ROAD RESEARCH LABORATORY

Ministry of Transport

RRL REPORT No. LR 197

A SURVEY INTO THE ACCIDENT RATES OF ARTICULATED AND RIGID COMMERCIAL VEHICLES

by

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Crowthorne, Berkshire
1968

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ABSTRACT

This survey compares the accident rates of articulated and rigid commercial vehicles in the medium and heavy category.

The accident rates are based on information from a traffic census at about 40 sites throughout the counties of Leicestershire and Rutland during 1966/7 and on Police reports of accidents involving commercial vehicles in Leicestershire, Rutland and Warwickshire in which personal injury and/or damage only occured.

It is estimated that the articulated vehicles had an accident rate of 2.6 accidents per million km (4.2 accidents per million vehi mile) which compares with a rate of 3.0 (4.8) for rigid commercial vehicles of over 5 tons unladen weight. Thus, despite jack-knifing and other handling problems peculiar to articulated vehicles, their overall accident rate was slightly lower than that for rigid vehicles of the same weight under the conditions prevailing in Leicestershire and Rutland. If, however, the Motorway M1 was excluded from the survey the rate for the articulated vehicles may be slightly higher than for the rigid vehicles.

Other results from the accident and traffic surveys are discussed in the note.

1. INTRODUCTION

Economic advantages are leading to the increasing use of articulated vehicles (sometimes referred to as tractor units with semi-trailers). This has led to queries about their accident rate, partly because of the occasional spectacular accident which occurs, in which considerable damage apart from injuries to the driver and to other people occur.

This survey attempts to compare their accident rate per vehicle km with that for large and medium size rigid commercial vehicles and to find what may account for any differences noted. The accident rate was found by collecting data for accidents including personal injury and damage only that involved commercial vehicles in Leicestershire and Rutland, during 1966/7 and by carrying out a survey to find the traffic composition in the same area during that time. Additional data relating to accidents involving articulated vehicles in Warwickshire during the same period are included to clarify some of the results.

2. TRAFFIC SURVEY

The traffic survey was carried out in Leicestershire and Rutland by the Laboratory during April 1966, some additional checks being made later in the summer of 1966 to check seasonal and other variations; an additional survey was also made on one day in July, 1967. Although the survey was on a small scale, sufficient data were obtained to enable estimates to be made of the commercial traffic flow on the various classes of roads.

Being situated in a less industrialised sector of the Midlands, the commercial traffic consisted mainly of through traffic, the usual local distributive traffic but only a small amount of locally generated industrial traffic. The main roads throughout the county are fairly flat with few difficult hills or hazards for commercial vehicles. As the City of Leicester was not included in the accident survey, the remaining area had a large proportion of rural roads and so the additional accident data from Warwickshire which has a large mileage of urban roads was particularly useful, even though no traffic survey was carried out in the county.

2.1 Method of survey

The traffic survey was designed to provide estimates of the annual flow of articulated and of medium and large rigid commercial vehicle traffic on the different classes of urban and rural roads. The daily variations in traffic at about 20 sites was noted, although full data was not obtained at all of them. Sufficient data were obtained on Saturday and Sundays to enable estimates to be made for the reduced flows at the weekends. Several sites were on Class 3 or unclassified roads and although these made little contribution to the total traffic flow, a reasonable estimate of the vehicle annual distance was obtained so that the accident risk could be assessed for this class of road.

2.1.1 Relation between unladen weight and number of axles of rigid vehicles. The Police, in compiling their accident data, noted the unladen weight of the vehicles but not the number of axles. In the traffic flow counts, however, the Laboratory observers were unable to record the unladen weights with the equipment easily available and so the number of axles were noted instead. It thus became necessary to establish the relationship between the unladen weight and the number of axles and this was done by subsidary surveys in Leicestershire and Rutland (Fig. 1) and also near the Laboratory. Both surveys showed that nearly 90 per cent of the rigid vehicles with two axles had an unladen weight of less than 5 tons and that most of the remaining 10 per cent had an unladen weight of 5 to 7 tons. The rigid commercial vehicles having more that 2 axles had unladen weights ranging from 5 to 10 tons but 45 per cent of them had an unladen weight of 8 to 9 tons, the remaining 55 per cent being fairly evenly distributed between 5 and 10 tons.

These subsidiary surveys not only enabled the survey and accident data to be related but gave an indication of the relative traffic flows of the medium and heavy rigid vehicles in the different unladen weight categories.

2.1.2 Choice of sites and survey procedure. It was not possible to provide the effort to carry out a comprehensive survey and only 20 sites were used; these were not selected on a truly random basis, but were chosen from a knowledge of the counties to be as representative of the roads as possible.

Observations were made at each site for different four-hour periods during the day and week. The daily traffic flows were assessed by adding up the estimates for the six periods of 4 hours. The weekly flows for each site were estimated on the basis of observation and sometimes by using the flow pattern from a similar site observed at a different time of the day or week.

2.1.3 Estimation of traffic flow in counties on basis of flows at sites. The total length of each category of road (Table 1) was known and with a knowledge of the area and use of maps, estimates of the number of vehicles/km of each category of road were made by adding together the multiples of the vehicle flow and an appropriate length for each site. The length of each road in the county was allocated to the survey site which appeared likely to have a smilar traffic flow. For example, there are 248 km (154 miles) of Rural Class 1 roads and seven sites provided useful data. These were on the A4114 west of Lutterworth, A512 west of the southern outskirts of Shepshed, A447 north of the intersection with B5324, A50 in Coalville, A444 north of the intersection with B585, A607 at Melton Mowbray and A6003 in Caldecott. The traffic flows at these sites were multiplied by 21, 18, 29, 32, 45, 50 and 53 km respectively to give the estimate of Rural Class 1 vehicle kilometres in the county. The traffic survey results are listed in Table 2.

This method may be compared with the more conventional one of giving each survey point equal weight in the estimate, which gives results which are usually, but not always, within 10% of the traffic flows listed in Table 2. However, there would be large differences for the Class III roads, for which the equal weight method gave estimates at least three times higher, as the survey points were probably more often on the busier roads.

3. ACCIDENT DATA

3.1 Leicestershire and Rutland data

The accident data mainly relate to articulated vehicles and came from two sources. Through the suggestion of the County Surveyor of Leicester, the Leicestershire and Rutland Constabulary co-operated by sending details of every accident that came to their notice and that involved an articulated vehicle in their area over a period of 12 months. A questionnaire prepared by the Laboratory was filled in by the Police attending each accident. The Police also supplied monthly returns of the number of accidents involving rigid and articulated commercial vehicles, which were classified according to the unladen weight of the vehicle and the severity of the most severly injured person in the accident. The combined results for the twelve months of the survey are given in Table 3. It is known that the Police do not hear about all accidents, particularly those in which damage to vehicles or property occurs but in which nobody is hurt. However, it seems likely that the Police would hear of damage only accidents in cases where the damage was other than slight. It is probable that the results in this report relate to personal injury accidents and those in which fairly serious damage occurred rather than to all accidents.

3.2 Warwickshire data

A second source of accident data was supplied by the Area Road Safety Unit in Warwickshire which has been collating data on accidents involving articulated vehicles over a period of several years. This area includes Birmingham and other nearby densely populated boroughs and is a particularly valuable source of data because of large number of accidents on urban roads. The Laboratory has not carried out a traffic survey in this area but the distribution of the roads is given in Table 4. The questionnaire for accidents involving articulated vehicles was suggested by the Laboratory and extended by the Road Safety Unit, but being earlier than that used in Leicestershire contained fewer questions; for example, it did not request details of injuries to road users other than the occupants of the articulated vehicles. The questionnaire was filled in by the vehicle owners, usually with comments by the driver, and always included brief particulars of the accident by the Police together with details sufficient to locate the site to give the class of road, the date, time, weather and road conditions when the accident occurred. One purpose of the survey was to study the causes of the accidents or at least to see what influence the design features of the articulated vehicle had on accidents in which they were involved. Inevitably any procedure to do this must be open to doubt and the results must to some extent reflect the ideas of those completing the questionnaires and the person assessing the data.

3.3 Assessment of accident data

One problem with accident information is how it should be assessed. As an example, consider the incidence of jack-knifing. The usual method is to note those accidents which involve jack-knifing and to divide them into various categories such as occurring before or after the main impact and then dividing them into the various injury classifications for the most severely injured person in the accident. This method may over-estimate the incidence of jack-knifing as a cause of accidents and injuries because, for example, though it might occur in an accident it might in no way be a cause of the injuries. Also all accidents are partially due to many factors such as driving too fast, driving too close to the vehicle ahead or loss of control of another vehicle and so the simple statistic of the percentage incidence of say jack-knifing may be misleadingly large.

An alternative procedure used was to allocate a point score of 1 for each accident and to divide this among the likely 'causes' with a minimum of ¼ for any one cause. The 'causes' (Table 5) are mainly design, mechanical or handling features and everything else is attributed either to the driver or to 'other' category. For example, poor loading of the vehicle would be attributed to the driver and mechanical faults in another vehicle would go in the 'other' category. In many cases it is not possible to divide numerically the blame between the driver and his vehicle. For example, if a vehicle collides with something in its path, is it due to poor driving or inadequate braking? An arbitrary, and it is hoped, a consistent division between driver errors and vehicle features was attempted and this may not be too important as long as the relative score of points for the 'driver' and 'other' categories are not compared in detail with the design feature scores, although the last may be compared among themselves. Road layout and road surface considerations are not included in the list of 'causes' and so for the purpose of this study, accidents are considered to be due only to the design features of the vehicle or to the drivers of the articulated and other vehicles involved.

The division between the 'design feature cause' categories must be explained in more detail if the results are to be correctly interpreted. A point is given to braking, if the vehicle pulls up in substantially the intended course but the braking is inadequate. If the vehicle swings during braking the point is given either to jack-knifing or trailer swing; it is probably a jack-knife if the tractor swings about the trailer, and trailer swing if the trailer does not take the intended course through a corner and swings out. The swing may be large or small but it is only likely to be large at higher speeds. Occasionally a power jack-knife occurs when the tractor wheels spin on a slippery road. If the driver loses control without any evidence of braking or if the vehicle overturns on a corner then a point is usually given to 'other handling'. Such an incident may be due to the driver entering the corner too fast, but usually no comment would be made by the driver about this. A point is given to vehicle length if it is considered that the accident would not have occurred or would not have been serious if the vehicle had been shorter. This usually happens when there is an impact against the rear portion of the side of the trailer. Mechanical failures refer only to the articulated vehicle in question. If there is a suggestion that the vehicle was not seen in darkness or conditions of poor visibility, a point, not more than ¼, is given to lights, as the fault may be with the driver of that vehicle or of the other vehicle.

The difference in results between the percentage incidence and the point scoring methods is illustrated by the jack-knifing accidents. In Leicestershire 22% (23 out of 105) involved jack-knifing, though in Warwickshire the result was 10% (23 out of 222). However, the point score method gives 15% and 7% respectively. An even larger difference might be expected for those factors which are rarely the most important factors in the accidents.

4. RESULTS

4.1 Accident rates

The accident rate of articulated vehicles in Leicestershire and Rutland was 2.6 accidents per million veh. km (4.2 accidents per million vehicle miles), compared with 3.0 (4.8) for heavy rigid vehicles of more than 5 tons unladen weight (Table 6). Most articulated vehicles are more than 5 tons when unladen and much longer than rigid vehicles in this weight range. Articulated vehicles therefore seem to be safer than rigid vehicles of the same weight even though they are usually longer in length. It is possible that the lower accident rate for the articulated vehicles may be due to the mild winter of 1966/7 and to the relatively flat country in Leicestershire. Studies suggest that loss of control often occurs on hills as braking may be inadequate and jack-knifing and trailer swing are easily induced on wet slippery surfaces. It has also been noted that in fleets of vehicle the best drivers are usually given the articulated vehicles.

Another factor is that Leicestershire has a long stretch of the motorway M1 which carries a particularly large articulated vehicle traffic, but in the year under consideration it had only 2 accidents involving these vehicles. So if the motorway is excluded from the survey the articulated vehicle accident rate goes up from 2.6 to 3.6 accidents per million vehicle km (4.2 to 5.8 accidents per million vehicle miles) and the fatal or serious injury accident rate from 0.4 to 0.55, which are higher figures than those for rigid vehicles. The number of accidents to rigid vehicles on this stretch of motorway M1 during this period was not readily available but if it is assumed that no accidents occurred in the motorway an upper limit to the accident rates of rigid goods vehicles is obtained. For the remaining roads the over 5 ton unladen rigid vehicle accident rate must go up from 3.0 to less than 4.4 and probably less than 3.7 accidents per million vehicle km and the fatal or serious injury rate from 0.39 to less than 0.56 and probably less than 0.50 accidents per million veh. km. These estimates suggest that whereas articulated vehicles seem to be slightly safer than rigid vehicles in the same weight range for traffic on all roads in Leicestershire, if the motorway M1 is excluded then the articulated vehicles probably have a slightly higher accident rate. The accident rate for articulated vehicles for all degrees of injury was 0.75 per million veh. km (1.20 per million veh. miles), though for serious or fatal injury accidents the rate was 0.40 (0.64). The comparable rates for rigid vehicles of over 3 tons unladen weight were 0.79 (1.27) and 0.32 (0.51). These results compare with the National Statistics[1] for 1966 which give a total injury accident rate of 1.6 per million veh. km (2.58 per million veh. miles) for all goods vehicles over 1½ tons unladen and a rate of 0.55 (0.89) for fatal plus serious injury accidents. Again the lower rates recorded in the present survey in Leicestershire may be for the reasons mentioned above.

In an independent survey[2] by members of the Association of Road Industrial Safety Officers it was found that one large fleet of vehicles had a rate of 25 accidents of all kinds per million veh. km (41 per million veh. miles) in 1965 which is 10 times higher than the injury accident rate estimated in the present survey, and the rigid vehicles were found to compare unfavourably with the articulated vehicles. This high-rate included many minor damage incidents not brought to the notice of the Police. This agrees well with data for a few months from one district of British Road Services which had only about 1 in 8 of all its accidents reported to the Police as most of them were trivial and some occurred off the public roads. In over 18,000 accidents recorded in the ARISO survey over a period of years only 300 were suggested as involving jack-knifing.

4.2. Effects of handling of articulated vehicles on accidents

Tentative estimates of the relative importances of the various causes of each accident involving an articulated vehicle in Leicestershire and Rutland, and Warwickshire were made using the scoring system mentioned earlier, (Tables 5 & 8). Between a third and a half were attributed to other road users and their vehicles, about a quarter to the drivers of the articulated vehicles and the remainder to design features of the articulated vehicles.

Jack-knifing accounted for 15 per cent of the score for accidents in Leicester and Rutland but for only 7 per cent in Warwickshire. This difference was probably due to the larger number of incidents occurring on rural trunk roads in Leicestershire and Rutland, and may also possibly be influenced by the different reporting procedures in the two areas. Trailer swing accounted for 9 per cent of the score for Leicestershire and Rutland, and 3 per cent for Warwickshire, poor braking had 6 per cent and 3 per cent and other handling faults 4 per cent and 3 per cent respectively of the total score.

These figures show that handling problems present one of the major hazards and any reduction in these incidents would be well worthwhile. The survey shows that jack-knifing occurs in just over a half of these handling incidents. Recent developments in anti-jack-knifing devices should reduce the number of jack-knifing accidents. Trailer swings seems to play a larger part in accidents than is usually realised and preventive measures are needed. Most of the other handling incidents are inability to negotiate corners or roundabouts, probably due to excessive speed at entry, but sometimes due to too high a load giving a high centre of gravity. A study of the actual accident data shows that the articulated vehicles had most difficulty on rural trunk roads on which higher speeds are usually possible. Little difficulty is experienced on motorways where though speeds are high, there presumably is much less need to brake or make rapid movements.

Though the survey suggests that few accidents were due to inadequate braking, it probably underestimates the effect, as poor braking oftens means that hazards are reached at too high a speed and drivers seem to swerve or lose control because of this; the resulting cause may well be classified as due to one of the handling features.

This survey does not show what features give rise to the higher accident rate for heavy rigid commercial vehicles but it is clearly not true to assume that handling problems for articulated vehicles lead to additional accidents to those to be expected for rigid vehicles.

4.3 Effect of length of vehicle on accidents

A small group of accidents involving articulated vehicles (5 per cent score in Leicestershire and Rutland, 3 per cent in Warwickshire) were considered to be due to their length, as side impacts were recorded against the trailer axle or further aft and these would probably not have occurred if the trailers had been shorter. However, it is likely that few of them would have been prevented if trailer lengths were restricted to say 30 ft. and so there seems to be little reason to restrict trailer lengths on the grounds of safety.

4.4 Effect of faulty brakes and lights on accidents

Brake faults (other than poor performance) and poor lighting on articulated vehicles both appeared to make very small contributions to the number of accidents and although improvements would be worthwhile the expected reduction in accidents would not be large.

4.5 Effect of time of year on accidents

In Leicestershire and Rutland 63 per cent of the accidents occurred in winter (October to March) and the remaining 37% in summer. In Warwickshire the respective figures were 51 per cent and 49 per cent. The mild winter may have influenced these results as it is known that snow and ice causes great difficulties for the operation of articulated vehicles. The distribution of the factors leading up to the accidents were similar in winter and summer except that jack-knifing formed formed a greater proportion of the winter accidents and poor braking of the summer accidents.

4.6 Class of road

The influence of the type of road may be studied by inspecting Tables 5, 7 and 8. Table 7 gives the traffic flow estimates and the number of accidents, and these are combined to give traffic density per kilometre, accidents per kilometre of road and accidents per million kilometres travelled. The M1 motorway had a very low number of accidents recorded in this period and as it is estimated that 28% of the Leicestershire and Rutland articulated vehicle flow is on this road, it follows that the total county rate is noticeably reduced. The Class I rural roads also had a low accident rate, but the rural trunk roads rate was relatively high and the difference is highly significant. Probably the greatest difference between these rural trunk and ClassI roads is that the former have much greater traffic flows, so that articulated vehicles need to brake much more frequently and also the number of vehicles trying to pass a vehicle causing an obstruction is very much higher.

The division of the factors contributing to accidents among the various classes of road in Tables 5 and 8 shows a general similarity rather than any consistent trends. As noted elsewhere, the rate of jack-knifing on rural trunk roads in Leicestershire is high.

4.7 Relative risk of injury to articulated vehicle occupants and other road users

Other road users were four times more likely to suffer an injury than the driver of the articulated vehicle. The ratio was ten to one for serious or fatal injuries; there was no fatal injury to an articulated vehicle driver but five to other road users. In the incidents in which a serious or fatal injury occurred about a half were attributed to other road users, a quarter to jack-knifing, about one eighth to trailer swing, and articulated vehicle length led to most of the remainder. Although the numbers are small, and may apply particularly to Leicestershire it is noted that almost none can be attributed to the driver, braking or other design features not mentioned. An analysis of accidents resulting in slight injury gave results similar to those for all accidents, although few could be attributed to vehicle stability and handling.

4.8 Point of impact on the articulated vehicle

The differences in the results for Leicestershire and Rutland, and Warwickshire may partly stem from the fact that 63 per cent and 86 per cent respectively of the accidents in these areas were impacts between articulated vehicles and other vehicles or pedestrians. The distribution of these impacts around the articulated vehicle (Table 9) was different in the two counties, but if the results are added, about half the impacts occurred to the tractor and about a half to the trailer, This is so for cars, which collided with the front of the tractor twice as often as the sides but collided with the sides and rear of the trailer equally often and this latter group frequently resulted in serious under-run impacts. Commercial vehicles more often hit the front of articulated vehicles and less often the rear of the trailer than other road users. Pedestrians and cyclists are mainly struck by the sides of the trailer, although pedestrians are just as frequently hit by the front or sides of the tractor unit.

4.9 Main causes of injury

A study of the details of the accident reports shows that the main cause of injury to the occupants of articulated vehicles is the crushing of cabs into the vehicle by objects that they hit. Sliding of the load forward into the cab has been noted as a source of occupant injury but a larger accident problem appears to be that of loads falling off.

Most of the severly injured occupants of vehicles which collided with articulated vehicles were in those accidents in which the tractor unit was hit and so the other vehicle was, as might be expected, severely damaged because of the large mass and momentum of the articulated vehicle. In possibly one-fifth of the accidents involving severe injury to another vehicle occupant, the vehicle had under-run the rear of the trailer.

5. CONCLUSIONS

This survey suggests the following conclusions which apply to Leicestershire and Rutland, Warwickshire and probably to counties with similar road traffic conditions. (The accident results are based on data collected during a year including the mild winter 1966/7.)

(i) Articulated vehicles had an accident rate similar to that of other commercial vehicles, so there appears to be no reason to discourage the increasing use being made of this type of vehicle on safety grounds. They had a slightly lower accident rate 2.6 accidents per million veh. km (4.2 accidents per million veh. miles) than the heavy rigid vehicles 3.0 accident per million veh. km.(4.8 accidents per million veh. miles) though the rate would probably be slightly higher than the rigid if traffic on the motorway M1 were excluded.

(ii) The handling problems of articulated vehicles form the major contribution of design features leading to accidents. Jack-knifing with a contributing factor score of 15% in Leicestershire, but only 7% in Warwickshire, seems to be twice as frequent as both trailer swing and the remaining handling problems which are mostly the load rolling the trailer over when cornering. Poor braking appears to be no more serious than trailer swing though in reality many of the handling accidents might not have occurred if the articulated vehicle braking had been better. It would be of relevant interest to find out what are the major causes of accidents to heavy rigid goods vehicles.

(iii) The motorway M1 in Leicestershire had very few articulated vehicle accidents during the twelve months under study despite the large traffic flow of this type of vehicle, but there were insufficient data to be able to say precisely how low was the accident rate. Rural Class I roads also had a low articulated vehicle accident rate though the rural trunk roads had a high rate with jack-knifing occurring relatively frequently.

(iv) The results suggest that no overall safety advantage would accrue from restricting the length of articulated vehicles if this meant the same goods would have to be carried by a larger number of shorter vehicles. No predictions are possible as to the number of accidents to articulated vehicles if their permitted lengths were increased and as a result the total volume of goods carried by them increased.

(v) Of the few mechanical failures leading to accidents, several were brake faults. Tyre failures caused almost none of the incidents. Some of the accidents at intersections and on straight roads seem to have been due to the articulated vehicles not having been seen in time, but it is not possible to say whether these were due to inadequate lighting of the articulated vehicles.

(vi) The risk to other road users in serious or fatal injury accidents is approximately ten times that for the drivers of the articulated vehicles involved. This, and a study of the actual accident reports, suggests that further study should be given to the problem of impact protection for other road users.

(vii) In most accidents in which the articulated vehicle drivers were injured, the vehicle cabs were crushed by the object struck by the vehicle. Although in a few accidents the load moved forward and crushed the driver's cab, injuring the occupant(s), a bigger accident problem appeared to be loads coming adrift and maybe falling off, particularly when the vehicle was cornering.

6. ACKNOWLEDGEMENTS

The large amount of work carried out by the Leicestershire and Rutland Constabulary and the Warwickshire Area Road Safety Unit for this survey is gratefully acknowledged.

7. REFERENCES

1. Ministry of Transport. Road Accidents 1966 London, 1967 (Her Majesty's Stationery Office).

2. Roadway, Journal of the Road Haulage Association p.37. April, 1967.

TABLE I

Distribution of length of road by class in Leicestershire and Rutland (excluding City of Leicester)

Type of Road	Kilometres of Road	
	Urban	Rural
Trunk (Motorway	–	43
(All purpose	42	158
Class I	61	248
Class II	89	348
Class III	60	1104
Unclassified	391	1521
Total	643	3412
	4055	

TABLE 2

Traffic Survey – Leicestershire and Rutland 1966/7 (Excluding Leicester City)

Type of Road	Million vehicle kilometres per annum			Traffic ratio Artics. to all rigids (Artics = 1.0)	Traffic ratio Artics. to more than 2 axle rigids (Artics = 1.0)
	2 axle rigids over 3 tons unladen	More than 2 axle rigids	Artics.		
Trunk, motorway	27.8	10.6	11.2	3.4	0.94
Trunk, all purpose	63.5	11.1	15.9	4.7	0.70
Class I, Urban	9.9	2.0	2.3	5.2	0.86
Class I, Rural	24.0	6.5	6.0	5.1	1.08
Class II, Urban	9.5	1.0	1.1	9.6	0.93
Class II, Rural	14.5	2.6	2.6	6.7	1.0
Class III and unclass, urban	5.2	0.2	0.3	17.9	0.67
Class III and unclass, rural	9.3	0.6	0.8	12.6	0.74
TOTAL	163.4	34.5	40.2	4.9	0.86

TABLE 3

Number of accidents involving commercial vehicles in Leicestershire and Rutland
March 1966 – February 1967

Type	Unladen weight of vehicle – tons	Number of accidents in which at least one injury was:-			Number of accidents which were damage only	Total
		Fatal	Serious	Slight		
Rigid	3 – 4	2	19	38	135	194
	4 – 5	6	14	29	96	145
	Over 5	6	16	26	120	168
Articulated	3 – 4	–	–	1	8	9
	4 – 5	–	5	1	7	13
	Over 5	3	8	12	60	83

TABLE 4

Distribution of length of road by class in Warwickshire
(including all boroughs)

Type of road	Kilometres of Road	
	Urban	Rural
Trunk (Motorway	–	5
(All purpose	68	251
Class I	270	185
Class II	234	298
Class III	246	856
Unclassified	1962	1149
TOTAL	2780	2744
	5524	

TABLE 5

Accident contributing factor scores, (expressed as percentages)

L = Leicestershire & Rutland
W = Warwickshire

Scoring system used in this assessment,

Contributing factor \ Class of road	Total		Trunk		Rural I & II		Urban I & II	
	L	W	L	W	L	W	L	W
Other road user	32	51	34	55	24	48	31	43
Driver	21	25	15	22	38	23	25	29
Braking	6	3	4	3	7	6	16	3
Jack-knife	15	7	21	7	6	8	0	8
Trailer swing	9	3	11	4	6	2	6	5
Other handling feature	4	3	5	2	0	6	3	3
Length of vehicle	5	3	4	3	4	2	11	2
Mechanical failure	5	1	3	0	12	2	6	2
Lights	3	4	3	4	3	3	2	5
Total = 100%								

TABLE 6

Comparison between accident rates for articulated and rigid commercial vehicles in Leicestershire and Rutland

Type of vehicle	No. of accidents per year		Annual vehicle flow – millions of Km	Accident rates per million kilometres		
	Fatal and serious injuries	Slight injuries and/or damage only		Fatal and serious injuries	Slight injuries and/or damage only	All accidents
Articulated vehicles	16	89	40	0.37	2.2	2.6
All rigid vehicles	63	444	198	0.31	2.2	2.5
Rigid vehicles with unladen weight:-						
3 – 4 tons	21	173	85*	0.25	2.1	2.3
3 – 5 tons	41	298	142*	0.31	2.1	2.4
4 – 5 tons	20	125	56*	0.37	2.2	2.6
more than 5 tons	22	146	56*	0.37	2.6	3.0

* Indicates estimated results based on relation between number of axles and weight

TABLE 7

Articulated vehicle traffic and accidents on the various classes of road in Leicestershire and Rutland

	Motorway, M1	Trunk roads		Class I roads		Class II roads		Other roads	
		Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Kilometres of road	43	158	44	248	61	348	88	2624	451
Articulated vehicle flow (million veh. km. per year)	11.3	15.9		6.0	2.3	2.6	1.0	0.79	0.32
Number of accidents per year	2	56	9	9	12	8	4	3	
Articulated vehicle traffic density – (vehicles per day)	720	220		66	101	20	32	1	2
Accidents involving articulated vehicles/ kilometres of road per year	0.04	0.35	0.22	0.04	0.20	0.02	0.04	less than 0.01	
Accidents involving articulated vehicles per million vehicle kilometres	0.19	4.1		1.5	5.3	3.1	3.9	2.7	

TABLE 8

Contributing factor scores for accidents involving articulated vehicles (% score per million vehicle kilometres)

Scoring system used in this assessment,

Contributing factor \ Class of road	Trunk (Excluding Motorways)	Class I Rural	Class I Urban	Class II Rural	Class II Urban	Other	All roads
Other road user	2.1	0.2	3.2	2.0	0.8	1.5	1.3
Driver	1.0	0.7	2.0	2.5	1.9	1.5	0.9
Braking	0.3	0.3	1.2	0	1.2	0	0.3
Jack-knife	1.4	0.3	0	0	0	1.5	0.6
Trailer swing	0.8	0.3	0.7	0	0	0	0.4
Other handling	0.3	0	0.4	0	0	0	0.2
Length of vehicle	0.3	0	0.9	0.5	0.8	0	0.2
Mechanical failure	0.2	0.5	0	0	1.5	0	0.2
Lights	0.2	0.1	0.2	0	0	0	0.1
TOTAL	6.6	2.4	8.6	5.0	6.2	4.5	4.2

TABLE 9

Point of impact on articulated vehicle involved in an accident with another road user

Relative frequency of impact – (percentage)	Other vehicle involved	Point of impact on articulated vehicles (percentage) Front of Tractor	Side of Tractor	Side of Trailer	Rear of Trailer
51	Car	33	17	26	24
35	Commercial vehicle or p.s.v.	42	20	22	14
6	Motor cycle	31	13	37	19
8	Pedal cycle or pedestrian	23	18	55	4
100	ALL	36	18	27	19

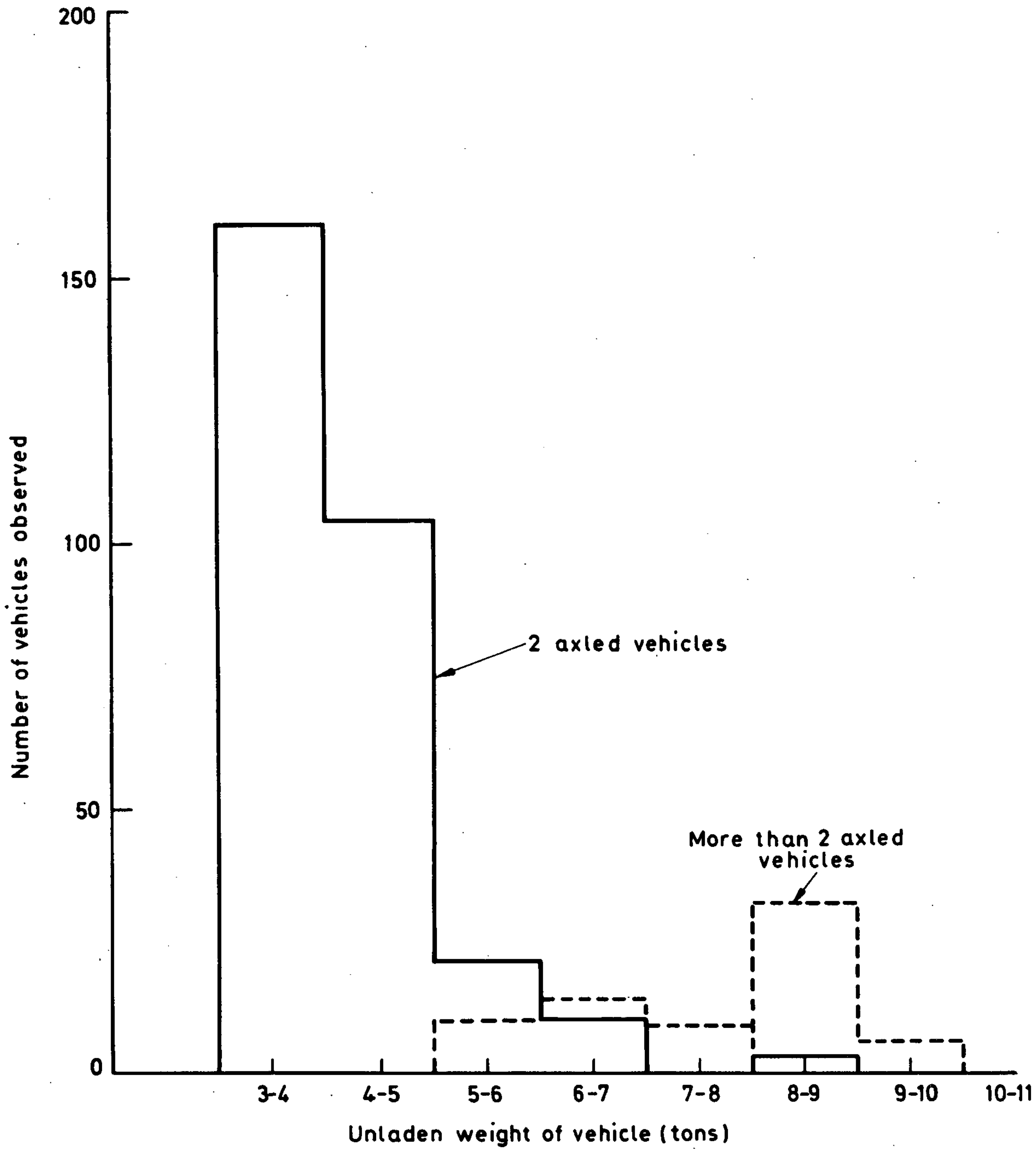

Fig. 1. DISTRIBUTION OF RIGID COMMERCIAL VEHICLES BY UNLADEN WEIGHT IN LEICESTERSHIRE AND RUTLAND, 1967

Printed at the Road Research Laboratory, Crowthorne, Berkshire, England

ABSTRACT

A survey into the accident rates of articulated and rigid commercial vehicles: B. N. Farr and I. D. Neilson: Ministry of Transport, RRL Report LR 197: Crowthorne, 1968 (Road Research Laboratory). This survey compares the accident rates of articulated and rigid commercial vehicles in the medium and heavy category.

The accident rates are based on information from a traffic census at about 40 sites throughout the counties of Leicestershire and Rutland during 1966/7 and on Police reports of accidents involving commercial vehicles in Leicestershire, Rutland and Warwickshire in which personal injury and/or damage only occurred.

It is estimated that the articulated vehicles had an accident rate of 2.6 accidents per million km (4.2 accidents per million veh. mile) which compares with a rate of 3.0 (4.8) for rigid commercial vehicles of over 5 tons unladen weight. Thus, despite jack-knifing and other handling problems peculiar to articulated vehicles, their overall accident rate was slightly lower than that for rigid vehicles of the same weight under the conditions prevailing in Leicestershire and Rutland. If, however, the Motorway M1 was excluded from the survey the rate for the articulated vehicles may be slightly higher than for the rigid vehicles.

Other results from the accident and traffic surveys are discussed in the note.