1. Introduction

This document is intended to give guidelines which could be incorporated into district plans for the control of the location of vehicle driveways on the road network.

These guidelines are for all road controlling authorities covering rural, small urban and large urban areas. Some of the guidelines given, e.g. typical traffic volumes, low and high volume driveway definitions, may not be fully applicable to specific authorities. These can be amended locally for inclusion in district plans.

Analysis of injury accidents for all New Zealand shows approximately 10% of urban accidents and 6% of rural accidents occur at driveways. About half the accidents at driveways involve collisions between vehicles turning into a driveway, mainly right turning vehicles, and through traffic on the frontage road. Collisions between vehicles exiting from a driveway and through traffic represent about 20% of the accidents at driveways and collisions between vehicles manoeuvring (reversing) at a driveway and through traffic about 10%. One of the contributing factors to these accidents is inadequate visibility along the frontage road from and of the driveways. This document gives guidelines for visibility requirements for various driveway and frontage road classifications.

Driveways should be located, designed and constructed so that vehicles can enter or leave the driveway in a safe and convenient manner without causing undue adverse effect on the safe and efficient operation of the road network.

The potential for adverse effects depends on:

- the number of movements to or from the driveway;
- the traffic functions and traffic flow on the frontage road;
- the number and spacing of driveways along the road.

Generally the potential for adverse effects increases with increasing numbers of movements to or from driveways and higher traffic flows on the frontage road.

2. Summary

Driveways should be located, designed and constructed so that vehicles can enter or leave the driveway in a safe and convenient manner without causing any undue adverse effect on the safe and efficient operation of the road network.

The ideal visibility criteria would allow vehicles manoeuvring to or from a driveway to leave or enter the traffic flow on the frontage road without disrupting that flow. The minimum acceptable safety criteria is for vehicles on the frontage road to react to, and if necessary stop before colliding with, a vehicle manoeuvring at a driveway. This minimum criteria would allow sufficient distance for the frontage road traffic to avoid a collision if, for instance, a manoeuvring vehicle stalled on the roadway opposite a driveway. The minimum criteria do not imply the frontage road traffic should have to stop, only that it can if necessary. It is the obligation of traffic turning to or from a driveway to select gaps in the through traffic adequate for their manoeuvre.

The recommendations in this document are the minimum requirements for various combinations of driveway classifications, frontage road classifications and operating speeds. Design principles for these are given in Section 3.

The visibility requirement is for minimum lines of clear sight established from the sight distance and its measurement along the road.

Table 1, Section 2.1 lists the recommended minimum sight distances. These distances are measured along the centre of the appropriate lane to establish points C and D in Figures 1 and 2, Section 2.2. The resulting recommended minimum lines of clear sight are shown in Figure 2, Section 2.2.

Driveways with lines of clear sight greater than these minimum recommendations are desirable.

2.1 Sight distances

Table 1 lists the recommended minimum sight distances for various combinations of driveway classifications, frontage road classifications and operating speeds.

Section 3.2 outlines the design principles and logic for the sight distances recommended.

Table 1: Sight distances

These sight distances are the distances to be measured along the centre of the appropriate lane to establish points C and D in Figures 1 and 2, Section 2.2.

Driveway classifications	Operating speed (km/h)*	Minimum sight distance (metres)** Frontage road classification		
		Local	Collector	Arterial
Low volume	40	30	35	70
Up to 200 vehicle manoeuvres per day	50	40	45	90
	60	55	65	115
	70	85	85	140
	80	105	105	175
	90	130	130	210
	100	160	160	250
	110	190	190	290
	120	230	230	330
High volume	40	30	70	70
More than 200 vehicle manoeuvres per day	50	40	90	90
	60	55	115	115
	70	85	140	140
	80	105	175	175
	90	130	210	210
	100	160	250	250
	110	190	290	290
	120	230	330	330

* Operating speed = 85th percentile speed on frontage road. This can be taken as the speed limit plus 15% if survey data are not available.

** Distances are based on the Approach Sight Distance and Safe Intersection Sight Distance tables in NAASRA, *Intersections at Grade* [1] assuming reaction times of 1.5 seconds on local roads with operating speeds up to 60 km/h and 2.0 seconds for all other speeds and all collector and arterial roads.

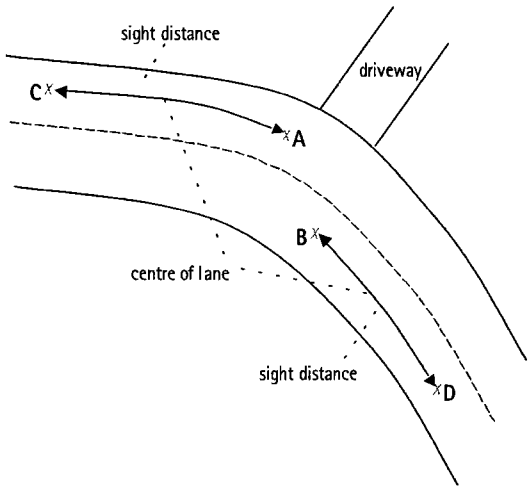
2.2 Visibility measurements

There are two aspects to visibility measurements. One is the sight distance measurement and the other is the lines of clear visibility. These are summarised below with the design logic for the recommendations in Section 3.3.

2.2.1 Sight distance measurement

The sight distances recommended in Table 1 are the stopping distances for vehicles on the frontage road. They should be measured along the centre of the appropriate lane as indicated by the lines AC and BD in Figure 1. For practical purposes, A and B can be taken as opposite the centre of the driveway.

Figure 1: Sight distance measurement



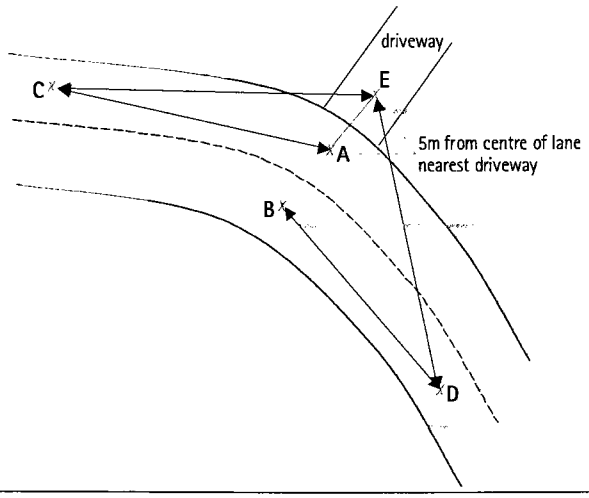
2.2.2 Lines of clear sight

There should be lines of clear sight from driver's eye height to driver's eye height, i.e. 1.15 metres above ground level, along the lines detailed below and shown in Figure 2.

- Lines AC and BD - All driveways, all roads.
- Lines EC and ED (no permanent obstructions, exclude parked vehicles which may obstruct these sight lines occasionally)
  - High volume driveway, collector road.
  - Low volume driveway, arterial road in urban area.
- Lines EC and ED (no obstructions, parked vehicles not excluded)
  - Low volume driveway, arterial road ~~in rural area~~.
  - High volume driveway, arterial road.

Figure 2: Lines of clear sight

Points A, B, C and D are as shown in Figure 1, with points C and D established by measuring the sight distance from Table 1 along the centre of the appropriate lane from points A and B.



3. Design principles for visibility at driveways

3.1 General

Driveways provide the link between land use activity and the road network. Traffic manoeuvring to or from driveways can potentially conflict with the traffic flow on the frontage road and may therefore affect the safe and efficient operation of the road. Analysis of the 1987-91 Ministry of Transport accident records has shown approximately 10% of urban accidents and 6% of rural accidents occurred at driveways.

Driveways should be located, designed and constructed so that vehicles can enter or leave the driveway in a safe and convenient manner without causing any undue adverse effect on the safe and efficient operation of the road network.

The potential for adverse effects depends on:

- the number of movements to or from the driveway;
- the traffic functions and traffic flow on the frontage road;
- the number and spacing of driveways along the road.

Generally the potential for adverse effects increases with increasing numbers of movements to or from driveways and higher traffic flows on the frontage road.

In general the design of driveways should:

(a) Achieve sufficient visibility between vehicles on the frontage road and vehicles using the driveway.

(b) Cater for the types of vehicle using the driveway and in particular allow vehicles to turn left to or from the driveway without crossing the road centre-line.

(c) Avoid confusion between vehicle manoeuvres at other driveways or intersections.

(d) Provide adequate visibility between vehicles using the driveway and pedestrians.

3.2 Sight distances

3.2.1 General

The sight distance required at a driveway depends on the traffic speeds and function of the frontage road and on the expectancy of driveway manoeuvres.

Whatever sight distance is provided, it is the obligation of traffic turning to or from a driveway to select gaps in the through traffic adequate for their proposed manoeuvre. The minimum criteria for safety is that the through traffic on the frontage road can, if necessary, stop in time to avoid a collision with a vehicle turning to or from a driveway that may have misjudged gap selection or stalled during its manoeuvre.

The ideal criteria is for vehicles manoeuvring to or from the driveway to leave or enter the traffic flow on the frontage road without disrupting that flow. The minimum acceptable criteria is for vehicles on the frontage road to observe a vehicle manoeuvring at the driveway and react and if necessary stop before entering the conflict area.

These criteria are equivalent to the Approach Sight Distance (ASD) and the Entering Sight Distance (ESD) as defined in Clauses 5.2.2 and 5.2.3 of NAASRA, *Intersections at Grade* [1]. An intermediate

criteria is the Safe Intersection Sight Distance (SISD) defined in Clause 5.2.4 of the same publication. This is the ASD plus the distance a vehicle would travel in three seconds. The three seconds is the time allowed for a vehicle to observe a potential conflict developing. The NAASRA, *Intersections at Grade* [1] definitions for these sight distances are included in the Definitions in this document.

Initial project work for this guideline began by investigating the distances required on arterial routes that would allow vehicles to enter the traffic stream with no more than a 25% speed disruption to the traffic stream. Limited surveys were undertaken in Christchurch to find the in-service acceleration rates for single unit trucks and semi-trailers. Following these surveys entering sight distances for the vehicles were calculated. For heavy vehicles entering traffic streams travelling at 100 km/h a distance of 1,100 metres was calculated. These distances, though desirable, were considered impractical to impose as sight distance requirements for driveways. This project work recommended intersection sight distances from NAASRA, *Intersections at Grade* [1] be adopted for driveways. These were considered more practicable than the calculated distances noted above. It also recommended for driveways on arterials with operating speeds higher than 70 km/h that minimum roadway and shoulder widths be set.

Tables for intersection sight distances (ASD, ESD and SISD) in NAASRA, *Intersections at Grade* [1] assume driver reaction times from 1.5 seconds to 2.5 seconds. The lower value for restricted urban situations with high expectation of flow interruptions and the higher value for rural unalerted driving conditions. The ESD are based on the entering requirements for passenger cars.

3.2.2 Local roads

The main function of local roads is to serve the adjacent properties rather than to provide for through traffic. Drivers on these roads should be aware of the potential for conflicting manoeuvres at driveways, particularly in urban areas.

The minimum safe visibility requirement is therefore that drivers on the road seeing a vehicle in the conflict zone opposite a driveway can if necessary stop before reaching the conflict point. This is equivalent to the Approach Site Distance (ASD) in NAASRA, *Intersections at Grade* [1].

Reaction times of 1.5 seconds for drivers on local roads with operating speeds up to 60 km/h and 2.0 seconds for speeds over 60 km/h are considered appropriate (assuming the operating speed gives some indication of the driver's awareness of the potential for conflicting manoeuvres).

The minimum sight distances given in Table 1 for local roads is therefore the ASD from NAASRA, *Intersections at Grade* [1] with the above reaction times.

3.2.3 Collector roads

Although these roads often serve a significant number of adjacent properties, their main function is to distribute through traffic between local and arterial roads.

Users of most low volume driveways are probably regular users aware of the main traffic function of the road. It can be assumed that they take account of this and take extra care to indicate and observe the through traffic when they turn to or from the driveway. The safe visibility requirements for these low volume driveways can therefore be as for local roads except a driver reaction time of 2.0 seconds for all operating speeds is more appropriate. Drivers of the through traffic would not be as aware of potential conflicts as they would on local roads.

At high volume driveways on collector roads, the users may not be as aware of the main traffic function of the road. They may not therefore take as much care to indicate or observe the through traffic when turning to or from the driveway. Time for the through traffic to observe and react to potential conflicts developing is therefore required in addition to the sight distance requirements for local roads. The minimum visibility requirement is therefore equivalent to the Safe Intersection Sight Distance (SISD) in NAASRA, *Intersections at Grade* [1].

3.2.4 Arterial roads

The dominant function of arterial roads is to carry through traffic from one major area of activity to another. Drivers on these roads are therefore unlikely to expect many driveway manoeuvre type conflicts. The minimum visibility requirement at driveways therefore must allow time for these drivers to observe and react to potential conflicts and then if necessary stop before reaching the conflict point. This is equivalent to the Safe Intersection Sight Distance (SISD) from NAASRA, *Intersections at Grade* [1]. Driveways onto arterial roads will create conflicts between through traffic and driveway manoeuvres whatever visibility distance is provided. In particular right turn movements into a driveway will disrupt the through traffic. They are also the most common movement in accidents at driveways. High volume driveways on arterial roads should therefore be banned or strongly discouraged particularly on high volume rural arterials.

3.3 Visibility measurements

3.3.1 Sight distance measurement

The sight distances recommended (see Table 1, Section 2.1) are the stopping distances for vehicles on the frontage road to see, react to and stop before colliding with vehicles manoeuvring at driveways. They are therefore measured along the travel path (centre of lane) of the through traffic. This is shown by the lines AC and BD in Figure 1, Section 2.2.

3.3.2 Lines of clear sight

Visibility requirements at driveways are for clear lines of sight between vehicles on the frontage road and vehicles using the driveway. The lines of clear sight can therefore be measured from driver eye height to driver eye height, i.e. 1.15 metres above ground level. If the driveway is expected to be regularly used by heavy vehicles, then the lines of clear sight should also allow for the different driver's eye height between these and light vehicles.

Ideally lines of sight should be between vehicles waiting to leave a driveway and vehicles on the frontage road. This is impractical, however, on local roads and on many collector and arterial roads, that have a high parking demand near driveways. The ideal lines of clear sight would require unreasonable prohibition of parking. The majority of accidents at driveways involve vehicles turning into rather than from driveways. The minimum acceptable lines of clear sight are therefore between vehicles travelling on the frontage road and vehicles turning into a driveway.

The acceptable lines of sight for driveways are dependent on the functions of the driveway and the frontage road and the probability of conflicts. General discussion on the functions and operational aspects of driveways fronting local, collector and arterial roads are in Sections 3.2.1 to 3.2.4.

Based on these the following lines of sight are recommended:

Local roads

For all driveways on local roads there should be lines of clear sight between vehicles at or within the sight distance of the driveway and vehicles on the road opposite the driveway.

This is shown by the lines AC and BD in Figure 2, Section 2.2.

Collector roads

For low volume driveways the required lines of clear sight are as for driveways on local roads, i.e. lines AC and BD in Figure 2, Section 2.2.

For high volume driveways there should in addition to the above be clear visibility between vehicles waiting to leave the driveway and vehicles on the frontage road. That is between a point five metres into the driveway from the centre of the lane nearest the driveway to a vehicle at the sight distance along the road from the driveway. The five metre offset is the minimum recommended distance to allow intervisibility between drivers and allow adequate clearance from the front of the vehicle at the driveway and the edge of the traffic lane. The additional lines of clear sight are shown by the lines EC and ED in Figure 2, Section 2.2.

If parking is in demand near these driveways, then it may be impractical to fully insist on these lines of clear sight. It is accepted therefore that for these driveways parked vehicles may obstruct these lines of sight but there should be no permanent obstructions to these sight lines.

Arterial roads

For low volume driveways on arterial roads in urban areas the same conditions as for high volume driveways on collector roads are recommended.

For low volume driveways in rural areas and for all high volume driveways on arterial roads even parked vehicles should not obstruct the required lines of sight between vehicles at the driveway and vehicles on the frontage road. The recommended lines of clear sight are therefore as shown by lines EC and ED in Figure 2, Section 2.2 with no exemption for parked vehicles.