COFFS HARBOUR CITY COUNCIL

DEVELOPMENT SPECIFICATION
DESIGN

0041 Geometric road layout

Version 1 01 January 2009

0041 GEOMETRIC ROAD LAYOUT

1 SCOPE AND GENERAL

1.1 SCOPE

This worksection sets out a method for the geometric layout design of Council's roadworks, using principles of street design to ensure safety, improved amenity and to reduce pedestrian/vehicular conflicts.

1.2 OBJECTIVE

A road system shall be designed to achieve the following aims:

- Provide convenient and safe access for pedestrians, vehicles and cyclists.
- Provide appropriate access for buses, emergency and service vehicles.
- Provide for a quality road network that minimises maintenance costs.
- Provide a convenient way for public utilities.
- Provide an opportunity for street landscaping.
- Provide convenient parking.
- Have appropriate regard for the climate, geology and topography of the area.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this worksection are:

Worksections

0021 Site regrading

0042 Pavement

0043 Subsurface drainage

0044 Pathways and cycleways

0160 Quality (Design)

0061 Bridges and other structures

0074 Stormwater drainage (Design)

0075 Control of erosion and stormwater management

Standards

AS 1348	Roads and traffic engineering
AS 1348.1	Glossary of terms, road design and construction
AS 2890	Parking facilities
AS 2890.1	Off-street car parking
SAA HB 69.14	Guide to traffic engineering practice—Bicycles
AS/NZS 3845	Road safety barrier systems

Other publications

AUSTROADS

Rural road design—guide to the geometric design of rural roads

AP-G69 Urban road design - Guide to the geometric design of major urban roads

AP-G11 Guide to traffic engineering practice:

PART 5:	Intersections at grade
PART 6:	Roundabouts
PART 10:	Local area traffic management
PART 13:	Pedestrians
PART 14:	Bicycles

Design vehicles and turning templates

Design Single unit Truck/Bus template.

Commonwealth Department of Housing and Regional Development—1995: Australian Model Code for Residential Development. (AMCORD). A National Resource Document for Residential Development

Institute of Public Works Engineering Australia

Qld Division—1993 Design Guidelines for Subdivisional Streetworks

1.4 BIBLIOGRAPHY

The following documents provide additional information:

Workgroup

11 *Construction - Roadways*

Other publications

Council's Development Control Plans (DCPs)

Road Design Guides of all State Road Authorities

Road Planning Guides of all State Road Authorities

1.5 DEFINITIONS

For the purpose of this worksection the definitions of terms used to define the components of the road reserve shall be in accordance with AS 1348.1 and Australian Model Code for Residential Development (AMCORD).

The words 'street' and 'road' are interchangeable throughout all parts of this worksection.

- Carriageway: That portion of the road or bridge devoted particularly to the use of vehicles, inclusive of shoulders and auxiliary lanes.
- Footpath: The paved section of a pathway.
- Pathway: A public way reserved for the movement of pedestrians and of manually propelled vehicles (see verge).
- Pavement: That portion of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic.
- Shoulder: The portion of the carriageway beyond the traffic lanes and contiguous and flush with the surface of the pavement.
- Verge: That part of the road reserve between the carriageway and the road reserve boundary. It may accommodate public utilities, footpaths, stormwater flows, street lighting poles and plantings.

1.6 CONSULTATION

Council and other Authorities

Designers shall consult with the Council and other relevant authorities during the preparation of design. Designers shall, in addition to the requirements of this worksection ascertain the specific requirements of these authorities as they relate to the designs.

Public consultation

Public consultation on designs shall be provided where such action is required by Council policy.

Utilities service plans

The Designer shall obtain service plans from all relevant utilities and other organisations whose services exist within the area of the proposed development. These services shall be plotted on the relevant drawings including the plan and cross-sectional views.

1.7 PLANNING CONCEPTS

Road hierarchy

In new areas, as distinct from established areas with a pre-existing road pattern, each class of route should reflect its role in the road hierarchy by its visual appearance and physical design. Routes should differ in alignment and design according to the volume of traffic they are intended to carry, the desirable traffic speed, and other relevant factors.

Conformance with Development Control Plan

The road pattern and width shall conform with any relevant Development Control Plan (DCP). In areas not covered by these plans, the pattern and width(s) shall be determined by Council.

Legibility

The road network shall have clear legibility.

The following factors assist in achieving clear legibility:

- Differentiation: The road network should reinforce legibility by providing sufficient differentiation between the road functions (see road classifications in **Urban design criteria**).
- Landmark features: Distinct landmark features such as watercourses, mature vegetation or ridge lines should be emphasised within the structural layout so as to enhance the legibility.
- Introduced features: Whilst legibility can be enhanced by introduced physical features such as pavement and lighting details, the road network should by its inherent design and functional distinction provide the necessary legibility.

Salinity prevention

The following constraints apply to the design of roads through or adjacent to land known to be salt affected:

- Consultation: Consultation with the relevant land and water resource authority shall be undertaken.
- Early planning: Early planning shall consider avoiding detrimental interference with land known to be salt affected. Adjustments in horizontal and vertical line shall be considered to avoid recharge of subsurface water within or adjacent to the road reserve.
- Landscaping: Appropriate native deep-rooted species should be selected for plantings in association with road reserve works. Plantations should be of sufficient size and density, multiple row belts and relatively close spacings are recommended, to be effective in their desired role of lowering the groundwater table.

Integrated design principles

All relevant design principles shall be integrated in the development of the road network. A careful balance is required between maximising amenity, safety and convenience considerations and those related to the drivers' perception of driving practice.

Acceptable vehicle speed

A fundamental requirement of the design process is to determine the vehicle speed deemed acceptable for the particular section of road.

Intersection turning movements

The maximum number of turning movements at intersections or junctions that a driver should be required to undertake to reach a particular address within the development should be minimised.

1.8 DRAWING REQUIREMENTS

Reduction ratios

The reduction ratios for plans shall be as follows:

- All plans for council works 1:500, however, rural plans may be 1:1000
- Longitudinal Sections 1:500 Horizontal and 1:100 Vertical
- Cross Sections 1:100 Natural

Drawing sheets

The scope and sequence of drawing sheets shall comply with Annexure B of 0160 *Quality (Design).*

Separate sheets should be provided for:

- Cover sheets
- Plan views
- Longitudinal sections
- Cross sections
- Structural details
- Standard drawings

Drawing presentation

Drawings form part of the permanent record and are legal documents. Terminology should be kept in 'plain English' where possible, enabling drawings to be easily read and understood by those involved in the construction of the Works.

Drawings shall be presented on A1 sheets unless otherwise authorised. They shall be clear and legible and prepared in consistent lettering and style. All drawings shall be clearly referenced with notations and tables as appropriate.

Logitudinal Sections 1:500 Horizontal and 1:100 Vertical

Compliance

The scope and sequence of drawing sheets shall be consistent with the example provided in Annexure B of 0160 *Quality (Design).*

Certification

Drawings shall bear the signature of the Council Designer or Council's Consultant and shall where required by Council be certified as complying with the appropriate design worksections.

The certificate shall be in the format detailed in 0160 *Quality (Design).*

2 URBAN DESIGN CRITERIA

2.1 HIERARCHICAL ROAD NETWORK

A hierarchical road network is essential to maximise road safety, residential amenity and legibility. Each class of road in the network serves a distinct set of functions and is designed accordingly.

The design should convey to motorists the predominant function of the road. A typical hierarchy is shown in Figure 2.1.

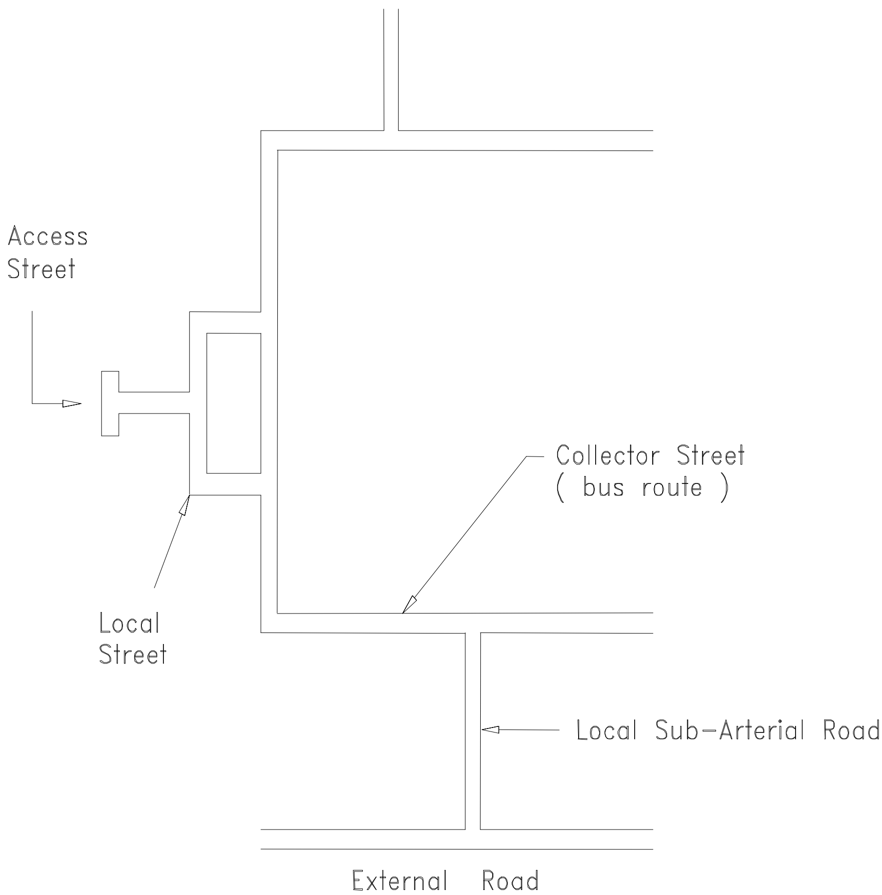


Figure 2.1 Typical road hierarchy

2.2 CLASSIFICATION

Terminology

The terminology used to describe each class of road varies from state to state. This worksection uses the classes common to the majority of states. However, the four distinct levels of roads are Access Street, Local Street, Collector Street and Local Sub-Arterial Road.

The generally accepted road hierarchy classes adopted is given in Table 2.1.

Table 2.1 Australian road hierarchy classes

State	1 (Lowest Order)	2	3	4 (Highest Order)
NSW	Access Street	Local Street	Collector Street	Local Sub-Arterial Road
QLD	Access Place	Access Street	Collector Street	Trunk Collector Street
SA	Access Street	Local Street	Collector Street	Local Distributor Road
TAS	Access Place	Access Street	Minor Collector Road	Major Collector Road
VIC	Access Street	Local Street	Collector Street	Local Distributor Road
WA	Access Place	Access Way	Local Distributor	District Distributor (B)

Access street

Access street is the lowest order road and has as its primary function residential space. Amenity features of access streets facilitate pedestrian and cycle movements, and vehicular traffic is subservient, in terms of speed and volume, to amenity, pedestrians and cyclists.

Figure 2.2 Typical access street

Local street

Local street is the next level road. As a local residential street, it should provide a balance between the status of that street in terms of its access and residential amenity functions. Resident safety and amenity are dominant but to a lesser degree than access streets. A typical local street is shown in Fig 2.3.

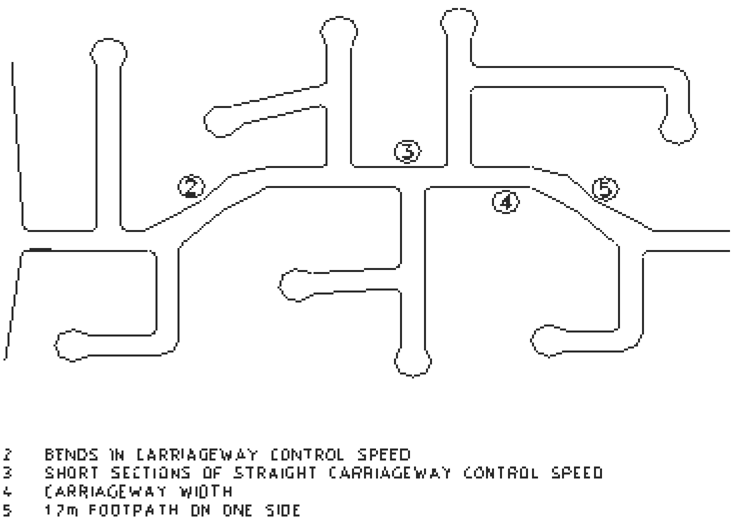


Figure 2.3 Typical local street

Collector street

Collector street is the second highest order road. It has a residential function but also carries higher volumes of traffic collected from lower order streets.

A reasonable level of residential amenity and safety is maintained by restricting traffic volumes and speeds, however, amenity and resident safety do not have the same priority as access or local streets. A typical collector street is shown Fig 2.4.

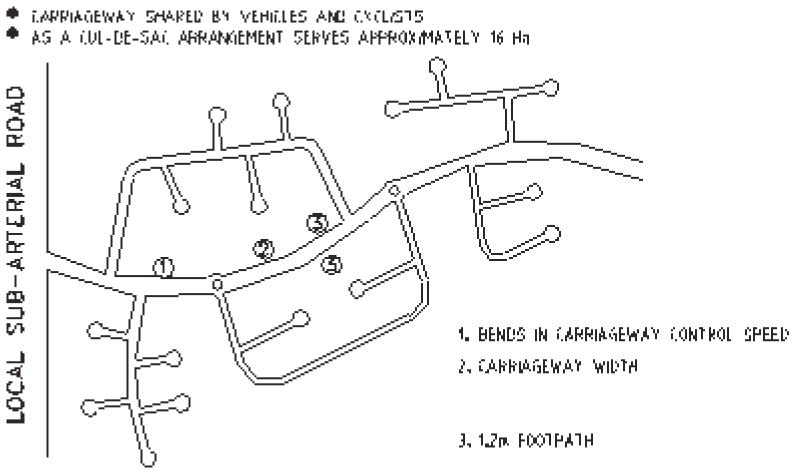


Figure 2.4 Collector street

Local sub-arterial road

Local sub-arterial road is the highest order road within a residential development and should have as its main function the convenient and safe distribution of traffic generated by the development.

Direct access should not be provided for single dwelling allotments but access can be provided to multi-unit developments and non-residential land uses.

The local sub-arterial road should serve only the development and should not attract through traffic. Typical layout of local Sub-arterial road is shown in Fig 2.5.

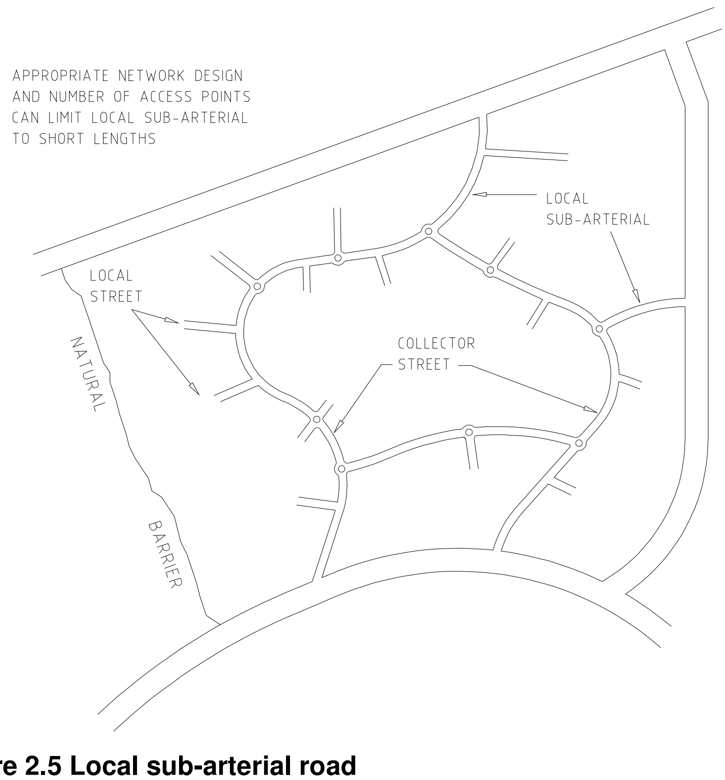


Figure 2.5 Local sub-arterial road

2.3 ROAD NETWORK

Routing

The internal road system should not provide through routes that are more convenient than the external road network.

The external road network should be designed and located to provide routes that are more convenient for potential through traffic within the network.

Major roads should be provided at intervals of no more than 1.5km and should be complete and of adequate capacity to accommodate through network movements.

Road layout is to accommodate the terrain and should limit earthworks, suitable access grades to lots should also be accommodated.

Road links

No road should link with another road that is more than two levels higher or lower in the hierarchy. In exceptional circumstances roads may link with others that are more than two levels apart.

No access street or local street shall have access to an access-controlled arterial road.

Traffic volumes and speeds

Traffic volumes and speeds on any road shall be compatible with the residential functions of that road.

Transport provisions

The road layout should conform to the requirements of the external road network and satisfy the transport provisions of an outline development plan.

Design features

The design features of each type of road should convey to the driver its primary functions and encourage appropriate driver behaviour.

Travel time

The time required for drivers to travel on all streets within the development should be minimised.

Internal road connections

Connections between internal roads should be T-junctions.

Access street

The maximum length of an access street should ensure its status as a residential place is retained. Its speed and volume will enable the integration of pedestrian, bicycle and vehicular movements. Residential convenience should not be impaired as a result of speed restraints.

Local sub-arterial

The length of local sub-arterial within a development should be minimised.

Pedestrian or bicycle network

Where access streets form part of a pedestrian or bicycle network, access links should provide suitable connectivity with adjoining access streets or open space systems so as to ensure such pedestrian and bicycle network are functionally efficient. Concrete footpaths to be provided on one side of all local and access streets, on both sides of collector roads.

2.4 DESIGN SPEED

State road authority guidelines

Design speed is generally used as the basic parameter in the Worksection of road design. Some State Road Authorities base their current design standards on a travel speed rather than a design speed. Travel speed identifies a speed/horizontal radius relationship.

This approach is intended for roads of a minimum travel speed of 60 km/h. In difficult topography, the design speed may be reduced. Vehicular speeds are also limited by road intersections as well as changes in horizontal and vertical alignment.

The following design speeds should be adopted:

- Access Street: 25 km/h
- Local Street: 40 km/h
- Collector Street: 60 km/h
- Local Sub-Arterial Road: 60/80 km/h

Low speeds
Adoption of a low design speed discourages speeding. However, where vertical or horizontal curves of low design speed are located in otherwise high-speed sections (tangents) the result is a potentially dangerous section of road. It should be recognised that in low design speed roads, operating speeds will tend to be in excess of arbitrary speed standards.

Hazardous features
Potentially hazardous features shall be made visible to the driver. Traffic engineering measures that help a driver avoid errors of judgement should be adopted.

Road safety barriers
Road safety barriers shall be assessed and designed in accordance with AS/NZS 3845.

2.5 LONGITUDINAL GRADIENT

General
A general minimum gradient of 0. 7% should be adopted. Where underground drainage with gully pits or other special works are used it is preferable to allow near level grades rather than reverting to the unsatisfactory device of introducing artificial undulations. Variable crossfall may be necessary to produce the required grade in the gutter.

Maximum recommended grades are shown in Table 2.1.

Intersections
Longitudinal grade of the minor street on the approach to an intersection should not exceed 4%, the actual gradient being dependent on the type of terrain. Design of the road alignment and the grades used are interrelated. A steep grade on a minor side street is undesirable if vehicles have to stand waiting for traffic in the major road.

Cul-de-sacs
Turning circles in cul-de-sacs on steep grades should have grades less than 5 %.

Table 2.1 Recommended maximum gradients

Gradient	Local access road %	Collector road %	Local sub-arterial road %	Rural road %
Desirable maximum*	16	12	12	16
Absolute maximum*	20	12	12	20
* Maximum length 150 m on straight alignment.				

Note – Grades >16% and <20% to be constructed in Reinforced Concrete to prevent shoving

2.6 HORIZONTAL CURVES AND TANGENT LENGTHS

Speed/radius relation
The horizontal alignment of a road is normally a series of tangents (straights) and curves connected by transition curves.

The choice of the horizontal alignment is normally determined from the design speeds for a particular street within the road hierarchy (see **Design Speed**).

Designers should ensure that, for a given design speed, the minimum radius of curvature utilised is such that drivers can safely negotiate the curve.

Curves that progressively tighten (e.g., parabolic curves) produce an uncomfortable sense of disorientation and alarm.

Sudden reverse curves that drivers cannot anticipate also have a potential to cause similar conditions.

Speed restriction
Where speed restriction is provided by curves in a street the relationship between the radius of the curve and the desired vehicle speed is given in Table 2.2(A).

Appropriate lengths for tangents between speed restrictions, which may be curves, narrow sections or other obstructions, is given in Table 2.2(B).

Sight distance on curves is determined by formula, values of which are tabulated in State Road Authorities' Road Design Guides.

Table 2.2(A) Speed/radius relationship

Desired vehicle speed (km/h)	Curve Radii (m) on road centreline	
	Curvilinear alignment (no tangents)	Isolated curve alignment (with tangent sections)
20 25 30	15 20 30	10 15 20
35 40 45	50 90 105	30 40 50
50 55 60	120 140 160	60 70 80
NOTE: Tables 2.2(A) is derived from AMCORD.		

Table 2.2(B) Speed/tangent length relationship

Desired vehicle speed in curve Km/h	Maximum advisable tangent length (m) between curves or restrictions appropriate to a selected design speed.						
	Design speed km/h						
	25	**30**	**35**	**40**	**45**	**50**	**60**
20 or less 25 30	40 — —	75 45 —	100 75 45	120 100 80	140 120 100	155 140 120	180 165 150
35 40 45	— — —	— — —	— — —	50 — —	80 55 —	100 80 60	135 120 105
NOTE: Tables 2.2(B) is derived from AMCORD.							

2.7 VERTICAL CURVES

Criteria

Vertical curves should be simple parabolas and should be used on all changes of grade exceeding 1%. The desirable minimum design speed is 60 km/h. The length of the crest vertical curve for stopping sight distance should conform with State Road Authorities' Road Design Guides.

These standards are based on 1.5 second's reaction time that provides a reasonable safety margin for urban conditions, where drivers' reaction time is usually considered to be lower than in rural conditions.

Riding comfort

For adequate riding comfort, lengths of sag vertical curves should conform with the State Road Authorities' Road Design Guides. As residential roads are usually lit at night, the criterion for designing sag vertical curves is a vertical acceleration of 0.05g for desirable riding comfort, and 0.10g for minimum riding comfort.

The minimum lengths for sag vertical curves are shown in Table 2.3.

Table 2.3 Minimum length of sag vertical curves

Curve	Local access road (m)	Collector road (m)	Local sub-arterial road (m)
Minimum vertical curve	25	35	50
Absolute minimum vertical curve (to be applied at road junctions only)	6	12	20

Side road junctions

Junctions of roads should be located at a safe distance from a crest, determined by visibility from the side road. Location of a side road at a crest should only occur if there is no suitable alternative.

Sag curves

Drainage poses a practical limit to the length of sag curves. A maximum length (in metres) of 15 times the algebraic sum of the intersecting vertical grades (expressed as a percentage) is suggested. This will avoid water ponding in excessively flat sections of kerb and gutter.

A minimum grade of 0.5% should be maintained in the kerb and gutter. This may require some warping of road cross sections at sag points.

Horizontal and vertical alignment coordination

The three dimensional coordination of the horizontal and vertical alignment of a road should aim to improve traffic safety and aesthetics. Economic considerations often require a compromise with aesthetic considerations.

The following principles should be applied:

- The design speed of the road in both horizontal and vertical planes should be of the same order.
- Combined horizontal and vertical stopping sight distance and minimum sight distance should be considered three dimensionally.
- Sharp horizontal curves should not be introduced at or near the crest of a vertical curve. A horizontal curve should leave the vertical curve and be longer than the vertical curve.
- A short vertical curve on a long horizontal curve or a short tangent in the grade-line between sag curves may adversely affect the road's symmetry and appearance.

2.8 SUPERELEVATION

Criteria

Superelevation not permitted on local access roads or collector roads.

In general, curve radii larger than the minimum and superelevation rates less than the maximum should be used where possible.

The minimum radius of curves is determined by the design speed, the minimum superelevation (or maximum adverse crossfall) at any point on the circular portion of the curve, and the maximum coefficient of side friction which allows safe lane changing. This is 0.15 where there is positive superelevation and 0.12 where there is adverse crossfall.

The coefficient of side friction depends upon the type and condition of tyres, the pavement, and on speed.

Low design speed and crowned pavement

The use of superelevation in association with horizontal curves is an essential aspect of geometric design of roads with design speeds in excess of 60 km/h.

Local access roads which are designed for speeds of 40 km/h or less, and with curves of 60 m radius or less, generally have the pavement crowned on a curve instead of superelevation.

Design standards for such curves have little meaning as drivers usually cut the corners and rely on friction to hold them on a curved path. As the radius of the curve falls, friction becomes more important than superelevation.

High design speed

The maximum superelevation for urban roads of higher design speeds should be 6%. Any increase in the longitudinal grade leading to excessive crossfall at intersections should be considered with caution. While it is desirable to superelevate all curves, negative crossfall should be limited to 3%.

Curve radii

Recommendations for minimum curve radii (in metres) on major urban roads under varying superelevation/crossfall are shown in Table 2.4. All other roads are to be designed to design speeds set out in Section 2.4.

Table 2.4 Minimum radius of curvature

Superelevation/crossfall		**Design speed km/h**		
Type	**Percent**	**60**	**70**	**80**
		Minimum radius of curvature		
Minimum	5	145	195	255

superelevation	4 3 2 1	150 160 170 180	205 215 230 245	265 280 300 315
Maximum Crossfall	0 1 2 3	190 260 285 315	260 355 390 430	340 460 505 560
(Source: *AUSTROADS, Guide policy for the geometric design of major urban roads*)				

Transitions, offset crowns (Specific Council Approval Required)

Plan transitions are desirable on superelevated curves for appearance and to provide a convenient length in which to apply the superelevation.

On urban roads, superelevation may be conveniently applied to the road cross section by shifting the crown to 2 m from the outer kerb.

The axis of rotation of the cross section for urban roads will normally be the kerb grading on either side which best enables access to adjacent properties and intersections.

On the outside of superelevation, or where the longitudinal grade of the gutter is less than 0.5%, a crossfall of 63 mm in a 450 mm wide gutter may be adopted.

2.9 ROAD RESERVE CHARACTERISTICS

Cross section

The cross section of the road reserve must provide for all functions that the road is expected to fulfil, including the safe and efficient movement of all users, provision for parked vehicles, acting as a buffer from traffic nuisance for residents, the provision of public utilities and streetscaping. Table 2.5 details characteristics of the road reserve.

Operational aspects

The carriageway width shall allow vehicles to proceed safely at the operating speed intended for that level of road in the network and with only minor delays in the peak period. This must take into consideration the restrictions caused by parked vehicles where it is intended or likely that this will occur on the carriageway.

(Vehicles include trucks, emergency vehicles and, on some roads, buses (Refer to Hierarchical road network for bus routes)).

Pedestrians and cyclists

The safety of pedestrians and cyclists where it is intended they use the carriageway must also be assured by providing sufficient width.

Access to allotments

The carriageway width should also provide for unobstructed access to individual allotments. Drivers should be able to comfortably enter or reverse from an allotment in a single movement, taking into consideration the possibility of a vehicle being parked on the carriageway opposite the driveway.

Table 2.5 Characteristics of roads in residential and Industrial road networks

Road type	**Max traffic volume (vpd)**(1)	**Max speed** (2) **(km/h)**	**Carriageway width (m)**(3)		**Parking provision within road reserve**	**Kerbing** (4)	**Footpath require-ment**	**Bicycle path requirement**	**Verge width (each side)**
			Min.	Max.					
Access Street	300	25	Single Lane(5) 3.5	6.0(5)	1 verge space per 2 allot-ments(5)	Roll-over/ Flush	No	No	See Note(6)
			Two Lane 5.5	7.0	Carriage-way	As above	Yes	No	See Note(6)
Local Street	2,000	40	7.0	8	Carriage-way	As above	1.2 m wide(7) footpath(s	No	Min. 4.0 m

							)		
Collect-or Street	6,000 (with access to resi-dential allot-ments)	50(8)	9.0 (On bus routes 9.0(10))	11.0	Carriage-way or Indented parking.	Roll-over(9) 9.0m SA 11.0m	1.2 m wide footpath both sides.	No 1.0 m gap in pro-tuberances required for cyclists(10)	Min. 4.0 m(14)
Local Sub-Arterial Road / Industrial (Commercial)	10,000 (no access to single dwelling resi-dential allot-ments)	60(11)	13.0 (On bus routes 13.0(10))	13.0	Parking not permitted on carriageway for local sub-arterial roads(12)	Barrier	If required, 1.2 m wide footpath, and/or 2.0 m bicycle path one side only(13)	If required, 2.0 m bicycle path one side only in the verge, or two 1.5 m wide bicycle lanes marked on carriageway(13)	Min. 4.5 m.

NOTES:
(1) For single dwelling allotments apply traffic generation rate of 10 vehicles per day (vpd)/allotment (equivalent to approximately one vehicle per hour (vph) in the peak hour) unless a lower rate can be demonstrated. Lower rates can be applied to multi-unit dwellings based on locally derived rates.
(2) See **Design speed** and **Horizontal curves and tangent lengths** on designing for specific operating speeds.
(3) Widening required at bends to allow for wider vehicle paths (using AUSTROADS *Turning Templates*).
(4) Where kerbing is not required a flush pavement edge treatment can be used. Maximum carriageway widths required if barrier kerbing used.
(5) Requires:
. Provision for widening to6.0 m if necessary in the future. Concrete.
. Verge parking as noted with scope for additional spaces (see **Parking**)
(6) Minimum width required to provide for pedestrians, services, drainage, landscape and preservation of existing trees. Add additional width on one side for future widening of carriageway to 5.0 m if required. For two lane carriageway design, no provision for widening required.
(7) A minimum of one footpath on one side of the street to be constructed initially with provision to construct a second footpath if required by residents in the future.
(8) Reduced speeds are required at designated pedestrian/bicycle crossing. A speed of 20 km/h is desirable, achieved by the road design principles outlined in this worksection.
(9) Barrier kerbing may be used if required for drainage purposes without reducing the carriageway width.
(10) On bus routes,9.0 m travelled way with 2.0 m wide indented parking and bus bays defined by kerbed protuberances. Where bicycle way can be anticipated, a bicycle lane is required along the kerb.
(11) Speed on local sub-arterial road not to exceed legal limit.
(12) If required, to be provided in parking areas which can be exited in a forward direction.
(13) Required only if part of a pedestrian/bicycle network.
(14) Provide adequate road reserve width for widening of carriageway for future bus route if required.
* Many elements are inter-related. Therefore variations from any particular recommended characteristic may require changes to others.
Derived from AMCORD

Discourage speeding

The design of the carriageway should discourage drivers from travelling above the intended speed by reflecting the functions of the road in the network. In particular the width and horizontal and vertical alignment should not be conducive to excessive speeds.

Verge width
Appropriate verge width should be provided to enable the safe location, construction and maintenance of required footpaths and public utility services (above or below ground) and to accommodate the desired level of streetscaping. Wherever possible services should be located in common trenches.

Sight distance across verge
The verge when considered in conjunction with the horizontal alignment and permitted fence and property frontage treatments should provide appropriate sight distances, taking into account expected speeds and pedestrian and cyclist movements.

Stopping sight distances and junction or intersection sight distances, provided by the verge, should be based on the intended speeds for each road type.

2.10 CROSSFALL

General
Desirably, roads should be crowned in the centre. Typical pavement crossfalls on straight roads are given in Table 2.6.

Table 2.6 Typical pavement crossfalls on straight roads

Pavement Type	**Crossfall %**
Bituminous seal coat:	3
Bituminous concrete pavement:	2.5
Cement concrete pavement:	2
(Source: AUSTROADS, *Guide policy for geometric design of major urban roads*)	

Offset crown lines (Specific Council Approval Required)
There are many factors affecting levels in urban areas that force departures from these crossfalls. Differences in level between road alignments can be taken up by offsetting crown lines or adopting one way crossfalls. Sustained crossfalls should not exceed 4%, although up to 6% may be used where unavoidable.

Rate of change
The rate of change of crossfall should not exceed: 6% per 30 m for through traffic; 8% per 30 m for free flowing turning movements; or 12% per 30 m for turning movements for which all vehicles are required to stop.

Precedence of crossfall over grade
The crossfall on a collector or local sub-arterial road should take precedence over the grade in minor side streets. Standard practice is to maintain the crossfall on the major road and adjust the minor side street levels to suit.

The crossfall in side streets should be warped quickly either to a crown or a uniform crossfall depending on the configuration of the side street.

A rate of change of grade of two % in the kerb line of the side street relative to the centre line grading is a reasonable level.

2.11 VERGES AND PROPERTY ACCESS

Criteria
A suitable design for the verge will depend on utility services, the width of footpath, access to adjoining properties, likely pedestrian usage and preservation of trees. Low level footpaths are undesirable but may be used if normal crossfalls are impracticable.

Crossfalls in footpath paving should not exceed 2.5%, in accordance with AUSTROADS *Guide to traffic engineering practice.* Longitudinal grade usually parallels that of the road and this may be steeper than 5%.

Level differences across the road
Differences in level across the road between road reserve boundaries may be accommodated by:

- Cutting at the boundary on the high side and providing the verge at normal level and crossfall.
- Battering at the boundary over one third the verge width with the remainderagainst the kerb constructed at standard crossfall.
- .

The above measures can be used singularly or combined. The verge formation should extend with a 0.5 m berm beyond the road reserve boundary.

Driveway profile

The Designer shall design a vehicular driveway centreline profile for the property access and check this design using critical car templates, available from Council, to ensure that vehicles can use the driveway satisfactorily.

2.12 INTERSECTIONS

Criteria

Intersections should be generally located in such a way that:

- The streets intersect preferably at right-angles and not less than 70º.
- The landform allows clear sight distance on each of the approach legs of the intersection.
- The minor street intersects the convex side of the major street.
- The vertical grade lines at the intersection do not impose undue driving difficulties.
- The vertical grade lines at the intersection will allow for any direct surface drainage.
- Two minor side streets intersecting a major street in a staggered pattern should have a minimum centreline spacing of 40 m where a left turn.
- Right turn manoeuvre between the staggered streets is likely to occur frequently.

Traffic volumes

The design of intersections or junctions should allow all movements to occur safely without undue delay. Projected traffic volumes should be used in designing all intersections or junctions on local sub-arterial roads.

State roads and national highways

Intersection design for the junction of Council's roads with existing state rural or urban roads and national highways should generally be in accordance with the publication AUSTROADS *Guide to traffic engineering practice—Part 5.*

Approval of State road authority

Intersections with state roads or national highways shall be designed, approved and constructed in accordance with the requirements of the State Road Authority.

Sight distance

Adequate stopping and sight distances are to be provided for horizontal and vertical curves at all intersections.

Parking

Where required, appropriate provision should be made for vehicles to park safely.

Drainage

The drainage function of the carriageway and/or road reserve shall be satisfied by the road reserve cross-section profile.

Turning movements

All vehicle turning movements are accommodated utilising AUSTROADS *Design Vehicles and Turning Templates*, as follows:

- For intersection turning movements involving local sub-arterial roads, the 'design semi-trailer' with turning path radius 15.0 m.
- For intersection turning movements involving local streets or collector streets, but not local sub-arterial roads, the 'design single unit' bus with turning path radius 13 m.
- For intersection turning movements on access streets but not involving local sub-arterial roads, collector streets or local streets, the garbage collection vehicle used by the local authority.
- For turning movements at the head of cul-de-sac access streets sufficient area is provided for the 'design single unit' truck to make a turn. Where driveway entrances shall be used for turning movements, the required area shall be designed and constructed to withstand the relevant loads.

Turning radii

Turning radii at intersections or driveways on local sub-arterial road accommodate the intended movements without allowing desired speeds to be exceeded.

Bus routes

On bus routes 3-centred curves with radii 7.0 m, 10.0 m, 7.0 m are used at junctions and intersections.

2.13 ROUNDABOUTS

Are only to be installed where warranted by traffic requirements and are subject to specific Council approval, concrete pavement is required.

Criteria

Roundabouts should generally be designed in accordance with the requirements of the publication AUSTROADS *Guide to traffic engineering practice—Part 6*. Designs adopting alternative criteria will be considered on their merits.

Roundabout design should generally comply with the following:

- entry width to provide adequate capacity
- adequate circulation width, compatible with the entry widths and design vehicles eg. buses, trucks, cars.
- central islands of diameter sufficient only to give drivers guidance on the manoeuvres expected
- deflection of the traffic to the left on entry to promote gyratory movement
- adequate deflection of crossing movements to ensure low traffic speeds
- a simple, clear and conspicuous layout
- design to ensure that the speed of all vehicles approaching the intersection will be less than 50 km/h.

Approval

Roundabouts shall be approved by the Council and the relevant State Road Authority.

2.14 TRAFFIC CALMING (Specific Council Approval Required)

Criteria

Calming devices such as thresholds, slowpoints, speed humps, chicanes and splitter islands should be designed in accordance with the requirements of AUSTROADS *Guide to traffic engineering practice—Part 10.*

Devices designs should generally comply with the following:

- Streetscape
  - reduce the linearity of the street by segmentation
  - avoid continuous long straight lines (eg. kerb lines)
  - enhance existing landscape character
  - maximise continuity between existing and new landscape areas
- Location of devices/changes
  - devices other than at intersections should be located to be consistent with streetscape requirements
  - existing street lighting, drainage pits, driveways, and services may decide the exact location of devices
  - slowing devices are optimally located at spacings of 100 m–150 m.
- Design vehicles
  - emergency vehicles must be able to reach all residences and properties
  - local streets with a ‘feeding’ function between arterial roads and minor local streets might be designed for a AUSTROADS *Design Single Unit Truck/Bus*
  - where bus routes are involved, buses should be able to pass without mounting kerbs and with minimised discomfort to passengers
  - in newly developing areas where street systems are being developed in line with local area traffic management (LATM) principles, building construction traffic must be provided for
- Control of vehicle speeds
  - maximum vehicle speeds can only be reduced by deviation of the travelled path. Pavement narrowings have only minor effects on average speeds, and usually little or no effect on maximum speeds
  - speed reduction can be achieved using devices which shift vehicle paths laterally (slow points, roundabouts, corners) or vertically (humps, platform intersections, platform pedestrian/school/bicycle crossings)

. speed reduction can be helped by creating a visual environment conducive to lower speeds. This can be achieved by ‘segmenting’ streets into relatively short lengths (less than 300 m), using appropriate devices, streetscapes, or street alignment to create short sight lines

- Visibility requirements (sight distance)

. adequate critical sight distances should be provided such that evasive action may be taken by either party in a potential conflict situation. Sight distances should relate to likely operating speeds

. sight distance to be considered include those of and for pedestrians and cyclists, as well as for drivers

. night time visibility of street features must be adequate. Speed control devices particularly should be located near existing street lighting if practicable, and all street features/furniture should be delineated for night time operation. Additional street lighting shall be provided by the Developer at proposed new speed control devices located away from existing street lighting.

- Critical dimensions

Many devices will be designed for their normal use by cars, but with provision (such as mountable kerbs) for larger vehicles. Some typical dimensions include:

. pavement narrowings

. - single lane 3.50 m between kerbs

. - 3.75 m between obstructions

. - two lane 5.50 m minimum between kerbs

. bicycle lanes (including adjacent to pavement narrowings)—1.2 m absolute minimum (1.0 m in special circumstances in accordance with *AUSTROADS Guide to traffic engineering practice—Part 14.*)

. plateau or platform areas—75 mm to 150 mm height maximum, with 1 in 15 ramp slope

. width of clear sight path through slowing devices—1.0 m maximum (i.e. the width of the portion of carriageway which does not have its line of sight through the device blocked by streetscape materials, usually vegetation)

. dimensions of mountable areas required for the passage of large vehicles to be determined by appropriate turning templates.

Approval

Traffic calming devices shall be approved by Council.

2.15 PARKING

2.15.01 On-site

The parking requirements for normal levels of activity associated with any land use should be accommodated on-site.

All on-site parking should be located and of dimensions that allow convenient and safe access and usage.

The number of on-site parking spaces for non-residential land uses conforms to parking standards as determined by the relevant authority.

The layout and access arrangements for parking areas for non-residential land uses should conform to AS 2890.1.

2.15.02 On-site residential spaces

Two car parking spaces (which may be in tandem) are provided on-site for each single dwelling allotment.

Three spaces are provided on-site for each two dwelling units for multi-unit residential developments.

2.15.03 On-site residential space dimension

Of the on-site parking one space for each residential unit is provided within the allowable building area and has a minimum dimension of 5.0 m by 3.0 m.

2.15.04 Road reserve parking

Adequate parking should be provided within the road reserve for visitors, service vehicles and any excess resident parking since a particular dwelling may generate a high demand for parking.

2.15.05 Future spaces
On single lane carriageways one space for each two allotments is constructed on the verge (to comply with Clause 2.15.7) within 25 m of each allotment, with scope to provide one additional space for single dwelling allotments or for each two units in a multi-unit development if required at a future time.

2.15.06 Short term truck parking
On single lane carriageways a number of verge spaces are combined to provide for short term truck parking within 40m of any allotment.

2.15.07 Verge and carriageway parking
On single lane access streets parking spaces should be provided within the verge.

Verge and carriageway parking should be of adequate dimensions, convenient and safe to access, well defined with traffic control devices and an all-weather surface provided.

Such parking shall not restrict the safe passage of vehicular and pedestrian traffic.

2.15.08 Obstruction due to cars on the opposite side of the street
The availability of parking should be adequate to minimise the possibility of driveway access being obstructed by cars parked on the opposite side of the street.

2.15.09 Joint use
For non-residential land uses the opportunity for joint use of parking should be maximised by being shared by a number of complementary uses.

2.15.10 Road reserve space dimensions
A single (car) space is 6.5 m by 2.5 m and combined spaces are 13.0 m by 2.5 m (for two cars) and 20 m by 2.5 m (for truck parking) with adequate tapers at both ends to allow the necessary parking manoeuvres determined by using *AUSTROADS Design Vehicles Turning Templates*.

2.15.11 Verge spaces, indented parking
All verge spaces and indented parking areas are constructed of concrete, interlocking pavers, lawn pavers, bitumen with crushed rock or other suitable base material and are designed to withstand the loads and manoeuvring stresses of vehicles expected to use those spaces.

2.15.12 Right-angled parking
Right-angled parking is provided only on access streets and local streets where speeds do not exceed 40 km/h.

2.16 BUS ROUTES CRITERIA

Bus routes will normally be identified by Council. It is important that the road hierarchy adequately caters for buses.

The main criteria in determining the location of bus routes is that no more than 5% of residents should have to walk in excess of 400 metres to catch a bus.

Normally roads above the local street in the hierarchy are designed as bus routes.

Table 2.7 details minimum criteria for bus route design. BUS ROUTE CRITERIA

Road	Carriageway Width (min)	Stops (Spacing)	Bays
Collector*	See Table 2.5	400 metre **	Single
Local sub-arterial	See Table 2.5	400 metre	Shelters***
Arterial	See Table 2.5	400 metre	Shelters and bays
* Collector roads not identified as bus routes may have9 m carriageways (see Table 2.5) ** Loop roads with single entry/exit only require stops and bays on one side road. *** Shelters are subject to Council's requirements.			

3 RURAL DESIGN CRITERIA

3.1 APPLICATION

In addition to the foregoing sections this section specifically applies to all those sites identified as being suited to rural subdivisions inclusive of rural home sites and hobby farms types of developments.

3.1 GENERAL

Design speed

Design speed shall be generally used as the basic parameter of design standards and the determination of the minimum design value for other elements for Council Works is to be based on the concept of a 'speed environment' as outlined in AUSTROADS *Guide to the geometric design of rural roads.*

Where appropriate, superelevation, widening and centreline shift and their associated transitions shall comply with the relevant State Road Authorities' *Road Design Guide* or *AUSTROADS Guide*.

Restricted access to major roads

All rural subdivisions should be designed to restrict access to major roads.

Access should be limited to one point on to local, collector, local sub-arterial or arterial road networks.

Kerb and gutter

All rural residential subdivisions will be required to provide kerb and gutter on both sides of roads and piped drainage will generally be required.

Table drain

Where the table drain is likely to scour, a dish drain, or similar structure shall be constructed along the invert. Also, for grades of less than 0.8%, the inverts of the drain are to be lined to prevent siltation.

3.2 SIGHT DISTANCES

Stopping and sight distance

Stopping and sight distance should be provided at all points on the road.

The stopping distance is measured from an eye height of 1.15 m to an object height of 0.20 m, using a reaction time of 1.5 seconds.

A minimum sight distance measured from a height of 1.15 m to a height of 1.15 m is preferable for speeds of 60 km/h and over.

Tables are provided in the relevant State Road Authorities' *Road Design Guide*.

Stopping and braking distance

Stopping distance is the sum of the braking distance and the distance the vehicle travels during a reaction time of 1.5 seconds, and may be calculated using the following formula:

$$d = 0.42[V+(V^2/254f)]$$

where

d = stopping distance (m)

V = speed of vehicle (km/h)

f = coefficient of longitudinal friction

(Source: AUSTROADS *Guide to the geometric design of rural roads.*)

Recommended sight distances (based on State Road Authority Road Design Guides and adjusted to include lower speeds and minimum sight distances using the above formula) are shown in Table 3.1.

These figures may apply on crest vertical curves only where there are straight alignments. Adjustments should be calculated for steep grades.

Table 3.1 Stopping sight distance

Travel speed km/h	Coefficient of * longitudinal friction	Stopping sight distance (m)	Minimum sight distances (m)
40	0.52	33	**
50	0.50	46	**
60	0.47	60	180
70	0.45	80	220
80	0.43	100	260
* bituminous or concrete surfaces ** not applicable at lower speeds			

3.3 HORIZONTAL AND VERTICAL ALIGNMENT

Criteria

Horizontal and vertical curves are to be designed generally to the requirements of *AUSTROADS Guide to geometric design of rural roads*. These requirements are essential to satisfy the safety and performance of proper road design.

Roads having both horizontal and vertical curvature should be designed to conform with the terrain to achieve desirable aesthetic quality and being in harmony with the landform.

3.4 INTERSECTIONS

Criteria

Intersections should generally be designed in accordance with the publication *AUSTROADS Guide to traffic engineering practice—Part 5*. The type of intersection required will depend on existing and planned connecting roads. Generally intersections with main and local roads will conform to the layouts shown in Fig 3.1.

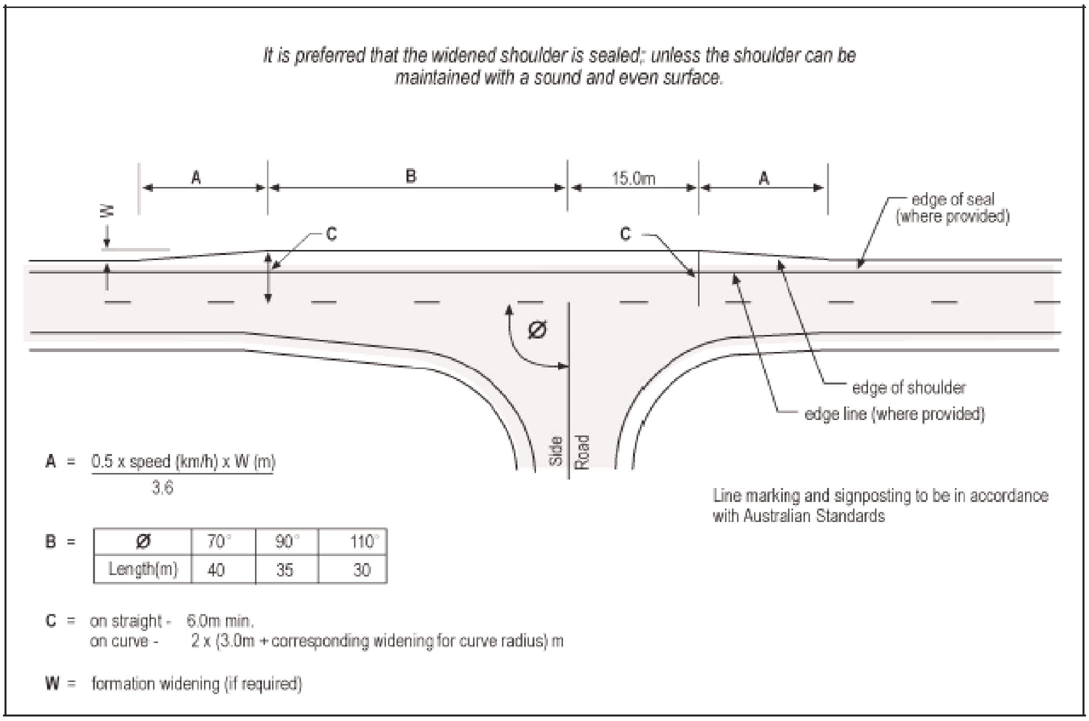
Sight distance

Adequate sight distance should be provided at intersections both horizontally and vertically. Each intersection location shall be examined for conformance with the criteria for Approach Sight Distance (ASD), Entering Sight Distance (ESD) and Safe Intersection Sight Distance (SISD).

ASD, ESD and SISD relate as follows:

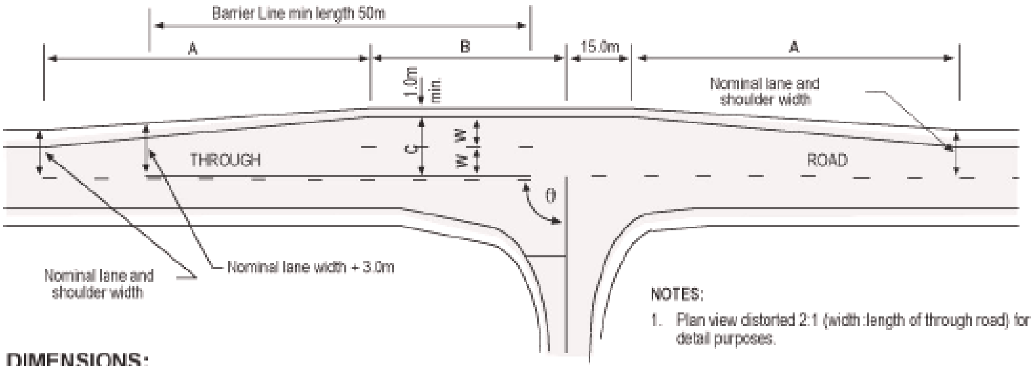
- ASD relates to the ability of drivers to observe the roadway layout at an anticipated approach speed.
- ESD relates to the driver entering the intersection from a minor road and ability to observe the roadway layout and assess traffic gaps.
- SISD relates to an overall check that vehicles utilising the intersection have sufficient visibility to allow reaction and deceleration so as to provide adequate stopping distance in potential collision situations.

Tabulated speed/sight distance requirements together with detailed explanations for each of the sight distance criteria are given in *AUSTROADS Guide to traffic engineering practice—Part 5*. Repositioning of an intersection may be required to obtain conformance with the sight distance criteria.



Ø	70°	90°	110°
Length(m)	40	35	30

TYPE A



NOTES:

1. Plan view distorted 2:1 (width :length of through road) for detail purposes.
2. Broken separation lines where shown assume overtaking sight distance available. If not, barrier line should be used.
3. 1.0m shoulder should be widened adjacent to safety barrier or when catering for bicycles
4. Layout to be linemarked as shown. **Do not use continuity lines**
5. This layout is not applicable in New Zealand.
6. Refer to notes in Figure 2.4

DIMENSIONS:

A =

	Travel Speed (km/h)			
W	80	90	100	110
3.50	60	70	75	85
3.25	55	65	70	80
3.00	50	60	65	75

Dimension **A** based on formula:

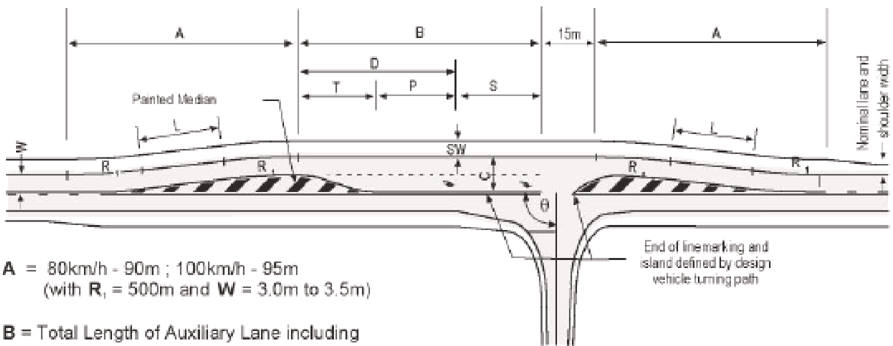
$$\frac{0.8 \times \text{travel speed(km/h)} \times \text{Lane Width } (W)}{3.6}$$

B =

θ	70°	90°	110°
Length(m)	40	35	30

C = on straight - 2 x **W** (nominal lane width).
on curve - 2 x **W** (nominal lane width) + corresponding widening for curve radius; refer to Austroads *Rural Road Design* (2003)

TYPE B



A = 80km/h - 90m ; 100km/h - 95m
(with **R**1 = 500m and **W** = 3.0m to 3.5m)

B = Total Length of Auxiliary Lane including **T**aper , **D**iverge / Deceleration and **S**torage

C = Total width of through and auxiliary lanes = 2 **W**

D = Diverge / Deceleration Length
(refer to Figure 6.46 / Table 6.15)

L = Allows 1.5 sec of travel to reverse steering
(80km/h - 33.5m ; 100km/h - 42.0m)

P = Length of Parallel Lane. (refer to Figure 6.46)
min.**P + S**- 20m semi-trailers; 12.5m single unit
25m b-double, 40m double road train.
Correction Factors : θ = 70°+5m; θ = 110°-5m

R1 = min 500m

S = Storage Length (Calculated Car Spaces -1) x 6m
(refer to Appendix A, Section A 1.3 and Appendix B, Figure B4
or use computer program eg aaSIDRA)

T = Length of Taper (refer to Figure 6.46);
min 20 - 30m

W = Nominal lane width (incl. widening for curves)

SW = Shoulder width

Refer to AS 1742.2 for details of
- pavement markings
- linemarking and
- warning and regulatory signs

TYPE C

Figure 3.1 Typical rural intersection treatments

Staggered-T intersections

Staggered-T arrangements proposed for rural cross-intersections should preferably be of the 'right to left' type. This arrangement eliminates traffic queuing in the major road, the need for additional pavement for right turn lanes and greater stagger length associated with 'left to right' T-intersections.

Figures and discussion on staggered-T treatments are given in *AUSTROADS Guide to traffic engineering practice—Part 5*.

3.5 PLAN TRANSITIONS

Widening and shift on curves

A plan transition is the length over which widening and shift is developed from the 'tangent-spiral' point to the 'spiral-curve' point; i.e., the length between the tangent and the curve.

In urban road design it is often impracticable to use plan transitions as kerb lines are fixed in plan and any shift requires carriageway widening. Widening on horizontal curves compensates for differential tracking of front and rear wheels of vehicles; overhang of vehicles; and transition paths. Where proposed roads are curved, the adequacy of carriageway width should be considered.

Crossfall changes

Abrupt changes in crossfall, can cause discomfort in travel and create a visible kink in the kerb line. A rate of change of kerb line of no more than 0.5 % relative to the centreline should ensure against this. The wider the pavement the longer the transition.

Superelevation transitions should be used at all changes in crossfall, not just for curves. Drainage problems can arise with superelevation transitions which may require extra gully pits and steeper gutter crossfalls.

Where crossfalls change at intersections, profiles of the kerb line should be drawn. Calculated points can be adjusted to present a smooth curve.

3.6 CARRIAGEWAYS

Carriageway widths for rural roads should comply with Table 3.2.

Table 3.2 Carriageway widths

Road type	Max traffic volume (vpd)	Max speed (1) (km/h)	Carriageway width (m)(2)	Shoulder (3) (4)	Reserve width
Local Minor	<200	60	6.0 (sealed)	1.0	20
Local Major	>200	80	6.0 (sealed)	1.0	20
Collector	>2000	80(8)	7.0 (sealed)	1.0 (sealed)	20
Arterial Road	NA	100(11)	7.0 (sealed)	1.0 (sealed)	30
Rural Residential	400	60	6 (sealed)	(kerb)	20

NOTES:

(1) See **Design speed** and **Horizontal curves and tangent lengths** on designing for specific operating speeds.

(2) Widening required at bends to allow for wider vehicle paths (using AUSTROADS *Turning Templates*).

(3) Where kerbing / edge beam is not required a flush pavement edge treatment can be used.

(4) Passing and auxiliary lanes and all other criteria as per the RTA Road Design Guidelines and Austroads – Intersections at grades.

3.7 SUPERELEVATION DESIGN SPEED

Use of maximum superelevation shall be considered where the radius of the curve in approaching the minimum speed environment. Reference should be made to *AUSTROADS Guide to geometric design of rural roads.*

At low and intermediate ranges of design speed (i.e. below 80 km/h) it is desirable to superelevate all curves at least to a value equal the normal crossfall of straights.

3.8 SCOUR PROTECTION OF ROADSIDE DRAINAGE AND TABLE DRAINS

Scour protection of roadside drainage and table drains is required. The level of protection will depend on the nature of the soils, road gradients and volume of stormwater runoff.

Protection works may involve concrete lined channels, turfing, rock pitching, grass seeding, individually or any combination of these. Geotechnical investigations should be carried out of determine the level and extent of any protection works prior to proceeding to final design stage.