SPEED TRENDS ON MAJOR ROADS IN SOUTH AFRICA

C.J. Bester and F Geldenhuys

University of Stellenbosch, Department of Civil Engineering
Private Bag X1, Matieland 7602

ABSTRACT

A recent report from the Road Traffic Management Corporation (Botha, 2006) shows that the percentage of vehicles exceeding the speed limit on South African roads during weekends in December has increased from 24,1% in 2004 to 30,7% in 2005. This is a very high increase for a period of one year only. It is an internationally accepted fact that speeds do play a role in road traffic accidents and especially the severity thereof. It is therefore important to know what is happening to the average speeds of vehicles on our major roads.

In a recent study on the roads that are monitored by The South African National Roads Authority Ltd (SANRAL), longer term trends were determined – for some roads over ten years and for others over five years – depending on the period for which records are available. When it is considered that for some of the permanent stations the average value is calculated for at least a couple of million vehicles, it is clear that even the smallest change in the speed is statistically significant.

On the majority of urban freeways the average speeds of vehicles have decreased as a result of increased congestion. Mixed results were found on rural roads. On some the speeds decreased and on others it increased.

In the paper the background to the study and the results are given. Possible reasons for the different results are discussed and the consequences for road safety and delays are spelled out.

1. INTRODUCTION

There are various reasons why the speed of vehicles changes over time. It can come about as a result of changes in:

- vehicle performance;
- road conditions – geometry and pavement structure;
- traffic conditions – increased congestion;
- speed limits;
- law enforcement; and
- drivers' perception of the danger of speeding.

The performance of vehicles is constantly being improved with the result that it has become easier for drivers to exceed the speed limit. On the national roads in South Africa the geometry has improved and in most cases also the riding quality. However, on many of the provincial roads the pavement conditions have deteriorated to such an extent that speeds are affected by the presence of potholes. Traffic conditions have also deteriorated

so much so that even on rural roads the speeds of vehicles are significantly affected.

In South Africa the general posted speed limits have stayed relatively constant over the last two decades. This followed on the worldwide decrease in speed limits during the seventies when oil shortages forced governments to implement fuel saving measures. Since the general speed limit was increased to 100 km/h for light vehicles and 80 km/h for heavy vehicles in the eighties; and a limit of 120 km/h could be used on any road where it was deemed appropriate, it was only the speed limit applicable to buses and combi taxis that was changed.

Speed is probably the most important factor in road design. It is reflected in aspects such as design speed, sight distance, passing and climbing lanes and interchange ramp designs. It is therefore not surprising that vehicle speeds should play a major role in road safety. Without movement there cannot be any collisions and the higher the speed of the movement, the more serious will be the consequences of a collision. The energy to be dissipated in a collision is proportional to the square of the impact speed (Ogden, 1996). For example, an impact speed of 130 km/h involves more than twice the energy of one at 90 km/h.

Lay (1986) has suggested four factors that contribute to the greater accident potential at higher speed, namely that the vehicle becomes less stable at higher speeds, the driver has less time to react, other road users have less time to react, and the severity of accidents increase, as mentioned above.

In the United States it is estimated that aggressive driving, or the so-called “road rage” is increasing by 7% per year. It is typified by the notion that any journey must be completed in the shortest time possible. Inappropriate speed is one of the consequences of such an attitude.

Judging from articles in and letters to the newspapers in South Africa it is clear that many people are not aware of the role of speed in road safety. A statement that is often heard is “ Speed does not cause accidents”. Some of the advertisements of vehicle manufacturers can be seen as encouraging high speeds.

It is reassuring that the government in its “Arrive alive” campaign has emphasized the importance of inappropriate speeds, with the slogan “Speed kills”.

The purpose of this paper is to show the changes in vehicle speeds on our major roads over the last ten years. In the paper the importance of speed in road safety and the data analyses are described and the results are shown. Possible reasons for the different results are discussed and the consequences for road safety and delays are spelled out.

2. THE IMPORTANCE OF SPEED

2.1 International experience

The Organisation for Economic Co-operation and Development (1981) has quantified the effect of speed on accidents and accident severity, based upon Swedish data, as follows:

The percentage drop in accident rates outside built up areas is n times the percentage drop in mean speed, where n = 4 for fatal accidents, 3 for personal injury accidents, and 2 for all accidents.

In the United States the Committee for the Study of Benefits and Costs of the 55 mph National Maximum Speed Limit estimated (TRB, 1984) that during the first ten years

between 25 000 and 50 000 lives had been saved as a result of the speed limit. An increase in the speed limit to 65 mph (104 km/h) on certain rural freeways did not significantly increase the number of fatalities (Pant et al, 1992). However, it should be taken into account that these dual carriageway facilities had been designed for at least 70 mph.

In Australia (Ogden, 1996) the speed limit on two-lane, two-way roads in rural areas is 100 km/h. On rural freeways of very high standard, a limit of 110 km/h is applicable. South Africa is the country with probably the highest speed limit on two-lane two-way rural roads. Even on roads that have been designed for 100 km/h, the speed limit is 120 km/h.

Research in the Adelaide metropolitan area in Australia (McClean, 1984) has shown that the risk of involvement in an injury accident is twice as great at 65 km/h as it is at 60 km/h and four times as great at 70 km/h. It was further shown that as many as 46% of injury accidents could probably have been avoided if none of the vehicles investigated had been travelling above the speed limit.

Many European countries are considering a 50 km/h speed limit in urban areas to reduce the number of pedestrian casualties.

2.2 The South African situation

A recent study (Van Niekerk, 2006) on fatal accidents in the Western Cape Province showed a very high correlation between the accident rate and the percentage of vehicles exceeding the speed limit. In the only other known study on the subject by the CSIR (Fieldwick, 1981) it was concluded that the lower speed limits in South Africa during the energy crisis in the seventies lead to lower accident rates.

According to reports from the South African Police Service (SAPS) to the National Fatal Accident Information Centre, the number of fatal crashes that occurred due to excessive speeds, increased by 1,093 (46,10%) from 2,370 in 2003 to 3,463 in 2004. In 2003 fatal crashes in which speed played a role were 23,13% of a total of 10,246 fatal crashes. In 2004 fatal crashes in which speed played a role increased to 32,91% of a total of 10,523 fatal crashes.

The accident statistics in South Africa show clearly that inappropriate speed is a problem. When the South African injury and fatality rates (Bester and Stander, 1999) are compared to those of other countries, it is clear that we do not have that many accidents, but that our problem is that of fatalities. The injury accident rate in South Africa is 36,5 % higher than that in the USA, whereas the fatality rate is about 1000 % higher indicating that the number of accidents in South Africa is not such a great problem as is the seriousness of the accidents. This can also be seen from the fact that in South Africa about 12 people are killed for every 100 injury accidents as against 1,5 in the USA, Great Britain and Japan. One of the reasons for the high fatality rate in South Africa is clearly the high incidence of pedestrian accidents. The role of speed in pedestrian accidents is well established in overseas research. When the second, third and fourth highest types of fatal accident are considered, the importance of inappropriate speed becomes even more obvious. The single vehicle accident is responsible for 25% of the fatalities (Van Niekerk, 2006) on our roads. This is an increase from the 21% in 1990 (AA, 1990). The reason is usually given as the driver having lost control of the vehicle. This is most likely to happen at speeds that are too high for the circumstances. The head-on collision contributes to about 9,8% of fatalities. Again, speed and speed differences together with dangerous overtaking can be assumed to be the main reason. About 7,5% of fatalities are caused by rear-end accidents. Here, close following and a speed differential play an important part.

2.3 Speed variance

There is also evidence that accident rates are related to the dispersion or variance of speeds of vehicles in the traffic stream. Various researchers (Solomon, 1964; Taylor, 1965 and Munden, 1967) reported that the chance of being involved in an accident follows a U-shaped distribution, with the minimum occurring when the vehicle is travelling at, or slightly above the average speed. Sweatman, et al (1990) in a study of truck accidents in Australia found that vehicles travelling slowly were a factor in 20% of the accidents, and vehicles travelling at excessive speed were a factor in more than 40% of the accidents.

The effect of speed variance on road safety is the main reason why most countries do not have a differential speed limit between heavy and other road vehicles. In Australia the observed difference in the average speed of light and heavy vehicles is about 5 km/h. In South Africa the difference is between 20 km/h and 30 km/h (the difference in speed limits on rural roads being 40 km/h).

It is therefore clear that fatality rates can be reduced by reducing the number of vehicles travelling at excessively high speeds. To increase the speed of slow vehicles will be much more difficult.

3. DATA COLLECTION

Traffic data are collected on behalf of SANRAL on a large number of the major roads in South Africa. The number of stations increased from 44 in 1985 to 796 in 2004. At the 381 permanent stations it is attempted to collect the speeds of all the vehicles that pass the site during the year. The summarised data for all the stations from 1994 to the middle of 2006 were made available by SANRAL for the purpose of this study. The following information was extracted from the database:

- Station name;
- Calendar year of observation;
- Number of lanes;
- Number of vehicles observed;
- Average daily traffic (ADT);
- Percentage of heavy vehicles;
- The posted speed limit:
- Average speed of all vehicles;
- Average speed of light vehicles;
- Average speed of heavy vehicles;
- Average night time speed; and
- Percentage of vehicles exceeding the posted speed limit – note that this percentage does not include trucks, buses and minibus taxis exceeding the 80 or 100 km/h speed limit applicable to them.

4. DATA ANALYSES

The data analyses were done with the specific purpose of determining changes in speed since 1995. However, not many stations were in operation in both 1995 and 2005. Therefore it was decided to also compare the 2005 speeds with the 2000 speeds for the same stations as well as the annual average speeds for all roads observed. Further analyses determined the overall percentage of vehicles exceeding the speed limit in a specific year as well as the average night time speeds.

4.1 Annual average speeds

As was seen previously the number of stations observed increased over the years. Also the stations seem to have shifted away from the rural roads towards the high volume urban roads. In Table 1 the weighted average speeds (according to the number of vehicles observed), of all, light and heavy vehicles are given together with the number of vehicles observed and the percentage of heavy vehicles.

Table 1: Annual average speeds of all vehicles.

Year	Number ($\times 10^9$)	Average speeds (km/h)			% Heavy
		All	Light	Heavy	
1995	0,07	101,1	105,2	74,7	13,5
1996	0,18	99,4	102,3	75,3	10,7
1997	0,18	101,1	104,0	76,7	10,6
1998	0,24	100,4	102,7	76,7	8,7
1999	0,51	97,2	99,2	74,1	8,0
2000	0,63	95,2	97,2	74,2	8,7
2001	0,73	95,4	97,4	74,5	8,9
2002	0,89	93,0	95,1	72,7	9,1
2003	1,04	92,6	94,6	73,5	9,4
2004	1,27	92,3	94,1	74,4	9,3
2005	1,32	91,5	93,3	74,7	9,4
2006	1,00	93,3	95,1	75,5	9,1

From the table it is clear that over the eleven years the speed of light vehicles decreased by more than 10 km/h whereas the speed of heavy vehicles stayed within a four-km/h range. The increase from 2005 to 2006 for all vehicles is, however, significant. The general decrease in the percentage of heavy vehicles is a further indication that more urban roads (with their lower volumes of heavy vehicles) are included in the sample during the later years. This is why in the next section comparisons will be made for the same stations. The average speeds are also shown in Figure 1.

4.2 Speed comparisons

It is clear that traffic volumes play a role in the speed changes and therefore the speed comparisons were done in three lane categories, namely roads with six or more lanes, roads with four or five lanes and roads with two or three lanes. These categories will be referred to as six, four and two lane roads respectively. In Tables 2 and 3 the comparisons of speeds for the same roads over ten years (1995 to 2005) and five years (2000 to 2005) respectively are shown.

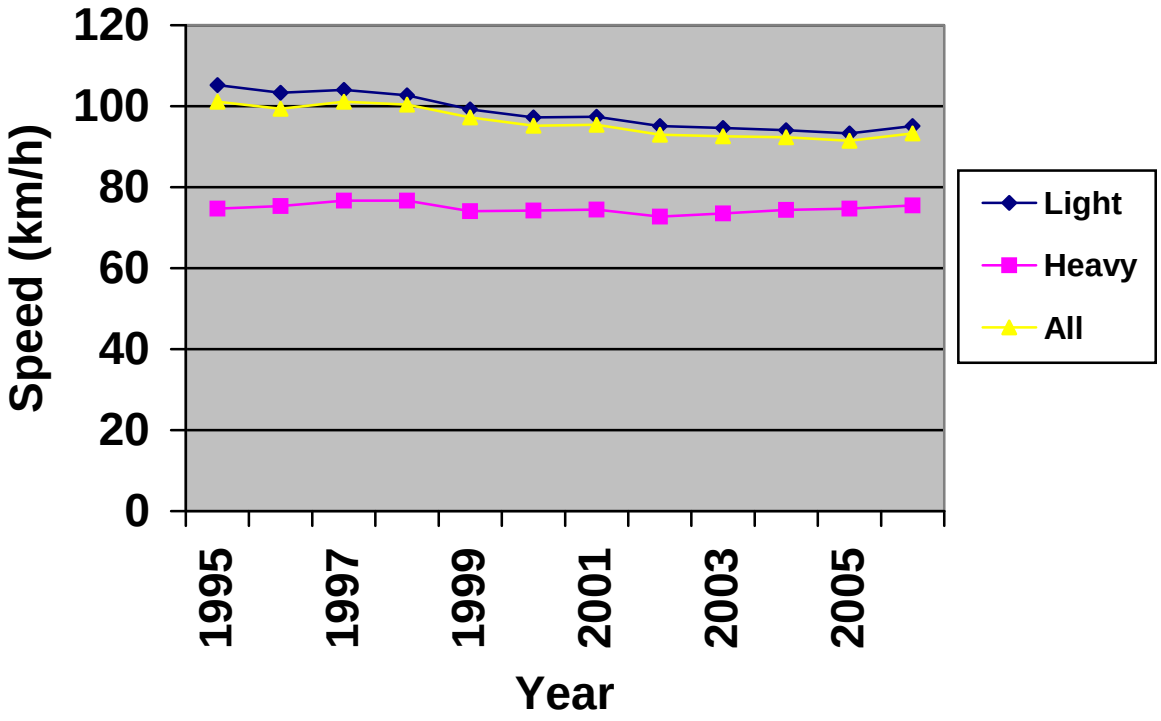

FIGURE 1: Average speeds of all observed vehicles per annum

Table 2: Speed comparisons over ten years (1995 to 2005) (km/h)

	Two-lane roads		Four-lane roads		Six-lane roads	
	All	Heavy	All	Heavy	All	Heavy
1995	105,5	81,8	90,0	52,7	108,6	85,5
2005	105,6	87,3	87,1	66,9	95,2	76,3
# stations	16	16	4	4	4	4

Table 3: Speed comparisons over five years (2000 to 2005) (km/h)

	Two-lane roads		Four-lane roads		Six-lane roads	
	All	Heavy	All	Heavy	All	Heavy
2000	90,7	74,9	95,8	76,3	97,5	71,8
2005	90,8	77,7	92,9	76,3	95,4	72,9
# stations	82	82	98	98	102	102

Over the ten-year period all vehicle speeds increased on two-lane roads and decreased on four-lane and six-lane roads, the latter by more than 13 km/h. Heavy vehicle speeds increased dramatically on two-lane and four-lane roads with a large decrease on six-lane roads. Only a few stations were, however, observed during both 1995 and 2005.

Over the five-year period all vehicle speeds increased slightly for two-lane roads, but decreased for both four-lane and six-lane roads. Heavy vehicle speeds either increased or stayed the same for all three categories of road. It is clear that on all higher volume roads all vehicle speeds tended to decrease, while heavy vehicle speeds generally increased. The number of roads on which the speeds increased or decreased is shown in Table 4 for the five-year period.

Table 4: Number of roads on which speeds increased/decreased over five years

Road type	All vehicles		Heavy vehicles	
	Increased	Decreased	Increased	Decreased
Two-lane	29	53	53	29
Four-lane	20	78	55	43
Six-lane	14	88	63	39

From this table it is clear that on the majority of roads the all vehicle speeds decreased and the heavy vehicle speeds increased. It is interesting to note that on 11 of the 14 six-lane roads showing an increase in the overall vehicle speed, the average daily traffic (ADT) was less than 20 000 vehicles per day (average 11 600) where the average ADT for all the six-lane roads was 41 700 vehicles per day. This again clearly illustrates the effect of the traffic volumes on the speed of vehicles – where capacity allows, the speeds increased. It also shows that heavy vehicles will generally avoid congested roads during the peak hours.

4.3 Vehicles exceeding the speed limit

The total percentages of vehicles exceeding the speed limit over the last five years (2002 to 2006) were calculated for all roads and all vehicles. It should again be stressed that these percentages do not include the trucks, buses and minibus taxis exceeding their respective speed limits of 80 and 100 km/h. The results are shown in Table 5.

Table 5: Percentage of vehicles exceeding the posted speed limit

Year	Percentage
2002	18,9
2003	18,7
2004	17,9
2005	17,8
2006	18,1

After a gradual decrease in the percentage up to 2005, it increased during the first part of 2006. This is in line with the RTMC statement as well as with the results shown in Table 1.

4.4 Night time speeds

The average night time speeds (20:00 to 06:00) for all vehicles for the different lane groups are given for 2000 and 2005 in Table 6.

Table 6: Average night time speeds (km/h)

Year	Two-lane	Four-lane	Six-lane
2000	85,1	89,5	97,3
2005	85,5	88,1	96,0

On two-lane roads the night time speeds increased and on four- and six-lane roads the speeds decreased. This is the same trend as for the overall speeds. When compared to Table 3, it is interesting to note that on two- and four-lane roads the night time speeds are about 5 km/h lower than the overall speed, but for six-lane roads the night time speed is of the same order as the overall speed with even a higher value for 2005 (96,0 as against 95,4 km/h). There is clearly a tendency to drive faster when the opportunity is presented by lower traffic volumes.

4.5 A specific six-lane road

The speed changes on the N1 between Johannesburg and Pretoria at the Halfway House Station are shown in Figure 2.

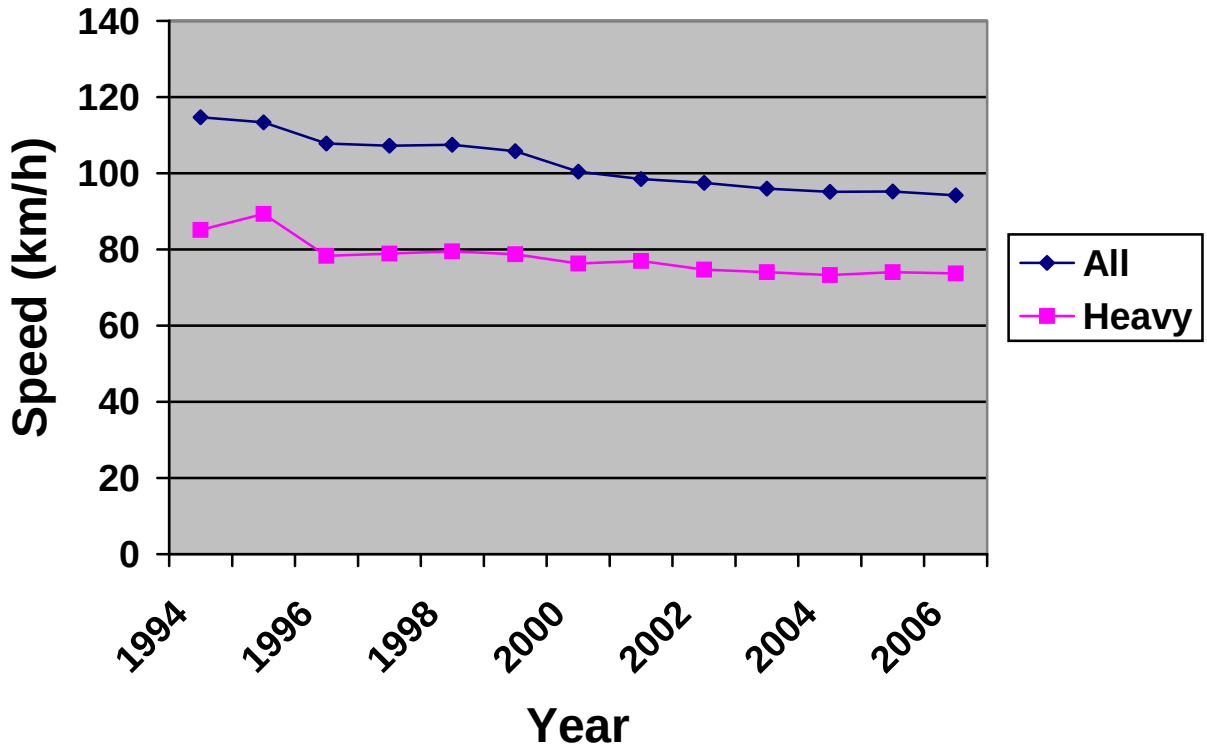

Figure 2: Average speed at Halfway House

The average speed of all vehicles at this station decreased from 114,7 km/h in 1994 to 94,2 km/h in 2006 by about one km/h per year. During this period the ADT increased from 72 000 veh/day to 121 000 veh/day – an annual growth rate of 4,4%. The heavy vehicle percentage decreased from 5,5% to 4,1%.

5. DISCUSSION

Average speeds of all vehicles have shown a general decrease up to 2005 and then a sharp increase for 2006. This is confirmed by the percentage of vehicles exceeding the speed limit. An increase in fatality rates can therefore be expected for 2006. On two-lane roads the speeds showed small increases over the last five to ten years. The speed of heavy vehicles generally increased over the study period. The latter means that the difference in speed between heavy and light vehicles decreased – from 30 km/h in 1995 to 20 km/h in 2005 (Table 1). From overseas experience this should be good for road safety. However, it was shown that a decrease in the speed of fast vehicles is much better than an increase in the speed of slow vehicles. It is also possible that there are many slow, light vehicles on the roads.

It is a general perception in South Africa that the only traffic law enforcement that is being done is that on speed limits. From this research it is clear that not even that is done on a sufficient basis.

If the decrease in speeds shown in this paper is representative of the South African travel pattern it can be calculated that it will now take 3,74 seconds more than in 1995 to travel a kilometre. This would mean an additional 135 million hours per year – or at a conservative time cost rate of R25/h a waste of R3,4 billion per year. This figure does not include increased vehicle operating costs and increased pollution.

6. CONCLUSIONS

The following can be concluded from this study:

- As a result of congestion on four and six-lane roads that are mainly in urban areas, speeds on South African roads have decreased up to 2005. During 2006 there was, however an increase.
- Heavy vehicle speeds have increased over the past five to ten years.
- The percentage of vehicles exceeding the speed limit has increased in 2006.
- On two- and four-lane roads the night time speeds are about 5 km/h lower than the overall speed, but for six-lane roads the night time speed is of the same order as the overall speed with even a higher value for 2005 (96,0 as against 95,4 km/h).
- The time cost of congestion alone can be in excess of R3 billion.
- South African drivers will increase their speeds whenever it is possible.
- Speed law enforcement in South Africa is not sufficient.

7. ACKNOWLEDGEMENT

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