Staysafe 9

PARLIAMENT OF NEW SOUTH WALES
JOINT STANDING COMMITTEE ON ROAD SAFETY

SAFE SPEED AND OVERTAKING ON 100 KM/H ROADS

DISCUSSION PAPER DISTRIBUTED FOR PUBLIC COMMENT

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FOREWORD

This paper has been produced by STAYSAFE with the intention obtaining the views of members of the public and of experts, views which should be sent to the address below.

THE OPTIONS PUT FORWARD ARE MERELY IDEAS FOR IMPROVING ROAD SAFETY, AND HAVE ARISEN DURING PUBLIC HEARINGS WHICH THE COMMITTEE HAS HELD ON SPEEDING AND OVERTAKING. THESE IDEAS SHOULD NOT BE INTERPRETED AS INDICATING THE OPINIONS OF ANY MEMBER OF STAYSAFE, OF ITS STAFF OR OF ITS ADVISERS. IT IS STRESSED THAT THESE OPTIONS ARE LISTED FOR DISCUSSION ONLY AND IN IN WAY ARE RECOMMENDATIONS OF THE COMMITTEE.

Simply put, the problems addressed are included in the question:

"How can I, as a driver, decide what speed is legal and safe and when it is safe to overtake a slower vehicle on lO0 km/h roads?"

These problems are encountered by almost everyone who drives in the country. They are not resolved merely by adhering to the speed limit of 100 km/h. There are many occasions when we as drivers come up behind a towed caravan, a heavily-laden truck, a tractor or a very slow car driver, and feel that there should be some rational method available to us for determining if and when we can overtake safely. There are times when we feel we have to abandon overtaking, and other times when we could have safely overtaken but did not.

The paper is open for debate until 28 February, 1987 following which STAYSAFE will consider every response to the issues raised, arguments for and against each of the options listed, and other relevant material.

It is confidently expected that the news and public affairs media will participate. Further copies of this paper may be obtained from the Clerk to the Committee, Mr. Leslie Gonye.

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Brian Langton,M.P.,
Chairman,
STAYSAFE.

ACKNOWLEDGEMENTS

The Committee wishes to record its thanks to the many motorists of New South Wales, who have by their submissions highlighted the issues raised in this paper. Their concerned interest is most appreciated.

We also acknowledge the courtesy and permission of Sergeant Ray Godkin of the Police Accident Investigation Squad for reproduction of the cover photograph.

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(prepared by Mr. F. Schnerring during secondment from the Traffic Authority of N.S.W.)

SAFE SPEED AND OVERTAKING ON 100 KM/H ROADS

ISSUE A -- THE CRASH PROBLEM FOR DRIVERS

A.1 Examination of 100 successive police reports about fatal crashes on 100 km/h roads has revealed a number of fatal crashes in which vehicles, known to have been overtaking others, hit oncoming vehicles head-on, or went out of control and hit vehicles or rigid roadside objects. At least 17% definitely involved overtaking.

A.2 Sometimes in such cases, the driver being overtaken seems to have been unaware of the incident and has not reported it.

A.3 There are many other cases in which vehicles careered off the road for no apparent reason except that the drivers might have encountered problems whilst attempting to overtake unidentified vehicles. As many as 51% of these fatal crashes might have involved overtaking . It is therefore possible that up to 68% of these fatal crashes involved overtaking.

A.4 In most cases there was no reliable evidence that speeds were over the legal limit of 100 km/h. Among the 100 fatal crashes studied, speed was reported only in 22, and only 4 were over 100 km/h.

A.5 Because of the large and sudden change of speed upon impact (typically from 90 km/h to 0 in less than a second) in these crashes, they are mostly unsurvivable for car occupants even occupants wearing seat belts. Occupants of heavy vehicles are more likely to survive.

A.6 During the year 1985 there were 388 fatal crashes on 2 lane undivided high speed roads (more than 60 km/h limit) and

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208 on straight sections of high speed roads. It is thought that many of these fatal crashes involved overtaking at legal speeds.

A.7 In 1985, 50.7% of all fatal crashes were on streets posted 60 km/h speed limit. However, 80.7% of all recorded crashes in 1985 occurred on 60 km/h streets. This means that most crashes were on 60 km/h streets, but in the 13.6% that were on 100 km/h roads, death was four times more likely than on 60 km/h streets. Crashes on 100 km/h roads were also twice as likely to result in hospital admission, as crashes in 60 km/h areas. Moreover, much of our country road system is posted 100 km/h. It is therefore appropriate that roads posted 100 km/h should be used in the present analysis.

A.8 Because overtaking is obviously one of the most common and dangerous acts on those country roads that have only two lanes (one each way) and no special overtaking lanes, the problem of overtaking in such conditions should be studied.

A.9 The problem for drivers is that of working out how safely to overtake on 2 lane undivided 100 km/h roads. (Expressway and other divided roads are not considered in this paper).

SOME OPTIONS FOR CHANGE

OPTION No. 1 Do nothing. Clearly this is not acceptable.

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CONTROLLING SPEED ON 100 KM/H ROADS

- THE ISSUES -

ISSUE B - ABSENCE OF EVIDENCE THAT SPEED IS CONTROLLABLE OR, THAT CONTROLS HAVE SAFETY BENEFITS.

The following paragraphs are reprinted from the Committee's First Report on Speed Control and Road Safety (STAYSAFE 8), tabled 15 October, 1986.

1.1 *BACKGROUND*

1.1.1 As far as this Committee is concerned, there is only one good reason for controlling the speed of traffic, and that is to improve road safety.

1.1.2 Other reasons for limiting speed may be advanced, as happened in the 1973 fuel crisis in the U.S.A., where an absolute speed limit of 55 m.p.h. (88.5 km/h) was imposed nationally in order to reduce fuel consumption. But generally, speed limits which do not have clear road safety benefits are not justified.

1.1.3 As an illustration of the difficulty of relating the breaking of speed limits on country roads to the road toll, a recent series of official police reports on 100 successive fatal crashes on roads posted 100 km/h legal limit was examined with the following results:--

(a) Out of the 100 crashes on 100 km/h roads, police made numerical estimates of speed of the drivers blamed in only 22 crashes.
(b) In only 4 of these was speed estimated to have been more than 100 km/h, the figures being 140, 120, 120 and 110, the last of which (110) police stated was "normal".
(c) In summary, police described speed as "normal" in 51 of the 100 crashes and as "50 to 60" in another, without the "normal" description.
(d) Out of the total of 55 crashes for which any estimate was made of legality of speed, speed was established as abnormal and illegal in only 3, namely in 5% of the sample.
(e) The term "excessive" or "possibly excessive" was used to describe 24 of the many crashes for which speed was "unknown". In many if not most cases the term related clearly, not to legality of speed, but meant "excessive for the conditions",

e.g. * Sharp left hand bend

* On right hand bend

* 75 advisory speed.

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(f) In 12 of the 30 cases in which the term "excessive" was used, there was no independent witness, and usually there was no surviving witness at all, to vouch for the safety or legality of driving.

1.1.4 There is thus little evidence from official police reports of illegal speed being a frequent factor in fatal crashes on 100 km/h roads.

1.1.5 In N.S.W., until 1979, many country roads were posted with De-restricted Speed signs. These implied that such roads were subject to the so called 'prima facie' limit of 80 km/h. "Exceeding a 'prima facie' limit is not an offence if the driver can discharge the onus expressly placed on him to prove that his speed was not dangerous in the prevailing circumstances." (Commissioner for Motor Transport, 1978/79).

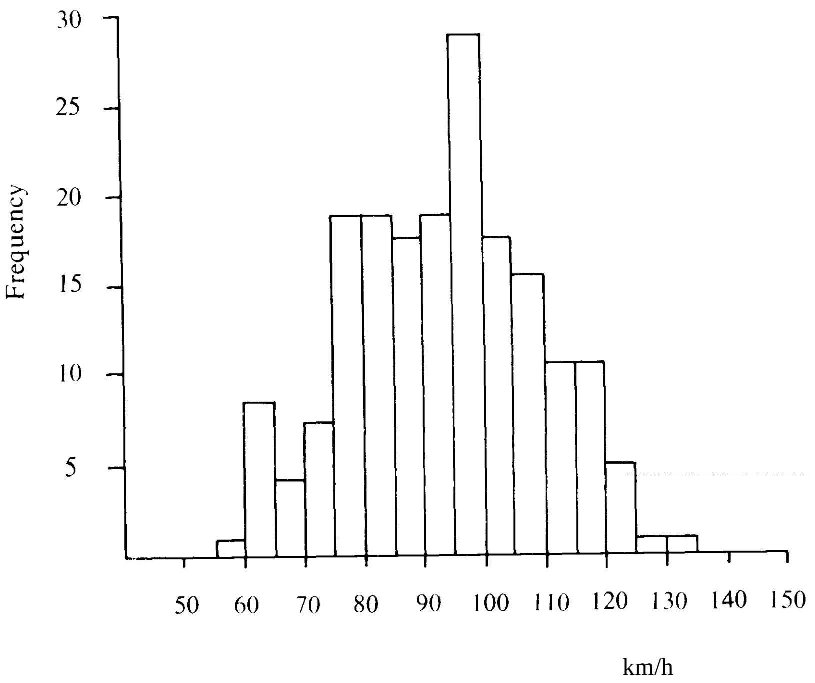
1. 1.6 Police were very dissatisfied with 'prima facie' speed limits because they found it very difficult to control speed on country roads, since it was not an offence to drive at any speed, provided there was no crash as a consequence.

1.2 *RANGE OF SPEEDS*

1.2.1 The wide range of speeds chosen by different drivers at any one point on the country road system, was also advanced as a reason for replacing the 'prima facie' limit with an absolute limit.

1.2.2 Figure I is taken from a Traffic Accident Research Unit report (Croft 1979) and shows the range of speeds in good conditions in one direction at a particular point on a derestricted highway. It is clear that whereas the average speed of vehicles was only 94 km/h, some drivers chose to drive at 130 km/h, whereas others drove at only 55 km/h, perhaps being limited by the performance of their vehicles. This led to a great deal of overtaking, sometimes a dangerous practice, as discussed later in this report.

Figure l: Speed distribution on derestricted N.S.W. rural highway (1979)



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1.2.3 Figure I should be considered with two other facts. First, there was nothing inherently dangerous about travelling at 130 km/h, since no crashes were reported by the TARU survey team. Second, the wide range of speeds meant that a great deal of overtaking took place, and overtaking vehicles sometimes do collide with on-coming vehicles. A potential for danger was therefore present, well illustrated by Figure 2 taken from a report by Solomon (1964) on road conditions in Michigan, U.S.A.

Figure 2: Variation of involvement rate with departure from average speed (daytime).

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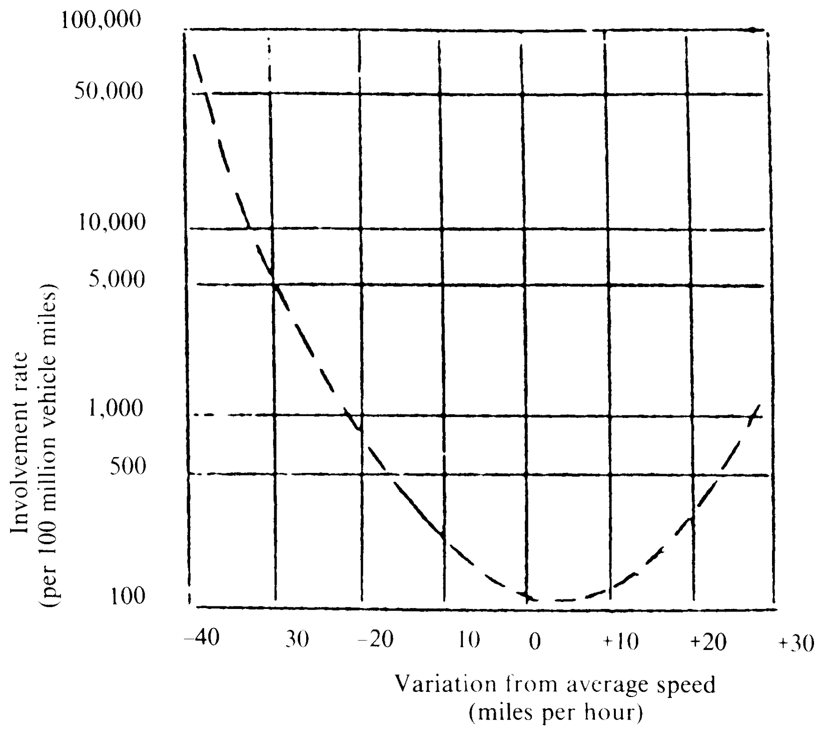

1.2.4 Cumming and Croft (1973) said of this in their review of speed control and safety:

"The existence of this relationship has led to a consideration of regulatory efforts aimed at reducing the spread of speeds in the traffic stream. For example, in a recent study (West and Dunn, 1971) the authors advocate the imposition of a maximum speed limit to reduce the number of vehicles travelling much faster than the mean, and a minimum speed limit to reduce the number of vehicles travelling at speeds considerably below the mean."

1.2.5 It was because of the wide range of speeds illustrated by diagrams like Figure l, that absolute speed limits replaced in 1979 the 80 km/h 'prima facie' limit, with an expected result of producing a narrower range of speed. In other words, slow drivers would be encouraged to speed up, while fast drivers would be persuaded by threats of penalties to reduce speed. The result would be fewer crashes because of less overtaking.

1.3 *SPEED ZONING*

1.3.1 The Motor Traffic Act was amended, with effect from 1 July 1979, so that the "prima facie" limit of 80 km/h was replaced by an "absolute" speed limit of 100 km/h. Section 4A (speed limits) (3) now reads:

"(3) The Traffic Authority may, at any time, with respect to any length of public street, give a direction fixing the speed limit applicable to that length of public street."

1.3.2 Gradually the De-restricted Speed signs which the Act required after 1 July 1979 to be interpreted as 100 km/h Legal Speed Limit, have been replaced by 100 km/h signs and a few 80 km/h signs have been erected. There does not seem to have been any general move by the Traffic Authority to utilise Section 4A (3) of the Motor Traffic Act, in order to post speed zones; for example a stretch of hilly road might have been posted 75 km/h. (Expressways were already posted 110 km/h).

1.3.3 According to Vaughan (1975) attempts were made in N.S.W. to speed zone some sections of the principal State Highways prior to 1974. Vaughan gave no details of the speed selected but pointed out that speed zoning was then operating in a general environment of a 50 m.p.h. 'prima facie' limit. That author could not from his analysis of crash records, conclude whether or not speed zoning had any safety benefits.

1.3.4 In other countries there has been both support for and opposition to speed zoning, and both favourable and negligible results in terms of reductions in crash frequency.

1.3.5 The New Zealand Transport Ministry (1971) is quoted by Cumming (1973) as not finding "a strong relationship between general speed limits and accident reductions. However, speed zoning was recommended because of the underlying principle, namely, that of imposing a limit on those sections of road where the conditions render the existing limit unsuitable".

1.4 *EFFECTIVENESS OF 100 KM/ H SPEED LIMIT*

Effectiveness in reducing speed.

1.4.1 The immediate result expected from giving police a legal absolute limit of speed to enforce on all roads, which was done early in 1979, was a reduction in the percentage of drivers exceeding 100 km/h on country roads.

1.4.2 According to Cowley (1980) the average free speed of *cars* on de-restricted country roads in N.S.W. during 1978 was 103.0 km/h, and on roads then zoned 100 km/h it was 97.8. So the speed limit may then have slowed traffic a little.

1.4.3 Surveys reported by the Traffic Authority for 1985 showed an average for cars of 100.2 km/h for all high speed country roads. That is, half were exceeding 100. Moreover 15% were found to be exceeding 111 km/h. So clearly the half million or so prosecutions of drivers for exceeding the speed limit in the intervening years, has had little or no deterrent effect.

1.4.4 For heavy trucks Cowley reported that in 1978 they averaged 80.9 (rigids) and 87.1 (semis) on de-restricted roads, and 82.2 (rigids) and 83.3 (semis) on 100 km/h roads.

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1.4.5 The Traffic Authority for 1985 reported 85.3 km/h as the average for all heavy trucks, with 15% exceeding 93 km/h. So trucks (specially limited to 80) are now travelling somewhat faster, in spite of the law.

1.4.6 It can only be concluded that rural speeds have not been affected by the types and levels of enforcement employed.

Effectiveness in saving lives

1.4.7 A more important effect of legal speed limits would be a reduction in rural road deaths. Table I shows relevant fatal crash numbers for the period 1976 to 1985 (DMT).

Table 1: Road deaths on rural roads 1976 85, N.S.W.

YEAR	Annual Fatal Crash Numbers		
	100 km/h	De-restricted	100 + De-restricted
1976	227	205	432
77	207	218	425
78	210	236	446
79	336	116	452
80	453	0	453
81	444	0	444
82	447	0	447
83	344	0	344
84	351	0	351
85	360	0	360

1.4.8 It can be seen that there was no improvement from 1979 until random breath testing for alcohol was introduced late in December, 1982.

1.4.9 It can only be concluded that rural road deaths have not been affected by the introduction of speed limits, a result to be expected, since there was no reduction in speeds.

3.6 *HEAVY TRUCKS ON COUNTRY ROADS*

3.6.1 Since commencing the inspection of rural crash sites involving heavy trucks, and discussing truck traffic with people in Goulburn, Yass, Gunning and Gundagai, the Committee has reached the conclusion that truck speeds should be investigated as part of the general problems of speed and overtaking.

3.6.2 Some of the matters put to us include:

(i) Truck speeds on the Hume Highway are higher at night than in daytime, often up to 130 km/h compared with the 80 km/h legal limit for trucks and 100 km/h for cars outside the towns.

(ii) Truck speeds at night through the towns mentioned are over 80 km/h.

(iii) Trucks illegally travel in convoys of 12 or 15, only 3 or 4 metres apart, compared with the legal minimum of 60 metres.

(iv) Heavy trucks overtake cars that are travelling at 100 km/h.

(v) Convoys of trucks travelling uphill cannot safely be overtaken, because of convoying.

3.6.3 From its preliminary investigation of truck speeds and overtaking the Committee has become concerned about the implications. The Committee is seeking more information on these matters, before it draws conclusions.

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OPTIONS Nos. 2 to 9 - CONTROLLING SPEED ON 100 KM/H ROADS

OPTION No. 2 Ban from 100 km/h roads all vehicles which cannot easily and safely travel at this speed.

OPTION No. 3 Substantially lower the speed limit on 2 lane undivided country roads, except on sections where overtaking lanes are provided.

OPTION No. 4 Maintain the 100 km/h speed limit, on overtaking lanes only, but substantially lower the speed limit on the normal lanes and on sections of 2 lane undivided roads which have no overtaking lanes.

OPTION No. 5 Maintain the existing penalties for breaking the 100 km/h speed limit, on overtaking lanes only, but substantially increase them on normal lanes and on 2 lane undivided roads which have no overtaking lanes.

OPTION No. 6 Increase the speed limit of buses and heavy trucks (at present 90 and 80 km/h) to the same as for other vehicles (namely 100km/h), in order to reduce overtaking, only for vehicles meeting current brake standards.

OPTION No. 7 Any slow vehicle holding up a queue of 4 or more following vehicles, would be required to pull off the road to allow them to overtake.

OPTION No. 8 Revert to 'prima facie' speed limits because absolute limits are inappropriate for all driving conditions.

OPTION No. 9 Absolute speed limits imposed on sections of roads should be made compatible with the conditions for safe travel a practice which is sometimes called "speed zoning" as implied by Section 4A (3) of the Motor Traffic Act.

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ISSUE C - ADVICE & ASSISTANCE IN SELECTING SPEED AND THE PATh TO FOLLOW.

- THE ISSUES -

The following is copied from STAYSAFE 8 -

1.5 *ADVISORY SPEED SIGNS*

1.5. l As stated above, the Traffic Authority does not appear to have adopted the practice of speed zoning that is embodied in the 1979 amendments to the Motor Traffic Act. Instead, a proliferation of Advisory Speed signs has appeared on the approaches to curves, on roads sign-posted 100 km/h.

1.5.2 Advisory speeds were preferred to speed limits by Leeming (1969) in a study quoted by Cumming (1973): "He complained that such limits bring about contempt for the law and are largely unenforceable. He advocated that they be abolished and replaced by advisory limits set at the observed 85th percentile speed" (the speed exceeded by only 15% of drivers).

1.5.3 According to the Motor Traffic Handbook (January 1984), advisory speed signs "advise you of the safe speed to travel around the next curve in the road IN GOOD CONDITIONS" (our emphasis).

1.5.4 The Committee, through the Minister for Roads, asked the Commissioner for Main Roads for some information on the advisory speed signs on main roads. His responses (Loder, 1986), with the Committee's comments, are as follows:

(a) *Legal basis.* "There is no legal basis for advisory speed signs. They are classified as supplementary warning signs, and are used to give information about horizontal curves additional to that displayed on the basic curve warning sign, i.e. location and direction of the curve".

COMMENTS': (i) The Committee concludes that police have no power to enforce advisory speeds, just as they had no power to enforce the prima facie limit, with which advisory speeds can therefore be compared.

(ii) It would however seem likely that failure to observe advisory speeds could be used in evidence in both criminal and civil litigation.

(b) *Explanatory signs.* "It is true that when advisory speed signs were first introduced, explanatory signs were also erected to inform motorists of their purpose. However the advisory signs were quickly accepted by motorists and the need to continue to publicise their function was therefore negated . . . When the signs were first introduced, there were unsubstantiated claims by motoring writers that the speeds shown were too low".

COMMENTS': (i) Although the Commissioner did not say so, these explanatory signs, like the Motor Traffic Handbook already quoted, stated that advisory speeds were for good conditions.

(ii) It is usual, however, to find much of the traffic driving considerably faster than advised speeds when conditions are good.

(iii) Therefore the advisory speeds are *not* "accepted by motorists".

(iv) It is the Committee's view that the advised speeds are for average vehicles driven by average drivers, in average conditions.

(c) *Technical basis.* "The speeds shown are determined scientifically, as set out in the attached extracts from the Department's Signs and Markings manual".

COMMENTS: (i) The extracts state that the method is to be used for horizontal curves; it is not clear what is intended when there is a side slope as well as a curve.

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(ii) The method is to determine the angle away from vertical of a pendulum whilst a car is cornering at a "normal" speed, then to estimate the advisory speed from a graph.

(iii) The graph employs the calculation

$$V_A = \left[V_o \sqrt{V_o^2 + 6000\,(B + 3)} \quad V_o \right] \Big/ \quad 16\,(B + 3),$$

to determine the advised speed (V_A) from the speed (V_O) of the operator's car (V_O) and B the angle of a ball bank indicator.

(iv) It appears from the graph that a bank angle of about 10 degrees is allowed for speeds around 85 km/h (see Figure 3).

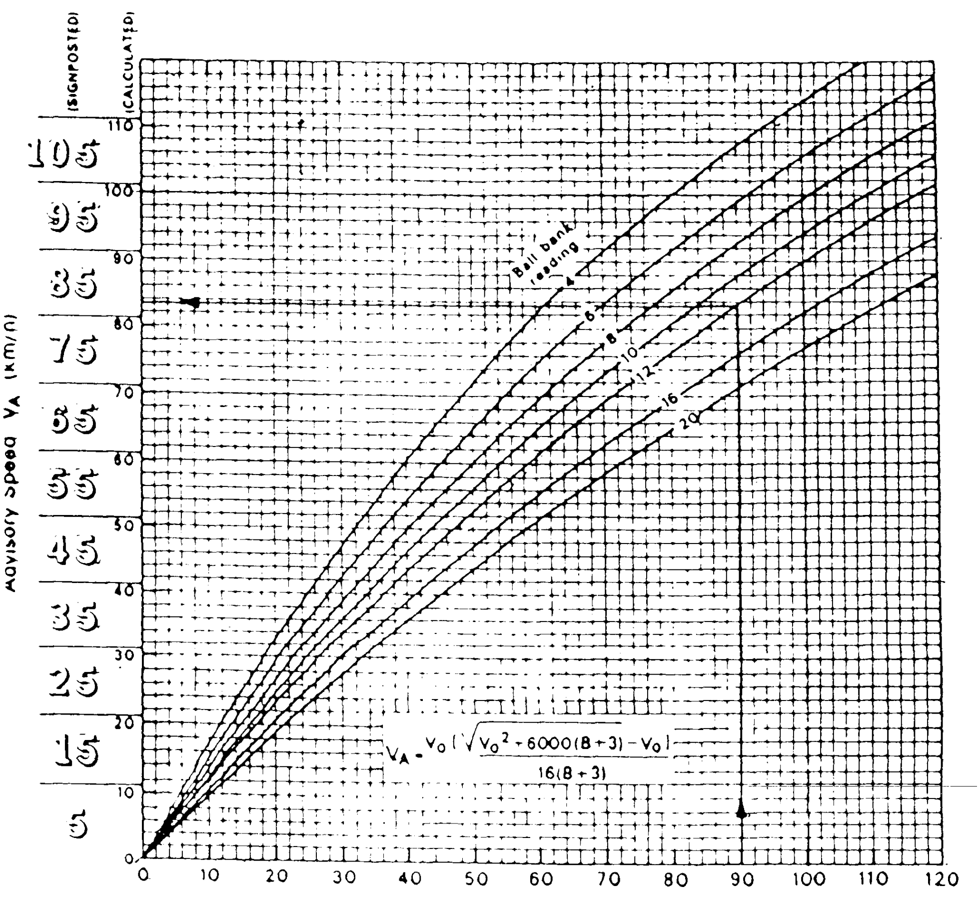
(v) The Commissioner was asked to explain the basis of the formula and the 10 degrees. A 9 page reply received on 17 June is being studied by the Committee. (Cable, 1986).

(vi) Cumming (1973) explains the use of the bank indicator thus:

"Briefly, this device is used to measure the resultant side thrust on a test vehicle as it negotiates a curve, and tables have been developed which set out maximum permissible values of ball bank angle or side thrust for certain speed ranges. These relationships have been based on tests concerning driver and passenger discomfort under the action of lateral acceleration."

Figure 3: Determination of Advisory Speed on Horizontal Curve.

SIGNS AND MEANINGS



Survey Speed V_O (km/h)

"The safe speed for a curve is defined as the maximum speed at which a curve may be negotiated without a feeling of discomfort to the driver or passengers, subject to such further reduction as sight distance limitations and wet road friction coefficients might warrant. The determination of advising speeds is discussed in detail in the papers by Palmer (1962) and Kneebone (1964). As indicated in Appendix D to the report by the Eno Foundation (1970), the ball bank indicator method is used in the U.S. for determining not only advisory speeds for isolated sharp curves but also general speed limits for roads with many curves."

(vii) The topic of wet roads will be pursued later in this report.

1.5.5 Cumming (1973) quotes a Department of Main Roads report (Kneebone, 1964) which showed that "the erection of advisory speed signs can cause greater than 60% reduction in casualty accidents"; however this was in an environment where there was a "prima facie" speed limit and no absolute speed limit on country roads.

1.5.6 On country highways in N.S.W. a driver usually is subject to a 100 km/h limit, he may then pass a 75 km/h advisory sign and, after the curve, has to remember what is the absolute speed limit (80 or 100). Cumming (1973) quoted the following on this "intolerable confusion":

"In the paper by the British Ministry of Transport (1968) the application of advisory limits to certain categories of road was considered, but this was eventually discarded on the principle that, as this system of mixed limits developed, it might well lead to 'intolerable confusion amongst motorists'. The conclusion was drawn that the most effective speed limits would be those which were subject to enforcement."

1.5.7 As stated earlier, the basic function of absolute speed limits is to reduce the range of speeds, expecially by using the threat of court-imposed penalties to reduce excessively high speeds. Speed signs on curves, if they are purely advisory, will not prevent excessive speeding on curves by the most dangerous drivers those who take delight in demonstating how fast they can negotiate the curve.

ROADS IN GOOD ROAD AND TRAFFIC CONDITIONS

2.4.1 As stated by Mr Fred Schnerring in a personal submission to STAYSAFE:

"Cowley (1980b) found that N.S.W. had the lowest proportion of motor vehicle occupant fatalities in the high speed regions of N.S.W., Queensland, Victoria and South Australia, even though N.S.W. had the highest free speeds. He concluded by questioning whether rural free speeds and rural limits had an appreciable effect on road traffic fatality patterns."

"In general, research has been unable to determine how much safety increased, by limiting traffic to speeds considerably below the design speed."

2.4.2 In commencing upon the proposal to introduce the 100 km/h absolute speed limit Croft (1979) said:

"Since the objective under consideration is to reduce the number of fatal crashes on de-restricted roads, it is important to identify the significant factors that distinguish traffic behaviour on these roads from other traffic and that distinguish the roads themselves. An adequate scientific analysis of such factors has not been possible so far, but there is broad agreement that 'excessive speed for the conditions prevailing' and in particular, 'isolated instances of very risky overtaking at speeds all above the average speed of traffic' are two important examples of deviant driver behaviour that contribute to severe crashes. It is to these and similar kinds of behaviour that the 100 km/h proposal is addressed."

Before proceeding with an analysis of the 100 km/h absolute limit as a partial solution to rural crashes, it would be irresponsible of the Unit not to draw attention to three important matters:

(a) Rural fatal crashes *appear* to be even more likely than urban crashes to involve extremely high (more than 0.15 per cent) blood alcohol levels in drivers, although data supporting this indication are limited.

(b) Rural fatalities *appear* frequently to result from failure to wear a selt belt. Again, supportive data are limited.

(c) Some 60 or 70 fatal crashes on rural roads appear each year to involve a driver's inability after losing temporary control (say by nodding off to sleep) to regain control before hitting a large tree or other object that need not have been there. (See Annual Statistical Statements).

"It follows, if these 'appearances' are supported by more comprehensive studies, that attention to hazardous fixed roadside objects, to drink-driving and to seat belt wearing on de-restricted roads might be as important as changes in the speed limit. It also follows that changes in speed limits should take into account the responses of drink-drivers to such changes."

2.4.3 Shattock (1986) has described a new handbook of highway safety practice produced by the N.S.W. Department of Main Roads. He said that among the priority improvements listed for rural roads were:

First Priority Improvements.

- Ensure all signposting is erected in accordance with Departmental guidelines especially advisory speeds on curves.
- Provide clear pavement marking and augment with raised reflective pavement markers especially on curves.
- Provide further delineation with guideposts at correctly spaced intervals and ensure reflectors are in good condition.
- Pavement edge repairs and edgelines.
- Provide guardrail on approaches to bridges especially where these are narrower than the adjoining road.
- Provide guardrail across short bridges to replace weak timber or pipe handrails.
- Upgrading all significant intersections to provide auxiliary lanes.
- Ensure Breakaway Cable Terminals (BCT) are installed on exposed ends of lengths of guardrail.

Second Priority Improvements.

- Remove roadside trees or protect with guardrail particularly those within 6 m. of the edge of carriageway and on the outside of curves.
- Shoulder widening and/or sealing.
- Flatten batters wherever possible and especially on outside of curves or alternatively protected with guardrail.
- Provision of auxilliary lanes where warranted under HO Circular No. TS 9 dated 14 May 1985.
- Improvement of skid resistance of pavement where warranted under HO Circular No. M & R 2 dated 20 August 1984.
- Widening all short culverts and bridges.

2.4.4 The Committee applauds the Department's initiative.

2.4.5 The more widespread use of raised reflective pavement markers (RRPMs) is a matter of special interest to the Committee because of the potential for any raised pavement marker, whether reflectorised or not, to alert drivers who are nodding off to sleep, identified by police as a cause of many fatal crashes on rural roads. Wider spacing of the groups should largely eliminate their hazard to pedal and motor cyclists, and should permit their use as shoulder edge delineators. The psychological and practical aspects of RRPM's and similar devices have been reported on by O'Hanlon (1974) and Jarvis (1980 and 1985).

2.5 *SPEED IN POOR CONDITIONS*

2.5.1 Speed too high for the prevailing conditions is a major danger on our roads.

2.5.2 Conditions which transform a safe speed to a dangerous speed are many and varied, as Mr Schnerring pointed out:

"Theoretical *Considerations"*

"Ideally speed limits should, as the name suggests, reflect the maximum safe speed for any set of circumstances. However, the safe maximum speed depends on many factors all of which vary over time. These factors include the type of road and its condition, the surrounding land use, the vehicle and its condition, the driver, the weather and lighting conditions. Ideally speed limits should reflect this, so that they are lower at night, in wet weather, fog, poor road conditions and so on."

"Roads are designed for a particular design speed. The design speed is the speed at which a vehicle can travel without being exposed to hazards arising from curtailed sight distances, inappropriate alignments or pavements too narrow for the design traffic volume (NAASRA, 1976). Design speed takes into account the terrain, traffic volume, the speeds likely to occur on the road, and the type of road. As the design speed increases, so does the cost of the road; in undulating country an increase of 20 km/h in the design speed approximately doubles the cost of earthworks."

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2.5.3 As we have said, advisory speeds (and, for that matter, the present absolute speed limits) are perceived by drivers as safe in AVERAGE CONDITIONS, and *not* only in the good conditions mentioned in the Motor Traffic Handbook.

2.5.4 The Committee believes that drivers correctly perceive the situation: advisory speeds and the present absolute speed limits are not always appropriate for good conditions.

2.5.5 Presumably the margin built into these speeds is intended to improve safety. In practice, however, this is not achieved, for the simple reason that drivers believe that the Motor Traffic Handbook is exaggerating the dangers of exceeding the posted speed.

2.5.6 The Handbook (and the whole traffic regulation apparatus) is thereby seen to have LOW CREDIBILITY, except by those few drivers who behave much more cautiously than the majority, and accept the speed signs at face value.

2.5.7 Even this cautious minority would benefit from more accurate advice about safe speed because, as mentioned earlier in this report, driving more slowly than the majority is a major cause of dangerous overtaking by others.

2.5.8 Clearly there is a credibility problem with present speed signs.

OPTIONS 10 to 20 - ADVICE & ASSISTANCE IN SELECTING SPEED AND THE PATH TO FOLLOW

OPTION No. 10 Abolish the present dual system of speed signs (absolute and advisory) because it is confusing.

OPTION No. 11 Speeds for curves made the subject of absolute speed signs, achieved by speed zoning.

OPTION -No. 12 The Traffic Authority should proceed with a scheme of speed zoning throughout the State, to indicate the safe speed on sections of road, by means of legally enforced limits not exceeding the present maxima of 110 *km/h* on expressways and 100 km/h on ether country reads.

OPTION No. 13 Ensure all signposting is erected in accordance with Departmental guidelines especially advisory speeds on curves.

OPTION No. 14 Provide clear pavement marking and augment with raised reflective pavement markers especially on curves.

<u>OPTION No. 15</u> Provide further delineation with guideposts at correctly spaced intervals and ensure reflectors are in good condition.

<u>OPTION No. 16</u> Pavement edge repairs and edgelines.

<u>OPTION No. 17</u> Provide guardrail on approaches to bridges especially where these are narrower than the adjoining road.

<u>OPTION No. 15</u> Provide guardrail across short bridges to replace weak timber or pipe handrails.

<u>OPTION No. 19</u> Upgrading all significant intersections to provide auxiliary lanes.

<u>OPTION No. 20</u> Ensure Breakaway Cable Terminals (BCT) are installed on exposed ends of lengths of guardrail.

N.B. Options 13 - 20 are DMR plans.

CONTROLLING OVERTAKING

- ISSUES D, E and F -

ISSUE D - OVERTAKING DECISIONS FOR DRIVERS

D 1 The National Association of Australian State Road Authorities (1980) says that at the legal speed of 100 km/h, a sight distance of 490 metres ahead is required in order to safely continue an overtaking manoeuvre from a position alongside, assuming 100 km/h for oncoming vehicles and 86 km/h for overtaken vehicles.

D.2 The Motor Traffic Handbook (Dept. Motor Transport, June 1983) says that an unobstructed view, not less than 150 metres ahead, should be maintained when overtaking or at any time when the vehicle is over the middle of the road.

D.3 In fact, as the attached Tables prepared for STAYSAFE by F. Schnerring show, overtaking and distances range widely among vehicles depending upon their ability to accelerate. Taking a Toyota Corolla as an average car, his analysis shows that whilst quickly overtaking a vehicle that was travelling at 100 km/h the Corolla would under maximum acceleration reach about 135 km/h. If an oncoming vehicle was travelling at a legal 100 km/h a clearance distance of 858 metres would be required; if it was doing 120 km/h the necessary clearance increases to 937 metres. In his analysis he assumed that the Corolla was 1 second behind the overtaken vehicle at the beginning and 35 metres ahead upon completion of overtaking.

D.4 If an oncoming vehicle appears, it would seem to be relatively easy to return to the queue by a firm application of the brakes, provided that following drivers have left a suitable gap. Again, the braking distance ranges widely among vehicles and depending upon the road surface, from about 60 to nearly 200 metres.

D.5 Although a road may appear to be clear for a long distance ahead on a straight road, the situation may suddenly be changed by a vehicle being driven on to the road ahead. This may be from a driveway, an intersection, a rest area, or just from a temporary stop on the road shoulder. Under such circumstances there may be inadequate room for braking and a crash becomes inevitable.

D.6 It is also not easy to judge how far away is an approaching vehicle, let alone to gauge its speed.

D.7 Another problem comes from the changes of direction and speed required, first, in order to pull out around the vehicle being overtaken and second, to rejoin the queue behind that vehicle if overtaking is abandoned. Each of these manoeuvres calls for extraordinary adhesion between tyres and road surface whilst the vehicle is rapidly changing both direction and speed. Also, in the case of abandonment, an assurance is required that no wheel will lock under abrupt braking, sending the vehicle careering out of control.

D.8 There is evidence of drivers losing control of their vehicles because of these mechanical defects of the road-vehicle components of the system, during overtaking or abandonment of overtaking.

D.9 It seems clear that drivers rarely have sufficient knowledge of all the relevant factors, required to give high confidence in the safety of participating vehicles and people, in overtaking situations on our 2 lane undivided 100 km/h roads.

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The following is reprinted from STAYSAFE

3.4 *SEPARATING ON-COMING TRAFFIC*

3.4.1 It is obvious from the clearance distances calculated, that overtaking on undivided two-lane country roads can rarely be undertaken with complete safety. There is always the possibility that someone will approach at high speed, or that a farm tractor will enter the highway from a driveway.

3.4.2 In the previous section the rules about overtaking have been considered, but there is a case for banning overtaking on undivided two-lane roads, except on the overtaking lanes provided.

3.4.3 It is obviously the policy of the Department of Main Roads to provide more and more overtaking lanes, but limited funds are the chief obstacle to rapid progress. This still leaves for determination the problem of overtaking on the intervening long stretches of two-lane road.

3.4.4 The Department has a policy of providing double centre lines on sections of road which it considers especially hazardous for overtaking. It is clear, however, that the greater the length of such sections, the greater will be the likelihood of overtaking over the double lines.

3.4.5 Overtaking can be physically prevented, with the road being divided, with only occasional facilities for overtaking. Division in this way would greatly improve safety, but there would develop considerable pressure to ban the slower vehicles and to remove the dividing barriers, in order to speed up traffic.

3.4.6 Since double lines do not effectively prevent dangerous overtaking, it can be argued that all road dividers should be physical barriers. They should be designed to prevent deliberate overtaking but not make dangerous any inadvertent attempts at overtaking.

3.4.7 This last requirement involves making the divider safely mountable, which might not prevent deliberate overtaking, or of the New Jersey kind which guides straying vehicles back on to course, but takes I metre of road width and is expensive.

ISSUE E - ROAD PLANNING BY COUNCILS AND THE D.M.R.

E.1 Ideally, traffic should travel only in one direction on 100 km/h roads, because crashes at such speeds are mostly unsurvivable for car occupants.

E.2 The current problem is that of making safer our 2 lane undivided roads. If each was duplicated by the addition of another 2 lane road, then one could be dedicated to UP traffic and the other to DOWN traffic, as on mainline railway systems. This would eliminate head-on crashes. It would also provide for overtaking without the fear of meeting oncoming vehicles.

E.3 It seems clear that, when existing 2 lane undivided 100 km/h roads need to be "upgraded" in order to carry more traffic faster, the option of building a second, similar road to carry 2 lanes one way, leaving the old road to carry opposite traffic, should be given serious consideration. This should also be cheaper than the provision of a completely new two-way road.

E.4 The Committee has noted that on the Hume and Federal Highways the old sections of 2 laned road have been retained and new sections have been built - only for 1 direction.

E.5 The Committee is not certain whether this is a State-wide policy by DMR but clearly it is an option which should be strongly supported for financial as well as for safety reasons.

E.6 Gradually, more overtaking lanes are being provided; but this is expensive and therefore a long-term remedy.

E.7 Duplicating country roads so that they become one-way is a more expensive and longer 'term solution, but well worth considering as an alternative to replacement of existing roads.

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E.8 In the meantime a number of relatively short-term solutions or palliatives should be developed by the road and traffic bodies.

ISSUE F - COSTS & BENEFITS IN OVERTAKING

The following is reprinted from STAYSAFE 8

3.1 *COSTS AND BENEFITS*

3.1.1 Overtaking, like many driving operations, has its costs and benefits.

3.1.2 Its benefits may include one or more of the following depending upon the temperament of the driver:

(a) Shortening the journey, perhaps only by minutes.

(b) Removing the annoyance or boredom of following closely behind another vehicle travelling more slowly.

(c) Enjoying the pride, the thrill or the pleasure of beating another driver.

3.1.3 Its costs may include for the driver:

(a) Increased fuel consumption.

(b) Increased tyre wear.

(c) Being caught by police for exceeding the speed limit, with demerit points and a fine.

(d) Having a crash involving the death of or injury to another person, in which case evidence of exceeding the speed limit by even I km/h may provide grounds for a charge of manslaughter (maximum penalty penal servitude for life) or of culpable driving (maximum penalty 5 years imprisonment).

3.1.4 In making a judgment on the benefits against the costs, drivers will usually give greater weight to the obvious rather than the unseen. The benefits quoted in 3.1.2, such as saving time, alleviating boredom and gaining a thrill, are more obvious or immediate than the costs in 3.1.3. Most importantly, drivers do not believe they will be caught by the police, and they think that "I will never have a crash".

3.1.5 Drivers frequently will make a decision to overtake, and take the risk of meeting an oncoming vehicle while overtaking, because the chances are that it will be possible to accelerate if necessary, giving an even greater thrill.

3.1.6 That this acceleration quite clearly is likely to involve breaking the speed limit is justified *after the event,* on the basis that it is better (i.e. safer) to "accelerate *out* of trouble" than to risk a collision by obeying the speed limit.

3.1.7 That the need to break the speed limit would not have arisen, had the driver not got *into* trouble in the first place by overtaking, is conveniently overlooked by the drivers involved (often drivers who have had so-called "skills training" see STAYSAFE 2, Section 2.4 and especially 2.4.9.).

3.1.8 From a road safety viewpoint the *real* costs of overtaking are the deaths and injuries; these are the cost to the community as a whole, not merely to the individuals involved.

3.1.9 Among the 100 fatal crashes on roads posted 100km/h, mentioned in paragraphs l.l.3 and 2.5.7, overtaking was definitely involved in about 17% and might have been involved in a further 51%.

Behavioural change in relation to overtaking.

3.1.10 In considering any option for change in relation to overtaking, one might care to consider the following claims that have been made about the safety benefit of efforts by police to control speed:

(a) Lack of evidence that police have any measurable influence on the frequency or manner of overtaking, except when police are very conspicuous, something that even a great increase in their numbers would rarely permit.

(b) Lack of evidence that the severe penalties for dangerous driving have any influence on overtaking.

(c) Many drivers believe that it is usually safe to accelerate "out of trouble" rather than to return to the traffic queue, when an oncoming vehicle appears.

(d) Lack of evidence that more traffic rules would change driver behaviour.

(e) Need to improve the positive guidance given in specific situations to drivers, about when and how best to overtake safely.

(f) A feeling that an increase in double unbroken lines would only increase the frequency with which drivers cross them.

(g) The research finding that generally it is much quicker and easier to improve safety by physical changes to the road and vehicle parts of the system, than by trying to change the road users.

(h) Exceptions to the rule that it is difficult to change road user behaviour, arise in situations in which precisely defined and dangerous behaviour (e.g. drink-driving) has a very high likelihood of being discovered by police (e.g. through RBT).

(i) A more important exception arises where "behaviour" is modified by physical constraints e.g. physical barriers to overtaking such as median strips, producing divided roads.

(j) There would be less overtaking if all vehicles were capable of being driven at the same speed. Various ways of achieving this include bans on slow vehicles, introduction of minimum speed limits and lowering the maximum speed limits in some zones.

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OPTIONS Nos. 21 to 27 - CONTROLLING OVERTAKING

OPTION No. 21 Place barriers continuously along the centre line to prevent overtaking.

OPTION No. 22 In all instances, place the safety onus on the overtaking driver who would be charged automatically with culpable driving where the overtaking was a significant factor in producing an injury-producing crash.

OPTION No.23 Introduce SAFE-TO-BEGIN-OVERTAKING zones in which there would be 500 metres sight distance throughout, no driveways, intersections or parking, and a ban on stopping. Notices would remind drivers that overtaking must be abandoned should an oncoming vehicle appear. Overtaking would be banned elsewhere except on overtaking lanes.

OPTION No. 24 Ban all overtaking on 2 lane undivided high speed country roads, except on special overtaking lanes, with appropriate penalties.

OPTION No. 25 Provide overtaking lanes at frequent intervals on 2 lane undivided roads.

OPTION No. 26 Draw up and implement a programme for turning all high speed roads in the State into one-way thoroughfares; this would of course involve duplicating existing 2 lane roads.

OPTION No. 27 "Keep left unless 0vertaking" should be encouraged, and signs should indicate that traffic in other lanes should give way to the normal left lane during overtaking; this priority rule should be reinforced where overtaking lanes are provided i.e. "Give way when overtaking". Since there are no slow drivers amongst the speeding population of drivers, "Slow vehicles keep left" is not a sign that is likely to assist traffic control' such signs should be replaced by "Keep left unless overtaking".

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ISSUE G - PRIORITY DURING OVERTAKING

- THE ISSUES -

The following is reprinted from STAYSAFE 8

3.5 PRIORITY DURING 0VERTAKING

3.5.1 The N.S.W. Motor Traffic Regulations require that drivers drive on the left. Specifically, it is required that drivers keep as close as possible to the left hand edge of the carriageway at all times, except where there are special lanes provided for doing otherwise.

3.5.2 This can only be interpreted as giving priority to traffic that is on the left-hand side of the road, unless there are special controls at specific points requiring otherwise.

3.5.3 In the case considered in section 3.3 in which there are only two lanes, one for each direction, priority must be given at all times to the traffic in the left-hand lane, simply because this is consistent with driving on the left, and because the law says so.

3.5.4 Therefore drivers who are overtaking in such situations are under an obligation to ensure that they do not put at risk those whom they are overtaking, nor anyone else. They are however entitled to expect that the driver being overtaken will not speed up whilst being overtaken unless there is good reason to do so. One of these "good reasons" is a departure from a traffic light or any other stationary position. In such cases all vehicles will be accelerating, and priority to the left lane vehicle would be given and expected. It is not easy to see how these ideas could be translated into legislation.

3.5.5 Because priority is intended by law to be given usually to the left side traffic, this notion should not be ignored in the approach of planners to the problems of lane merging.

3.5.6 In a situation in which two north-bound lanes are merging into one, the left lane is the "normal" lane for all traffic, whilst the right lane is the "overtaking" lane to be used only for the purpose of overtaking. At the merge point it is the overtaking lane that ends, not the normal lane on the left. Therefore it would seem that it is the traffic in the right lane which should slow down and give way to vehicles in the left lane. Obviously too, drivers on the left should allow the others to enter the "normal" lane. The opposing argument is that vehicles in the overtaking lane are moving faster.

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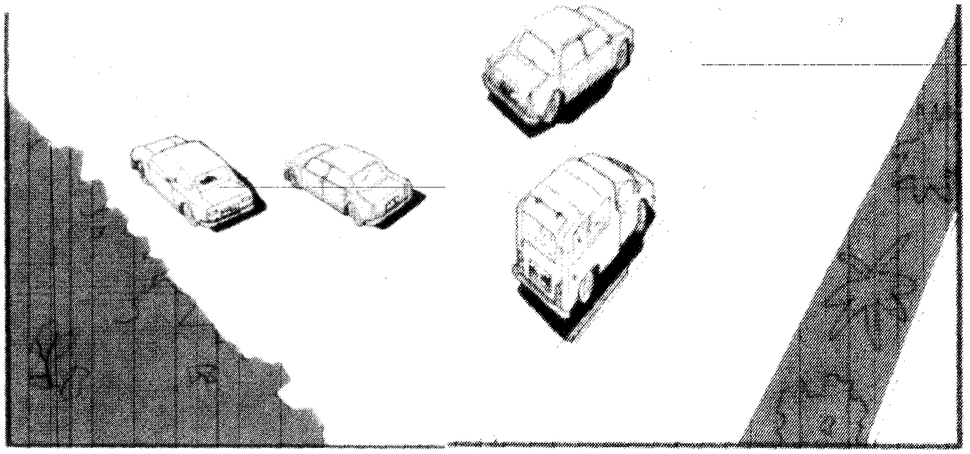
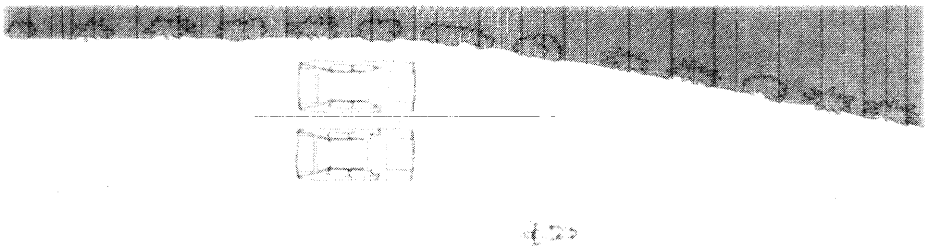
3.5.7 The Motor Traffic Handbook illustrates three situations in which (a) the lefthand driver (b) the righthand driver and (c) no driver has right of way. It says that you must give way if you have to cross the broken lane line. In the third example, with the lane discontinued, no driver has the right of way (See below).



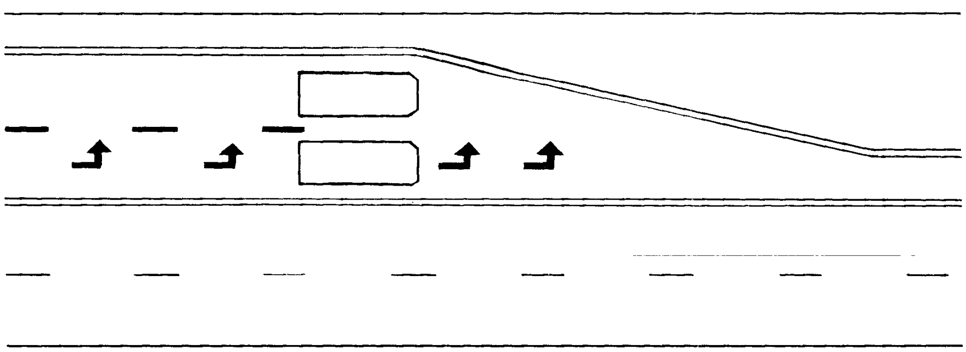


The RED car gives way

3.5.8 It is doubtful whether many drivers remember all these rules. In any case they are ineffective because collisions still occur.

3.5.9 It might be best to remove (a) and (b), leaving no lane for drivers to compete for, and to place a succession of left turn arrows on the surface in the righthand lane, indicating that the overtaking driver must merge behind vehicles in the left lane. (See Figure 5).

Figure 5: Possible remarking of end of overtaking lanes.



3.5.10 The present situation is reminiscent of the Give Way' to the Right Rule, in which the most aggressive driver won priority.

<u>OPTION No. 28</u> Mark all overtaking lanes to indicate that the kerbside lane has priority, and overtaking drivers must give way.

ATTACHMENT

OVERTAKING DISTANCES

(prepared by Mr. F. Schnerring)

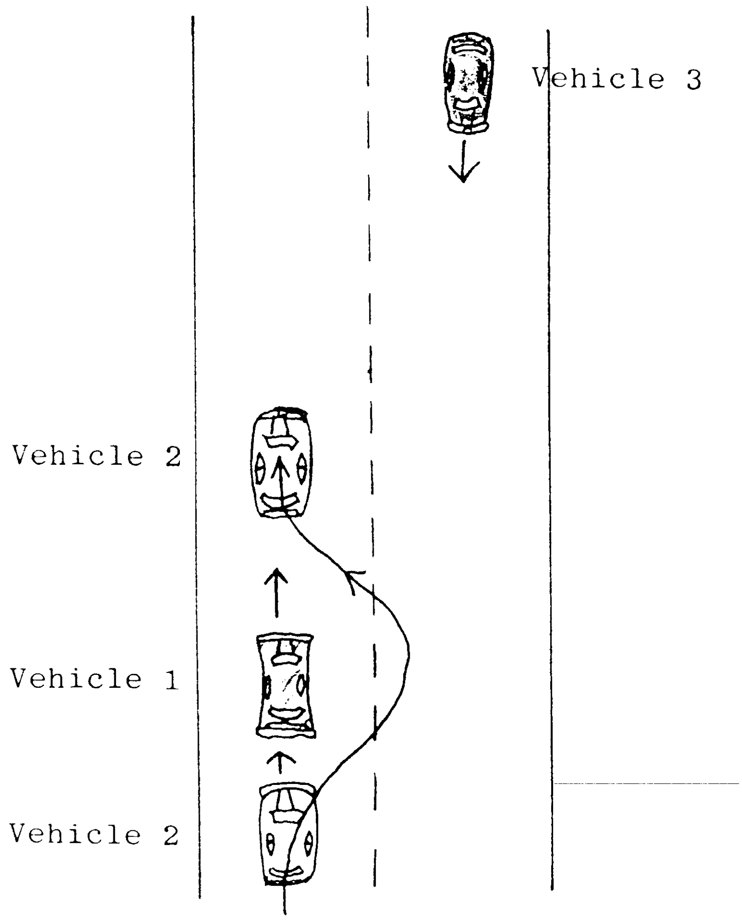
OVERTAKING DISTANCES

1. Introduction

The following assumptions and calculations are to determine the distance needed for one car to overtake another.

2. Assumptions

The scenario used for calculating overtaking distances is sketched below.



Vehicle 1 overtak<u>en</u> vehicle
Vehicle 2 overtak<u>ing</u> vehicle
Vehicle 3 oncoming vehicle.

ASSUMPTION 1 : The overtak<u>en</u> vehicle travels at a constant speed.

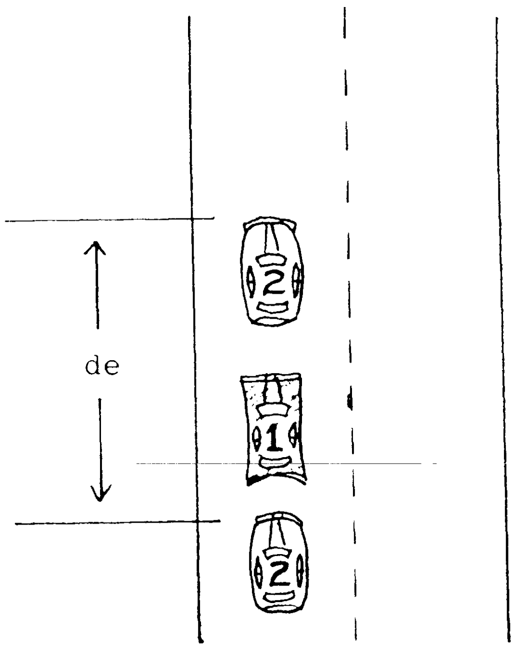
ASSUMPTION 2 : The overtak<u>ing</u> vehicle accelerates throughout the manoeuvre.

ASSUMPTION 3: The overtaking manoeuvre is considered completed when the overtaking vehicle just regains its side of the road.

ASSUMPTION 4: The overtaking vehicle has followed the overtaken vehicle for a time. It therefore starts its overtaking manoeuvre at the speed of the overtaken vehicle. It is not a "flying" overtaking manoeuvre.

ASSUMPTION 5: The oncoming vehicle travels at a constant speed.

3. Formulae Used



In overtaking vehicle 1, vehicle 2 must travel an extra distance d_e in the same time as vehicle 1.

$d_1 = u_1 t$ (1)

$d_2 = d_1 + d_e$ (2)

$d_2 = u_2 t + 1/2\ at^2$ (3)

Both vehicles travel at the same speed initially.

Thus

$d_2 = u_1 t + 1/2\ at^2$

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From equations 2 and 3

$d_1 + d_e = u_l t + 1/2\ at^2$ (4)

Substituting from equation 1 gives

$u_l t + d_e = u!t + 1/2\ at^2$,

Thus $de = 1/2\ at^2$ ....(5)

u_1, u_2 =initial speed of both vehicles (m/sec)
d_1=distance travelled by vehicle 1 (metres)
d_2=distance travelled by vehicle 2 (metres)
t =time (seconds).

4. Assumptions in determining de.

ASSUMPTION 6: Overtaking vehicle follows at a 1 second headway.

ASSUMPTION 7: Both vehicles are cars 5 metres long.

ASSUMPTION 8: Overtaking vehicle travels 35 metres past overtaken vehicle before regaining its side of the road.

5. Values of de

At	50 km/h and 60 km/h	de = 60 metres
	80, 90, 100 km/h	de = 70 metres.

6. Tables of Distances

Tables have been calculated for a number of vehicles:

(A) Toyota Tarago

(B) Daihatsu Charade

(C) Toyota Corolla (Seca)

(D) Holden Camira SLX

(E) Holden Calais 5.0 High Performance

(F) Yamaha XJ750 (motorcycle).

Distances have been calculated for each vehicle for the following speeds:

Overtaken vehicle travelling at	50 km/h
	60
	80
	9O
	100
Oncoming vehicle travelling at	80 km/h
	100
	120
	140

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Vehicle A: Toyato Tarago

Speed Of Overtaken Vehicle (km/h)	Performance Of Overtaking Vehicle (km/h)	(Seconds)	Overtaking Time (seconds)	Final Speed (km/h)
50	50-90	9.5	10. 1	95
60	60-100	1 1.2	11.0	99
80	80-110	12.5	14.5	115
90	90-1:20	15.2	16.0	122
1 00	100- 130	24.9	20.5	125

Distances Travelled (Metres)

	Overtaking Vehicle	Oncoming Vehicle Travelling At:			
		80 km/h	100 km/h	120 km/h	140 km/h
50	200	224	281	337	393
60	243	244	306	367	428
80	392	322	403	483	564
90	470	356	444	533	622
100	639	456	569	683	797
I				I	

Overtaking Distance (Metres)
[Distance travelled by overtaking vehicle
and oncoming vehicle]
Oncoming Vehicle Travelling At:

	80 km/h	100 km/h	120 km/h	140 km/h	1 Rat i o
50	424	481	537	593	1 , 40
60	487	549	610	671	1 , 38
80	714	759	875	956	1,34
90	826	914	1003	1092	1,32
100	1095	t 208	1322	1436	1 . 31
	III I	i Ill			
Ratio 1	2.58	2.51	2.46	2.42	

1. This refers to the ratio of the longest overtaking distance to the shortest overtaking distance for each row or column.

Vehicle B: Daihatsu Charade

Speed Of Overtaken Vehicle (km/h)	Performance Of Overtaking Vehicle (km/h)	(Seconds)	Overtaking Time (seconds)	Final Speed (km/h)
50	50-100	12.1	10.2	92
60	60-90	7.4	10.6	103
80	80-120	16.6	14.5	115
90	90-120	13.6	15.1	123
100	100-130	18.1	17.4	129

	Distances Travelled (Metres)				
	Overtaking Vehicle	Oncoming Vehicle Travelling At: 80 km/h	100 km/h	120 km/h	140 km/h
50	202	227	283	340	397
60	237	236	294	353	412
80	392	322	403	483	564
90	448	336	419	503	587
100	553	387	483	580	677

	Overtaking Distance (Metres) [Distance travelled by overtaking vehicle and oncoming vehicle] Oncoming Vehicle Travelling At:				
	80 km/h	100 km/h	120 km/h	140 km/h	Ratio [1]
50	429	485	542	599	1.40
60	473	531	590	649	1.37
80	714	759	875	956	1.34
90	784	867	951	1035	1.32
100	940	1036	1133	1230	1.31
Ratio [1]	2.19	2.14	2.09	2.05	

1. This refers to the ratio of the longest overtaking distance to the shortest overtaking distance for each row or column.

Vehicle C: Toyato Corolla (Seca)

Speed Of Overtaken Vehicle (km/h)	Performance Of Overtaking Vehicle (km/h)	Performance Of Overtaking Vehicle (Seconds)	Overtaking Time (seconds)	Final Speed (km/h)
50	50-110	11.6	9.1	97
60	60-90	5.9	9.2	107
80	80-110	7.2	11.0	125
90	90-120	9.6	12.7	129
100	100-130	12.0	14.2	135

	Distances Travelled (Metres)				
	Overtaking Vehicle	Oncoming Vehicle Travelling At: 80 km/h	100 km/h	120 km/h	140 km/h
50	186	202	253	303	354
60	213	204	256	307	358
80	314	244	306	367	428
90	388	282	353	423	494
100	464	316	394	473	552

	Overtaking Distance (Metres) [Distance travelled by overtaking vehicle and oncoming vehicle] Oncoming Vehicle Travelling At:				
	80 km/h	100 km/h	120 km/h	140 km/h	Ratio [1]
50	388	439	489	540	1.39
60	417	469	520	571	1.37
80	558	620	681	742	1.33
90	670	741	811	882	1.32
100	780	858	937	1016	1.30
Ratio [1]	2.01	1.95	1.92	1.88	

1. This refers to the ratio of the longest overtaking distance to the shortest overtaking distance for each row or column.

Vehicle D: Holden Camira SLX

Speed Of Overtaken Vehicle (km/h)	Performance Of Overtaking Vehicle (km/h)	(Seconds)	Overtaking Time (seconds)	Final Speed (km/h)
50	50-110	8.9	8.0	104
60	60-120	9.4	8.2	112
80	80-130	9.6	9.8	131
90	90-130	8.0	10.3	138
100	100-130	7.9	11.5	143

	Distances Travelled (Metres)				
	Overtaking Vehicle	Oncoming Vehicle Travelling At:			
		80 km/h	100 km/h	120 km/h	140 km/h
50	171	178	222	267	311
60	197	182	228	273	319
80	288	218	272	327	381
90	328	229	286	333	400
100	389	256	319	383	447

	Overtaking Distance (Metres) [Distance travelled by overtaking vehicle and oncoming vehicle] Oncoming Vehicle Travelling At:				
	80 km/h	100 km/h	120 km/h	140 km/h	Ratio [1]
50	349	393	438	482	1.38
60	379	425	470	516	1.36
80	506	560	615	669	1.32
90	557	614	661	728	1.31
100	645	708	772	836	1.30
Ratio [1]	1.85	1.80	1.76	1.73	

1. This refers to the ratio of the longest overtaking distance to the shortest overtaking distance for each row or column.

Vehicle E: Holden Calais 5.0 High Performance

Speed Of Overtaken Vehicle (km/h)	Performance Of Overtaking Vehicle (km/h)	Performance Of Overtaking Vehicle (Seconds)	Overtaking Time (seconds)	Final Speed (km/h)
50	50-110	6.2	6.7	114
60	60-120	7.3	7.2	119
80	80-130	8.0	7.6	128
90	90-130	7.0	9.4	143
100	100-150	12.0	11.0	146

	Distances Travelled (Metres)				
	Overtaking Vehicle	Oncoming Vehicle Travelling At:			
		80 km/h	100 km/h	120 km/h	140 km/h
50	153	149	186	223	261
60	180	160	200	240	280
80	239	169	211	253	296
90	305	209	261	313	366
100	375	244	306	367	428

	Overtaking Distance (Metres) [Distance travelled by overtaking vehicle and oncoming vehicle] Oncoming Vehicle Travelling At:				
	80 km/h	100 km/h	120 km/h	140 km/h	Ratio [1]
50	302	339	376	414	1.37
60	340	380	420	460	1.35
80	408	450	492	535	1.31
90	514	566	618	671	1.31
100	619	681	742	803	1.30
Ratio [1]	2.05	2.01	1.97	1.94	

1. This refers to the ratio of the longest overtaking distance to the shortest overtaking distance for each row or column.

Vehicle F: Yamaha XJ 750 RH

Speed Of Overtaken Vehicle (km/h)	Performance Of Overtaking Vehicle (km/h)	Performance Of Overtaking Vehicle (Seconds)	Overtaking Time (seconds)	Final Speed (km/h)
50	0-120	6.0	3.5	120
60	60-160	8.0	4.5	116
80			4.8	140
90			4.8	150
100	120-160	5.0	6.4	151

	Distances Travelled (Metres)				
	Overtaking Vehicle	Oncoming Vehicle Travelling At:			
		80 km/h	100 km/h	120 km/h	140 km/h
50	84	78	97	117	136
60	110	100	125	150	175
80	147	107	133	160	187
90	160	107	133	160	187
100	223	142	177	213	249

	Overtaking Distance (Metres) [Distance travelled by overtaking vehicle and oncoming vehicle] Oncoming Vehicle Travelling At:				
	80 km/h	100 km/h	120 km/h	140 km/h	Ratio [1]
50	162	181	201	220	1.36
60	210	235	260	285	1.36
80	254	280	307	334	1.31
90	267	293	320	347	1.31
100	365	400	436	472	1.29
Ratio [1]	2.25	2.21	2.17	2.15	

1. This refers to the ratio of the longest overtaking distance to the shortest overtaking distance for each row or column.

7. Comments on Tables

For a design speed of 110 km/h, State road authorities commonly provide either the intermediate sight distance (twice the stopping distance or the design speed) of 420 metres, or the overtaking sight distance of 900 metres.

Thus there are situations possible where the overtaking distances required will exceed the sight distance provided.

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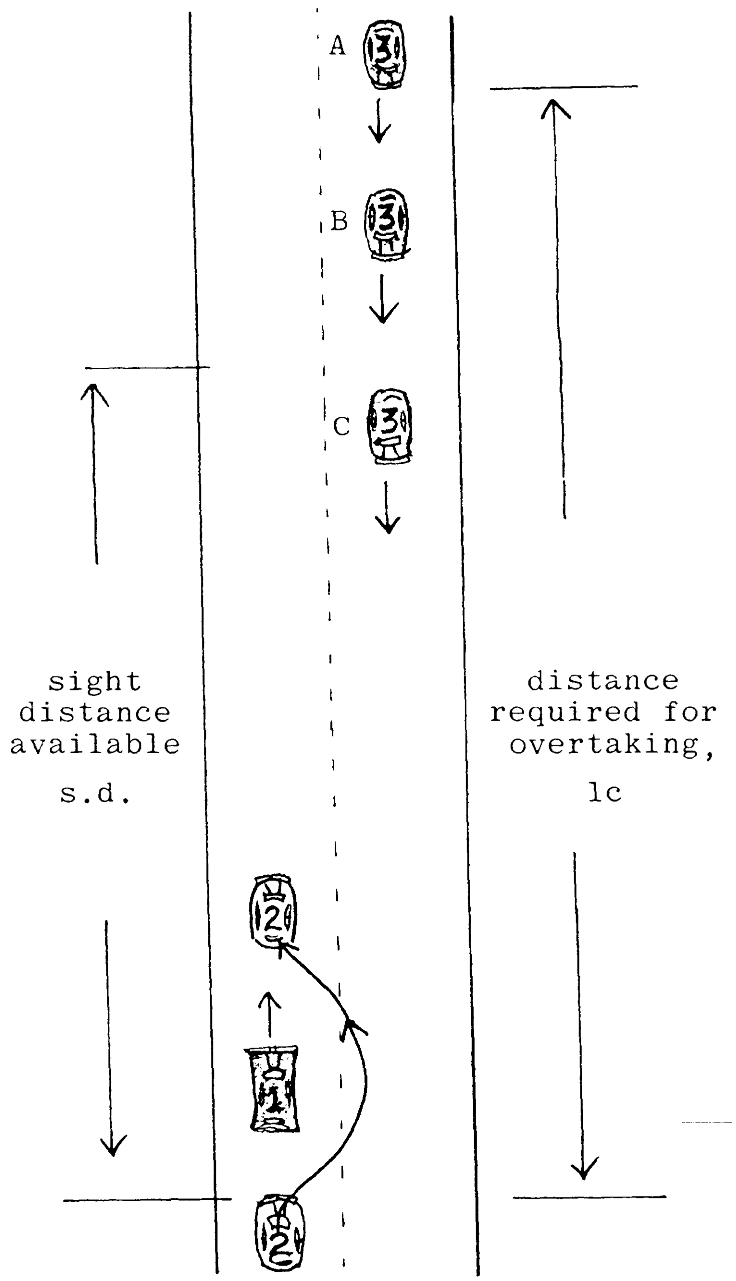
8. Discussion



Lc is the distance required for overtaking. This may be greater or less than the sight distance available.

(1) If the sight distance > distance required, then there are no problems.

(2) If the sight distance ~ distance required, then there are 3 possibilities-

A: Vehicle 2 can't see the oncoming car butit there is sufficient distance to overtake — it is safe to overtake.

B:	Vehicle 2 can't see the oncoming car, and there is insufficient distance to overtake	need to abort the manoeuvre
C:	Vehicle 2 can see the oncoming car, and there is insufficient distance to overtake	.'. shouldn't start to overtake.

Dilemmas arise in cases A and B.

In case A it doesn't matter, because the oncoming car is far enough away to allow safe overtaking, although the overtaking driver doesn't know this. The oncoming car will appear after the manoeuvre has been completed.

In case B the oncoming car will appear part way through the overtaking manoeuvre. Now, we know, by definition, that the manoeuvre can't be completed, so the overtaking car must abort the manoeuvre. Therefore as an absolute minimum, sufficient sight distance is needed for both vehicles to be able to brake to avoid a crash.

9. References

1. NAASRA (1976) · Policy for Geometric Design of Rural Roads.

2. Wheels (1985) · Performance figures from road tests.

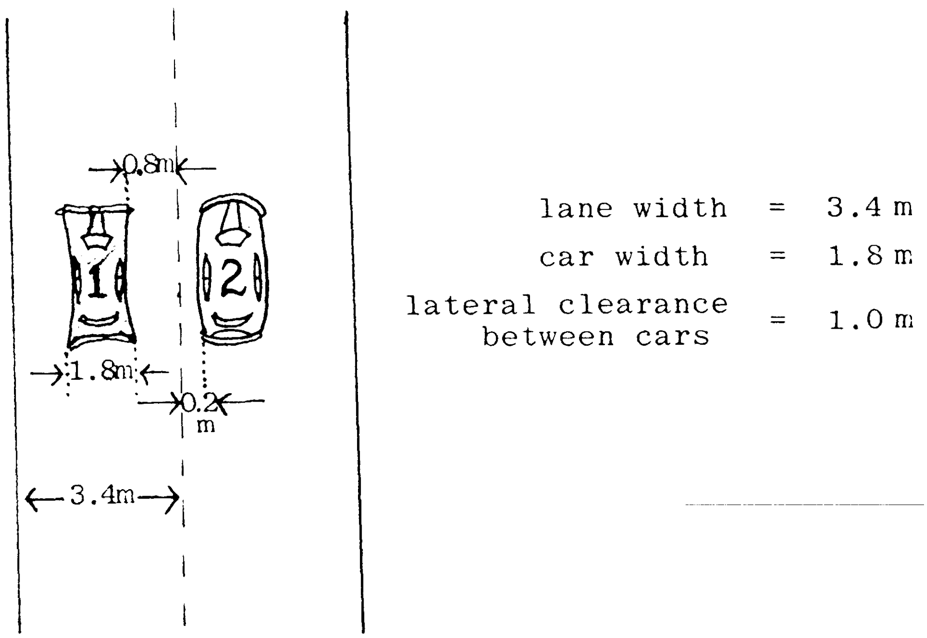
APPENDIX : DERIVATION OF De.

De is based on 4 distances.

1. Following distance
2. Lead distance (distance the <u>overtaking</u> vehicle must travel past the overtaken vehicle before regaining its side of the road.
3. Length of overtaken car
4. Length of overtak<u>ing</u> car

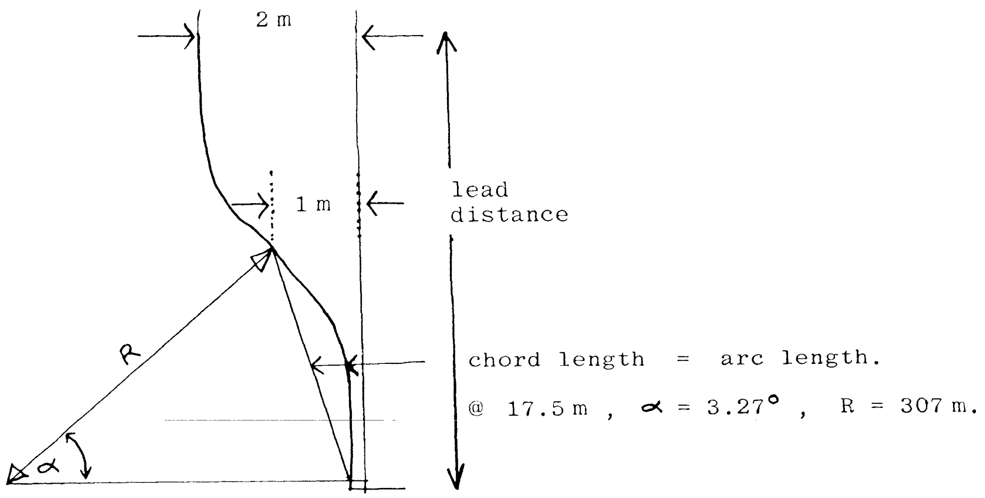
Assume that the following distance is a 1 second gap and both cars are 5 metres long.

Lead distance is calculated from below.



Car 2 must "deflect" 2.0 metres to the left to regain its side of road.

Thus the return manoeuvre for the car should look like this. (See over)



This then is two curves each of radius R.

By trial and error, a chord length of 17.5 m gives a reasonable value.

$$e + f = \frac{v^2}{127\,R}$$

f = sideways coefficient of friction

e = crossfall = - 0.03

v = 110 km/h

$$f = \frac{110^2}{127 \times 307} + 0.03$$

$$= 0.34$$ not unreasonable

Thus the lead distance is 2 x 17.5 metres, i.e. 35 metres.

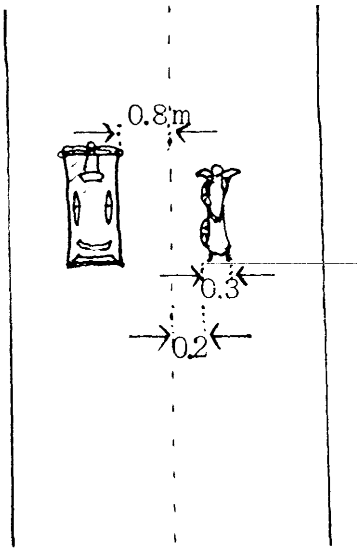
Thus the overtaking car travels an extra	59	metres at	50 km/h
	62		60 km/h
	67		80
	70		90
	73		100

Thus use 60 metres for 50, 60 km/h

70 metres for 80 to 100 km/h.

De for motorcycles

The lead distance for motorbikes is based on'



The motorbike needs to deflect only 0.5 metres to the left to regain its side of the road.

Thus the lead distance can be 10 metres.

The de for motorbikes is based on

following distance	1 sec
lead distance	10 m.
car length	5 m.
bike length	1.5 m.

Thus the bike travels an extra	30 metres at	50 km/h
	33	60
	39	80
	41.5	90
	44	100

Therefore use	35 metres at	50, 60 km/h
	40	80, 90
	45	100.