LARGE TRUCKS INVOLVED IN FATAL CRASHES:

THE NORTH CAROLINA DATA 1993-1997

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By

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Abstract

An analysis of large, truck-involved crash outcomes in North Carolina for the period 1993-1997 was conducted for the purpose of establishing an empirical basis for subsequent GHSP intervention efforts to reduce the number of fatal, truck-involved crashes**.** Data sources used in the analysis were the Fatal Accident Reporting System (FARS) and North Carolina DMV crash data files.

Results of the analyses suggested that GHSP truck safety efforts should give priority to tractor trailer operations on US and NC-numbered routes, to large truck operations in Interstate work zone areas, to the adoption of conspicuity improvements, and to traffic engineering countermeasures associated with reducing the probability of 'angle' crashes, especially in rural areas. The recommended focus on angle crashes constitutes a much needed addition to the "No Zone" educational focus on sideswipe and rear end collisions associated with the visual limitations of large vehicle operations.

The vehicle inspection issue was not addressed although the study supported the need to eliminate equipment defects contributing to the inherent stopping distance limitations of large trucks. With regard to inspections , the study also recommended greater attention be placed on the *driver* as a critical component in the overall formula for reducing large truck-involved crashes.

The study pointed out a clear need to examine the 1998 crash data to better understand the significance of the major reversal in progress following crash reduction gains made between 1993 to 1996. The study also pointed to the need for future analyses to incorporate information on *carrier* and *driver* performance factors, perhaps by linking the usual FARS and DMV type data sources to on-line information contained in the SAFESTAT system currently under development.

Inasmuch as there are efforts ongoing within North Carolina to improve truck safety (e.g, the NC Forestry Association's 'ProLogger**'** Program), the study also recommends work to evaluate the effectiveness of these programs as a basis for the development of similar efforts in industries other than logging. In doing so, the study points out the obvious need for data to be gathered on the 'commodity' being transported to make it possible to evaluate the effectiveness of truck safety programs in specific sub-components of the overall trucking industry.

Large Trucks Involved in Fatal Crashes:
The North Carolina Data
1993-1997

Executive Summary

A study conducted by the UNC Highway Safety Research Center (HSRC) focused on large truck-involved crashes in North Carolina from 1993 through 1997. The primary focus was on *fatal* crashes involving tractor trailer and high cross vehicle weight (over 10,000 lbs) single unit trucks (SUT). The purpose of the analysis was to aid in identifying where the emphasis should be placed in programs intended to reduce fatal large truck involved crashes in North Carolina.

Five Year Trends

During the period between 1993 and 1997, fewer than 2% of the 47,666 large truck-involved crashes involved a fatality. Over the first four years of this period (1993-1996), large truck-involved, fatal crashes in North Carolina declined on the average by 5% per year. This decreasing trend, however, showed a reversal in 1997 when fatal crashes rose by 14% to their earlier 1993 level. The reason for this reversal was not immediately obvious and suggests a clear need to review the 1998 as so as it becomes available.

Counties With Highest Number of Crashes

Counties with the highest number of fatal, truck-involved crashes over the five year period were Wake, Guilford, and Mecklenberg. These were also the counties with the highest estimated numbers of daily vehicle miles traveled (VMT). While a correlation may exist between crash frequency and 'exposure,' it does not suggest that truck volumes, or number of truck miles traveled in the state, is the sole contributor to crash risk.

Rate of Involvement for Tractor Trailer Trucks

Tractor trailer vehicles accounted for 84.5% of all fatal, truck-involved crashes in North Carolina from the period 1995 to 1997. During this period, fatal tractor trailer-involved crashes in North Carolina increased at a faster rate than in tractor trailer involved crashes in the US as a whole.

Rural vs Urban Crashes

While most fatal truck-involved crashes in North Carolina as well as the US occurred in 'rural' areas, the North Carolina data showed sharp increases in fatal truck-involved crashes from 1996 to 1997 on *urban interstates*, *primary and minor urban arterials*, as well as on *'local' urban roadways*. While only 9% of all fatal truck-involved crashes on urban roadways in the US occurred on local urban roadways, 24% of all urban roadway fatal crashes in North Carolina occurred on local urban roadways.

NC and US Routes Versus Interstates

During this period, approximately 6 out of every 10 fatal large truck-involved crashes occurred on NC or US-numbered routes. Interstates accounted for only about 2 out of every 10 fatal crashes involving a large truck. Non fatal crashes involving large trucks were more evenly spread across functional road classes. As in the case of fatal crashes, Interstates accounted for only about 2 out of every 10 non-fatal crashes.

Trend Toward More Vehicles Involved

While most (94 percent) truck-involved crashes in North Carolina involved only a single truck, the data clearly showed that as the number of vehicles in a crash increased, so did the likelihood of a fatality. The data also showed that over this period of time, the likelihood of multiple vehicle crashes (defined here as three or more vehicles) was increasing, and that it was increasing at a faster rate than the year to year increase in total truck miles traveled.

Driver Age

With respect to age, the data showed that as the number of individuals over the age of 65 involved in crash (i.e., a crash involving a large truck), the higher the likelihood of the crash being fatal. With respect to the age of the truck driver, the only trend to emerge from the analysis was that of an apparent increased involvement of drivers under the age of 26 in fatal truck-involved crashes in North Carolina. There was no evidence of similar trend in the US data as a whole. Given the relatively small number of fatal crashes in North Carolina for this age group (n=19 over the five year period), caution is urged in the importance attached to this observation.

Crash Types

With respect to the types of crashes observed, those having the highest 'joint' likelihood of occurrence and probability of being fatal were (from highest to lowest): (a) Angle, (b) Head-On, (c) Rear End Slow, (d) Ran Off Road, Right, (e), Left Turn, and (f) Sideswipe. The relative importance given to 'angle' types of crashes is consistent with the observation that approximately 6 out of every 10 times where a roadway feature was cited as being involved in the crash, that feature was an 'intersection.' While sideswipes and angle collisions each accounted for approximately 14 percent of all crashes, the probability of an angle collision being fatal was 7 to 8 times greater than that for a sideswipe.

Work Zones

In terms of fatal truck-involved crashes in work zones, the data showed that only 1-4 % of all fatal truck-involved crashes actually occurred in work zones; that 63 percent involved two or fewer vehicles; that the most prominent (37% of the time) type of collision was a Rear End collision followed by a Head-On collision (21% of the time). . . and that contrary to Interstates accounting for only 20-21 percent of the total number of fatal large truck involved crashes, two thirds of all fatal truck-involved crashes which occurred in work zones occurred on Interstates.

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INTRODUCTION

Background

At the request of the North Carolina Governor's Highway Safety Program (GHSP), the University of North Carolina Highway Safety Research Center (HSRC) conducted an analysis of the data on large truck involved crashes in the state over the period 1993-1997. The GHSP effort was in response to the fact that North Carolina continues to rank among the top ten states in the country in terms of fatal, large truck-involved crashes.

Purpose of the Present Study

The purpose of the present study was to provide empirical data for use by the GHSP in identifying *targets*, or areas of *focus*, for program efforts aimed at reducing the number of large truck-involved fatal crashes in the state. The HSRC effort, while conducted concurrently with the NCDOT Truck Safety Task Force Study, was not a formal part of that effort. The purpose was to aid in focusing state resources on (a) where fatal, large truck-involved crashes were most likely to occur geographically by county and type of development, (b) the extent to which clear trends could be identified over the five year period addressed by the study, (c) the type of vehicle most often involved, (d) the functional class of roadway most often involved, (e) the extent to which specific roadway features were involved, (f) the degree of risk associated with work zone activities, (g) age of those involved, both the operator of the commercial motor vehicle as well the driver/occupant(s) of the other vehicles, as well as (h) the specific type of crash(es) involved.

Fatal, 'Large Truck' Focus

The heavy truck selection criteria used to identify "large trucks" in the 1993-1997 FARS data relied on the use of data variables from the vehicle oriented SAS subfile. The two variables used were BODY_TYP and TOW_VEH. The Boolean expression which was used to identify the "large trucks" was taken from the FARS documentation titled "FARS Analytic Reference Guide 1975-1998" from page V-3 (for vehicles in FARS data 1991 and later):

> 60LE BODY_TYP LE OR BODY_TYP EQ 66 OR
> 71 LE BODY_TYP LE 72 OR BODY _TYP EQ 78 OR
> (BODY_TYP EQ 79 AND (1 LE TOW_VEH LE 4))

If this expression was true and the vehicle was in a crash in NC, then the target vehicle was identified as a large truck and was included in the FARS NC "large truck" analysis file. There were more large trucks than crashes so the actual number of crashes which had at least one large truck was slightly smaller than the number of large trucks.

The FARS case numbers were available in Raleigh at the NC Division of Motor Vehicles for the last two and a half years (i.e., 1997, 1996, and a portion of 1995). These numbers were used to identify the NC crash case numbers. Hard copies for this subset of the overall five year data set were obtained for further individual analyses.

Study Limitations

The HSRC study does not provide a detailed analysis of carrier related information. Because current data sources do not permit an identification of the particular ‘commodity’ being transported, it was not possible to differentiate the contribution of different ‘industries’ (e.g, logging, agricultural, fuels, etc.) to the overall number and type of crashes. Neither does the present study address the relationship of carrier operations and maintenance factors to the likelihood of large truck-involved crashes. While the study recognizes the potential relationship of driver-related variables to the likelihood of crashes (e.g, both driver history as well as driver state variables), a comprehensive investigation of such factors was beyond the scope of the present effort. Issues dealing with the effectiveness of various enforcement practices and actions (e.g., vehicle inspections by the NCDMV) are not directly addressed other than to point out the obvious rationale for such inspections, especially as they have to do with large vehicle stopping distance limitations.

THE DATA

Number of Fatal Large Truck Involved Crashes

Figure 1 shows the number of fatal truck involvements in the US and in North Carolina for the period 1993-1997. The data in this chart are from the Fatal Accident Reporting System (FARS). During this period, fatal truck involvements in the US showed a slight increase over the five year period. In North Carolina, fatal involvements for trucks in these classes decreased an average of 5 percent per year from 1993 to 1996. A reversal in this downward trend occurred between 1996 and 1997, when large truck fatal involvements in North Carolina increased by approximately 17 percent to levels more characteristic of the beginning of the period. The reason for the 1997 reversal in the downward trend from 1993 to 1996 is not clear at this time.

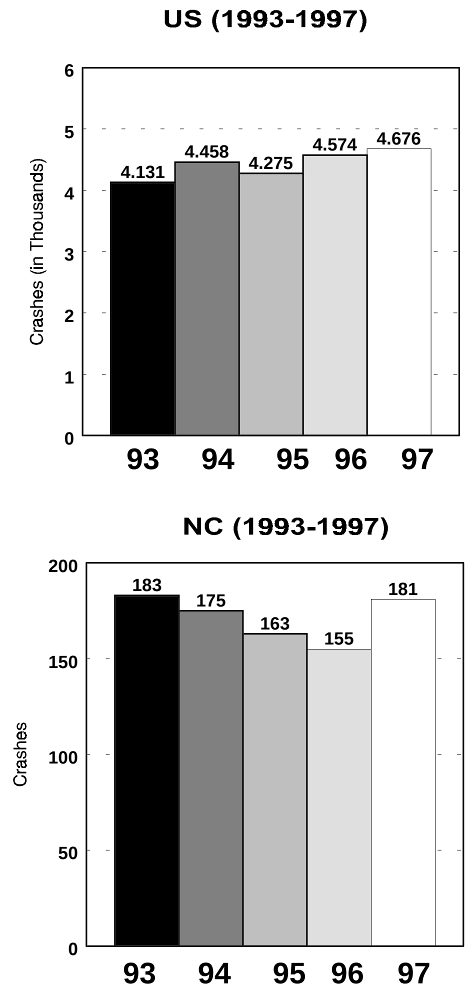

Figure 1. Fatal Large Truck-Involved Crashes in the US and in North Carolina During the Period 1993-1997.

Geographical Location of Crashes

Figure 2 shows the location of these fatal involvements by county. Wake, Guilford, and Mecklenberg were the three counties with the highest number of fatal involvements over the five year period, each having experienced 31 or more fatals suring this timeframe. Those shown in the next lighter shade experienced from 21 to 30 fatals; those in the next lighter shade of gray between 11 and 20, and those in white from1 to 10 fatal involvements.

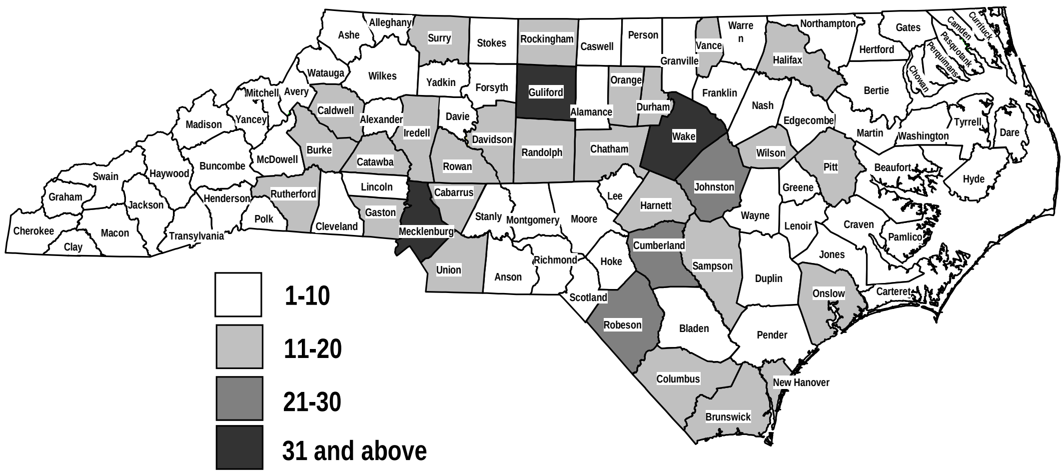

Figure 2. Large Fatal Truck Involvements by North Carolina County During the Period 1993-1997.

Figure 3 shows the NCDOT's estimate of daily vehicle miles traveled (VMT) by North Carolina county. The relationship between exposure (vehicle miles traveled) and the number of large truck involved fatal crashes is clear especially in the upper range of vehicle miles traveled.

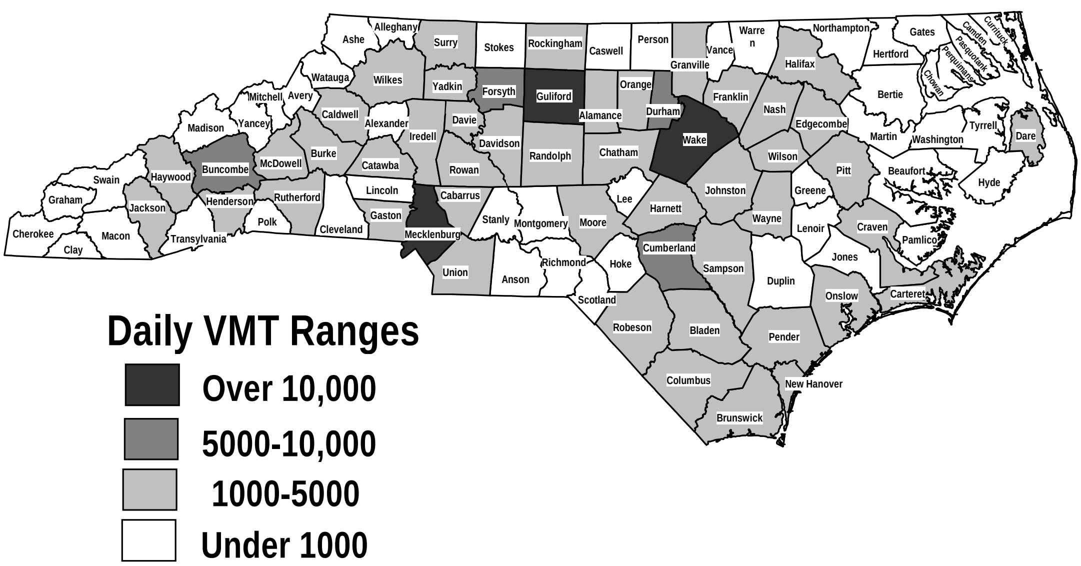

Figure 3. NCDOT Estimates of Daily Vehicle Miles Traveled (VMT) for 1997 by North Carolina County.

Rural Versus Urban Location

Figure 4 shows where large truck, fatal crash involvements occurred with respect to the type of development (that is, rural versus urban). Similar profiles are seen for the US and the state of North Carolina. In the US overall, 66 percent of all fatal, large truck-involved crashes occurred in rural areas. In North Carolina, 73 percent occurred in rural areas. The data for crashes in rural areas show similar trends to the overall crash frequency patterns shown in Figure; that is, a slight increasing trend over time for the US as a whole and a decreasing trend in NC from 93 to 96 followed by a reversal in 1997.

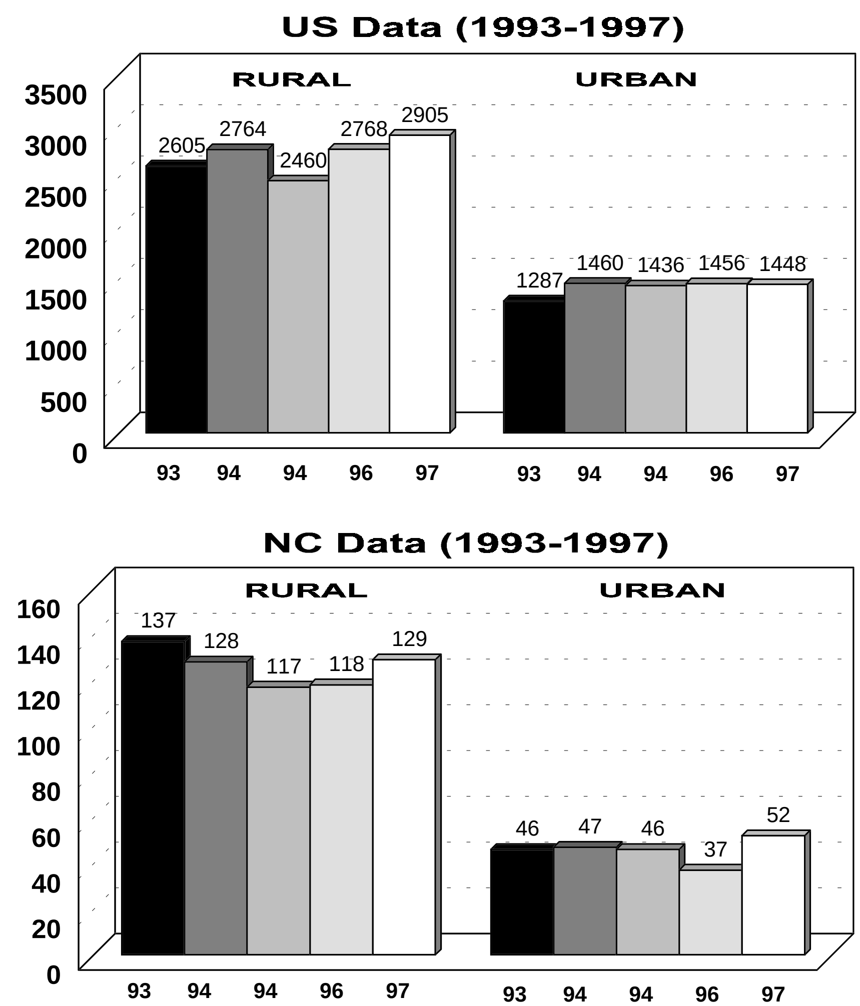

Figure 4. Rural Versus Urban Location of Fatal Large Truck Involved Crashes in the US and In North Carolina (1993-1997)

Type of Vehicle Involved

Figure 5 shows that of the 47,666 large truck involved crashes over the period 1993-1997, only 1.6 percent (n = 762) were fatal; 46,904 were not fatal. For fatal and non-fatal crashes alike, the type of large truck involved was most frequently (83-84 percent of the time) a tractor trailer with the remainder being either 3 or 4 axle trucks.

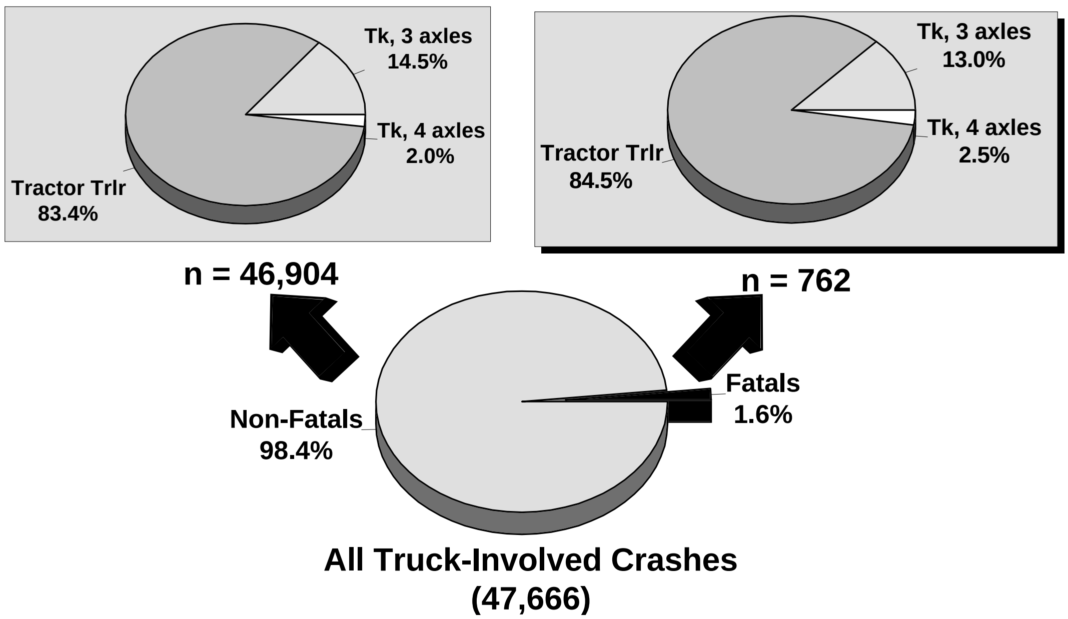

Figure 5. Fatal and Non Fatal Large Truck Involved Crashes by Vehicle Type (Source: North Carolina crash data, 1993-1997)

Figure 6 looks at vehicle type by individual year during this period of time. While there appears to be no consistent trend across years in terms of the involvement of single unit trucks (SUT), the number of tractor trailer involvements in the US showed an increasing trend during this period. Likewise, there is evidence of an increasing trend toward tractor trailer involvement in North Carolina between 1995 and 1997.

Figure 7 shows the ratio of fatal tractor trailer involved crashes to fatal high gross vehicle weight single unit truck crashes in the US as a whole and in North Carolina. The data show that in North Carolina, since 1995, the ratio of tractor trailer fatal involvements to SUT fatal involves has increased markedly. Whereas in the US the increase in tractor trailer fatal involvements grew by 7 percent a year between 1995 and 1996, and by only 3 percent between 1996 and 1997, the rates of increase for tractor trailer involved fatal crashes in North Carolina grew by 12 and 11 percent respectively over the same period of time.

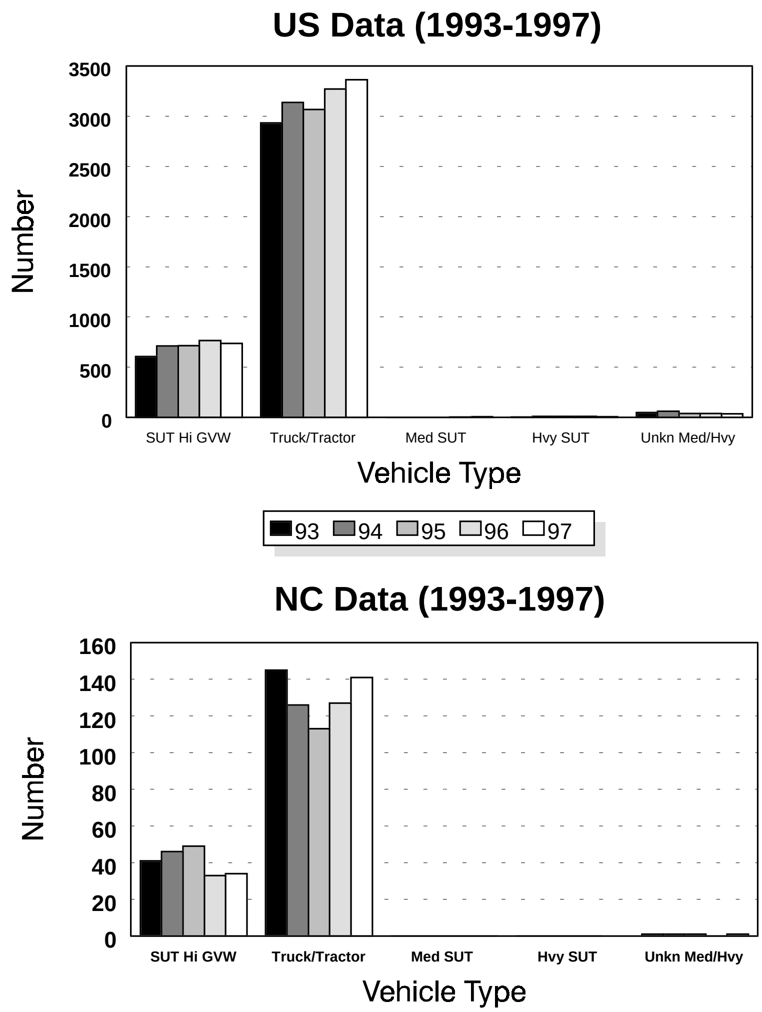

Figure 6. Fatal Large Truck Involved Crashes by Type of Truck (1993-1997),

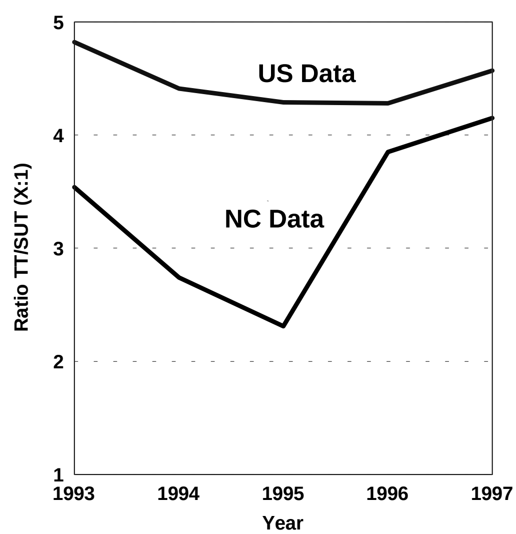

Figure 7. Ratio of Tractor Trailer Fatals to Hi-GVW SUT Fatals for the US and for North Carolina (1993-1997)

Fatal Truck Involved Crashes by Class of Roadway

Figure 8 shows a comparison of US and North Carolina data in terms of the functional class of roadway on which large truck fatal crashes occurred. Figure 8 provides data for crashes on rural roadways. Figure 9 provides data for crashes on urban roadways. In terms of fatal crashes on rural roadways, whether in North Carolina or the US as a whole, the highest number of fatals occured on primary arterials. In North Carolina, as contrasted with the US, there was little or no difference between primary rural arterial crash frequencies and those on minor arterials and major collectors.

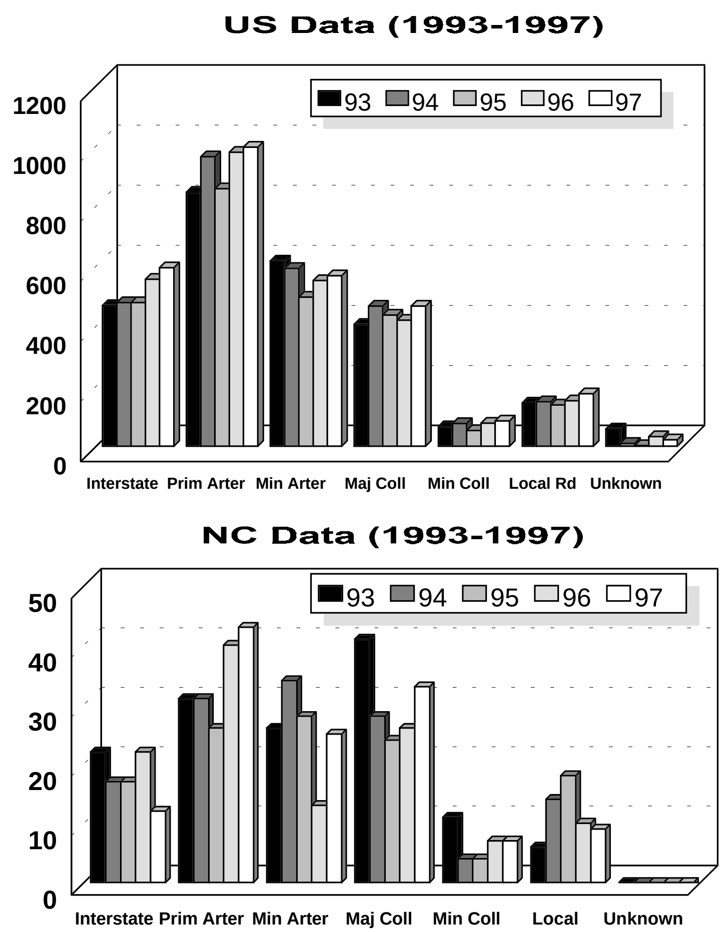

Figure 8. Fatal Large Truck-Involved Crashes in the US and in North Carolina as a Function of the Type of Rural Roadway (1993-1997).

With respect to crashes on urban roadways, the number of fatal involvements on urban interstates began to approach those on urban arterials. It is hard to interpret the significance of the year to year changes in fatals on North Carolina urban roadways. Two things however stand out in the North Carolina crash data for large truck involved fatals on urban roadways: first, the higher proportion of fatal crashes on *'local' urban roadways* in North Carolina compared to the US as a whole; and second the apparent sharp increase in fatals on *NC urban interstates, primary arterials, minor arterials, and local roads* from 1996 to 1997. No comparable magnitude changes in large truck involved fatals were observed during this same period of time for crashes on NC rural roadways. It seems that the marked increase in fatal truck involvements in North Carolina from 1996 to 1997 may have been due, at least in part, to an increase in the number of fatal involvements occurring on urban roadways.

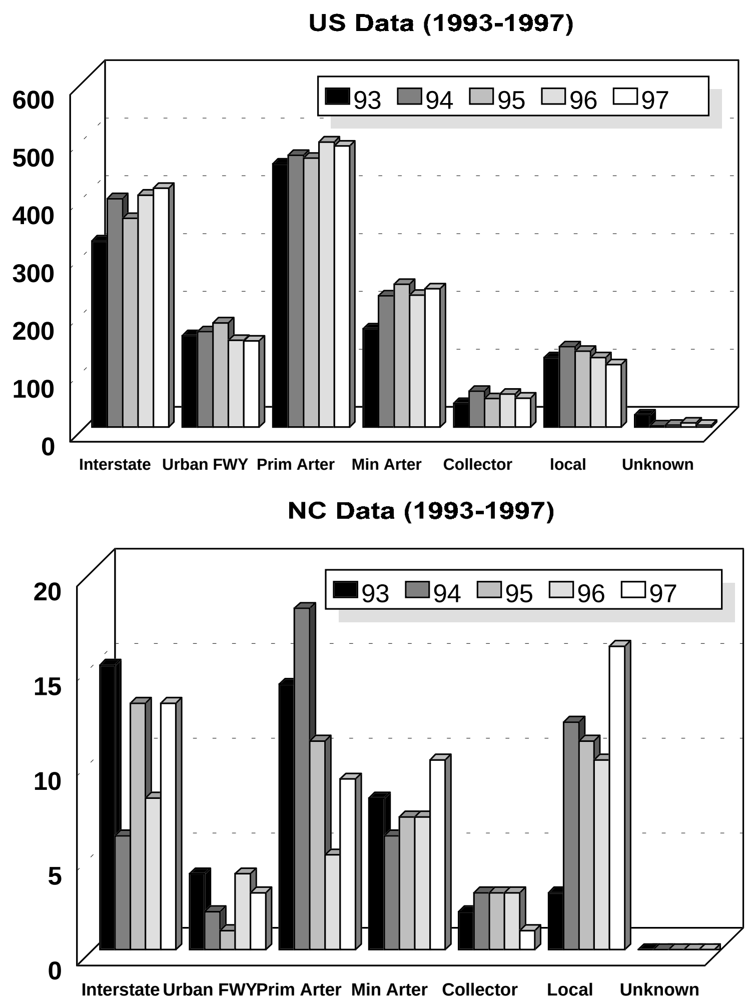

Figure 9. Fatal Large Truck Involved Crashes in the US and in North Carolina as a Function of Type of Urban Roadway (1993-1997)

Fatal and Non-Fatal Involvements by Type of Road

Figures 10 and 11 compare fatal and non-fatal crashes in North Carolina in terms of the functional class of roadway on which they occurred. Figure 11 shows data for fatal crashes. Figure 12 shows data for non-fatal crashes. The one common finding is that only 20-21 percent of crashes (non fatal and fatal, respectively) occurred on Interstates. The data show that fatal crashes were more likely to have occurred on US and NC-numbered routes whereas non fatal crashes were more likely to have occurred on secondary routes and local streets.

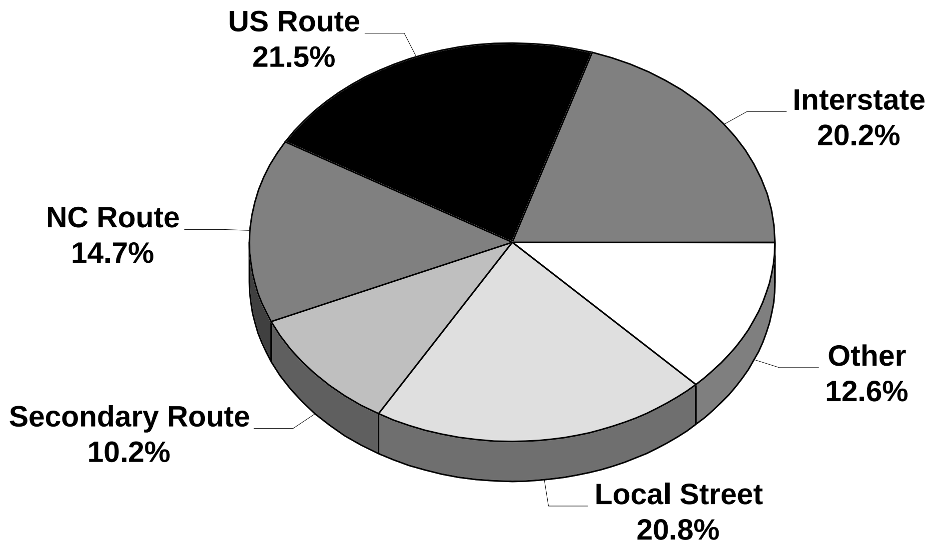

Figure 10. Non Fatal Large Truck Involved Crashes in North Carolina by Functional Road Class (1993-1997)

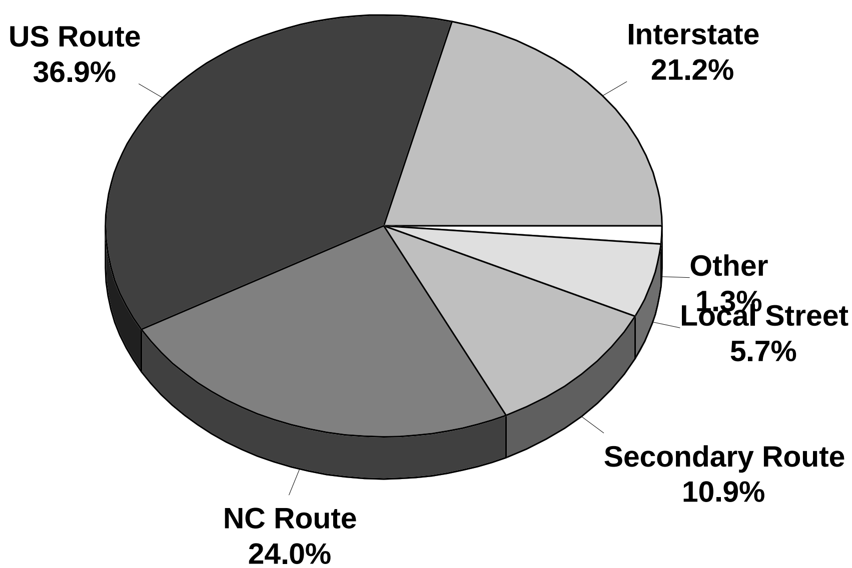

Figure 11. Fatal Large Truck Involved Crashes in North Carolina by Functional Road Class (1993-1997)

Fatal Truck Involved Crashes and the Role of Roadway Features

In over half (53 percent) of all fatal truck involved crashes in North Carolina for the period 1993-1997, no special roadway feature was indicated as having played a role in the crash. When a particular roadway feature was indicated, the most frequently occurring feature was an *intersection*. Intersection was indicated as being involved 29 percent of the time. The next most frequently occurring feature (10 percent of the time) was the presence of a public or private drive.

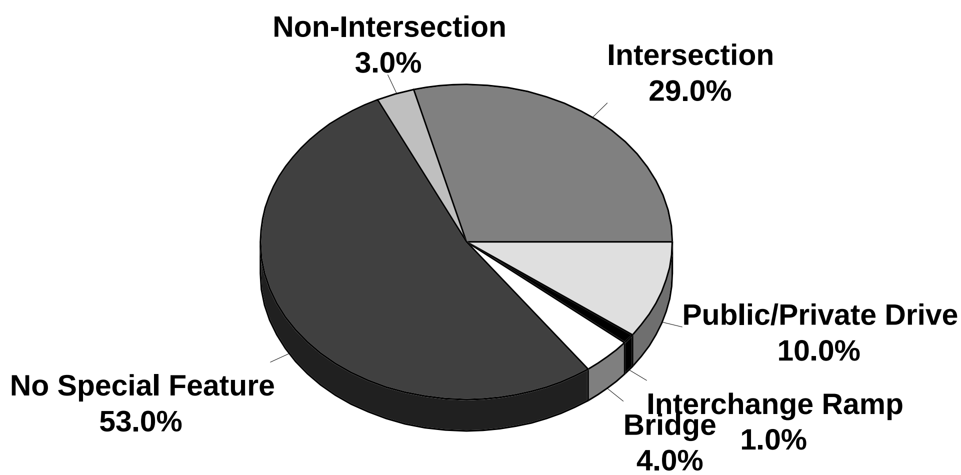

Figure 12. Fatal Large Truck Involved Crashes as a Function of Roadway Feature

Involvement of Border State Operators in Fatal Crashes

Figure 13 provides data which show fatals as a percentage of all truck-involved crashes in terms of the truck driver's state of registration. According to the data, 1.68 percent of crashes involving North Carolina licensed drivers were fatal compared to 2.15 percent of drivers from either Tennessee, South Carolina, or Virginia. (Recall that fewer than 2 percent of all truck involved crashes during this period were fatal).

Crashes involving North Carolina licensed drivers and those involving 'border state' drivers were further looked at in terms of the percent of all crashes where an equipment defect was noted. The data are shown in Figure 14. Two things are noted. First is the extremely low frequency of brake and/or tire defects associated with large truck-involved crashes. Second is the relatively higher frequency of brake and/or tire defects for North Carolina licensed drivers.

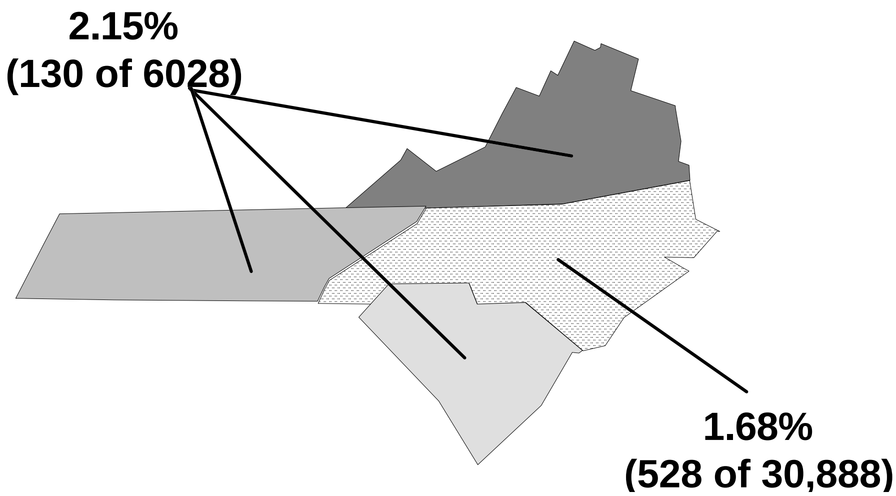

Figure 13. Fatal Crashes as a Percentage of All Truck-Involved Crashes in Terms of the State in Which the Driver was Licensed (Data are for the period 1993-1997)

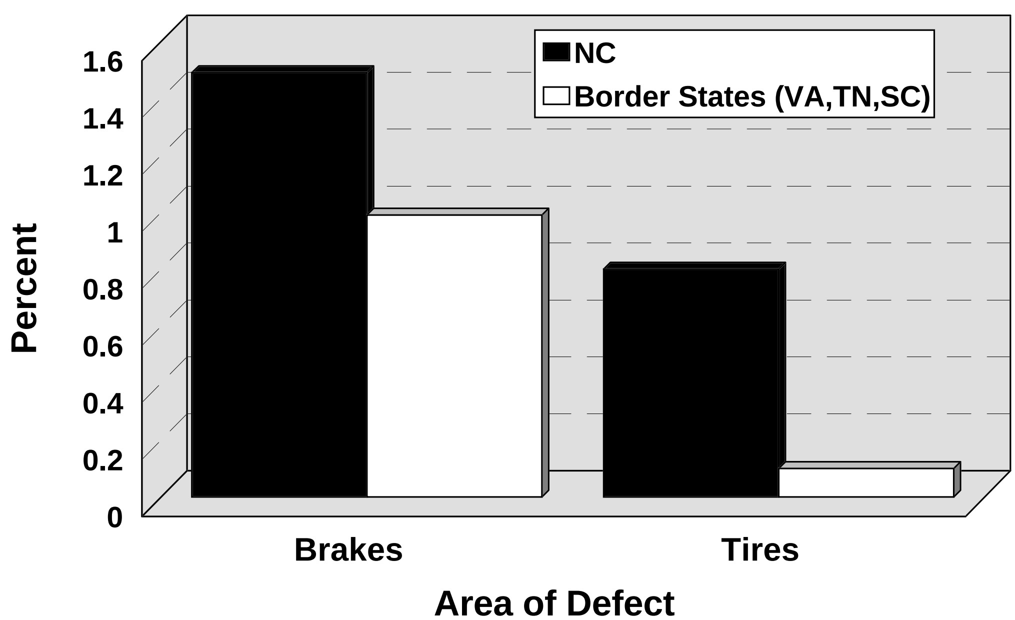

Figure 14. Percent of all Fatal Truck Involved Crashes Where Equipment Defect was Noted.

Number of Trucks and/or Other Vehicles Involved

Figure 15 shows that for 93.5 percent of all crashes involving large trucks, only one truck was involved. In those limited instances involving more than a single truck, the data (see Figure 16) show that the likelihood of a fatal outcome increased exponentially as the number of trucks increased.

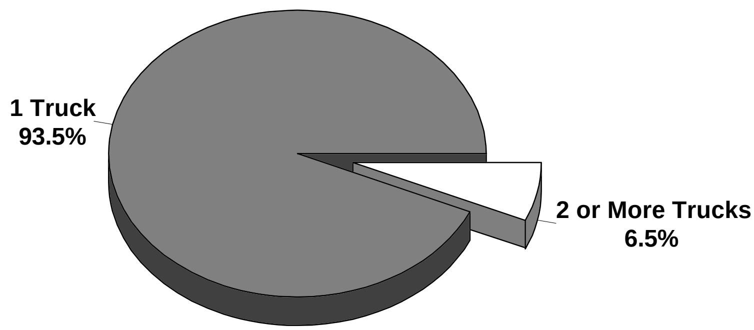

Figure 15. Single Versus Multiple Truck Involved Crashes in NC (1993-97)

Figure 16 shows that (in North Carolina) the likelihood of a fatal crash increased as a function of the number of vehicles involved. Figure 17 shows that as the number of overall truck miles traveled in the state increased during the period 1993-1993, the likelihood also increased for vehicle crashes involving 3 or more vehicles. The data show truck miles traveled increasing at an average of 4 percent per year, while the percentage of crashes involving 3 or more vehicles was increasing at a rate of approximately 14 percent per year

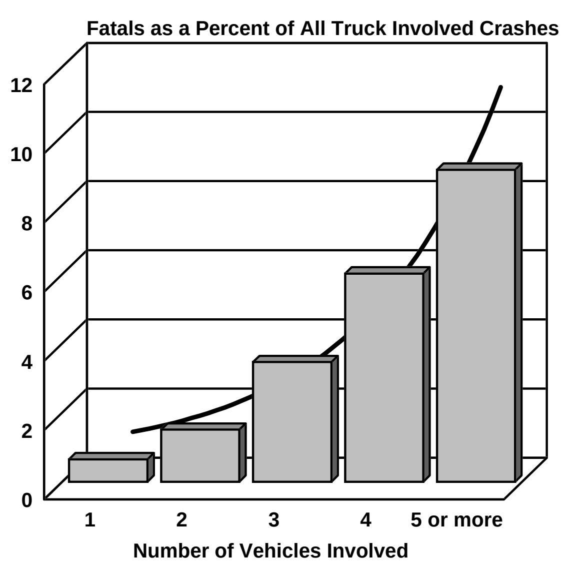

Figure 16. Fatals as a Percentage of All Truck-Involved Crashes: The Role of the Number of Vehicles Involved

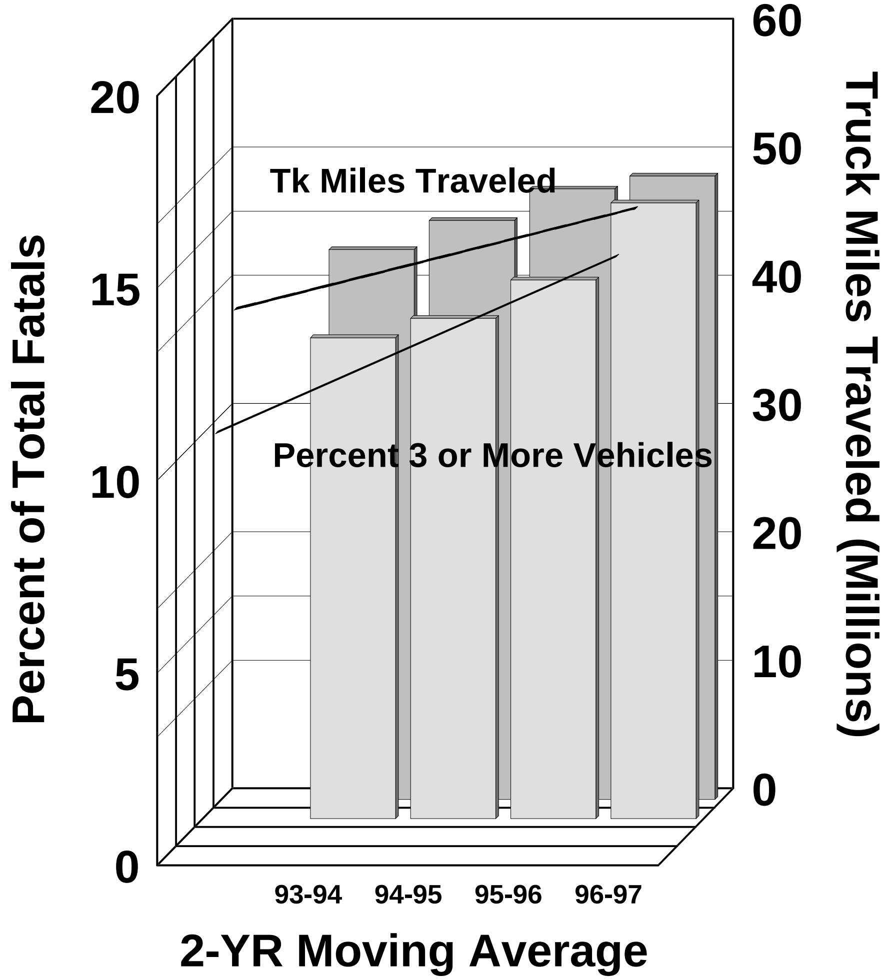

Figure 17. Percent of Large Truck-Involved Fatal Crashes Involving Three or More Vehicles

Fatal Truck Involvements and Speed

Figure 18 shows that fatal, truck-involved crashes were most likely in the 46-65 mph range. Remember that only 1.6 percent of all large truck-involved crashes on the average were fatal (refer to Figure 5). Figure 19 shows the distribution of posted speeds at which fatal and non-fatal crashes occurred. Fatal and non-fatal crash outcomes involving a large truck were most likely in the 45-65 mph range of posted speeds. Both distributions 'peak' in this range. At posted speeds below this level, truck involved crash outcomes were more likely to be non-fatal.

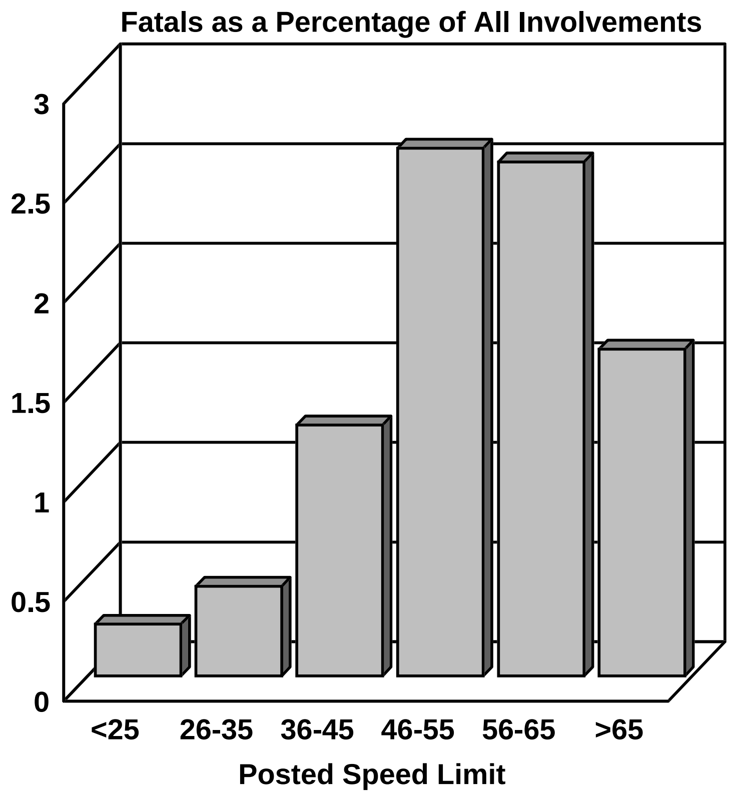

Figure 18. Fatals as a Percentage of Total Truck Involvements: Relationship to Posted Speed Limits

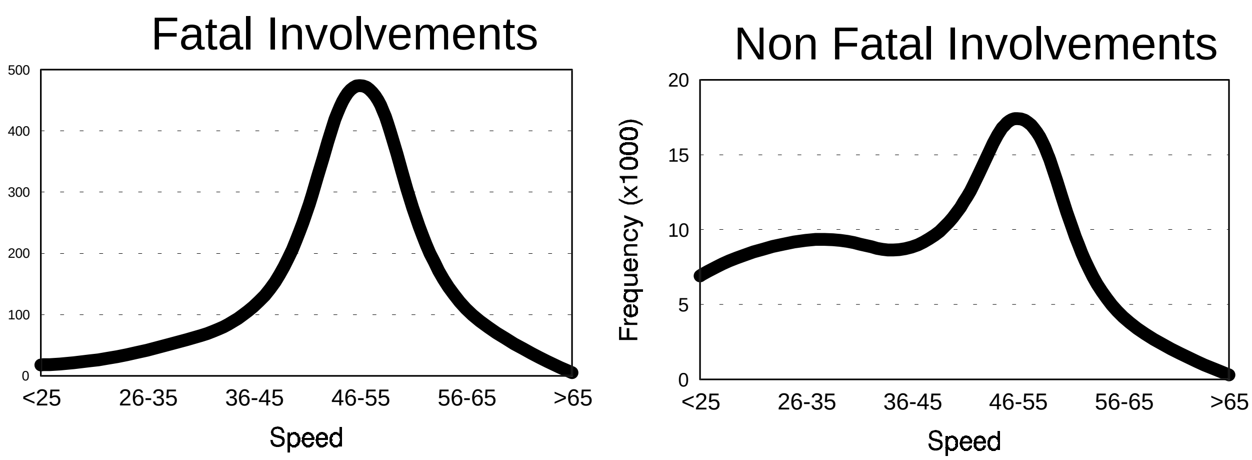

Figure 19. Distributions of Posted Speeds for Fatal and Non-Fatal Truck-Involved Crashes in North Carolina, 1993-1997.

The Role of Age in Truck-Involved Crash Outcomes

Figures 20 and 21 address the role of age in large truck involved crash outcomes. Figure 20 addresses the age of the truck driver; Figure 21 the age of the driver of the non-truck vehicle involved in the crash.

Figure 20 shows the distribution of ages of truck drivers involved in fatal truck-involved crashes in the US and in North Carolina over the five year period, 1993-1997. Drivers have been grouped by age into three categories: those under the age of 26; those between 26 and 65 years of age; and those drivers over 65 years of age.

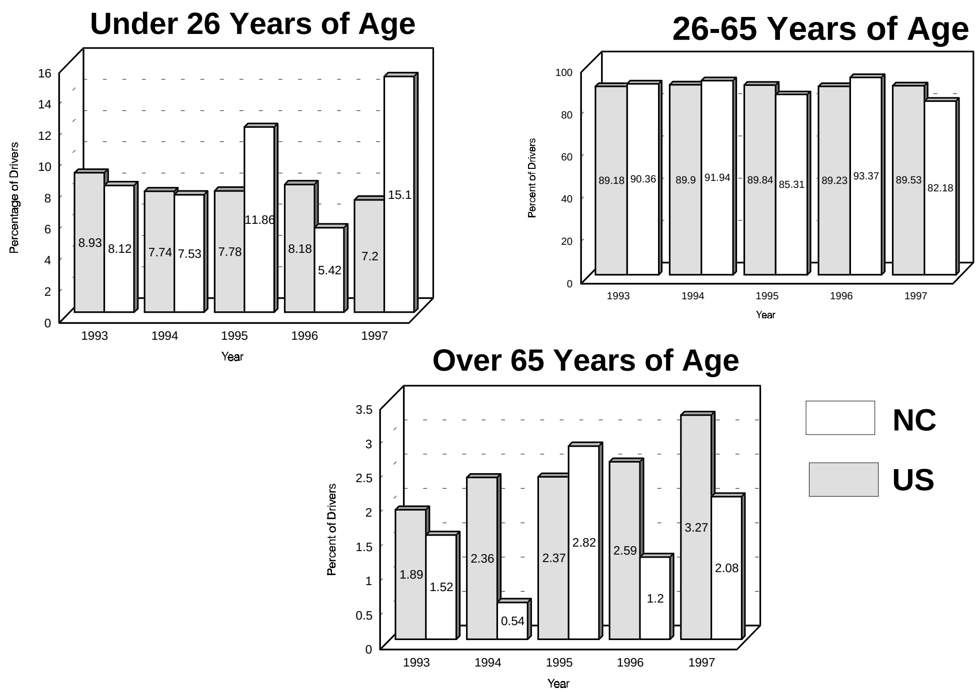

Figure 20. A ge Distributions of Truck Operators in Fatal, Large Truck-Involved Crashes in the US and in North Carolina, 1993-1997.

Looking first at those in the range from 26-65 years of age, the data indicate no apparent differences between the US and North Carolina data. Neither does there appear to have been any change over time in terms of the relative involvement of this age group in large truck-involved, fatal crashes. Looking at truck drivers in the older group (those over 65 years of age), the percent of drivers in the US over age 65 nearly doubled (from 1.89 percent to 3.27 percent) over the five year period beginning in 1993 and ending in 1997. The data for North Carolina drivers in this age range are harder to interpret on a year by year basis. Additional data are obviously needed to determine whether this change nationally indicates that the risk to the older driver of a large commercial vehicle was increasing over time, or simply that there was a trend toward more older drivers in the population.

Looking at the data now for the truck driver under age 26, there appear to be distinct differences between the involvements of drivers of this age in North Carolina and those in the US as a whole. Whereas in the US overall, there was less than a 2-percent difference in the involvement of drivers under age 26, the percent of young crash involved drivers in North Carolina went from 8.12 percent in 1993 to 15.1 percent in 1997. The most marked increase was between 1996 and 1997 when the percent of drivers under the age of 26 involved in crashes almost tripled (from 5.42 percent to 15.1 percent).

Figure 21 presents data on the age of the non-truck driver(s) involved in fatal truck-involved crashes. There is no evidence of a systematic trend over time changes in the involvement of the three age groups as they are defined here. It is clear from a comparison of the truck driver age data in Figure 20 and the non-truck driver age data in Figure 21 that the involvement of non-truck drivers at the two age extremes (under 26 and over 65) is higher for the non truck driver population. These data, by themselves, are not sufficient to infer that young and old truck drivers are at greater risk of being involved in fatal crashes than comparable age drivers of non-truck vehicles.

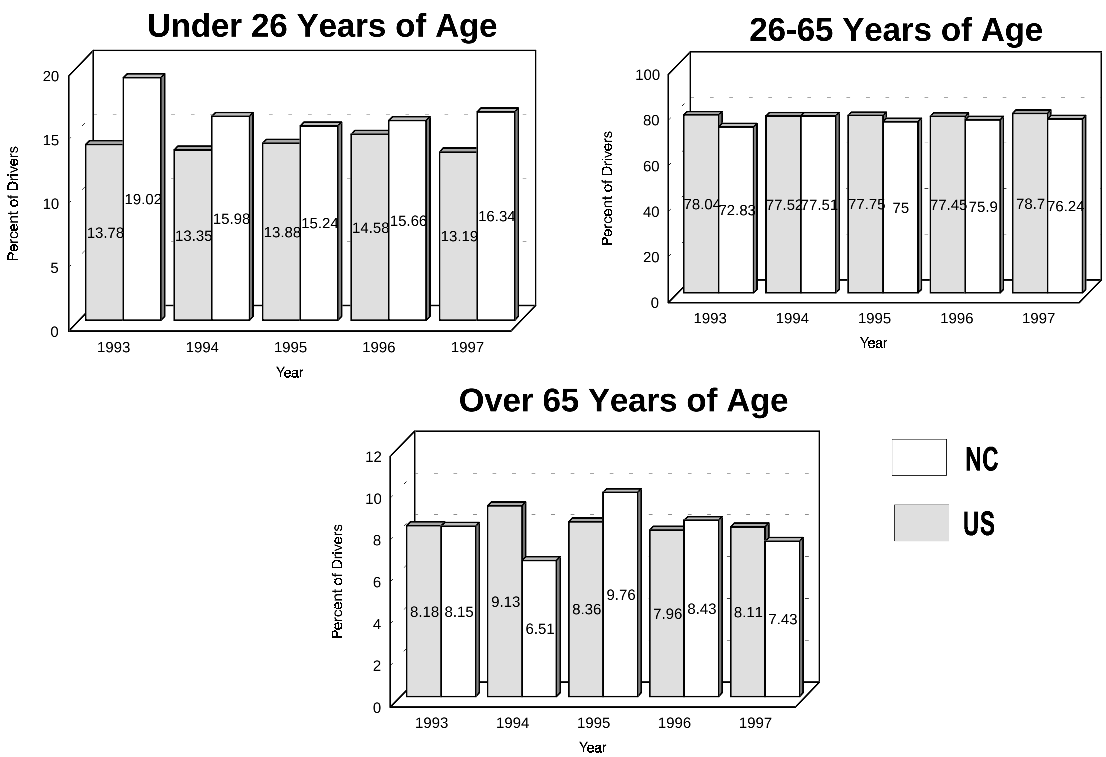

Figure 21. Age Distributions of Non-Truck Drivers in Fatal, Large Truck-Involved Crashes (1993-1997)

Lastly, with respect to age, the North Carolina crash data shown in Figure 22 indicate that as the number of persons involved in a truck-related crash over 65 years of age crash increases, so does the likelihood of a fatal outcome. These data indicate that with two individuals over the age of 65 involved, the percentage of time that the outcome is fatal is about twice that of the average overall.

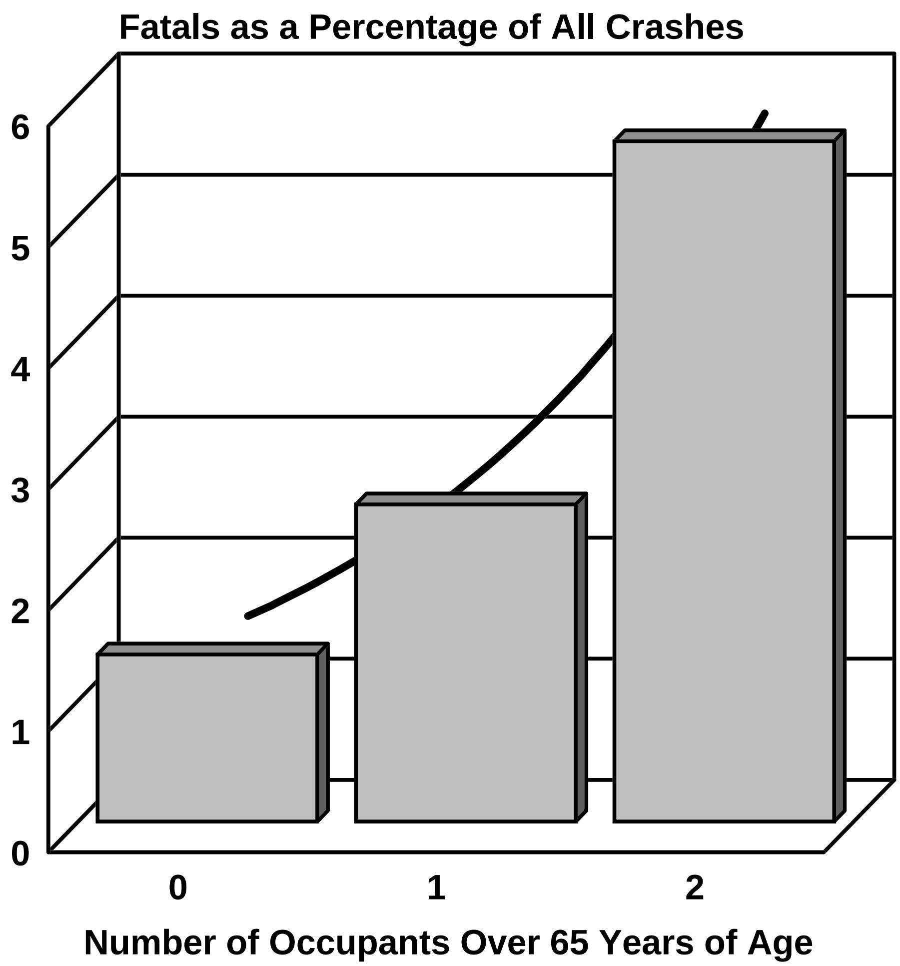

Figure 22. Percent of Fatal Crashes in North Carolina (1993-97) as a Function of the Number of Occupants Over 65 Years of Age

Type of Crash

To the extent that the greatest number of North Carolina fatal, truck-involved crashes from 1993 to 1997 occurred on NC and US-numbered routes in rural areas, the analysis focus on crash 'type' has been restricted to these locations. Table 1 presents data on the type of crash associated with these conditions. The type of crash is listed to the left. For each crash type, data are provided on the number of non-fatal crashes of that type, the number of fatal crashes for that crash type, the percent of all crashes (fatal and non fatal) accounted for by that crash type, fatals as a percentage of all crashes for that particular type crash, and a measure derived from taking the product of crash likelihood and probability of being fatal. The product of these two indices has been multiplied by 1000 for ease in comparing the results.

Type of Crash	Non Fatal Crashes	Fatal Crashes	Fraction of all Crashes All Types A	Fatals as Fraction of Specific Crash Type B	Product AxBx1000
Ran Off Road, Right	1200	23	.1503	.0188	2.8
Ran Off Road, Left	399	10	.050	.0244	1.2
Ran Off Road, Straight	32	1	.004	.030	0.1
Overturn	173	1	.021	.0057	0.1
In Road Other	204	2	.025	.0097	0.2
Hit Pedestrian	8	10	.002	.5555	0.1
Hit Parked Vehicle	93	3	.011	.03125	0.3
Hit Train	3	0	.0003	0	0
Hit Bicycle	6	1	.0008	.14285	0.1
Hit Moped	10	2	.0014	.1667	0.2
Hit Animal	233	1	.0287	.00429	0.1
Hit Fixed Object	117	0	.0144	0	0
Hit Other Object	280	0	.0344	0	0
Rear End, Slow	1384	28	.1735	.0198	3.5
Rear End, Turn	201	3	.0254	.0147	0.4
Left Turn	507	15	.0642	.0287	1.8
Left Turn Across Traffic	309	5	.0386	.0159	0.6
Right Turn	114	1	.0141	.0087	0.1
Right Turn Across Traffic	76	0	.0093	0	0
Head On	88	60	.0182	.4054	7.4
Sideswipe	1147	15	.1428	.0129	1.8
Angle	1092	118	.1488	.0975	14.5
Backing	155	4	.0192	.0252	0.5
Total	7831	303			

Note: Shaded boxes indicate the highest five (5) in each category

Table 1. Truck-Involved Crashes on Rural NC and US-Numbered Routes (1993-1997)

Since the purpose of the present study was to identify where the most appropriate 'focus' might be in terms of dealing with the factors responsible for truck-involved fatal crashes, it seems appropriate to address those crash types which both (a) have a high frequency of occurrence and (b) have a high likelihood of being fatal (See Figure 23).

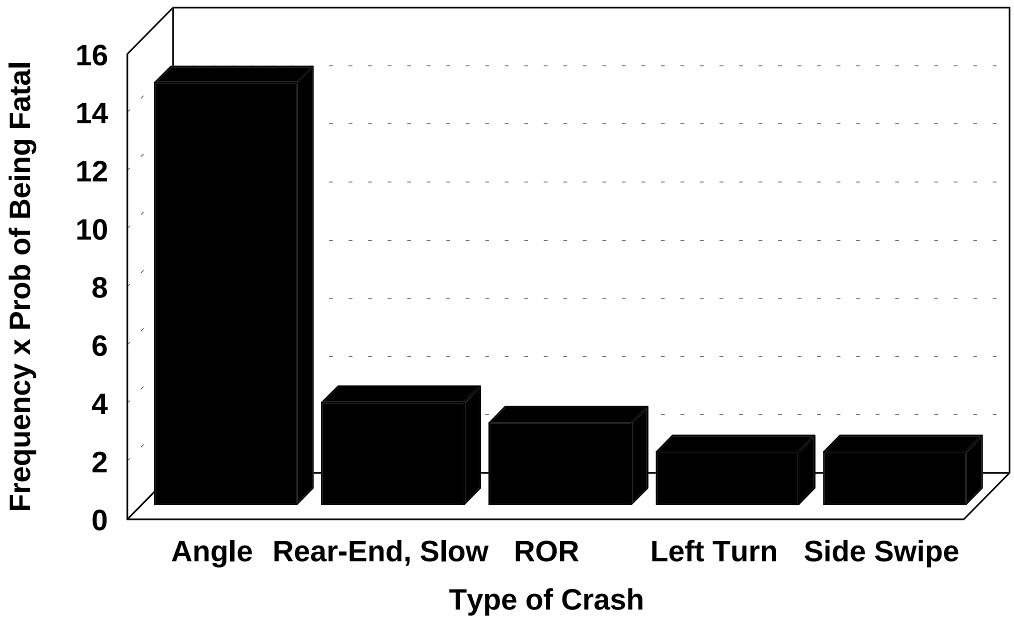

Figure 23. Frequency x Severity Index for Five Fatal Truck Involved Crash Types With Highest Frequencies of Occurrence on Rural NC and US Routes, 1993-1997 (***Does not include head on crashes which, despite a high 41 percent chance of being fatal, constitute less than 2 percent of all fatal truck involved crashes.***)

Note that there are other crash types having a higher probability of being fatal (e.g., hit pedestrian, hit bicycle, hit moped, head-on, etc.). Although each has a high probability of being fatal, each occurs much less frequently. Of the five crash types satisfying these criteria, it is clear that the 'angle' type crash. . . most often used to describe collisions occurring at intersections and other access points where vehicles converge at angles approaching 90 degrees. . . deserves the greatest attention. With respect to the relative importance of each, note that when using the weighted metric described above, Rear End and Run Off Road crashes approach an order of magnitude (squared) difference from Left Turn and Sideswipe crashes, and that Angle crashes represent an another order of magnitude difference from Rear End and Run Off Road crashes. From the standpoint of using these data to establish a 'focus' for reducing the involvement of large trucks in fatal crashes, it seems clear that *angle* (intersection) crashes and *rear end slow* crashes (vehicle following and stopping distance) should be primary areas of consideration.

While other metrics can be devised to differentially weight frequency of occurrence and likelihood of being fatal, the important point here is to note that these analyses point to the importance of crash types (in particular, angle crashes) that lie outside the primary focus of the FHWA 'No Zone' program. The present data suggest that angle crashes are, in fact, different in importance from the No Zone sideswipe and rear end crash scenarios by several orders of magnitude.

Work Zone Crashes Involving Large Trucks

Figure 24 presents data showing the percentage of large truck fatal involvements occurring in work zones within the state of North Carolina during the period 1993-1997. According to the data, the percent of fatals occurring in work zones ranged from a high of 3-4 percent at the outset of the five year period to a low of 1 percent in each of the last two years of the five year period.

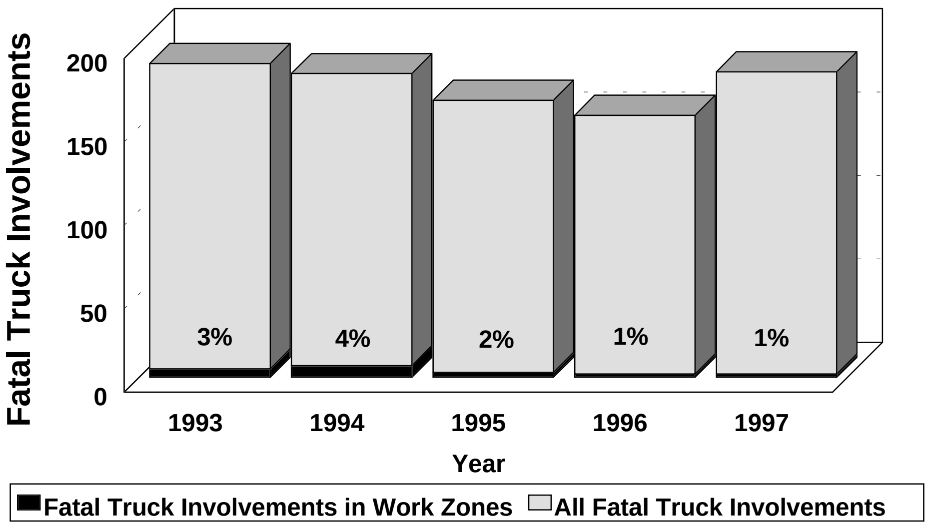

Figure 24. Fatal Involvements for Large Trucks (Overall) and for Those Occurring in Work Zones (North Carolina data, 1993-1997).

Figure 25 describes the types of crashes which occurred in work zones. The most frequent type of crash was the *rear end* which occurred approximately 37 percent of the time. The next most frequently occurring type of crash was the head-on, occurring approximately 21 percent of the time. Side swipes (both same and opposite directions combined) accounted for another 10-11 percent. Angle crashes occurred approximately 5 percent of the time in work zones compared to almost 15 percent of the time outside work zone areas, and in approximately 1/4 of all work zone crashes involving large trucks, no specific crash type was identified in the crash records.

Figure 26 shows the number of vehicles involved in truck-related work zone crashes. Approximately 60 percent of all truck involved work zone crashes involved two or fewer vehicles. Approximately 80 percent involved three or fewer vehicles; 84 percent 4 or fewer vehicles. There were no large truck related work zone crashes during this period which involved more than five vehicles total.

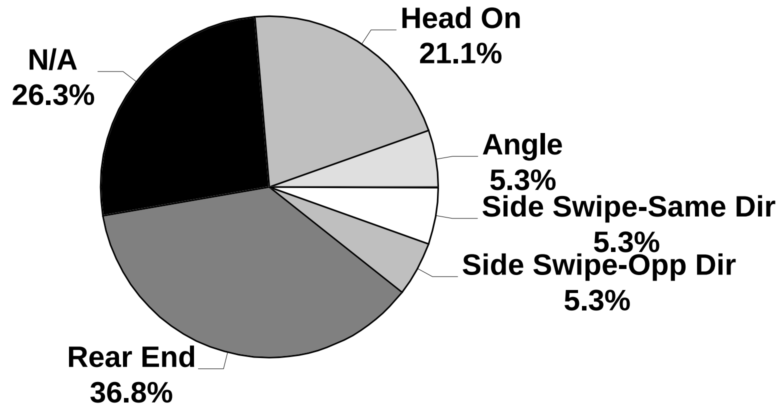

Figure 25. Fatal Large Truck Involved Crashes in North Carolina Work Zones by Crash Type (1993-1997)

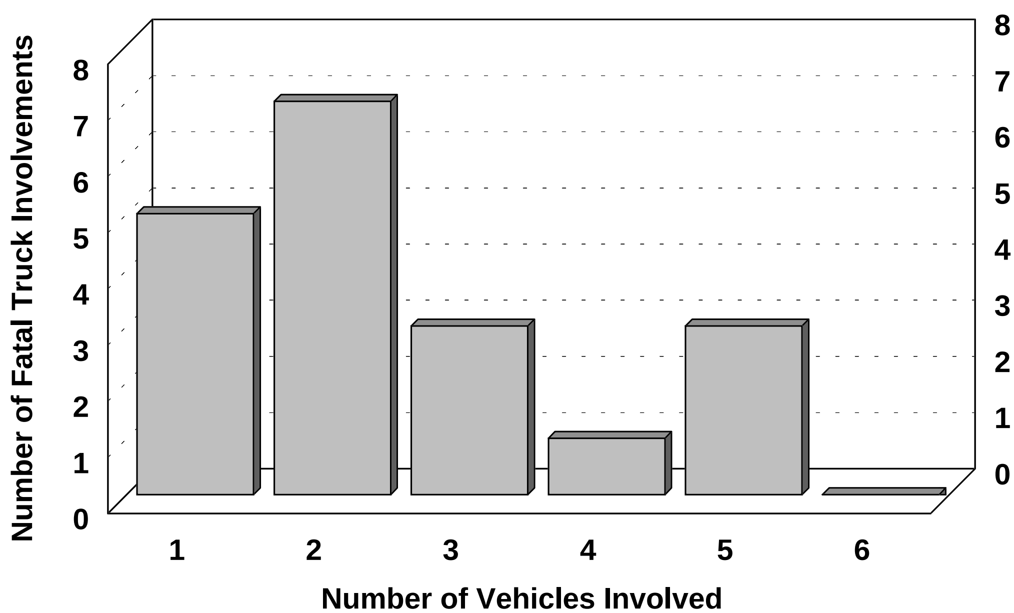

Figure 26. Number of Fatal Truck Involvements in Work Zones as a Function of the Number of Vehicles Involved in the Crash (NC data, 1993-1997)

With respect to location/type of roadway, Figure 27 shows that fatal large truck involved crashes in work zones were most likely to have occurred on Interstates. Contrary to the data reported earlier showing that only 21 percent of all fatal large truck crashes occurred on Interstates, the present data show that Interstate work zone locations accounted for 2/3 of all work zone fatal crashes involving large trucks.

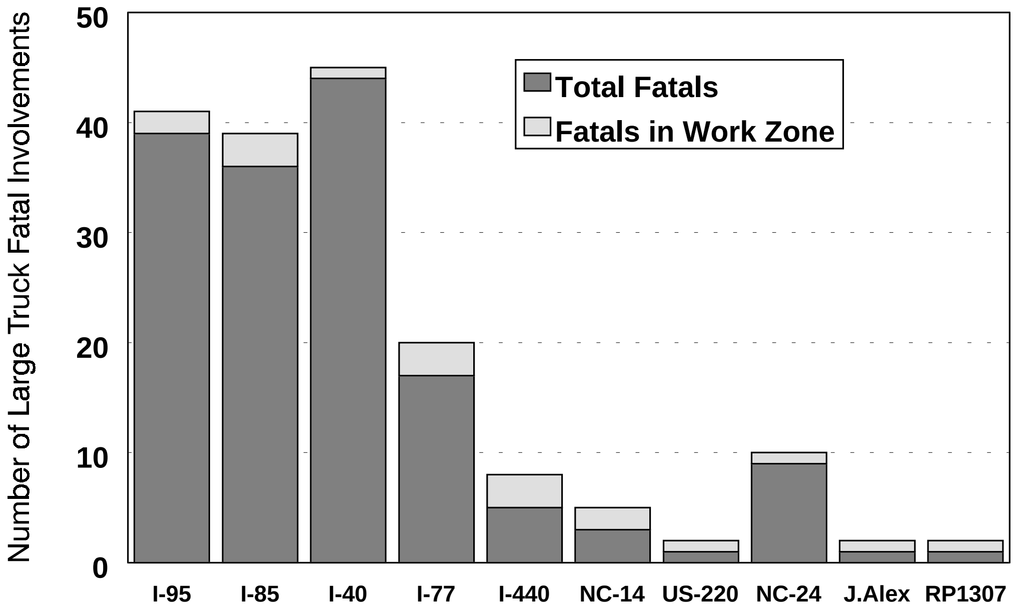

Figure 27. Frequency of Fatal and Non Fatal Work Zone Crashes Involving Large Trucks for Specific Routes Where Work Zone Crashes Were Recorded (1993-1997)

Figure 28 shows that truck involved crashes in 'rural' work zones were 2-3 times more likely to be fatal than were crashes in 'urban' work zones.

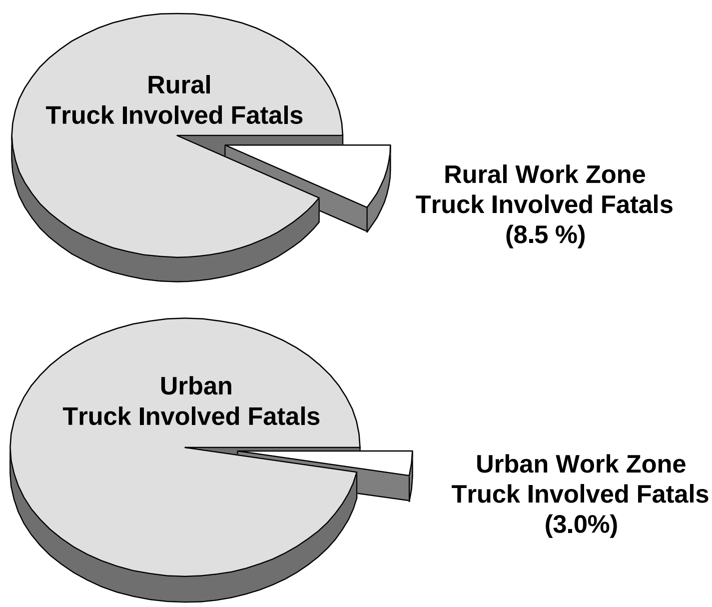

Figure 28. Relative Risk of Fatalities for Large Trucks Involved in Work Zone Crashes in Rural and Urban Areas (North Carolina Data, 1993-1997).

FOCUS

1. In terns of overall, fatal crash frequency, focus on rural NC and US-numbered routes.

- Approximately 7 out of every 10 fatal, large truck involvements occur on NC and/or US-numbered routes. Only 2 out of every 10 large truck-involved crashes (non fatal as well as fatal) occur on North Carolina interstate highways.

2. Monitor data for possible increase in fatal truck-involved crashes on urban roadways.

- 1996 and 1997 data show possible beginning of a trend toward an increase in fatal, large truck involved crashes on North Carolina urban roadways.

3. Focus of safety of large trucks in Interstate work zones.

- While only 2 out of every 10 fatal crashes involving a large truck occured on the Interstate, two thirds of all fatal crashes involving large trucks in work zones occur on the Interstate.

4. In terms of the type of 'large truck,' data suggests a focus on tractor trailer vehicles.

- Tractor trailers were involved in 83% of all large truck-involved crashes involving a fatality. While the data permit one to differentiate types of trailers (box, tank, flatbed, etc.) and whether the load is hazardous material, they do not permit one to identify the commodity being transported. The inability to do so makes it difficult for those segments of the industry (e.g., logging and wood products) to track the effectiveness of truck safety programs (e.g,, the ProLogger course sponsored by the NC Forestry Association). Neither does the current data permit one to identify those vehicles used principally in agricultural operations.

5. In terms of overall frequency of occurrence and likelihood of being fatal, the data suggest that focus should be placed on *angle crashes* in addition to No-Zone sideswipes and rear ends.

- When considering the joint importance of frequency of occurrence and probability of being fatal, 'angle' type crashes are several orders of magnitude more important than the sideswipe incident associated with No Zone. To the extent that the data show most fatal large truck-involved crashes occurring on rural roadways, traffic engineering emphasis needs to be placed on effective stop/yield control measures (regardless of level of signalization present).

6. Focus of ‘enforcement’ needs to be extended from its traditional role in terms of regulatory compliance to its essential role in shaping and maintaining appropriate driver behavior.

- Driving is a learned behavior which is dependent upon enforcement for its effective maintenance. Because of inherent limitations in stopping distance, vehicle speeds and following distances for large trucks need to be a primary target of enforcement efforts. To the extent that equipment defects (especially tires and brakes) can accentuate these limitations, enforcement (e.g, vehicle inspections) needs to eliminate such factors from the crash equation. The present data do not permit a recommendation as to the number or frequency of vehicle inspections required to ensure a given level of crash reduction. Inspections should also increase the focus on driver related factors. . . not just physical equipment status.

7. Begin to investigate the application of technologies that will reduce the ‘labor intensiveness’ of current enforcement approaches.

- Support efforts that allow one to get beyond the traditional ‘one officer-one ticket’ approach to enforcement (e.g., camera technologies for detecting undesirable operating practices, such as speeding, following too closely, frequent/unnecessary lane changes, etc.). Investigate methods that would increase the efficiency of the vehicle inspection process (e.g, new methods for brake inspections; ITS/CVO methods for weigh-on-the-move, electronic log books, etc.)

8. Examine whether North Carolina needs to change its perception from that of a ‘truck friendly’ state to a state that is ‘tough on trucks.’

- Discussions with North Carolina trucking company executives responsible for safety indicate that the perception of North Carolina by out-of-state drivers is that of a ‘truck friendly’ state (that is, a state which is ‘easy’ on truckers). While the data on fatal crashes do not suggest that out-of-state drivers are more likely to be operating defective equipment, there is the suggestion that ‘border state’ drivers were at a greater risk of being involved in a fatal crash than drivers licensed in North Carolina. NCDOT proposals to increase the fines and points associated with truck safety violations need to be tracked to determine their effectiveness in changing not only ‘perceptions’ but the actual behaviors to which they are presumed to be linked.

9. Continue efforts toward improved analysis and problem identification

- NHTSA’s “Top Ten” definition of a ‘large truck’ (generally anything greater than 10,000 lbs GVW) is too broad to serve as a practical basis for a focused approach to problem identification and/or the development of effective safety programs and countermeasures. Even limiting ones analysis to tractor trailer vehicles overlooks the fact that the safety of a particular vehicle type may be significantly affected by its mode of operation, the driver population that may be associated with that type of operation, the carrier, and the safety management environment in which that carrier operates.

- Future analyses need to include more detailed information on the driver, the status of the equipment, and the carrier in addition to the traditional crash related variables. Analyses need to be able to link traditional sources of crash data with data bases such as those being developed by the SAFER and SAFESTAT programs. Summary statistics of FARS data, for example, do not provide the type of operational insight needed by carrier management to develop effective truck safety programs.

- Work is need to document the effectiveness of commercial vehicle safety programs and policies. Common metrics (e.g., reportable crashes per x-miles traveled) are needed to make comparisons across different programs. Commodity identification is required to track programs by specific industry (e.g., the effectiveness of NCFA's ProLogger program).

- Truck safety analysis and program development efforts should involve appropriate elements of the insurance and risk management communities. Rate reductions by some insurers for driver participation in truck safety training programs need to be evaluated for their validity.

- Desperately need valid measures of 'exposure' (miles traveled) in order to move from a frequency-based approach to one based upon an independent assessment of 'exposure' (opportunity) and 'risk.' NHTSA and OMC within the FHWA need to move to an assessment of safety that is based on crash 'rates' rather than crash 'frequencies.'

10. Establish a central focal point for the analysis of truck crash data and truck safety program effectiveness within North Carolina.

- Establish the UNC Highway Safety Research Center (HSRC) as the focal point for the analysis of all truck crash data and (truck safety) program effectiveness evaluations within the state of North Carolina. Sustaining funding for this effort should come jointly from the state and federal sources (NCDOT, NC GHSP, and from via local FHWA/OMC office) as well as from outside/industry sources (e.g, NCTA).

- Jointly (i.e, NCDOT, DMV, GHSP, FHWA/OMC, and NCTA) establish clear program goals/expectations for the reduction of fatal truck-involved crashes and the means to objectively monitor progress toward attaining those goals.