# Fatal Crashes in Texas Involving Heavy Trucks: When, Where, Why?

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16. Abstract

The objective of this report was to document the circumstances surrounding fatal crashes in Texas involving heavy trucks with a gross vehicle weight rating greater than 26,000 pound in the years 2000 – 2004. There were 1,865 crashes involving 2,004 heavy trucks and 2,325 fatalities.

The study found that the overwhelming majority of the heavy-truck-involved crashes occurred under seemingly benign conditions – daylight hours; dry, straight roads; no adverse weather; no citable violations by the heavy-truck driver; no turning maneuver involved; no traffic control device involved; no work zone. However, they did occur most often on high-speed rural roads, and speeding was the most frequently cited driver-related factor for heavy-truck drivers. Non-heavy-truck occupants were about 6.5 times more likely to die in these crashes than heavy-truck occupants, and heavy-truck occupants were much more likely to have suffered no injury than non-heavy-truck occupants.

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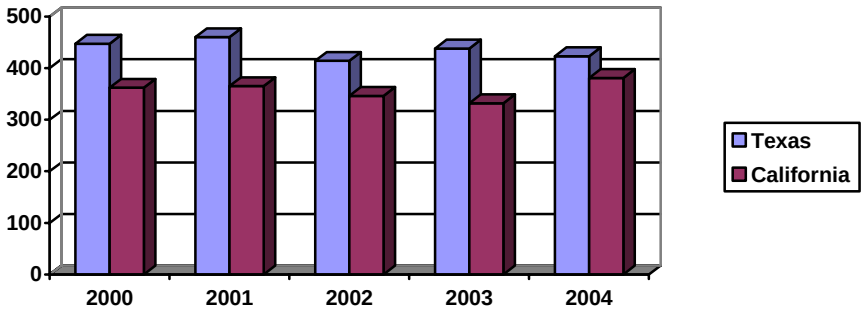
## Introduction

Texas consistently leads the nation in the total number of fatal crashes involving "large trucks" [1] (trucks with a gross vehicle weight rating (GVWR) of more than 10,000 pounds). California is second, as illustrated in Figure 1.

**Figure 1: Fatal Crashes Involving Large Trucks 2000 -2004**




Source: http://ai.fmcsa.dot.gov/CrashProfile/StateCrashProfileMain.asp?StCd=CA&CPY=2003

The objective of this report is to examine the circumstances surrounding fatal crashes in Texas involving a major subset of "large trucks" -- "heavy trucks"[2] -- during the five-year period 2000 – 2004. Heavy trucks with gross vehicle weight ratings in excess of 26,000 pounds are the focus, because they are by far the principal component of large trucks involved in fatal crashes in Texas; during the period 2000 – 2004 heavy trucks consistently made up 90% or more of the large trucks involved in fatal crashes.

Circumstances examined include:

- Vehicle configuration
- Time of day
- Day of week
- Driver violations charged, if any
- Driver-related factors, if any
- Jurisdiction in which driver was licensed
- Driver's commercial driver's license (CDL) status
- Alcohol involvement, if any
- Vehicle-related factors, if any
- Vehicle role

[1] For purposes of its Fatality Analysis Reporting System (FARS), the National Highway Traffic Safety defines a "large truck" as a vehicle with a gross vehicle weight rating of more than 10,000 pounds.

[2] A "heavy truck" is defined as a manufacturers' Class 8 single-unit truck, truck and trailer combination, truck-tractor (bobtail), or truck-tractor and semi-trailer(s) combination, with a gross vehicle weight rating in excess of 26,000 pounds.

- Vehicle maneuver
- Initial impact point
- Fire, if any
- Pedestrian involvement, if any
- Roadway class
- Posted speed limit
- Road alignment
- Road surface condition
- Weather
- Involvement of a traffic control device, if any
- Work zone involvement, if any
- Most harmful event
- Restraint use
- Injury severity

The focus, in each case, is on the heavy truck and its driver. All data used are from the annual reports produced by the National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS).

Over the 5-year period 2000 – 2004, 2,004 heavy trucks were involved in 1,865 fatal crashes in Texas. There were 6,209 persons involved in these crashes, 2,325 of whom were killed. Of those who died in these crashes, 263 were heavy-truck drivers and 46 were heavy-truck passengers. Thus, the occupants of other vehicles were about 6.5 times more likely to die in heavy-truck-involved fatal crashes than were the occupants of the heavy trucks.

Higher death risk for the occupants of vehicles with a GVWR of 26,000 pounds or less is a matter of physics. The kinetic energy generated in a crash is the product of mass of the vehicle times its velocity squared; thus, in a crash at 60 miles per hour an 80,000 pound heavy truck generates much more injury-causing energy than does a 4,000 pound car.

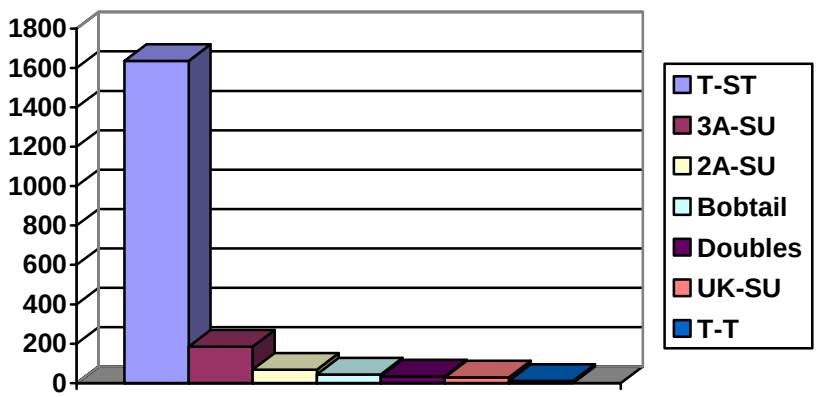
FARS does not assign fault in crashes; instead it cites "factors" for the driver, vehicle, and the roadway. It also notes violations charged. Assignment of fault in crashes is an often contentious issue; nevertheless, close examination of the Accident, Vehicle, Driver and Person files in FARS allows one to make a reasonable estimate of the at fault driver or drivers in most instances. Again, in the analysis below, the focus will be on drivers of heavy trucks who appear to have been at fault – or not at fault, as was more often the case – in their fatality-involved crash.

Analysis

*Vehicle configuration*

All vehicles included in this study were from FARS gross vehicle weight rating class 3; i.e., vehicles with a GVWR of 26,001 or greater. There were 2,083 such vehicles involved in fatal crashes in Texas 2000 – 2004. Only 2,004 were known to be heavy trucks; 54 were buses; and 25 were configurations other than buses or heavy trucks. Figure 2 illustrates the various vehicle configurations comprising these 2,004 heavy trucks. The vast majority of these heavy trucks (82%) were tractor-semi-trailer combinations (T-ST in Figure 2) – typically, but not always, a 3-axle truck-tractor pulling a 2-axle semi-trailer 53 feet long – an "18-wheeler." The next most commonly found vehicle configuration (9%) was the 3-axle single unit heavy truck (3A-SU), such as a large dump truck. Other configurations had much lower fatal crash frequencies.[3]

**Figure 2: Vehicle Configuration**
**N = 2,004**

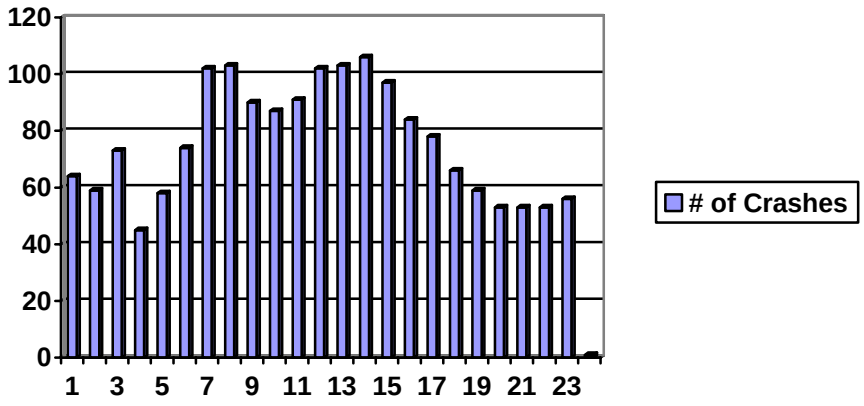



*Time of day*

Figure 3 illustrates crashes by hour of the day using a 24 hour clock.

[3] In Figure 2 these include the 2-axle single unit configuration (2A-SU), truck-tractor only (Bobtail), truck tractor with two semi-trailers and a converter dolly (Doubles), single unit of unknown type (UK-SU), and single unit truck with a full trailer (T-T).

**Figure 3: Number of Heavy-Truck-Involved Fatal Crashes by Hour of the Day N = 2,004**

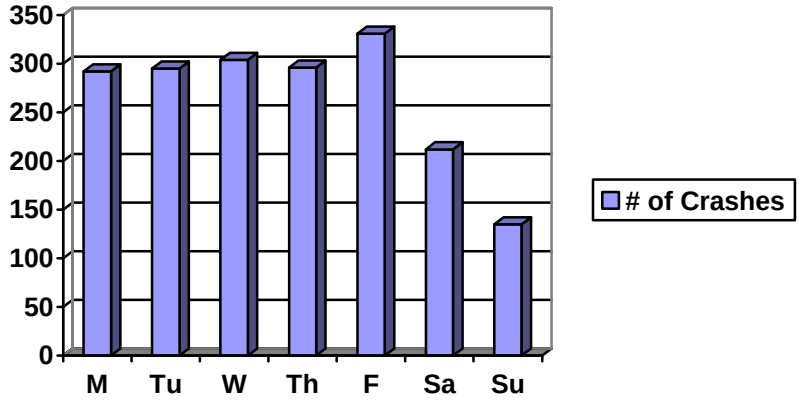



Peak periods for crashes were during the period from 6 a.m. to 6:00 p.m. (0600 – 1800), with another spike between 2:00 and 3:00 a.m. (0200 – 0300).

*Day of week*

As Figure 4 illustrates, the heavy-truck-involved fatal crashes were fairly evenly distributed across weekdays, with fewer on Saturday and Sunday.

**Figure 4: Number of Heavy-Truck-Involved Fatal Crashes by Day of the Week N = 2,004**



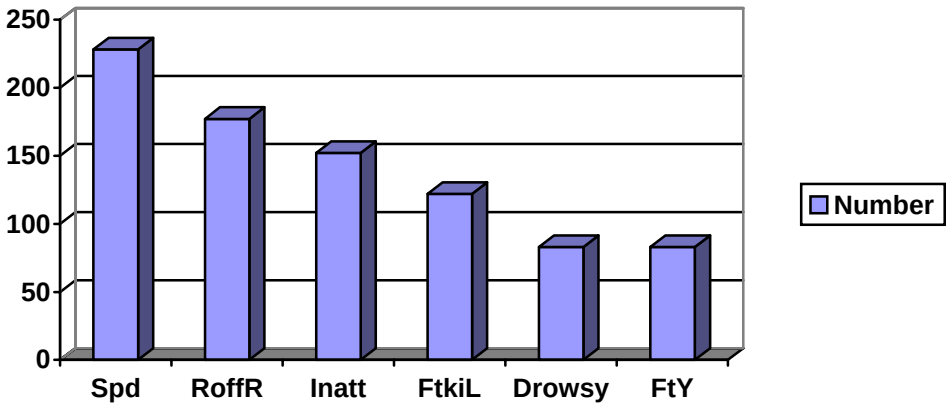

*Driver violations charged, if any*

The vast majority (88%) of the 2,004 heavy truck drivers in this study were not charged with any violation. The most common violation among the 236 heavy truck drivers with at least one violation charged was manslaughter (95), followed by speeding (unsafe speed or over the limit) (34).

*Driver-related factors, if any*

Sixty-one percent of the heavy-truck drivers had no driver-related factor recorded. Omitting three unknowns, this means that 38% of the drivers had at least one driver-related factor. Twenty-two percent had at least two driver-related factors, 8% at least three, and 2% had four (the maximum listed). The most commonly cited factors are shown in Figure 5.

**Figure 5: Most Frequently Cited Driver-Related Factors[4]**
**N = 2,004**




Of the 770 heavy-truck drivers with at least one driver-related factor, 228 (30%) were noted as speeding (Spd in Figure 5). Twenty-three percent ran off the road (RoffR); 20% were inattentive (Inatt); 16% failed to keep in proper lane (FtkiL); 11% were drowsy; and 10% failed to yield (FtY).

*Jurisdiction in which driver licensed*

Given the immense size of Texas, it should come as no surprise that a large majority (74%) of the fatal crash-involved heavy-truck drivers in this study were licensed in Texas. One percent was from Mexico, and one percent was from Canada. Jurisdiction of licensure was unknown for one percent, as well. The remaining drivers were from the rest of the U.S.

*Driver's commercial vehicle license (CDL) status*

Ninety-five percent (1,888 out of 1,986 for which CDL status was available) of the heavy truck drivers held a valid CDL. Two percent (37) had no CDL and two percent (38) were unknown. Less then one percent (6) were operating on

[4] Excludes 95 drivers (12% of those with a driver-related factor) with driver-related FARS code 91 (Non-Traffic Violation Charged – manslaughter, homicide or other assault offence committed without malice).

a learner's permit. The remainder held invalid licenses of one type or another (suspended, revoked, expired, cancelled or disqualified).

*Alcohol involvement, if any*

Of the 1,988 heavy truck drivers for whom alcohol use information was available, only 20 (1%) were noted for alcohol use. This figure is misleading, however, because there was not an alcohol use report for 1,811 (91%) of these drivers (FARS "police reported alcohol involvement" code 8). No alcohol use was affirmatively reported for an additional 157 drivers (8%).

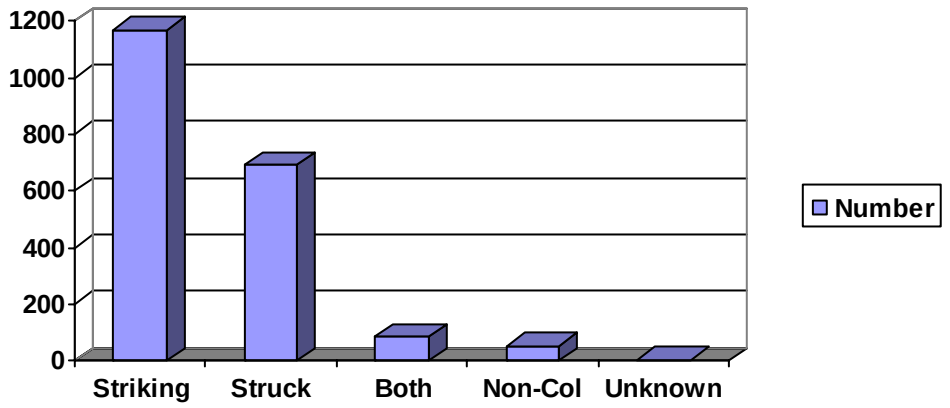
*Vehicle-related factors, if any*

Of the 2,004 heavy trucks in this study, 1,906 (95%) had no vehicle-related factor. By far the most frequently noted vehicle-factor among the remaining 98 vehicles was the braking system (38), followed by tires (17 vehicles).

*Vehicle role*

A heavy truck was the striking vehicle in 1,169 (63%) of the 1,865 fatal crashes in this study. Figure 6 illustrates the respective roles of all 2,004 heavy trucks.

**Figure 6: Vehicle Role**
**N = 2,004**



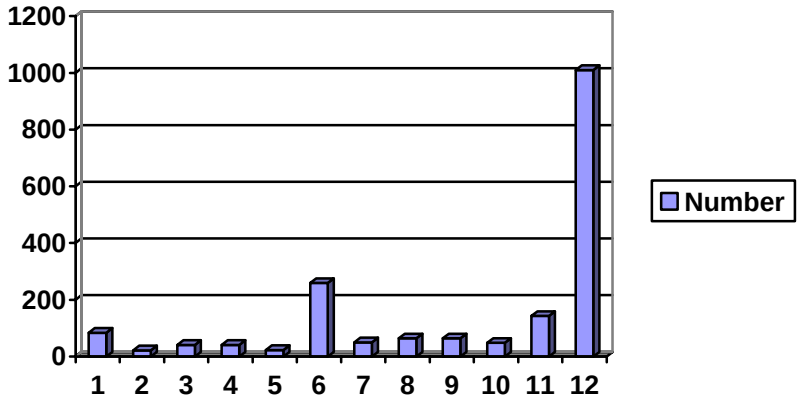

*Vehicle maneuver*

The heavy trucks in this study were involved in their fatal crashes most often when going straight ahead (1,555 of 2,004, or 78% of the time). The next most frequent maneuver was stopped in traffic (99), followed by turning left (89), and negotiating a curve (81).

*Initial impact point*

Given that the heavy trucks were overwhelmingly the striking vehicle while going straight, the 12 o'clock (straight ahead) position was the most frequent impact point, followed by the 6 o'clock position (being rear-ended), and the 11 o'clock position. Data for all 12 clock positions are shown Figure 7.

**Figure 7: Initial Impact Point (Clock Position)**
**N =1,849**




Additionally, 54 vehicles were coded as non-collision, and the vehicle's undercarriage was the initial impact point for another 41. The top of the vehicle was the initial impact point for 7 heavy trucks in this study, and the initial impact point was unknown for 53 others.

*Fire, if any*

One-hundred thirty-six (7%) of heavy trucks that crashed in this study caught fire.

*Pedestrian involvement, if any*

One hundred fifty-two (8%) of the 1,865 crashes involved at least one pedestrian. One hundred thirty-two involved a single pedestrian; 20 two or more.

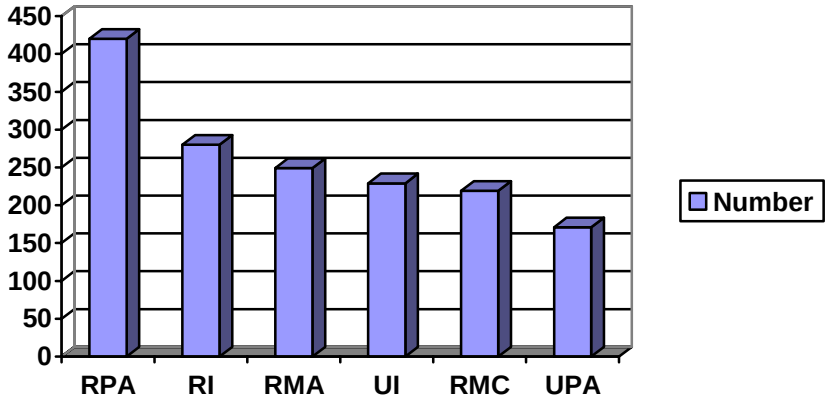
*Roadway class*

The crashes were broadly distributed among the various classes of Texas roads, as seen in Table 1, though heavy-truck fatal crashes on rural roads were particularly problematic. Of the 1,865 crashes, 67% occurred on rural roads. Figure 8 illustrates the six top roadway classes for heavy-truck fatal crashes in Texas; four of the six are rural.

**Table 1: Crashes by Road Class**
**N = 1,865**

| | |
|---|---|
| Rural Interstate (RI) | 280 |
| Rural Principal Arterial (RPA) | 420 |
| Rural Minor Arterial (RMA) | 249 |
| Rural Major Collector (RMC) | 219 |
| Rural Minor Collector | 28 |
| Rural Local Road/Street | 47 |
| Urban Interstate (UI) | 229 |
| Urban Other Freeway | 104 |
| Urban Principal Arterial (UPA) | 171 |
| Urban Minor Arterial | 29 |
| Urban Collector | 14 |
| Urban Local Road/Street | 74 |
| Unknown | 1 |

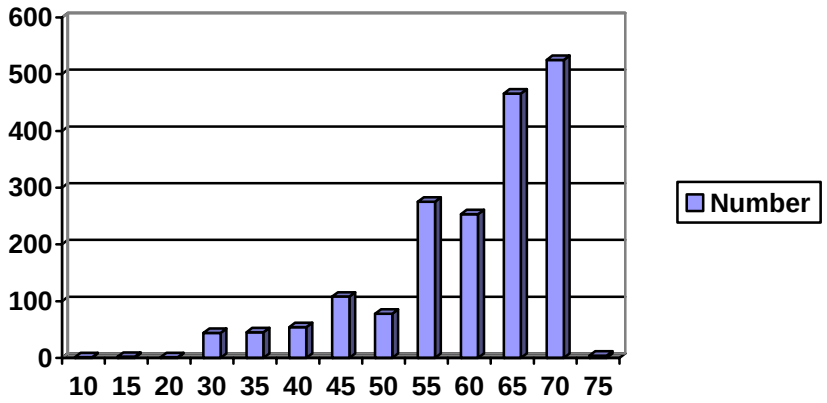
**Figure 8: Top 6 Roadway Classes for Heavy-Truck-Involved Fatal Crashes in Texas**
**N = 1,865**




*Posted speed limit*

The heavy trucks involved in fatal crashes in this study were most likely to be traveling on roads with a posted speed limit of 55 miles per hour or higher. Eighty-one percent of the crashes occurred on roads with a posted speed limit of 55 mph or more; 53% were on roads with speed limits of 65 mph or greater. See Figure 9 for more details.

**Figure 9: Posted Speed Limit**
**N = 1,856**




*Road alignment*

The road was straight in 93% of the 1,865 crashes and curved 7% of the time.

*Road surface condition*

The pavement was dry in 84% of the crashes; wet in 15%; and experiencing snow, slush, or ice 1% of the time.

*Weather*

No adverse weather was reported for 86% of the crashes. It was raining for 10%. In 2% it was foggy. Snow or sleet was occurring in less than 1% the crashes, as was smoke or blowing dust.

*Involvement of a traffic control device, if any*

No traffic control was involved in 78% of the cases. A stop sign was present in 12% and a red/yellow/green traffic light was present in 6%. The remaining 4% included flashing lights, warning signs, yield signs, railroad warning devices, etc.

*Work zone involvement, if any*

No work zone was involved in 93% of the crashes. Of the remaining 7% that did involve a work zone, the overwhelming majority (94%) involved a construction zone (as contrasted to a maintenance zone).

*Most harmful event*

For the 2,004 heavy trucks involved in the 1,865 crashes in this study the most frequently cited "most harmful event" was collision with another motor vehicle in transport (80%). The distant second most cited event was collision with a pedestrian (6%), followed by overturn (rollover) (5%). Fire or explosion was the most harmful event for 2% of the vehicles. All other most harmful events (collision with an animal, bridge pier or abutment, railway train, etc.) occurred in 1% or fewer of the crashes.

*Restraint use*

Restraint use figures are available for 1,988 of the 2,004 heavy-truck drivers. Only 18% of these drivers were reported to have been unrestrained at the time of their involvement in a fatal crash. Restraint use was unknown for 3% of the drivers. That means that 79% of the drivers were allegedly restrained.

This high rate of reported restraint use strains credulity given the low rates of use of safety belts by heavy-truck drivers reported in other research. Summarizing other studies, a 2005 report from the Transportation Research Board concluded that fewer than 50% of heavy-truck drivers use safety restraints.[5] The high reported rate of restraint use in the crashes in this study suggests "survivor bias," given that only 17% of the heavy-truck drivers were killed or seriously injured (see below). Since commercial motor drivers are required to use available restraints by the Federal Motor Carrier Safety Regulations (Code of Federal Regulations, Title 49, Section 392.16) and since not using safety restraints is a primary traffic offense in Texas (as opposed to a secondary offense), it is highly likely that uninjured or slightly injured heavy-truck drivers reported using restraints whether they did or not.

*Injury severity*

As Figure 10 illustrates, most of the heavy-truck drivers were uninjured or only possibly injured, even though they were involved in a fatal crash. Sixty-two percent of the heavy-truck drivers were uninjured. Another 11% suffered a possible injury (Pos in Figure 10). Ten percent had a non-incapacitating injury (NI Injury), 4% had an incapacitating injury (I Injury), and 13% died (Fatality). Injury status of 14 heavy-truck drivers was unknown.

There were 349 heavy-truck passengers. Their injury status is shown in Figure 11.

[5] G Berghoffen, R Knipling, S Tidwell, J Short, G Krueger, R Inderbitzen, G Reagle, and D Murray, *Commercial Motor Vehicle Driver Safety Belt Usage*, Commercial Truck and Bus Safety Synthesis Program Synthesis 8, Transportation Research Board, 2005

**Figure 10: Heavy-Truck Driver Injury Severity**
**N = 1,988**

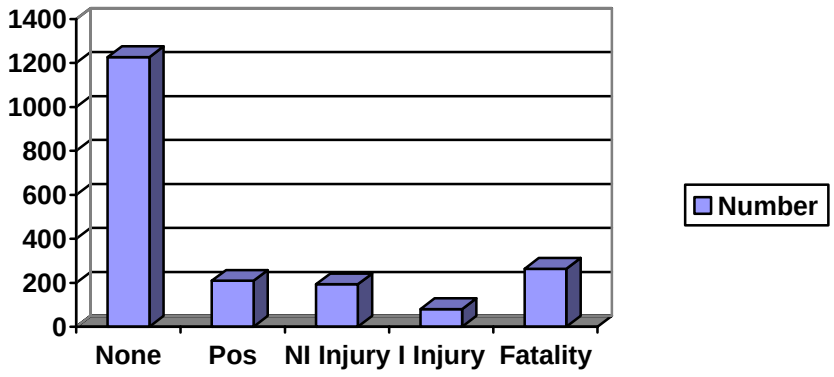
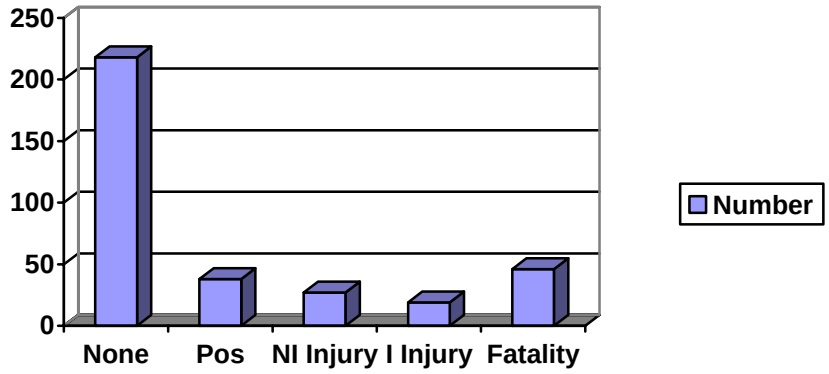
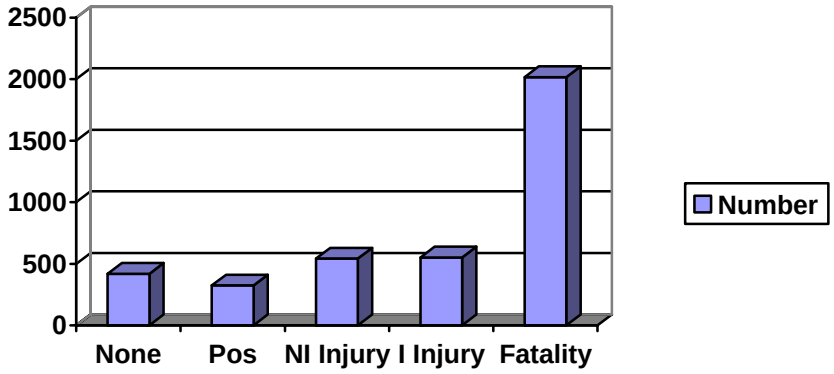



**Figure 11: Heavy-Truck Passenger Injury Severity**
**N = 349**




As noted at the beginning of this paper, given the weight differences between heavy trucks and most other types of vehicles, the occupants of the other vehicles were about 6.5 times as likely to die in a crash with a heavy truck as are heavy-truck occupants. Figure 12 illustrates how poorly the occupants of other vehicles fared as compared to heavy-truck occupants.

**Figure 12: Non-Heavy-Truck Occupant Injuries**
**N = 3,836**




Discussion

This study examined the circumstances surround 1,865 fatal crashes in Texas, 2000 – 2004, involving 2,004 heavy trucks (trucks with a gross vehicle weight rating in excess of 26,000 pounds). The most common type of vehicle involved in these crashes was a tractor-semi-trailer combination (82%).

These crashes typically occurred between 6 a.m. and 6 p.m. on weekdays on straight roads with dry pavement and a posted speed limited of 55 mph or higher. Adverse weather was present in only 14% of the crashes. Two-thirds of the crashes occurred on rural roads. Work zones and traffic control devices were minor factors in these crashes.

In keeping with the laws of physics, non-heavy-truck occupants were far – 6.5 times – more likely to die in these crashes than heavy-truck occupants. Conversely heavy-truck occupants were much more likely to have no injury than non-heavy-truck occupants – only 11% of non-heavy-truck occupants were uninjured versus 62% of heavy-truck occupants.

The heavy truck was the striking vehicle in more than six out over ten crashes (63%) and it was moving straight ahead 78% of the time. Despite being the driver of the striking vehicle most often, 88% of the heavy-truck drivers in this study received no citation and 61% had no driver-related factor noted. These statistics would seem to suggest that the heavy-truck drivers were not frequently "at fault" in their fatal crashes. While this finding is in general agreement with previous research,[6] "survivor bias," as in likely over-reported safety belt use by heavy-truck drivers, can be a factor here, too, since the heavy-truck driver is more likely to be the survivor in a fatal crash with a

[6] See, for example, Table 1.2 in L Kostyniuk, F Streff, and J Zakrajsek, *Identifying Unsafe Driver Actions that Lead to Fatal Car-Truck Crashes*, AAA Foundation for Traffic Safety, 2002

smaller vehicle. Survivors have an opportunity to explain and defend their actions that is unavailable to the dead.

## Conclusions and Recommendations

The overwhelming majority of the heavy-truck-involved crashes examined in this report occurred under seemingly benign conditions – daylight hours; dry, straight roads; no adverse weather; no citable violations by the heavy-truck driver; no turning maneuver involved; no traffic control device involved; no work zone. However, they did occur most often on high-speed rural roads, and speeding was the most frequently cited driver-related factor and the second most frequent violation noted for heavy-truck drivers.

Increased speed enforcement targeted at tractor-semi-trailer drivers on rural Texas roads might pay dividends in reducing the kinds of fatal crashes observed in this study. While the Texas Department of Public Safety's Highway Patrol Division is already stretched thin, automated speed enforcement using speed cameras/photo radar, while not yet permitted under Texas law, might be a successful new heavy-truck anti-speeding strategy for the state. Speed cameras have proven to be a viable speeding deterrent in other jurisdictions and have been shown to reduce speeding-related crashes.[7] While automated enforcement is unlikely to be warmly embraced by public policy makers in Texas, automated speed enforcement targeted specifically at speeding heavy trucks on rural roads might be politically palatable.

[7] D Willis, *Speed Cameras: An Effectiveness and a Policy Review*, Center for Transportation Safety, Texas Transportation Institute, 2006; available at http://tti.tamu.edu/product/product_details.asp?book_id=30803

## References

G Berghoffen, R Knipling, S Tidwell, J Short, G Krueger, R Inderbitzen, G Reagle, and D Murray, *Commercial Motor Vehicle Driver Safety Belt Usage*, Commercial Truck and Bus Safety Synthesis Program Synthesis 8, Transportation Research Board, 2005

L Kostyniuk, F Streff, and J Zakrajsek, *Identifying Unsafe Driver Actions that Lead to Fatal Car-Truck Crashes*, AAA Foundation for Traffic Safety, 2002

D Willis, *Speed Cameras: An Effectiveness and a Policy Review*, Center for Transportation Safety, Texas Transportation Institute, 2006; available at http://tti.tamu.edu/product/product_details.asp?book_id=30803