solid yellow center line for southbound traffic. Standard speed limit and no passing signs.

Vehicles

Vehicle 1, 1973 Kawasaki 500 Mach III motorcycle; dark green with yellow accent striping; odometer 182.7 miles. No recorded maintenance; no vehicle defects observed. Badly damaged front forks and wheel, dented fuel tank.

Vehicle 2, 1972 International Cargostar 1710; straight truck with aluminum box, red cab; odometer 9092 miles. No vehicle inspection. Power brakes and power steering, padded sunvisors, lap belts only. No vehicle defects. Routine maintenance done by a full-time mechanic working for Big George's Home Appliance Mart. Damage: aluminum cage box dented and penetrated by Driver 1 and Passenger 1 impact, and mud flap frame bent. VDI:** 09-LBMW-1.

* American Medical Association Abbreviated Injury Scale (AIS).

** Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Rear signals mounted near center of truck under overhang of flat bed.

Occupants

Driver 1, 20-year-old male Caucasian, 72 inches and 155 pounds. Four years driving experience with motorcycles and passenger cars; averaged 4,000 miles per year with cycles, 15,000 miles with passenger cars. Traveling from home in Saline to passenger's home in Ann Arbor; two miles from origin, seven miles from destination. Familiar with motorcycle, had accumulated 182 miles on it and had previously owned another cycle of same make and model. Lived in area and drove roadway four times a week. High school driver education course. Good physical and mental condition; poor driver record. No blood alcohol. Injuries: extensive head, chest, and abdominal injuries. Injury severity AIS code 10, fatal, details unknown.

Vehicle 1, passenger, 20-year-old Caucasian male, 63 inches and 135 pounds. Injuries: severe head and chest injuries. Injury severity AIS code 10, fatal, details unknown.

Driver 2, 34 years old, male, Caucasian, 74 inches and 215 pounds. Eighteen years driving experience; as part-time deliveryman, drove 100 miles per day with truck about three times a week; averaged 25,000 miles per year including both truck and passenger car. Driving from appliance store in Ann Arbor to make deliveries in the area; was making one of his stops on his 50-mile delivery circuit. Had driven Vehicle 2 8,000 miles in six months; familiar with roadway. Completed driver education courses at high school and at Ann Arbor Fire Department. Physical and mental health good. No blood alcohol. Unrestrained. AIS code 00, no injury.

Vehicle 2, right front passenger, 50-year-old male Caucasian, 65 inches and 150 pounds. Unrestrained. AIS code 00, no injury.

Standards

The following Motor Vehicle Program Standard (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|----------|--|
| MVPS 108 | Lamps, Reflective Devices, and Associated Equipment--Passenger Cars, Multipurpose Passenger Vehicles, Trucks, Trailers, Buses, and Motorcycles. Turn signal lights on Vehicle 2 were located below truck box in center of vehicle, thus reducing their visibility. |
| TSPS 3 | Motorcycle Safety. Driver 1, though experienced with a motorcycle, used poor judgement in passing line of cars at high speed. |

TSPS 5

Driver Licensing. Driver 1 had history of speeding--had been reexamined and had had his license suspended for three months, August-November, 1972.

Description

Preocrash. Vehicle 1, northbound at 55-60 mph (witness estimated), swung out to pass line of four or more cars just as Vehicle 2, northbound at 40 mph, had slowed to 5-10 mph and started to make lefthand turn. No oncoming traffic, so Vehicle 2 did not come to complete stop before turning. Driver 1 braked hard after passing first two cars. Excessive speed and improper passing maneuver by Driver 1 violations of traffic law. Vehicle 1 left 90 feet of skid marks.

Crash. Vehicle 1 struck Vehicle 2 on the side behind left rear wheel. Driver 1 and motorcycle passenger thrown forward over handlebars and each impacted side of truck with upper torso. Driver 1 sustained extensive head, chest, and abdominal injuries; probable concussion, deeply indented contusion right lateral neck, flail chest, extensive deep contusions and lacerations on extremities, facial abrasions and contusions, abdominal hemorrhaging. Injury severity AIS code 10, fatal, details unknown. Passenger sustained severe head and chest injuries: concussion, brain hemorrhage, multiple abrasions to chest particularly in right upper quadrant, multiple extremity abrasions. Injury severity AIS code 10, fatal, details unknown. Vehicle 1 badly damaged front fork and wheel and fuel tank was dented. Aluminum cargo box on Vehicle 2 dented and penetrated by Driver 1's head, mud flap frame bent. Direction of force to Vehicle 2 9:00 o'clock (not applicable to Vehicle 1).

Postcrash. Driver 2 and right front passenger exited from truck; passenger went to nearby house to call police. Driver 2, a fireman, removed Passenger 1's helmet and cleaned out his mouth. Police arrived in 3-4 minutes, ambulance in 4-5 minutes. Driver 2 assisted ambulance attendants in performing external heart massage and Ambu-bag method of resuscitation on Passenger 1. Although in the estimation of the police Driver 1 was dead on-scene, he was transported with Passenger 1 to the hospital. Driver 2 rode in ambulance; Passenger 1's vital signs questionable, cardiopulmonary resuscitation administered. At hospital, Passenger 1's vital signs unresponsive, tracheotomy performed, further resuscitation attempted; pronounced dead 50 minutes postcrash. No fire, explosions, or environmental problems. Boot and shoe belonging to motorcycle victims in roadway, also trim pieces from Vehicle 1. Police directed traffic into one open lane.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary/Principle Causes

- 1 Vehicle 1, while passing line of cars, impacted left-turning vehicle. (Definite)
- 1 Driver 1 traveling at excess speed and couldn't avoid collision by braking. (Definite)
- 1 Driver 2 didn't see Vehicle 1 to accelerate through turn and thus perhaps prevent the accident. (Definite)

Relevant

- 1 Driver 1 young driver who had numerous speeding violations and a recent license suspension. (Definite)
- 4 Turn signal and brake lights were mounted under truck box in middle of vehicle and did not have optimum visibility. (Definite)
- 1 Driver 1 got in at 3:00 a.m. the morning of the accident and may have been fatigued. (Possible)

Injury Causation

- 2 Driver 1 and Passenger 1 were helmeted, but still sustained severe head injuries in this high-speed collision. (Definite)

Postcrash Factors

- *3 Ambulance response rapid and treatment appropriate. (Definite)
- *3 Driver 2 was a fireman trained in first aid and gave immediate medical assistance to Passenger 1.

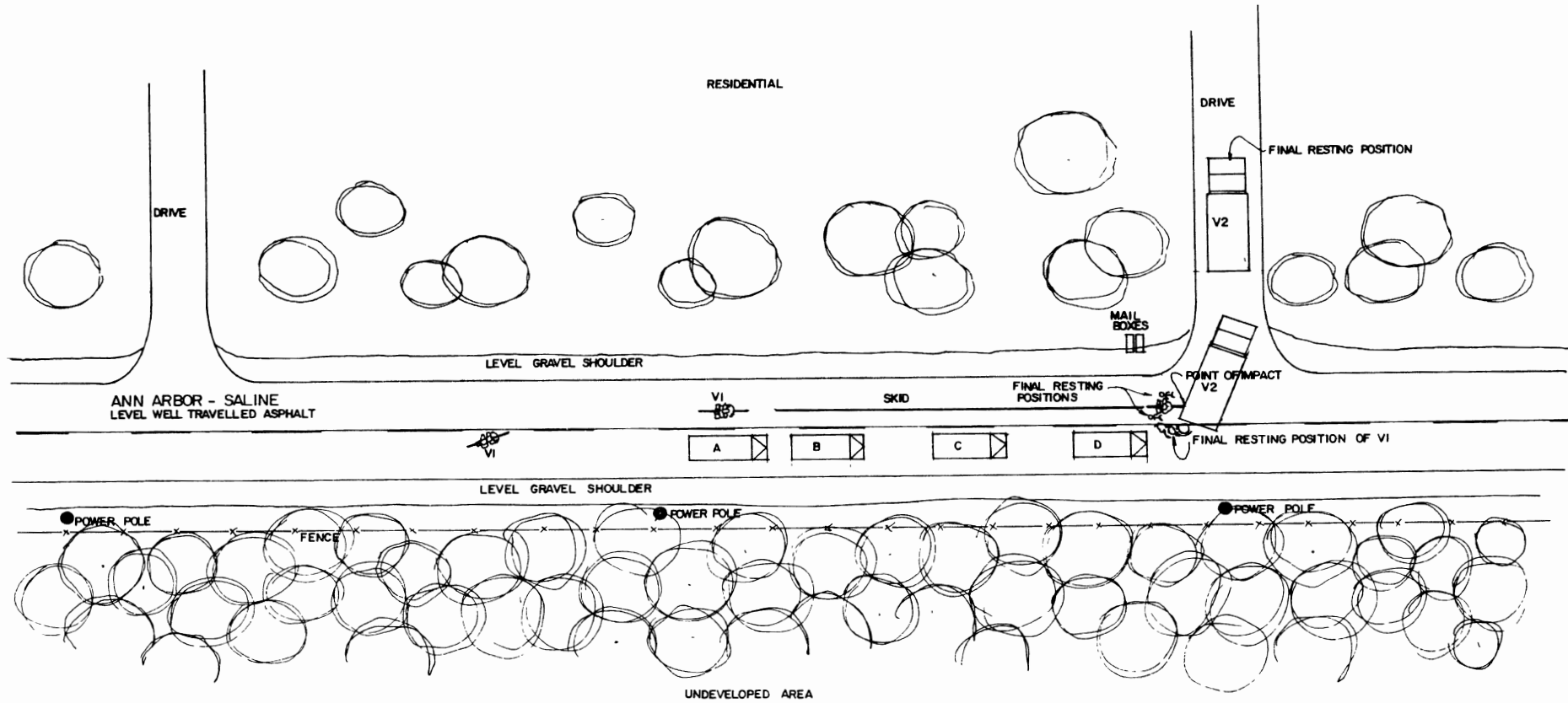
Recommendations

- 4 Rear lighting on truck should be improved for optimum visibility.

- 1 Driver education courses should caution motorcycle drivers to be especially alert when passing more than one vehicle, since a vehicle might be making a left turn.

- 1 Reevaluate driver licensing and reexamination procedure--there is a need to change driving attitudes among problem drivers.

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ACCIDENT SCHEMATIC

AA348



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-349
CASE SUMMARY

Identification

Accident occurred on Packard Road near intersection with Colony Road in residential area of city of Ann Arbor, Washtenaw County, Michigan, on Tuesday, March 27, 1973 at 1920 hours. Motorcycle impacted fixed object. Injury severity AIS* code 03, severe, not life-threatening.

Ambience

Nighttime, dark, street lights on. Temperature 48^o, relative humidity 34%, wind 10 mph from southeast. Roadway dry.

Highway

Packard Road major arterial, four lanes plus center lane for left turn only; each lane 12 feet wide. At point of impact, traffic island separates center lane for left turn only from westbound lanes. Surface well-travelled, well-maintained asphalt. Road edge 6-inch-high concrete curbing.** Roadway curved, level, crowned for drainage. Within quarter-mile radius: 12 mercury vapor luminaries, 5 driveways, 1 intersection, 15 utility poles, and 10 trees. A search of the Washtenaw County data file showed twenty accidents in a five-year period at the intersection of Packard Road and Colony Road, including 45 feet east of the intersection on Packard Road. The majority of the cases were out-of-control and right angle (seven each) with the remainder distributed over the categories of fixed object (3), rear end (2), and sideswipe (1). Eleven accidents were single-vehicle, seven two-vehicle, and two three-vehicle.

Traffic Controls

Speed limit 35 mph, posted. Intermittent white line delineators; double, solid, yellow channelizing lines, visibility good. Lighted median warning sign; "No Parking" and speed limit signs. No signals.

Vehicle

Motorcycle, 1972 Suzuki 350cc Road Bike; odometer 627.2 miles; orange with white accent stripes. No vehicle defects observed; no

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs are standard in city of Ann Arbor, Michigan.

recorded maintenance. Damage: bent handlebars, damaged tachometer and speedometer, bent front fender.

Motorcycle Driver

Driver, 18-year-old Caucasian male, 68 inches and 175 pounds. Had been operating motorcycles for 3 years, averaging 3,000 miles per year; driving passenger cars for two years, averaging 10,000 miles per year. Driving from friend's house in Ann Arbor to shopping center on east side of Ann Arbor; 3 miles from origin, 2 miles from destination. Had owned motorcycle 1 month and had accumulated all of the 627.2 miles on the odometer. Used to live in area so familiar with roadway. Had completed two-phase driver education course in high school; no motorcycle education. Overall physical and mental condition good. Had consumed one mixed drink a short time earlier. Injuries: 2-inch laceration and swelling on forehead, abrasions outer aspect of right arm and shoulder, abrasion outer aspect right ankle and lower leg; concussion, lost consciousness for one hour, post-traumatic amnesia lasting two days. Injury severity AIS code 03, severe, not life-threatening.

Standards

The following Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|---------|--|
| TSPS 3 | Motorcycle Safety. Driver had not taken a motorcycle examination and had no motorcycle permit as required by law. |
| TSPS 4 | Driver Education. Driver 1 attempted to pass vehicle on the right. |
| TSPS 7 | Alcohol in Relation to Highway Safety. Driver 1 stated he had had one mixed drink a short time before the accident; alcohol may have affected his driving ability. |
| TSPS 12 | Highway Design, Construction, and Maintenance. Gravel on road edge from sanding of icy roads in the wintertime created a hazard for motorcycle riders. |

Description

Pre-crash. Driver 1 southeastbound in outside lane of Packard Road. Driver stopped at traffic signal light one quarter mile from point of impact. When light changed to green, proceeded forward behind unidentified passenger car, then passed car on the right at an estimated speed of between 30 and 35 mph (based on driver's statement and pre-crash maneuvers). Last thing driver remembers is

shifting into second gear. Team investigators theorize that he was probably crowded by passenger car, swerved on the gravel at road edge because of lack of room on the roadway, and lost control. Passing on right violation of traffic law. No skids or scuffs.

Crash. Motorcycle struck curb, then impacted reflectorized delineator post about 12 feet from road edge, and fell over. Driver thrown forward over handlebars and to the right, coming to final rest beside the bike. Sustained 2-inch laceration and swelling on forehead from the helmet rim, and abrasions to outer aspect of right arm and shoulder, abrasion outer aspect of right ankle and lower leg, and concussion from ground contact. Lost consciousness for one hour, post-traumatic amnesia lasted two days. Vehicle damage included bent handlebars, damaged tachometer and speedometer, and bent front fender.

Postcrash. Police and ambulance arrived in two to three minutes. Ambulance attendants checked Driver 1's vital signs, bandaged lacerations, placed him on a backboard, and transported him to hospital where he remained for two days. No fires, explosions, or environmental problems. Only debris few pieces of motorcycle trim. No need for traffic controls because motorcycle off roadway.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell colum. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell Explanation

Accident Causation

- Primary or Principle Cause
- 1 Driver 1 passed to right of vehicle in outside lane and lost control of motorcycle. (Definite)
- Relevant Factors
- 1 Driver 1 skidded on gravel. (Possible)
 - 1 Driver 1 crowded on roadway while passing passenger car on right. (Possible)
 - 1 Driver 1's driving ability impaired by alcohol. (Possible)

- 7 Gravel left from winter sanding of roadway contributed to Driver 1's loss of control. (Probable)
- 7 Curved roadway configuration contributed to Driver 1's loss of control. (Probable)

Injury Causation

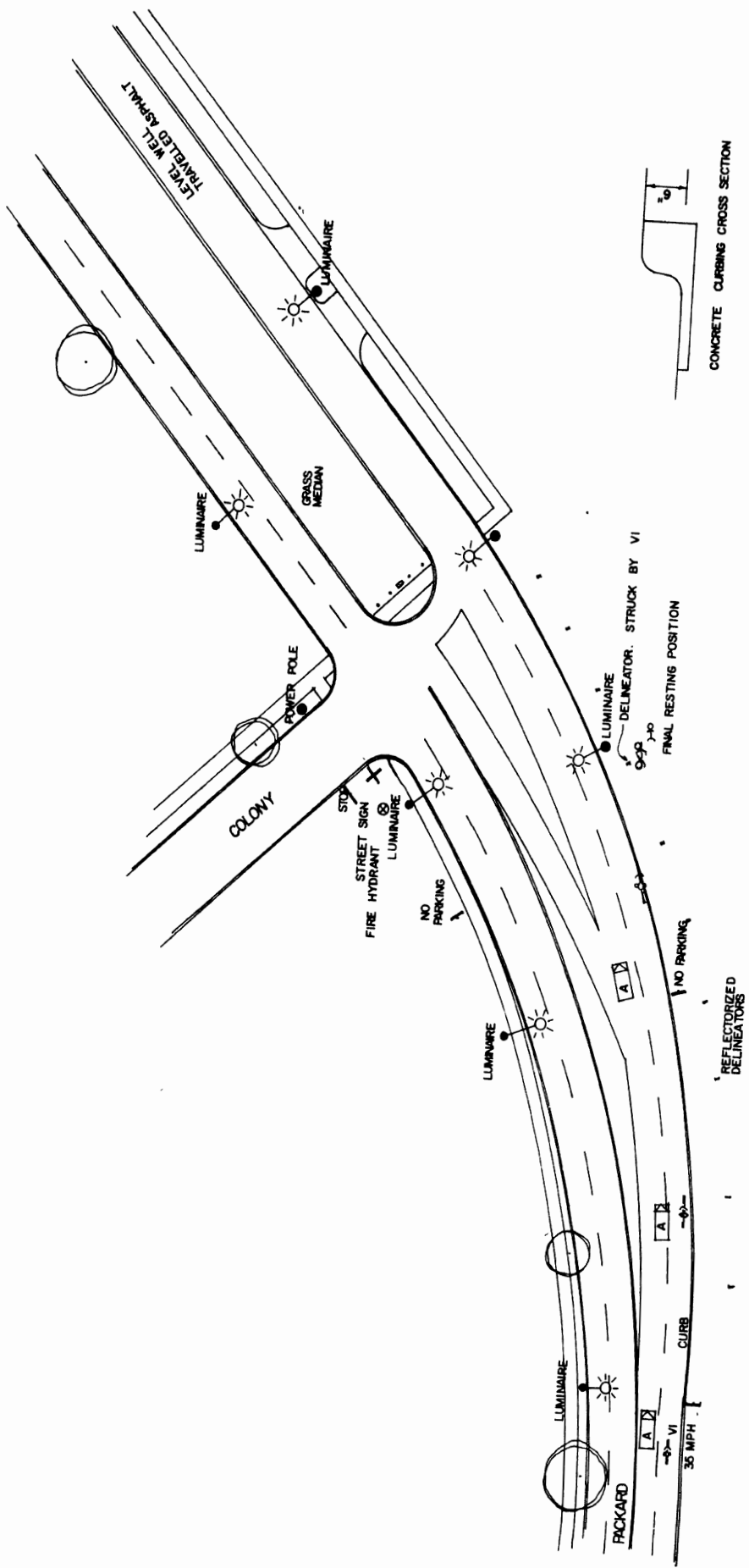
- 2 Helmet prevented serious head and facial injuries, but caused forehead laceration from helmet rim and allowed concussion. (Definite)
- 2 Driver 1's face shield detached from helmet. (Definite)

Postcrash Factors

- *3 Ambulance arrival prompt and treatment appropriate. (Definite)

Recommendations

- 1 Drivers need to be made aware of danger of passing motor vehicles on the right side.
- 1 Investigate feasibility of state establishing a cross reference system of motorcycle owners and those with motorcycle licenses to be sure all motorcycle owners are licensed.



UNIVERSITY OF MICHIGAN HSRI

ACCIDENT SCHEMATIC AA 349



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-350
CASE SUMMARY

Identification

Accident occurred on open roadway section of Washtenaw Avenue in residential area of city of Ann Arbor, Washtenaw County, Michigan, on Friday, March 30, 1973 at 0038 hours. Two passenger cars, head-on collision. Driver 1 impaired by alcohol. (0.08 BAC). Injury severity AIS* code 03, severe, not life-threatening.

Ambience

Dark, street lights on. Temperature 51^o, relative humidity 94%, wind 5 mph from the south. Roadway wet.

Highway

Washtenaw Avenue is 4-lane major arterial. Roadway southeast of accident site 42 feet wide, three 10-foot lanes and northwest outside lane 12-feet wide. Street narrows without warning to 38 feet at point of impact; all four lanes 9½ feet wide. No divider. Surface well-traveled asphalt. Road edge 6-inch-high concrete curbing**; tapers in 4-feet at point of impact. Roadway straight, crowned for drainage, graded -2' to northwest. Two mercury vapor luminaries. Within a quarter-mile radius: 15 driveways, 5 intersections, 15 utility poles (some very close to roadway), 50 trees. The Washtenaw County data base indicated no accidents at the accident site on Washtenaw Avenue in a five-year period. However, many of the trees and poles have scars from vehicles impacting with them, and there are fresh tire marks on and over the curb.

Traffic Controls

Speed limit posted 35 mph. Intermittent white lane delineators, solid yellow double center line; visibility worn. Two "No Parking" signs. No signals.

Vehicles

Vehicle 1. passenger car. 1968 Chevrolet Chevelle 2-door sedan; medium blue exterior and interior; odometer 53,299 miles. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission; no power accessories; padding on upper instrument panel, sunvisors, armrests, and upper A-pillars. Lap belts and upper torso restraints available. Rear tires of unequal size. Last maintenance at 49,324 on December 12, 1972, included lubrication, oil change, and oil filter. Damage: 25 inches of frontal sheet metal crush including hood, grill, bumper.

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs standard in city of Ann Arbor, Michigan.

and fenders; body mount in front of left rear wheel separated; left hood hinge spring came off and right hinge bent; engine and transmission mount separated; engine compartment telescoping unit compressed 2.5 inches; energy-absorbing steering device compressed 1.7 inches. VDI*:12-FDEW-3.

Vehicle 2, passenger car, 1973 Chevrolet Nova, 2-door sedan; olive green exterior, grass green interior; odometer 7,787 miles. No motor vehicle inspection. Automatic transmission; power steering; padding on upper instrument panel, sunvisors, seat backs, and armrests; very light padding on doors. Lap belts available to all six occupants, upper torso restraints available only to front outside occupants. No vehicle defects observed; no vehicle maintenance recorded. Frontal and left front corner damage to hood, grill, bumper, and fenders, 20 inches of sheet metal crush; hood latch damaged, left hood hinge bent; steering column flexible coupling bent; left body mount at end of stub frame bent, but still attached; 2.3 inches of compression to energy-absorbing steering device; shear capsule separated one inch; seat backs very badly damaged (some of the seat back damage probably done by ambulance attendants trying to extricate occupants); right pivot pin for left front seat back came out. VDI:11-FDEW-3.

Occupants

Driver 1, 24-year-old Caucasian male, 69 inches and 155 pounds. Had been driving for 8 years; averaged 10,000 miles per year until last year, when accumulated 22,000 miles because of commuting to work. Driving from bar to home; 5 miles from origin, 2 miles from destination. Had driven Vehicle 1 18,000 miles in eight months; unfamiliar with area, only traveled there four or five times. Completed 2-phase driver education course in high school. Overall physical and mental condition good. Blood Alcohol Concentration (BAC) 0.08. Driver unrestrained. Injuries: broken tooth, abrasions right cheek and nose, contusion left knee, soreness upper thorax. Injury severity AIS code 01, minor.

Vehicle 1, right front passenger, 24-year-old Caucasian male, 69 inches and 140 pounds. Unrestrained. Injuries: 2-inch laceration on forehead, fractured right mandible, bit lip with teeth, 2-inch scrape right shin, pain right leg and right elbow. Injury severity AIS code 02, moderate.

Driver 2, 37-year-old Caucasian female, 67 inches and 125 pounds. Driving 21 years, averaging 17,000 miles per year. Traveling from work to take passengers home to Ypsilanti, then to her home in Milan; 2 miles from origin, 16 miles from final destination. Familiar with vehicle, had accumulated 7,700 miles in five months; familiar with area, traveled route twice daily. No driver education. Physical and mental condition good. No alcohol involved. Driver unrestrained. Injuries: 3-cm mid-forehead laceration, 3-cm laceration right cheek, abrasion left

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

cheek, pain back of neck and mid-back, pain lateral aspect right upper arm, small abrasion left knee, fractured medial femoral-condyle right leg, brief unconsciousness. Injury severity AIS code 02, moderate.

Vehicle 2, center front passenger, 29-year-old Caucasian female, 64 inches and 117 pounds. Unrestrained. Injuries: Hematoma left occipital lobe, pain laterally and anteriorly across shoulders, contusion to back of left hand, open fracture right tibia and fibula midshaft, simple fracture lower third of left tibia and fibula. Injury severity AIS code 03, severe, not life-threatening.

Vehicle 2, right front passenger, 27-year-old Caucasian female, 64 inches and 175 pounds. Unrestrained. Injuries: contusions and pain left forehead; teeth knocked out of anterior upper plate; neck, chest, and abdominal pain; pain left scapula; bruise above left elbow; right hand black and blue; pain right hip; laceration left knee; contusions right knee and shin; contusions and soreness left ankle; brief unconsciousness. Injury severity AIS code 02, moderate.

Vehicle 2, left rear passenger, 40-year-old Caucasian male, 75 inches, and 243 pounds. Unrestrained. Injuries: pain and tenderness left forehead, pain lower left chest, fracture dislocation right wrist, comminuted fracture distal left femur, small abrasions mid-shin both legs. Injury severity AIS code 03, severe, not life-threatening.

Vehicle 2, center rear passenger, 52-year-old Caucasian female, 66 inches and 170 pounds. Unrestrained. Injuries: soreness top of head and right ribs; bruise lateral aspect left upper arm; contusions top of thighs; abrasion right knee; abrasions and contusions right shin; swelling, abrasions, contusions left shin, contusions top of right hand, ached all over. Injury severity AIS code 02, moderate.

Vehicle 2, right rear passenger, 32-year-old Caucasian female, 66 inches and 140 pounds. Unrestrained. Injuries: stiff neck, pain right shoulder, pain throughout chest, mid-back and sacral pain, pain right thigh, abrasions both shins, ankles contused. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

MVPS #201	Occupant Protection in Interior Impact-- Passenger Cars. Instrument panel padding in Vehicle 1 and padding on instrument panel, seat backs, and doors in Vehicle 2 minimized occupant injury.
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- MVPS # 203 Impact Protection for the Driver from the Steering Control System--Passenger Cars. Energy-absorbing device on Vehicle 1 compressed 1.7 inches; on Vehicle 2, 2.3 inches.
- MVPS # 204 Steering Control Rearward Displacement--Passenger Cars. Engine compartment telescoping unit on Vehicle 1 compressed 2.5 inches.
- MVPS # 205 Glazing Materials--Passenger Cars, Multipurpose Passenger Vehicles, Motorcycles, Trucks, and Buses. The windshields on both Vehicle 1 and Vehicle 2 fractured, but the glazing material prevented them from breaking into jagged pieces.
- TSPS # 8 Alcohol in Relation to Highway Safety. Driver 1 impaired by alcohol (BAC 0.08).
- TSPS # 12 Highway Design, Construction, and Maintenance. Roadway constructed so that northwestbound drivers traveling in the outside lane encounter unannounced 4-foot road width reduction, including a 2½foot narrowing of their lane.

Description

Pre-crash. Vehicle 1 northwestbound on Washtenaw Avenue in outside lane at 40 mph; Vehicle 2 southeastbound in outside lane at 30 mph. Vehicle 1 scuffed curb with right wheels, rode 150 feet along curb then mounted it, steered hard left to avoid telephone pole, braked, and crossed into opposing traffic lanes. Driver 2 braked hard, slowing to 25 mph. Driver 1 committed 2 violations of traffic law; was impaired by alcohol and failed to have vehicle under control. Vehicle 2 left scuff marks along right curb and 14 feet of intermittent skid marks leading into opposing lane. Vehicle 2 left 12 feet of skid marks with front tires.

Crash. Front end of Vehicle 1 impacted left front of Vehicle 2 at impact speed of 25 mph for both cars. None of the occupants of either car were restrained. Driver 1 thrown forward and sustained broken tooth and abrasions to right cheek and nose from striking windshield, contusion left knee from instrument panel, and soreness to upper thorax from impacting steering wheel. Vehicle 1 right front passenger heavily impacted windshield with right side of face resulting in two-inch forehead laceration, fractured right mandible, and bitten lip. He also had two-inch scrape on right shin from instrument panel. Driver 2 went forward and left; suffered 3-cm right cheek laceration and brief unconsciousness from contacting windshield; abrasion left cheek from either windshield or left A-pillar; pain lateral aspect right upper arm from instrument panel contact or contact with center front occupant, pain back of neck and mid-back from flexion at impact; and small abrasion left knee and fractured medial femoral condyle of right leg from striking lower instrument panel. Vehicle 2 center front passenger thrown forward and left and sustained hematoma left occipital lobe either from seat back or rear seat

occupant, lateral and anterior pain across shoulders from upper instrument panel, contusion to back of left hand from hitting either instrument panel or steering wheel, open fracture midshaft right tibia and fibula from the ashtray on mid-instrument panel, and simple fracture lower third of left tibia and fibula from mid-instrument panel. Right front passenger went forward and left into windshield and instrument panel and also contacted center front passenger; sustained contusions and pain left forehead, teeth knocked out of anterior upper plate, and brief unconsciousness from windshield, pain right hip from instrument panel, neck pain from force of impact, chest and abdominal pain from impacting upper instrument panel, pain left scapula from colliding with center front passenger, bruise above left elbow from either mid-instrument panel or center front passenger, black and blue right hand and laceration left knee from striking instrument panel, contusions right knee and shin from glove compartment door, and contusions and soreness left ankle from flexing at impact. Left rear passenger thrown forward, jammed his left leg between left door and seat back causing comminuted fracture of distal left femur and pain to lower left chest area; and also suffered pain and tenderness of left side of forehead from hitting either B-pillar, window, or windowframe; and had fracture dislocation of right wrist and small abrasions mid-shin of both legs from seat back. Center rear passenger impelled forward with upper torso over front seat; had soreness to top of head from hitting roof or front center passenger; ached all over from impact force; and from striking seat back suffered soreness right ribs, bruise lateral aspect left upper arm, contusions top of thighs, abrasion right knee, abrasions and contusions right shin, swelling, abrasions and contusions left shin and contusion top of right hand. Right rear passenger also went forward so that upper torso was over seat back resulting in pain right shoulder, pain throughout chest, mid-back and sacral pain, pain right thigh, and abrasions both shins; suffered stiff neck from impact force; and ankles contused from flexing at impact. Vehicle 1 sustained 25 inches of frontal sheet metal crush to hood, grill, bumper, and fenders; body mount in front of left wheel separated; left hood hinge spring came off and right hinge bent; engine and transmission mount separated; engine compartment telescoping unit compressed 2.5 inches; and energy-absorbing steering device compressed 1.7 inches. Vehicle 2 had heavy frontal and left corner damage to hood, grill, bumper and fenders, with 20 inches of frontal sheet metal crush; hood latch damaged; left hood hinge bent; steering column flexible coupling bent; left body mount at end of stub frame bent, but remained attached; 2.3 inches of compression to energy-absorbing steering wheel device; shear capsule separated one inch; seat backs very badly damaged; and right pivot pin for left front seat back came out. Directions of force 12:00 o'clock to Vehicle 1 and 11:00 o'clock to Vehicle 2.

Postcrash. Vehicle 1 occupants conscious, got out of car unassisted, and went to Vehicle 2 to help. Right front passenger of Vehicle 1 began to feel dizzy and returned to Vehicle 1 to lay down. Police arrived in 2-3 minutes, radioed for ambulance which arrived in seven minutes. All vehicle 2 occupants remained in car until ambulance arrived. Left front door of Vehicle 2 difficult

to open because it shifted on its hinges at impact. Vehicle 1 right front passenger, Driver 2, and Vehicle 2 front center passenger whose legs were splinted were backboarded and transported to hospital in first ambulance. Vehicle 2 left rear passenger removed through hatchback; remaining Vehicle 2 occupants removed out front doors; all placed on backboards and transported to hospital in second ambulance. Police drove Driver 1 to police headquarters, administered the breathalyzer test, then took him to hospital where he was treated and released. No fires, explosions, or environmental problems. Glass and grill pieces from both vehicles in roadway. Traffic routed in remaining open lanes.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Pre-crash	Crash	Post-crash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell Explanation

Accident Causation

Primary/Principle Causes

- 1 Driver 1 overcorrected and crossed into opposing lanes of traffic. (Definite)
- 7 Roadway narrows substantially with no warning (width of Driver 1's lane reduced by 2½ feet).
Definite

Relevant

- 1 Driver 1 impaired by alcohol (BAC 0.08).
(Definite)
- 1 Driver 1 unfamiliar with roadway and unaware road narrows at accident site. (Definite)
- 1 Driver 1 talking to right front passenger and inattentive to driving task. (Definite)
- *5 Seat back latches of Vehicle 2 held despite deformation from collision and loading by rear seat passengers. (Definite)
- *5 Padding of Vehicle 2 seat backs minimized injury-potential to rear seat passengers. (Probable)

7

Driver 1 driving at night which made it more difficult for him to see narrowing roadway.
(Definite)

Injury Causation

2

Injuries to occupants of both Vehicle 1 and Vehicle 2 would have been minimized had they used available restraint systems.
(Definite)

Recommendations

Driver education courses should emphasize need to wear safety restraint systems to minimize injury in event of an accident.

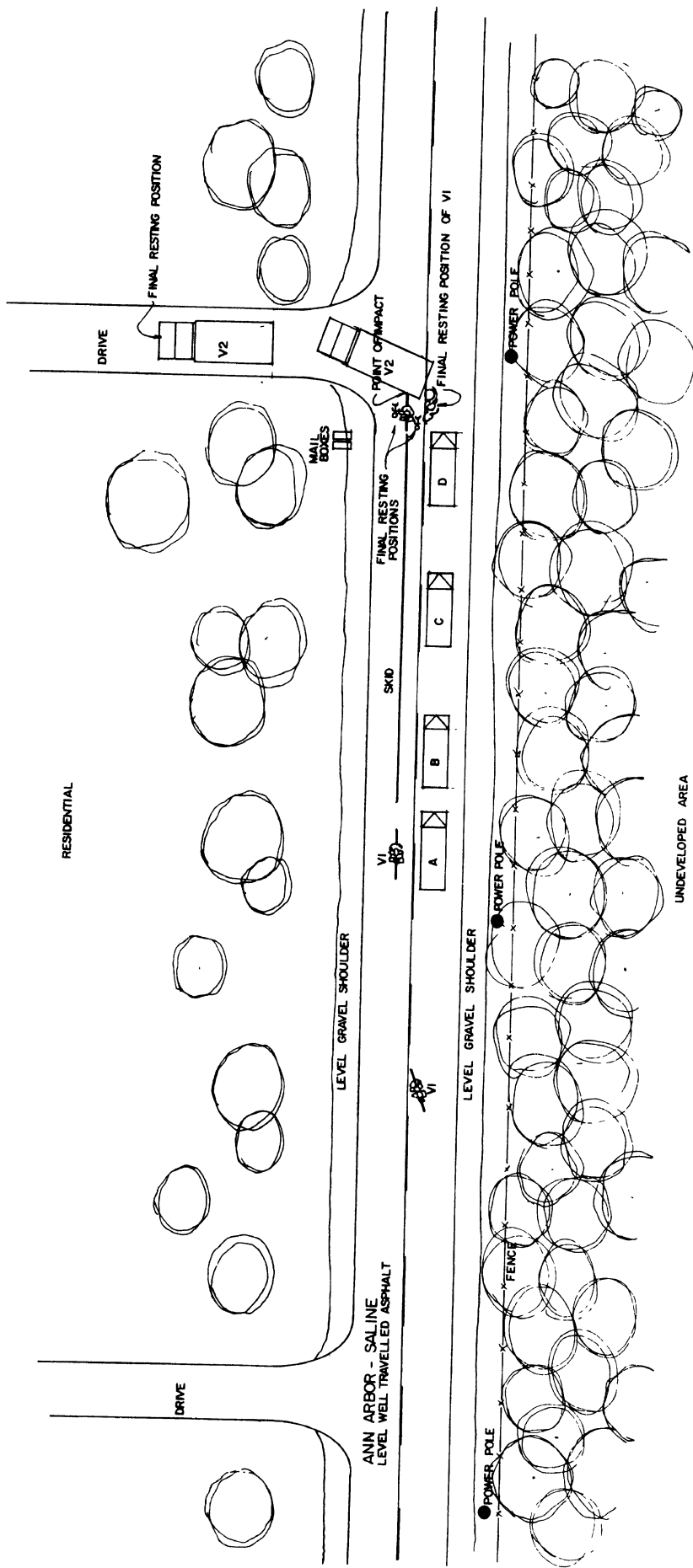
Driver education courses should emphasize need to pay attention to driving task, especially at night on unfamiliar roads, and should give instruction on corrective maneuvers.

Drivers should be cautioned not to drive under the influence of alcohol.

Inherent danger in abruptly narrowing traffic lanes should be considered in highway design.

A sign to warn of roadway configuration change should be erected on Washtenaw Avenue before lanes begin to narrow.

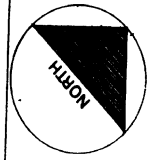
Redivide lane widths so that both southeast lanes and inside northwest lane are 9 feet wide, and the outside northwest lane is 11 feet wide.



ACCIDENT SCHEMATIC AA348



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-351
CASE SUMMARY

Identification

Accident occurred on Huron Street at intersection with Crest Street in residential area of city of Ann Arbor, Washtenaw County, Michigan, on Friday, March 30, 1973, at 1400 hours. Teenage male pedestrian ran into side of multipurpose vehicle. Injury severity AIS* code 03, severe, not life-threatening.

Ambience

Daylight, gray and overcast. Temperature 51^o, relative humidity 94%, wind 5 mph from the south. Roadway dry.

Highway

Huron Street. 4-lane major arterial, 42 feet wide, no divider. New surface, well-maintained asphalt; 6-inch-high concrete curbing**. Open roadway, straight, crowned for drainage, +1 $\frac{1}{2}$ ^o grade to the west. No artificial lighting. Per quarter mile radius of accident site: 25 driveways, 3 intersections, 15 utility poles, and 50 trees. Only three accidents occurred in five years on Huron Street at the intersection with Crest Street, according to a search of the Washtenaw County data file. One occurred in the intersection, and one 250 feet west of the intersection. None of the accidents involved pedestrians.

Traffic Controls

Posted speed limit 30 mph. Intermittent white lane delineators; double yellow center line. Signs: "Speed Limit 30," "No Parking Anytime"; visibility good. No signals.

Vehicle

Multipurpose vehicle, 1971 Dodge Van; bronze exterior; odometer, 24,493 miles. Pennsylvania State inspection sticker. Automatic transmission, power brakes and power steering, upper instrument panel and armrests padded. Availability of safety restraint system unknown. Vehicle well maintained; defects unknown. No damage to vehicle, pedestrian's body dusted side of van. VDI*: 02-RDMW-0.

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs standard in city of Ann Arbor, Michigan.

*** Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Occupants and Pedestrian

Driver 1, 37 years old, male, Caucasian, 67 inches and 135 pounds. Twenty-one years driving experience; averaged 45,000 to 50,000 miles per year as proprietor and traveling salesman of stained glass company. Traveling from restaurant in Ann Arbor to home in Ann Arbor; $1\frac{1}{2}$ miles from origin, 2 miles from destination. Although Vehicle 1 was borrowed, Driver 1 familiar with it because he owned one identical to it. Lived in area so familiar with roadway. No driver education. Good physical and mental condition. Had consumed one cocktail before lunch. Unrestrained. No injury.

Right front passenger, 41-year-old male Caucasian, 69 inches and 169 pounds. Unrestrained. No injury.

Left rear passenger, 26-year-old Caucasian female, 67 inches and 110 pounds. Unrestrained. No injury.

Right rear passenger, 45 years old, male, Caucasian, 71 inches and 190 pounds. Unrestrained. No injury.

Pedestrian, 15-year-old Caucasian male, 67 inches and 125 pounds. Had been at friend's house; got involved in a fight on the sidewalk with a retarded boy; in running from retarded boy's brother who was coming down sidewalk on motorcycle, dashed into street. Physical condition generally good; no mental aberrations, but under situational stress. Injuries: transverse comminuted fractures of right femur, tibia, and fibula; abrasions below right knee. Injury severity AIS code 03, severe, not life-threatening.

Standards

TSPS 14	Pedestrian Safety. Pedestrian, reacting to panic situation, had other alternatives than to run into busy street.
---------	--

Description

Pre-crash. Vehicle 1 was westbound at 30 mph in outside lane. Pedestrian ran southward into the roadway from north side of street. Driver 1 did not see pedestrian in time to take evasive action; pedestrian was not aware of Vehicle 1's presence.

Crash. Pedestrian ran into right front fender along side of van. Vehicle 1 left 10 feet of continuous skid marks with left front wheel and 10 feet of intermittent skid marks with right front wheel. After initial impact pedestrian bounced back and rebounded into right front door, then fell to pavement; came to final rest against curb facing east about 10 feet from last point of impact with door. Sustained transverse comminuted fractures of right femur, tibia, and fibula, and abrasions just below

right knee from impacting van. No damage to vehicle.

Postcrash. Taxi driver who witnessed accident called police and ambulance. Both arrived on-scene in three to four minutes. Attendants checked injuries and vital signs, splinted leg, placed pedestrian on backboard and transported him to hospital where he was admitted. Pedestrian conscious on scene, semi-conscious in ambulance from shock. No fires, explosions, environmental problems, or debris. Police directed westbound traffic around Vehicle 1 which had come to rest in outside westbound lane, then moved van around corner at intersection with Crest Street.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary/Principle Cause

1 Teenage pedestrian darted into street without checking for traffic clearance and ran into side of van. (Definite)

Relevant Factor

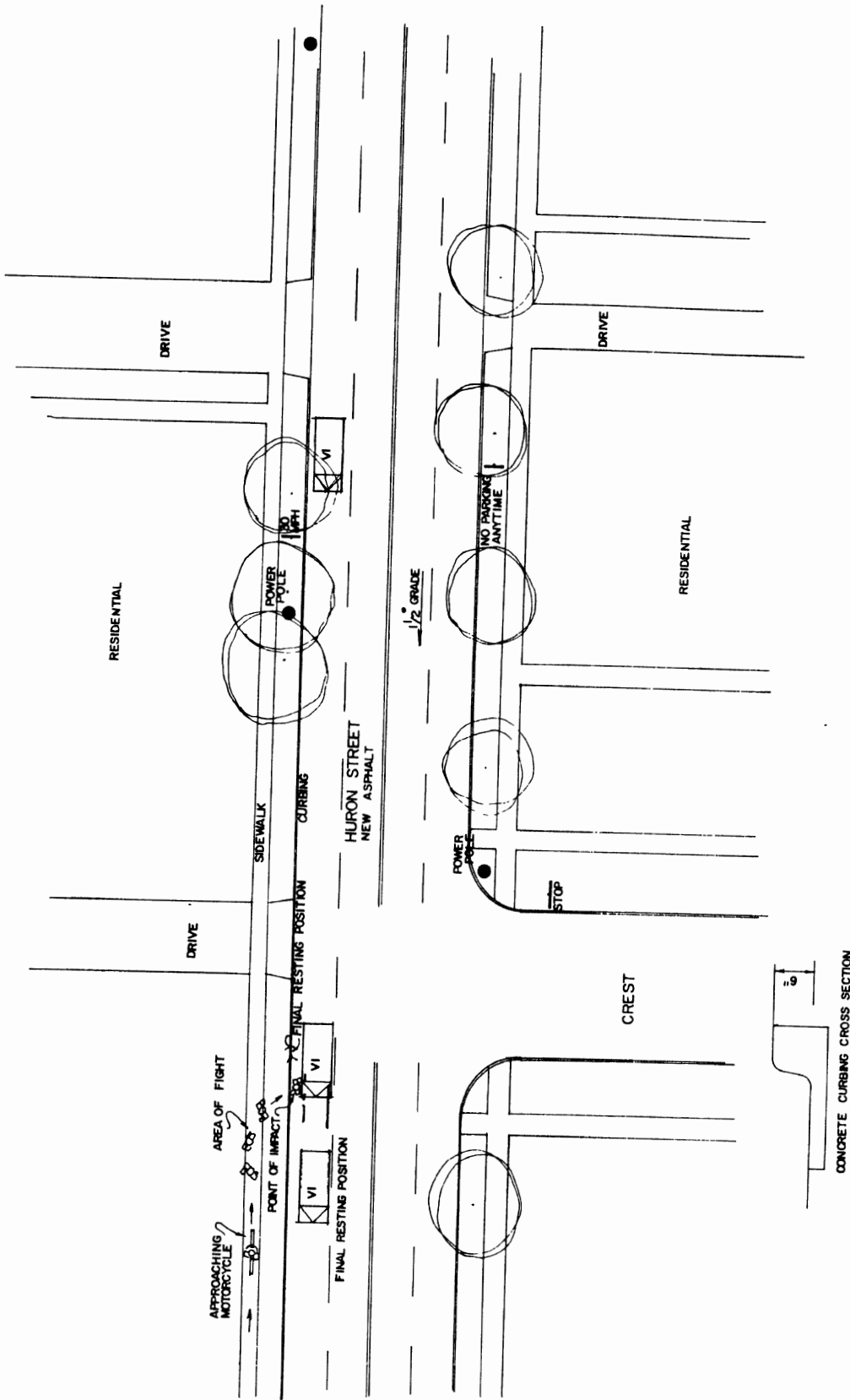
1 Pedestrian had been fighting on sidewalk and was fleeing panic situation. (Definite)

Postcrash Factor

*3 Ambulance response and treatment good. (Definite)

Recommendation

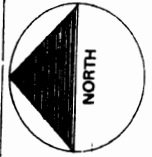
1 Safety programs should emphasize need for pedestrians to be extremely cautious when entering a street, especially a heavily-travelled roadway like Huron Street.



ACCIDENT SCHEMATIC AA 351



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-352
CASE SUMMARY

Identification

Accident occurred on Michigan Avenue (US-12), 300 feet west of intersection with US 23, in a commercial area of Pittsfield Township, Washtenaw County, Michigan, on Friday, April 13, 1973 at 1345 hours. Three passenger cars, chain reaction rear-end collision. Injury severity AIS* code 01, minor.

Ambience

Clear, sunny day; temperature 45^o, relative humidity 30%, wind 14 mph from the northeast. Roadway dry.

Highway

Michigan Avenue at accident location is 36-foot-wide three-lane major arterial, no divider. Surface well-travelled, well-maintained concrete. Road edge 6-foot-wide asphalt shoulders. Roadway straight, crowned for drainage, graded -2^o from the west. No artificial lighting. Within a quarter-mile radius: six driveways, one interchange, five utility poles, no trees. A total of 39 accidents was found in the five-year Washtenaw County data base for the intersection of Michigan Avenue (US-12) with US-23 and the area one to three hundred feet west of the intersection. There were five single-vehicle accidents, 29 two-vehicle, four three-vehicle, and one four-vehicle. Rear-end (16) and right angle (13) were the most frequent accident configurations, with the other categories distributed over out-of-control (5), sideswipe (4), and head-on (1). Using an approximated ADT of 2,000 (ADT given as between 1,000 to 3,000), the accident rate would be about one per every 100,000 vehicles.

Traffic Controls

Speed limit is posted at 45 mph. Solid white edge delineators; solid yellow center line for westbound traffic, intermittent yellow center line for eastbound traffic; no pavement marking between two westbound lanes. Visibility of pavement markings worn. "One Way," speed limit, directional, and route number signs. No signals.

Vehicles

Vehicle 1, passenger car, 1970 Ford Mustang Fastback 2-door sedan; odometer, 42,533 miles; blue exterior, black interior. No indication of vehicle inspection (periodic motor vehicle inspection

* American Medical Association Abbreviated Injury Scale (AIS).

not required in Michigan). Automatic transmission; no power accessories; padding on upper instrument panel, sunvisors, and armrests. Lap belts and upper torso restraints available. No vehicle defects observed. Last recorded maintenance at 32,594 miles on August 21, 1972, included new ball joints and steering linkage. Frontal damage included 15 inches of sheet metal crush; hood latch jammed; hood, bumper, splash pan, and right front fender damaged. VDI*: 12-FDEW-2.

Vehicle 2. passenger car, 1966 Buick Skylark convertible; odometer, 95,834 miles; black exterior and black convertible top, red interior. No indication of vehicle inspection. Automatic transmission; power steering; upper instrument panel, sunvisors, and armrests padded. Lap belts only available. Very little, if any, brake fluid; brake pedal went almost to the floor; left rear tire bald, 1/32 inch tread. Maintenance unknown; wife said brakes had been replaced two months earlier. Four inches of frontal sheet metal crush, damage to bumper and grill; rear damage to bumper, trunk lid, left quarter panel; fuel leakage from damaged fuel tank. VDI: 06-BDEW-2 (primary); 12-FDEW-1 (secondary).

Vehicle 3. passenger car, 1971 Mercury Cougar 2-door hardtop; odometer, 35,226 miles; metallic blue exterior with black vinyl top, blue interior. No indication of vehicle inspection. Automatic transmission; power brakes and power steering; upper instrument panel, sunvisors, and armrests padded. Lap belts and upper torso restraints installed. No vehicle defects observed. Last recorded maintenance at 30,064 miles on January 23, 1973 included oil, lubrication, and oil filter. Bumper, trunk lid, and right quarter panel damaged; five inches of rear end sheet metal crush. VDI: 06-BDEW-1.

Occupants

Driver 1, 50-year-old Caucasian female, 62 inches and 95 pounds. Driving for two years; limited experience first year, averaged 15,000 miles last year. Traveling from appointments and visiting in Ann Arbor to home in Saline; four miles from origin, five miles from destination. Familiar with vehicle, accumulated 15,000 miles on it in one year. Drove route four times a week. Had enrolled in high school summer session driver education course, but did not complete it. Physical condition good; mental condition poor. No blood alcohol; had taken methadone day before accident. Unrestrained. Injury: soreness to neck from whiplash. Injury severity AIS code 01, minor.

Driver 2, 26 years old, Black, male, 69 inches and 174 pounds. Ten years driving experience, averaged 20,000 miles a year. Driving from home in Detroit to work at Ford Plant in Saline; 40 miles from origin, 4 miles from destination. Familiar with vehicle, had driven it 20,000 miles in one year. Familiar with roadway, had traveled it twice daily for one month. No driver education. Good mental and physical condition. No blood

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

alcohol. Unrestrained. Injury: soreness to chest from impacting steering wheel. Injury severity AIS code 01, minor.

Driver 3, 27-year-old Black female, 64 inches and 127 pounds. Seven years driving experience, averaged 2,000 miles per year. Driving from home in Ypsilanti to work at Ford Plant in Saline; 5 miles from origin, 4 miles from destination. Familiar with vehicle, had driven it over 2,000 miles in one year; traveled roadway twice daily. No driver education. Good physical and mental condition. No blood alcohol. Unrestrained. Injuries: neck soreness and pain to right shoulder from whiplash, lower back pain from force of impact. Injury severity AIS code 01, minor.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|----------|--|
| MVPS 105 | Hydraulic Brake Systems--Passenger Cars. Vehicle 2 had poor brake pedal pressure due to low brake fluid level, poor overall vehicle maintenance. |
| MVPS 202 | Head Restraints--Passenger Cars. Vehicle 2 had no head restraints (Vehicle 2 prestandard, no injury to Driver 2); Vehicle 1 and Vehicle 3 had head restraints, but Driver 1 and Driver 3 still received whiplash injury. |
| MVPS 301 | Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. Fuel tank on Vehicle 2 (prestandard) damaged and leaked fuel. |
| TSPS 4 | Driver Education. Driver education courses should warn drivers to be alert while driving, especially while driving under stress; also educate drivers to wear safety restraints (none of drivers restrained, but did not affect their injuries). |
| TSPS 5 | Driver Licensing. There is a need to identify problem drivers (such as Driver 1) and make reeducation programs available specifically geared for rehabilitation. |
| TSPS 12 | Highway Design, Construction, and Maintenance. Roadway at accident location had poor geometric design, and truck stop driveway was too close to expressway exit ramp. |
| TSPS 13 | Traffic Control Devices. There is no signing on Michigan Avenue to warn drivers of trucks crossing from the truck stop to the expressway entrance ramp. |

Description

Precrash. Vehicle 1 westbound at 38 mph (based on skid marks and impact speed estimate); Vehicle 2 and Vehicle 3 westbound and stopped; all in inside lane. Vehicle 2 and Vehicle 3 had been stopped several seconds, took no evasive maneuvers; Driver 1 braked and slid 40 feet leaving 40 feet of skid marks with tires. Driver 1's inability to stop in sure, clear distance a violation of traffic law.

Crash. Front end of Vehicle 1 impacted rear end of Vehicle 2 at estimated impact speed of 25 mph; impact moved Vehicle 2 forward and Vehicle 2's front end struck rear end of Vehicle 3. Driver 1 thrown forward and sustained soreness to neck from whiplash; Driver 2 leaning forward slightly at impact, was jolted back, then went into steering wheel and had soreness to chest from impacting steering wheel; Driver 3 impelled rearward, then rebounded forward and suffered neck soreness and pain to right shoulder from whiplash, and lower back pain from force of impact. Vehicle 1 had 15 inches of frontal sheet metal crush; hood latch jammed; hood, bumper, splash pan, and right front fender damaged. Vehicle 2 had four inches of frontal sheet metal crush, damage to bumper and grill; rear damage to bumper, trunk lid, left quarter panel; fuel leaked from damaged fuel tank. On Vehicle 3, bumper, trunk lid, and right quarter panel damaged; five inches of rear end sheet metal crush. Directions of force 12:00 o'clock to Vehicle 1, 12:00 o'clock and 6:00 o'clock to Vehicle 2, and 6:00 o'clock to Vehicle 3.

Postcrash. Nearby gas station attendant called police. Cruising state police on-scene in one or two minutes but did not investigate accident; Washtenaw County Sheriff's deputies arrived in five minutes, ambulance in seven or eight minutes. Driver 2 and Driver 3 exited themselves; Driver 1 remained in car and was very stiff. Attendants feared Driver 1 had neck injury so used short backboard to extricate her from car. Driver 2 and Driver 3 did not request medical treatment, but few days later Driver 3 saw doctor because of sore neck. Driver 1 transported to hospital, treated, and released; described as still shaken by accident and suffering mild psychological shock. No fire, explosions, or environmental problems. Debris in roadway consisted of grill pieces and glass from Vehicle 1, radiator fluid leakage from Vehicle 1 and Vehicle 2, and small fuel leakage from Vehicle 2. Police directed traffic into open eastbound lanes, alternating between eastbound and westbound traffic.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary/Principle Causes

- 1 Driver 1, unable to stop in sure, clear distance, rear-ended Vehicle 2 which was stopped in traffic lane (Definite)
- 1 Vehicle 2 moved forward by Vehicle 1 and struck rear end of stopped Vehicle 3. (Definite)

Relevant Conditions

- 1 Driver 1 inattentive to driving task, did not observe stopped vehicles in time to avoid collision. (Definite)
- 1 Driver 1's poor mental condition impaired his driving ability. (Probable)
- 1 Prolonged drug use impaired Driver 1's driving ability. (Probable)
- 7 Truck stop located across from expressway entrance ramp which necessitates vehicles stopping on highway while trucks cross to on-ramp. (Definite)
- 7 No signing to indicate truck crossing. (Definite)

Injury Causation

- 2 Drivers 1, 2, and 3 were unrestrained (restraint usage would not have affected their injuries). (Definite)
- *2 Driver 2 leaned forward and relaxed when he became aware of the impending crash; this may have prevented whiplash. (Possible)
- 5 Head restraint in Vehicle 3 did not prevent whiplash injury to Driver 3 (Driver 1 also sustained slight whiplash even with head restraint). (Definite)

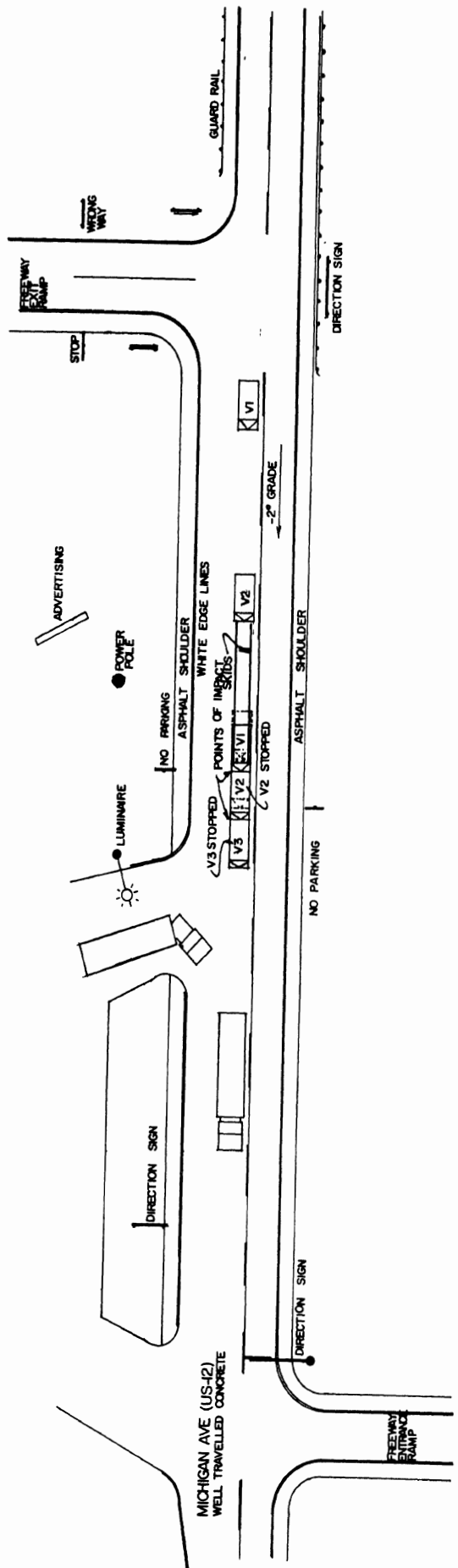
Postcrash Factors

- *3 Ambulance arrival prompt and treatment efficient and appropriate. (Definite)
- 6 Ruptured fuel tank in Vehicle 2 and fuel leakage caused potential fire hazard. (Definite)

Recommendations

- 1 Identify problem drivers such as Driver 1 (three accidents in one year), and establish driver reeducation programs directed at rehabilitating the individual.
- 1 Educate the public to use available restraint systems.
- 4 Reevaluate head restraint effectiveness.
- 7 Install adequate signing to warn of trucks crossing from truck stop to expressway entrance ramp.
- 7 Redesign traffic flow pattern at truck stop so that trucks would go in driveway near exit ramp and would go out driveway across from entrance ramp.

TRUCK STOP - GAS STATION - RESTAURANT



ACCIDENT SCHEMATIC AA 352



UNIVERSITY OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-353
CASE SUMMARY

Identification

Accident occurred on West Stadium Boulevard 20 feet west of South Main Street intersection in a commercial and school zone area in city of Ann Arbor, Washtenaw County, Michigan on Friday, April 13, 1973 at 1611 hours. Passenger car and motorcycle, head-on collision. Injury severity AIS* code 03, severe, not life-threatening.

Ambience

Clear, sunny day; temperature 42^o, relative humidity 37%, wind 10 mph from northwest. Roadway dry.

Highway

West Stadium Boulevard at point of impact is 57-foot-wide major arterial; four lanes plus center lane for left turn only; no divider. Surface well-travelled asphalt; road edge 6-inch-high concrete curbs.** Roadway straight, level, crowned for drainage. Within quarter-mile radius: 5 driveways, 1 intersection, 8 utility poles, and 25 trees. The Washtenaw County five-year file was filtered to include accidents on West Stadium Boulevard from the intersection with South Main Street to 20 feet west of the intersection. Twenty-seven accidents were found. The Average Daily Traffic (ADT) is 20,000; therefore one out of about every 1,352,000 vehicles is involved in an accident. All were two-vehicle accidents except one which was a single-vehicle accident. Accident configurations were distributed over right angle (12), rear-end (10), head on (3), sideswipe (1), and collision with pedestrian (1). One accident occurred 10 feet west of the intersection and the rest took place directly in the intersection, so there were no previous accidents exactly at the point of impact of this case.

Traffic Controls

Posted speed limit 35 mph. Solid, white lane delineators; solid, yellow, double center lines. Other pavement markings included turn arrows, word "ONLY," and pedestrian crosswalk indicated by wide white lines. School crossing and no parking signs; signs on hanging traffic signal giving light designations. Modern, multi-phase, traffic-activated traffic signals; one set of three 3-color lights each for north-, south-, and eastbound traffic; set of four 3-color lights for westbound traffic.

Vehicles

Vehicle 1, motorcycle, 1971 Honda 175 Scrambler; odometer 3,014

* American Medical Association Abbreviated Injury Scale (AIS).

** Six-inch-high curbs standard for city of Ann Arbor, Michigan.

miles; burnt orange with black accent stripes. No vehicle inspection. Maintained regularly by Honda dealer. Damage to fuel tank, front forks, and handlebars. No VDI* for motorcycles.

Vehicle 2, passenger car, 1971 Chevrolet Vega Hatchback; odometer 14,031 miles; robin's egg blue exterior, black interior. Automatic transmission; no power accessories; upper instrument panel, sunvisors, and armrests padded. Lap belts and upper torso restraints installed. Maintenance unknown. Driver's door damaged and inoperable from previous accident. Damage to front bumper, lower splash pan, and grill area; 12 inches frontal sheet metal crush. Damage to left side was from previous accident. VDI: 01-FCEN-2.

Occupants

Driver 1, 16 years old, male, Caucasian, 70 inches and 145 pounds. One-year experience with passenger cars, accumulated 3,000 miles; driving motorcycles 2 years, averaging 1,000 miles per year. Out for drive, on way home; 20 miles from origin, $\frac{1}{2}$ mile from destination. Familiar with motorcycle; traveled area daily. High school driver education course. Physical and mental condition good. No alcohol. Injuries: fractured head of left femur, briefly unconscious. Injury severity AIS code 03, severe, not life-threatening.

Vehicle 1, passenger, 17-year-old Caucasian male, 68 inches and 145 pounds. Experienced cyclist. Injuries: simple fractures of right tibia and femur, 3-cm vertical laceration between eyebrows; no loss of consciousness. Injury severity AIS code 02, moderate.

Driver 2, 21 years, Caucasian, female, 64 inches and 125 pounds. Driving 3 years, averaging 12,000 miles per year. Traveling from work at Chrysler Plant west of Ann Arbor city limits to babysitter's and home in Ypsilanti; was turning left into gas station. Eight miles from origin, 4 miles from final destination. Familiar with vehicle having driven it 14,000 miles in little over one year; traveled route twice daily. High school driver education. Physical condition good, mental condition good but fatigued, poor driver record. No blood alcohol. Unrestrained. No injury.

Standards

The following Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|--------|---|
| TSPS 3 | Motorcycle Safety. The size of motorcycles lowers their visibility to other motorists on the highway. |
| TSPS 4 | Driver Education. Drivers need to be cautioned to be alert and to check carefully for clearance when turning left near busy intersections; also should be encouraged to use safety restraint systems. Stopping at intersection with green light may cause other drivers to assume light is red. |

* Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

TSPS 5

Driver Licensing. Driver 1 did not have a permit to operate a motorcycle as is required by Michigan law. Driver 2 had poor driver record, had two license suspensions, and failed to complete a reexamination test.

Description

Precrash. Vehicle 1 westbound in inside lane at 35 mph; Vehicle 2 eastbound in center lane for left turn only, stopped to let traffic pass, then started left turn into filling station driveway. Driver 1 braked and swerved to right of his lane. Driver 2's failure to yield right-of-way violation of traffic law.

Crash. Front end of Vehicle 1 impacted center front of Vehicle 2 at impact speed of 25 mph. Driver 1 and his passenger impelled over handlebars and onto hood of car, continued over car and came to final rest on pavement about 15 feet west of Vehicle 2 in outside lane. Driver 1 fractured head of left femur from initial impact with car and was briefly unconscious from hitting head on pavement. Driver 1's helmet was scuffed from pavement. Passenger fractured right femur and tibia from striking car, and had a 3-cm vertical laceration between eyebrows from unknown cause. Driver 2 was not injured. Vehicle 1's fuel tank, front forks, and handlebars were damaged. Vehicle 2 had 12 inches of frontal sheet metal crush and damage to front bumper, lower splash pan, and grill area. Direction of force to Vehicle 2 was 1:00 o'clock.

Postcrash. Gas station attendant called police, and bystanders had boys lie still until ambulance arrived. Police arrived on-scene in about one minute, ambulance in five minutes. Ambulance attendants applied air splint to passenger's leg and placed him on backboard; not sure of nature of Driver 1's hip injuries so carefully backboarded him; both transported to hospital and admitted. No fires, explosions, or environmental problems. Grill pieces from Vehicle 2 and rear turn signal lens from Vehicle 1 on roadway. Traffic routed around accident into open lanes.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary/Principle Cause

1 Driver 2 turned left in front of Vehicle 1.
(Definite)

Severity Decreasing Factor

*1 Driver 1 braked and swerved right to avoid
accident. (Definite)

Relevant Conditions

1 Driver 2 inattentive to approaching cycle.
(Definite)

1 Driver 2 made incorrect decision to turn when
she did because Vehicle A* appeared stopped in
outside westbound lane and Driver 2 thought
traffic was stopped for red light. (Probable)

1 Driver 2 fatigued. (Definite)

1 Driver 2 had poor driver record. (Definite)

1,7 Independently activated signals enable traffic
bound in one direction to have different signal
phase than traffic bound in opposite direction.
Awareness of this may have confused Driver 2
and contributed to her assumption that westbound
traffic was stopped. (Possible)

Injury Causation

*2 Helmets worn by Driver 1 and Passenger 1
protected them from possible severe head
injuries. (Definite)

2 Driver 1 and Passenger 1's snap-on face shields
unsnapped on impact; Passenger 1 sustained a
3-cm facial laceration. (Definite)

Postcrash Factor

*3 Ambulance arrival prompt and treatment appropriate.
(Definite)

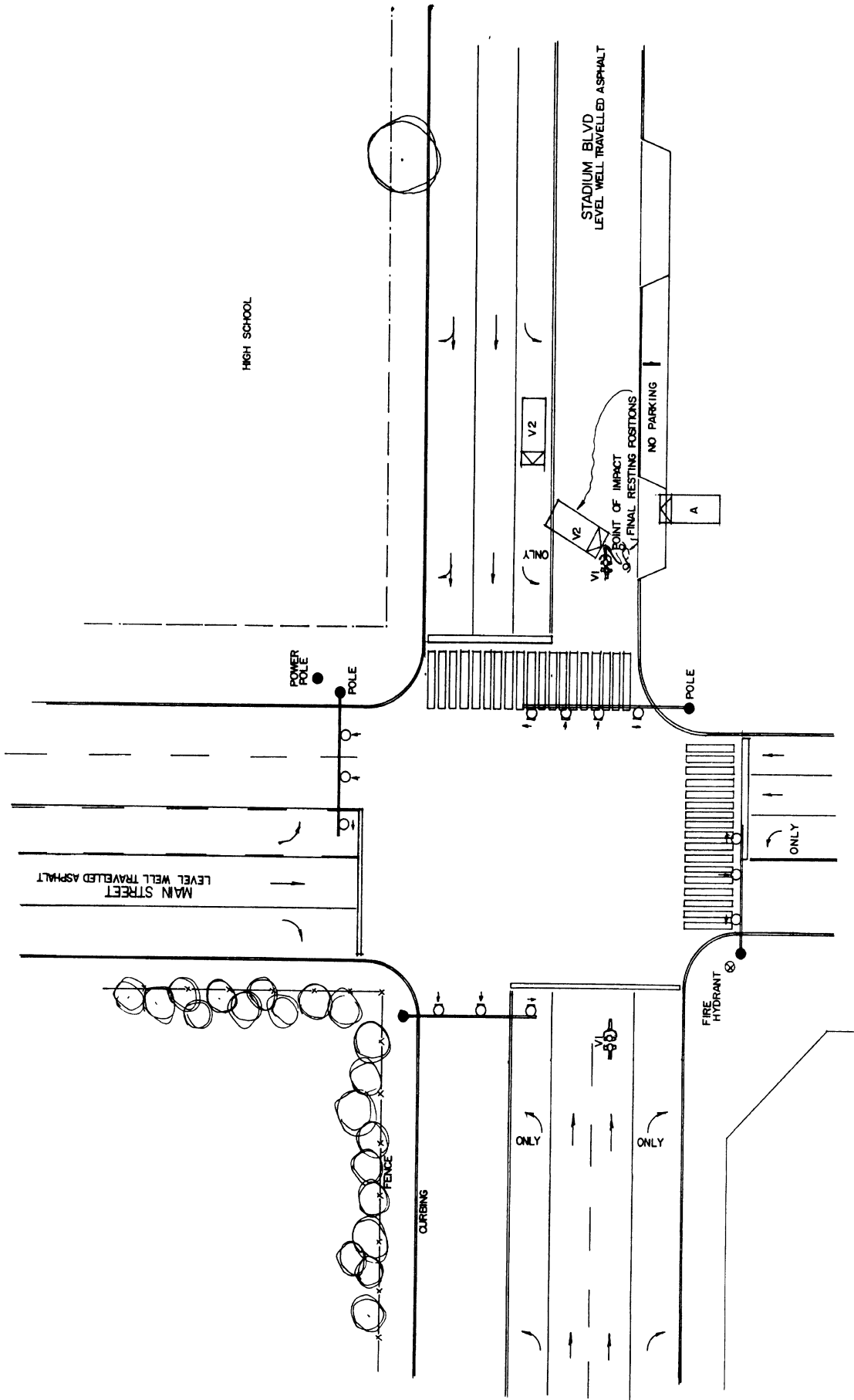
* Car stopped in outside westbound lane, designated as Vehicle A,
contributed to accident but was not directly involved so was not
investigated in-depth.

Matrix Cell

Explanation

Recommendations

- | | |
|---|--|
| 1 | Driver education courses should emphasize: that drivers must be especially careful near busy intersections; that motorists must be alert for motorcyclists because of their low visibility; and the need to wear safety restraint systems. |
| 1 | Face shield attachments to helmets need to be redesigned because they frequently come unsnapped in accidents and allow potential for severe facial injuries. |
| 1 | Programs need to be initiated that are geared at rehabilitating the individual problem driver and revising his attitudes toward driving. |

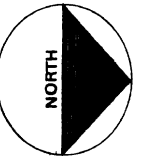


ACCIDENT SCHEMATIC

AA 353



UNIVERSITY
OF MICHIGAN **HSRI**



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-354
CASE SUMMARY

Identification

Accident occurred on Earhart Road, 200 feet south of intersection with Pine Brae, in residential section of city of Ann Arbor, Washtenaw County, Michigan, on Thursday, April 19, 1973, at 0954 hours. Two tractor-trailers, rear corner impact. Injury severity AIS* code 02, moderate.

Ambience

Overcast, but clearing after light rainfall. Temperature 58°, relative humidity 87%, wind 13 mph from east. Roadway wet.

Highway

Earhart Road 25-foot-wide 2-lane collector, no divider. Surface well-traveled, well-maintained asphalt. Road edge 6-foot-wide gravel shoulders. Roadway straight, crowned for drainage, graded +2° to north. No artificial lighting. One intersection within quarter-mile radius; many trees, six utility poles. Pine Brae local street. Filtering five years of Washtenaw County data to include accidents on Earhart Road from the intersection with Pine Brae to 200 feet south of intersection indicated only one accident. This was a two-vehicle right-angle collision at the intersection.

Traffic Controls

Speed limit posted 35 mph. No traffic controls.

Vehicles

Vehicle 1, 1968 Ford F700 semi-tractor with Fruehauf flat stake semi-trailer; odometer 108,943 miles; red cab. No indication of vehicle inspection (periodic motor vehicle inspection not required in Michigan). Cab had vacuum-assist hydraulic brakes, trailer had air brakes operated by using handle on steering column. Upper instrument panel padded. Lap restraints available. Tires very worn and cut. Maintenance unknown. Damage: 31 inches crush to left B-pillar, left and right A- and B-pillar damage, damaged left roof rail, fuel tank deformed and was partially disengaged, filler pipe separated from tank, steering wheel spokes deformed, 50% windshield bond separation, seat damage. VDI** :06-BPHN-9. Duo servo brakes multiply effective brake force by 3.0 to 7.0 times,

*American Medical Association Abbreviated Injury Scale (AIS).

**Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

but this advantage lost when going in reverse. When engine stalls, vacuum assist lost.

Vehicle 2, 1972 Diamond Reo with Garwood dump box and Fruehauf trailer; odometer 47,320 miles; red cab. No vehicle inspection. Power steering, no padded components. Air brakes. Lap restraints available. No vehicle defects; maintenance unknown. Sheet metal damage to right side of trailer, three inches of crush. VDI to trailer: 02-RRMN-1.

Occupants

Driver 1, 60-year-old male, Caucasian, 68 inches and 165 pounds. Forty years driving experience; averaged 50,000 miles per year with truck, 7,000 miles per year with personal pickup truck. Traveling from Ypsilanti, Michigan to Lutheran Retirement Center in Ann Arbor with load of heavy structural steel; 7 miles from origin, 1 1/2 miles from destination. Familiar with cab part of truck having operated it two years; trailer put on just that day so unfamiliar with it but had pulled similar trailers. Unfamiliar with route. No driver education. Good physical and mental condition. Alcohol on breath. Unrestrained. Injuries: contusion over left clavicle, abrasion posterior left shoulder, pain left chest and side, fractured left 7, 8, and 9 ribs, low back pain. Injury severity AIS code 02, moderate.

Vehicle 1, right front passenger, 44 years old, male, Caucasian, 65 inches and 200 pounds. Unrestrained. Jumped out of cab to get blocks under back wheels in attempt to stop rolling truck. No injury.

Driver 2, 24-year-old Caucasian male, 71 inches and 240 pounds. Driving 9 years; averaged 40,000 miles per year with truck, 10,000 miles with passenger car. Traveling with load of sand from gravel pit in Saline, Michigan, to Lutheran Retirement Home in Ann Arbor. Had driven Vehicle 1 40,000 miles in one year. Slightly familiar with area. High school driver education. Good physical and mental condition. No alcohol involved. Unrestrained. No injury.

Standards

The following Motor Carrier Safety Regulation (MCSR) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|-------------|---|
| MCSR 393.85 | Protection Against Shifting or Falling Cargo. The cargo guard on Vehicle 1 was not strong enough to prevent the shifting cargo from penetrating the back of the cab, even at such a low-speed impact. |
| TSPS 4 | Driver Education. None of the occupants of either Vehicle 1 or Vehicle 2 were restrained. |
| TSPS 8 | Alcohol in Relation to Highway Safety. Driver 1 reportedly had been drinking the morning of the accident. |

TSPS 15

Police Traffic Services. No breathalyzer test was administered to Driver 1.

Description

Pre-crash: Vehicle 1 was northbound on Earhart Road; Vehicle 2 also northbound, traveling behind Vehicle 1 at 10 mph. Vehicle 1 started up incline, engine stalled, Driver 1 braked, vehicle began rolling backwards so right front passenger jumped out to put something behind the rear wheels to stop the truck. When Vehicle 1 started rolling backward, Driver 2 tried to back up but his trailer jack-knifed, so he attempted to pass Vehicle 1. Driver 1's failing to have vehicle under control and overloading of Vehicle 1 both violations of traffic law. No pre-crash skids or scuffs.

Crash: Vehicle 2 was two-thirds of way around Vehicle 1 when left corner of Vehicle 1's steel load struck right side of Vehicle 2's trailer; steel load was pushed forward, bent down cargo guard; structural steel beam penetrated cab, caught piece of Driver 1's clothing and pinned him against steering wheel. Vehicle 1 came to final rest in northbound lane; Vehicle 2 diagonally across road. From intrusion of steel beam, Driver 1 sustained contusion over left clavicle, abrasion posterior left shoulder, pain left chest and side, and fractured left 7, 8, and 9 ribs; low back pain from seat back contact. Driver 2 jolted by impact but uninjured. Right front passenger out of Vehicle 1 and received no injury. Vehicle 1 had 31 inches of crush to left B-pillar, left upper A-pillar damaged, left upper and lower B-pillars damaged and partially separated, left roof rail damaged, fuel tank deformed and partially disengaged, filler pipe separated from tank, upper right A-pillar and upper and lower B-pillar damaged, 50% windshield bond separation, seat damage. Vehicle 2 had sheet metal damage to right side of trailer, three inches of crush. Direction of force to cab of Vehicle 1 caused by steel load, 6:00 o'clock; to trailer of Vehicle 2, 2:00 o'clock.

Post-crash: Nearby resident called police. Driver 1 pinned in cab; Driver 2 exited himself. Passersby and Passenger 1 extricated Driver 1 before ambulance arrived. Police on-scene in three minutes, ambulance in ten minutes. Ambulance attendants checked Driver 1's vital signs, cautioned him to lie still because of danger of puncture wounds from rib fractures. Driver 1 transported to hospital, treated and released. No fire, explosions, environmental problems, or debris. Police routed traffic around trucks which were blocking most of roadway.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Accident Causation

Primary or Principle Causes

- 1,5 Vehicle 1 rolled rearward into passing Vehicle 2 when engine stalled and hydraulic brakes lost vacuum power-assist. (Definite)
- 1,5 Driver 2 unable to back up far enough to avoid Vehicle 1 because trailer jackknifed. (Definite)

Relevant

- 4 Vehicle 1 stalled because engine was overloaded. (Possible)
- 7 Roadway had +2° grade. (Definite)
- 1 Driver 1's driving ability impaired by alcohol. (Possible)
- *1 Passenger 1 jumped out to put blocks behind rear wheels in effort to stop Vehicle 1's backward roll. (Definite)
- 4 When engine on Vehicle 1 stalled, brake system was not adequate to prevent vehicle from rolling backward. (Definite)

Injury Causation

- 5 Cargo guard on Vehicle 1, installed to prevent steel load from moving forward, was not strong enough and failed when steel load shifted. (Definite)
- 6 Load of structural steel on Vehicle 1 shifted and steel beam penetrated cab, pinning Driver 1 against steering wheel and causing injury to him. (Definite)

Postcrash Factors

- 3 Passenger 1 and passersby helped extricate Driver 1 before ambulance arrived. (Definite)

Matrix Cell

Explanation

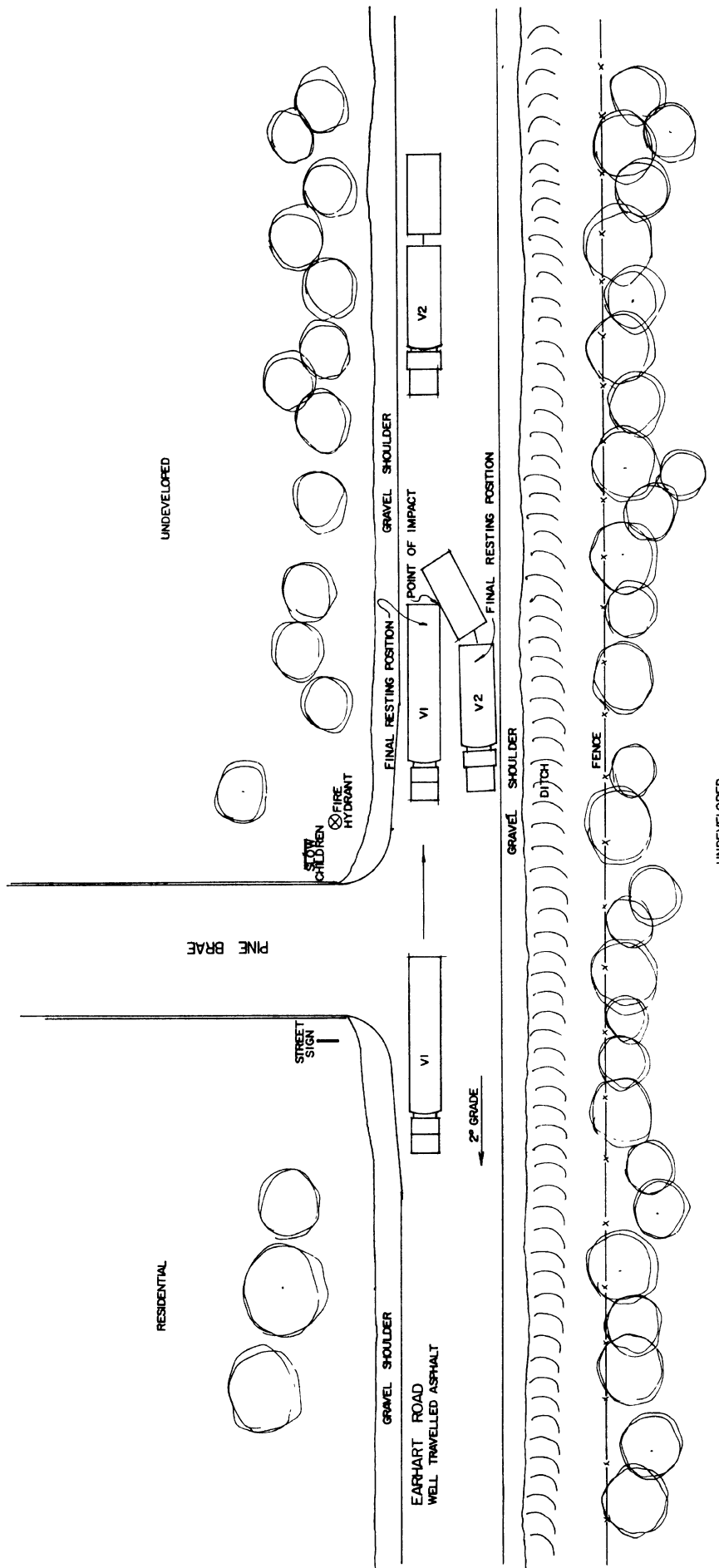
3 Ambulance response delayed, but treatment appropriate. (Definite)

Recommendations

4 Evaluate truck's braking system and use of two kinds of brakes (hydraulic brakes on cab of Vehicle 1, air brakes on the trailer).

4 Redesign cargo guard so it will adequately protect truck occupants from cargo intrusion of cab.

1 Administer breathalyzer or other tests when use of alcohol is suspected.



UNDEVELOPED

PINE BRAE

RESIDENTIAL

STREET SIGN

STOP CHILDREN
FIRE HYDRANT

GRAVEL SHOULDER

EARHART ROAD
WELL TRAVELLED ASPHALT

2" GRADE

GRAVEL SHOULDER

POINT OF IMPACT

FINAL RESTING POSITION

GRAVEL SHOULDER

DITCH

FENCE

UNDEVELOPED



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE
CASE #AA-355
CASE SUMMARY

Identification

Accident occurred on open roadway section of Rawsonville Road in agricultural area of Ypsilanti Township, Washtenaw County, Michigan, on Monday, April 23, 1973 at 1025 hours. Out-of-control passenger car impacted fixed object. Injury severity AIS* code 10, fatal, details unknown.

Ambience

Clear night; temperature 48°, relative humidity 60%, wind 13 mph from northwest. Roadway dry.

Highway

Rawsonville Road is 22-foot-wide 2-lane major arterial; no divider. Surface well-traveled, well-maintained asphalt; road edge 7-foot-wide gravel shoulders. Roadway straight, level, crowned for drainage. No artificial lighting. Per quarter mile radius: two driveways, one intersection, 20 utility poles, five trees. A survey of the Washtenaw County accident data file for 1968 to 1972 showed no previous accidents at this site.

Traffic Controls

Speed limit 65 mph day, 55 mph night, state statute. Worn intermittent yellow center line. No signs or signals.

Vehicle

Passenger car, 1973 Pontiac Grand Am, two-door sedan; odometer 13,722 miles; black exterior and interior. No indication of motor vehicle inspection (periodic motor vehicle inspection not required in Michigan). Automatic transmission; power brakes and power steering; padding on upper instrument panel, sunvisors, and armrests. Lap belts and upper torso restraints available. No vehicle defects. Last recorded maintenance on March 5, 1973, at 10,433 miles included oil change, oil filter, lubrication, and various items checked. Damage: 20 inches of frontal sheet metal crush; extensive front, rear, right and left side, and interior deformation. VDI**:11-FCEN-3 (primary); 03-RPAW-3 (secondary).

*American Medical Association Abbreviated Injury Scale (AIS)

**Vehicle Deformation Index (VDI), in accordance with recommended practice of vehicle accident deformation classification as set forth in SAE Technical Report J224a.

Occupant

Driver, 21-year-old Caucasian male, 72 inches and 164 pounds. Five years driving experience, averaging 10,000 miles per year. Driving from friend's house to home in Wayne, Michigan; 2 miles from origin, 17 miles from destination. Unfamiliar with vehicle which belonged to friend, had driven it only an estimated 25 miles. Raised in area so familiar with roadway. High school driver education. Good physical, mental condition. Blood alcohol concentration (BAC) 0.23 (0.10 legally intoxicated in Michigan). Unrestrained. Injuries: 20 x 3 x 1 cm scalp laceration, fractured left mandible, open "egg shell" skull fracture, brain avulsion; abrasions right side of face and neck, abrasion posterior aspect right forearm and back of hand, small cut left knuckle, superficial dirt skuff marks on both shins. Injury severity AIS code 10, fatal, details unknown.

Standards

The following Motor Vehicle Program Standards (MVPS) and Traffic Safety Program Standards (TSPS) were specifically relevant to this case.

- | | |
|----------|---|
| MVPS 201 | Occupant Protection in Interior Impact--Passenger Cars. Padding on doors and instrument panel may have minimized injuries. |
| MVPS 203 | Impact Protection for the Driver from the Steering Control System--Passenger Cars. Energy-absorbing steering device compressed 2.3 inches. |
| MVPS 205 | Glazing Materials--Passenger Cars, Multipurpose Passenger Vehicles, Motorcycles, Trucks, and Buses. Driver's head penetrated right side window. |
| MVPS 206 | Door Locks and Door Retention Components--Passenger Cars, Multipurpose Passenger Vehicles, and Trucks. Both doors opened, driver ejected out left door. |
| MVPS 212 | Windshield Mounting--Passenger Cars. There was 55% windshield bond separation, but crash far exceeded standard's compliance test requirements. |
| MVPS 301 | Fuel Tanks, Fuel Tank Filler Pipes, and Fuel Tank Connections--Passenger Cars. Fuel tank slightly scuffed, but did not rupture. |
| TSPS 4 | Driver Education. Driver was driving unfamiliar, high-powered vehicle at high rate of speed. |
| TSPS 8 | Alcohol in Relation to Highway Safety. Driver had 0.23 BAC. |

Description

Precrash: Vehicle 1 northbound at 75 mph estimated from vehicle damage and dynamics. Left roadway onto right shoulder, traveled approximately 600 feet with right wheel in ditch and left wheel on gravel shoulder, regained roadway, crossed both traffic lanes yawing counterclockwise, and went off onto left shoulder. No visible signs of braking. Driving at excessive speed and while under the influence of alcohol violations of traffic law. Scuffs on shoulder and 65 feet of skid marks on roadway indicated vehicle's path.

Crash: Vehicle, moving at estimated speed of 60 mph after traveling through ditch, impacted first tree with front end, rotated further counterclockwise and impacted second tree with right side. Came to final rest facing south-southwest on west shoulder with front end in ditch and left rear wheel on shoulder. Driver went forward into steering wheel, instrument panel, and windshield at initial impact with first tree, head and possibly right arm penetrated right window and impacted second tree; as car continued to rotate driver ejected out left door. Sustained abrasions to right face and neck from either windshield and instrument panel impact or later tree impact; 20 x 3 x 1-cm scalp laceration over open "egg shell" skull fracture, brain avulsion, and possibly abrasions to posterior aspect of right forearm and hand from window penetration and second tree impact; superficial dirt scuff marks on both shins from lower instrument panel and/or ground impact. Came to final rest on west shoulder slightly north of vehicle's final resting place. Vehicle was extensively damaged. Front: 20 inches sheet metal crush to hood, bumper, and grill area; hood latch safety jammed, left hood hinge bent, right hood hinge separated and spring came off; engine mount separated. Left side: upper A-pillar damaged; upper and lower B-pillar twisted, roof rails damaged and buckled; body mount separated at rear wheel housing; door latch damaged and released, upper door hinge loose; fender, quarter panel, and door sheet metal damage. Rear: fuel tank scuffed by ground, but no dents or leaks; trunk lid latch released, both lid hinges bent; backlight header damaged. Right side: A-, B-, and C- pillars damaged; roof rails damaged and buckled; windshield header buckled; body mount separated at rear wheel well; door latch damaged and released, upper hinge pulled away from A-pillar. Interior: steering wheel slightly deformed and spokes bent; energy-absorbing steering device compressed 2.3 inches; shear capsule separated 3.0 inches; instrument panel rotated vertically; firewall and floorpan deformed; windshield broken and had 55% bond separation; ashtray, rearview mirror, and console damaged; radio knob off; foot controls bent; right front bucket seat cushion and back damaged; rear seat cushion and back damaged; left and right door windows and rear window glass broken; hardware and armrest on right door damaged; roof headlining and structure damaged. Directions of force 11:00 o'clock and 3:00 o'clock.

Postcrash: Resident in nearby house called police; both State Police and ambulance arrived promptly. No first aid given as driver was dead on-scene; however, he was transported to Beyer Hospital in

Ypsilanti and pronounced dead there. No fires, explosions, or environmental problems; car pieces on road edge. Car off roadway so no traffic controls needed.

Causal Factors and Recommendations

The following diagram explains the numbers used in the matrix cell column. An asterisk (*) preceding a number indicates a positive factor.

	Precrash	Crash	Postcrash
Human	1	2	3
Vehicle	4	5	6
Environmental	7	8	9

Matrix Cell

Explanation

Accident Causation

Primary or Principal Cause

1 Driver 1 drifted off roadway into roadside ditch, regained roadway with yawing vehicle, out of control vehicle crossed roadway and impacted trees. (Definite)

Relevant Factors

1 Driver 1 was intoxicated (BA 0.23), which seriously impaired judgement and ability to handle a vehicle. (Definite)

1 Driver 1 exceeded the speed limit. (Definite)

1 It is theorized that Driver 1 was testing unfamiliar, high-powered vehicle. (Probable)

Injury Causation

2 Unrestrained Driver 1 sustained fatal head injury when head penetrated right window and impacted tree. (Definite)

2 Unrestrained driver totally ejected out left door. (Definite)

5 Left door latch released, and permitted the driver to be ejected.

Matrix Cell

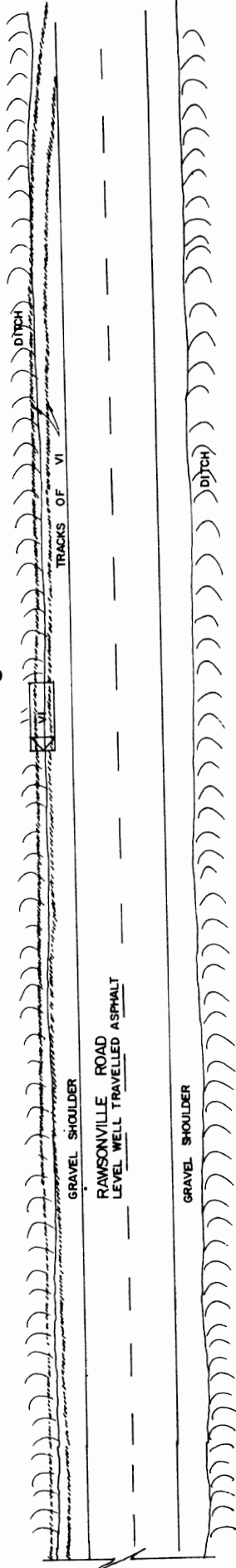
Explanation

Recommendations

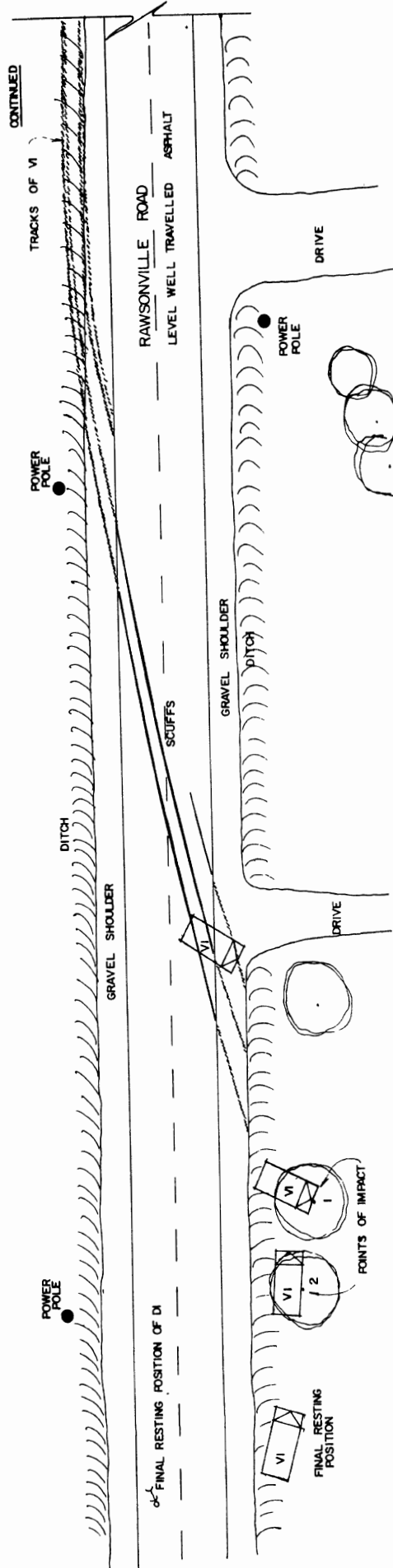
- | | |
|---|---|
| 1 | Continue to educate the public on the dangers of drinking and driving. |
| 1 | Driver education courses should warn students about experimenting with unfamiliar vehicles. |
| 1 | Use safety restraint system to prevent total ejection. |

AGRICULTURAL

POWER POLE



CONTINUED



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ACCIDENT SCHEMATIC AA 355



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