WANNEROO

DEVELOPMENT DESIGN SPECIFICATION

WD1

GEOMETRIC ROAD DESIGN (Urban and Rural)

DESIGN SPECIFICATION WD1
GEOMETRIC ROAD DESIGN (Urban and Rural)

DEVELOPMENT DESIGN SPECIFICATION WD1
DESIGN (Urban and Rural)

GENERAL

WD1.01 SCOPE

1. These Guidelines support the procedures and standards outlined in the AUS-Spec #1 documents for Geometric Road Design D1 and should be read in conjunction with that document.

2. The requirements outlined in this document represent standards traditionally accepted within the City for the design of roads and ways. Should designers wish to present alternative design standards they should support their design with objective evidence as to how they will meet desirable outcomes in the key elements of;

Performance Criteria

- Technical Compliance with recognised industry standards
- Safety
- Environmental Compatibility
- Amenity
- Accessibility and Convenience
- Economy (Efficient Capital Development and Effective Asset Management)

While the AusSpec Document highlights current design practice in respect to the determination of the vehicle speed that is deemed acceptable for a particular subdivision or section of road, the City reminds designers that they need to be mindful of the Regulatory speed zones that will be applied to the various roads within the subdivision when determining the design speeds.

Regulatory Speed

WD1.02 AIMS

1. To provide developers and designers with a clear and comprehensive guide as to the standards expected by the City of Wanneroo for the design of roads throughout the City. These design guidelines support and are to be read in conjunction with the Aus Spec #1 Standard D01 Geometric Road Design (Urban and Rural Roads). The guidelines outlined in this document represent those design standards that have been traditionally used throughout the City.

WD1.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

All Specifications for Design and Construction.

(b) Australian Standards

AS 2890.1 Parking facilities: Off-street car parking.
AS 1742 .1 Traffic Control Devices
AS 1742.13 Traffic Management Devices

(c) State Authorities

Policy for Installation by Public Utility Authorities within the Road Reserve

Western Australian Planning Commission's "Liveable Neighbourhoods"

d) Other

The Institute of Municipal Engineering Australia, W.A Division - 1998: Design Guidelines for Subdivisional Development.

(e) Standard Drawings

TS 02-1-0 - Bus Embayments – Setting Out Details

TS 05-1-0 - Extruded Sections – Mountable / Semi-Mountable (Type 1 & Type 2), Barrier, Flush, Reinforced Flush and Mountable with Key

TS 05-2-0 - Modified Mountable and Semi-Mountable for Roundabouts

TS 08-1-0 - Guide Posts – Location and Details

TS 10-1-0 - District Distributor to Local Distributor – Junction Type 1

TS 10-2-0 - District Distributor to Local Distributor – Junction Type 2

TS 10-3-0 - District Distributor to Local Distributor – Junction Kerbing and Lane Details

TS 10-4-0 - District Distributor to Local Distributor – Truncations

TS 10-6-0 - Local Road Median Island Set Out Details

TS 10-7-0 - Keep Left Sign Installation Details

TS 11-3-0 - Road Hump – Asphalt Watt's Profiles

TS 13-1-0 - Rural Road Cross Section

TS 13-2-0 - Rural Road and Bridle Path for 22m Road Reserve

TS 13-3-0 - Controlled Access District Distributor – Ultimate 3 Lane Dual Carriageway 52m Formation and Staging

TS 13-4-0 - Controlled Access District Distributor – Ultimate 2 Lane Dual Carriageway 45m Formation and Staging

TS 13-5-0 - Controlled Access District Distributor - Alternative Road Reserve

TS 16-1-0 - Profile Coordination with Superelevation Transitions

WD1.04 CONSULTATION

The consultation process shall be minuted and copies of such forwarded to the designer. A copy of the minutes of the preliminary consultation process is to be kept with the Subdivisional Planning file for future reference.

Consultation minuted

WD1.05 PLANNING CONCEPTS

Readers should note that the urban design concepts outlined in the AusSpec document reflect practice at the time of the preparation of the document. The information in respect to planning concepts and road hierarchy is intended to provide general concepts only.

Developers will be required to refer to current planning practices and policy as provided by the Council's Planning Department and the Western Australian Planning Commission.

For all matters relating to subdivisional layout developers should refer to current WAPC Policy and guidelines, "Liveable Neighbourhoods" and all relevant Design and Traffic Management Guidelines.

WD1.06 PLAN REQUIREMENTS

(a) Reduction Ratios

Suitable for Construction purpose

1. Drawings detailing the design shall be suitable for construction purposes, and show all existing contours or spot levels, services, survey pegs and marks, fences, structures and buildings, all new or proposed contours or spot levels, earthwork embankments, roads, verges, intersections, junctions, drainage, sumps, fencing, access ways, open space, retaining walls, underpasses and all other components of the project.

Australian Standards

2. Drawings shall in general be prepared in accordance with Australian Standard AS1100, Part 101-1992 and 401-1984. Drawings shall not only be provided in printed form but also be available in electronic format.

Copies of Drawings and Specifications

3. Two (2) copies of drawings and specifications are required to be submitted for approval. All drawings must be checked and signed by the Consultant's Project Manager. Amendments and variations will be marked on all sets of drawings and specifications and endorsed with an "approval" stamp. One set of drawings and specifications will be returned to the consultant/developer, these being the "approved specifications and construction drawings".

Where the specification to be used for the works has been previously approved by the Council, the above conditions relating to specifications will not apply.

Electronic Drawings

4. Drawings shall to be provided in electronic format following approval and at the practical completion with any changes made since the original approval of a project. These will be kept as the City's record of the subdivision submission.

It is therefore important that

- The consultant make the necessary changes as per Council's approval to the drawings electronically. This shall be completed immediately after approval is granted with a digital copy in AutoCad format (currently AutoCad version 2000) being provided to the Council. These drawings will not only be kept for its records but will enable copies to be made for Council on-site supervisors for inspection purposes.
- Also, drawings shall be provided at practical completion with any changes made since the original approval of a project. These shall be provided also in electronic format and shall represent as-constructed drawings for all infrastructure constructed.

AHD

5. The datum to be used shall be the Australian height datum (AHD). Temporary bench marks related to AHD shall be clearly indicated on drawings

Drawing Scales

6. The following drawing scales should be used for plans presented for approval. Should designers require alternative scales due to specific circumstances of the design, approval should be sought as part of the preliminary consultation process outlined previously.

Concept Plan	1:2000 preferred 1:1000
Locality Plan	1:5000 or 1:10000
Pre-Calculation Plan	1:1000
Layout Plan	1:1000
Road Plan	1:1000 (min) preferred 1:500
Road Profile	Horizontal 1:1000 (min) , Vertical 1:100 (min)
Road Cross Section	1:250
Intersection	1:250 (min)
Traffic Management Device	1:250
Culs-de-sac	1:250
Drainage Plans/ Profiles	To be included on Road Plans (preferably at horizontal/vertical scale of 1:500/1:50)
Standard Drawings	As appropriate

The storm water drainage plans should, if practical be shown on the same plan as the road longitudinal profile.

(b) Plan Sheets

Joint Plan Views and Longitudinal Sections will also be acceptable

(c) Plan Presentation (see AusSpec)

(d) Certification

Designers should note that currently the City has not formalised procedures in respect to Certification of Compliance, however designers are encouraged to indicate conformance with the design guidelines as outlined in Aus Spec #1 Design Specifications DQS.

URBAN DESIGN CRITERIA

WD1.07 ROAD HIERARCHY

1. The function of the road hierarchy and its sub-components are well documented in the **Western Australians Planning Commission's Policies and "Liveable Neighbourhoods" and MRWA's "Metropolitan Functional Road Hierarchy".** Designers are encouraged to ensure that the recommendations of the WAPC's policies, Codes and Guidelines are incorporated into their street designs.

WAPC "Liveable Neighbour-hoods"

Road Reserve Function

The Residential street serves a number of functions such as,

- Access to Residences :- Motor Vehicles, Pedestrian, Cyclists, Visitors, Services
- Parking
- Social and Activities
- Amenity and Aesthetics
- Storm Water
- Public Utility Service

Designers need to ensure that each of these functions are suitably assimilated into the street design and layout with due consideration for the critical performance elements previously mentioned. i.e.

- ❒ Technical Compliance
- ❒ Safety
- ❒ Environmental Compatibility
- ❒ Amenity
- ❒ Accessibility and Convenience
- ❒ Economy

Note that some aspect of Figure D1.2, in relation to the layout of Access Places, is not supported. Carriageway widths less than 5.5 metres is generally not supported. The indicative landscape treatment and right-angled parking provision at the end of the bulb is also not supported.

In Figure D1.3 for Access Ways, carriageway widths less than 6.0 metres is generally not supported.

WD1.08 ROAD NETWORK

11. Traffic volumes and speeds on any road should be compatible with the residential functions of that road as outlined in the WAPC's "Liveable Neighbourhoods". Designers should also refer to the summary of planning criteria outlined in the IMEA (W.A.) Guideline for Subdivisional Development.

Design Compatibility

12. The following criteria applies to development of lots with rear access lanes :-

Development of Lots with Rear Access Lanes

a) Restrictive Covenants shall be placed on all lots with rear access lane to establish access locations (i.e. restrictions on vehicular access via primary frontage) and require minimum garage setbacks, provision of an area along the rear boundary for the placement of rubbish bins for collection and rear fencing restrictions, including truncations of rear fences in order to create safe and amenable lot access.

b) The laneways shall be connected at either end to the local street network (open to through traffic) and designed such that the City's refuse collection vehicles are able access the laneways satisfactorily.

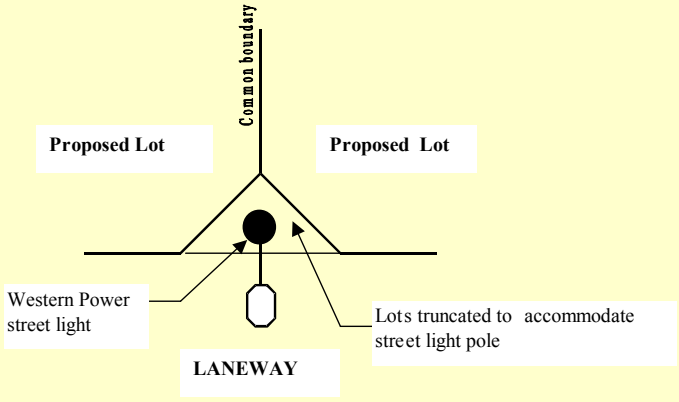
c) Adequate intersection and corner truncations being provided to enable access for a 12.5 metre Single Unit Design Vehicle. The City has previously approved for right angle access for laneways, a standard 3m x 3m truncation with 6m radius kerb line within a 6.0m wide laneway. This was based on recent field inspections. Truncation dimensions will vary where the bend in the road or intersections differ from 90 degrees.

d) A minimum of 1 visitor carparking bay for every two lots being provided along the primary road frontage.

e) The design of these lots shall allow for satisfactory pedestrian access to be provided along the primary frontage road.

f) The construction of a minimum of a 1.5 metre wide footpath (or 2.1 metre wide dual use path where applicable) in the road verge along the primary frontage of all lots with rear lane access to facilitate pedestrian access and postal deliveries.

g) All laneways shall be adequately lit. The length of the laneways shall be minimised and designed such that there will be sufficient lighting provided from street lights provided at either end of the laneway. Where this is not possible or



TYPICAL LIGHT POLE LOCATION IN LANEWAYS

NOT TO SCALE

where there are changes in direction in the laneway and lighting is deemed neccesary, the light poles shall be truncated into the lots such that the light poles are not within the effective width of the laneway. The City will consider other options based on site specific limitations and when supported by appropriate documentation.

WD1.09 DESIGN SPEED

Regulatory Speeds

While the design speeds outlined in D1.09, item 3 of the Aus Spec document represent current design practice, designers should also be aware of the current zoned speeds that would be applied to the subdivisional road network. Designers should also refer to the WAPC Policies, Codes and Guidelines when determining the appropriate design speed for the development. NOTE that the current speed limit in built-up areas is 50km/h.

WD1.10 LONGITUDINAL GRADIENT

Minimum Gradients

In very flat conditions the minimum longitudinal gradient of 0.5% may be accepted at Council's discretion, however designers shall endeavour to meet the general minimum requirement of 0.6%. Variable crossfall may be necessary to produce the required grade in the gutter.

WD1.11 HORIZONTAL CURVES AND TANGENT LENGTHS (See AusSpec D1.11)

WD1.12 VERTICAL CURVES (See AusSpec D1.12)

WD1.13 SUPERELEVATION (See AusSpec D1.13)

WD1.14 CARRIAGEWAY WIDTH

(a) Summary Characteristics of Roads

WAPC Guidelines

Designers should refer to the Western Australian Planning Commission's document "**Liveable Neighbourhoods'** and the IMEA (W.A) Guideline for Subdivisional Development when determining the reserve and carriageway characteristics,

Verges

1. Verge areas are required to provide a suitable buffer area between the road carriageway and the abutting lots. Verges provide opportunities for pedestrian movements, landscaping for the managing authority and residents, parking, noise reduction, public utility services and crossover facilities for lots.

Safety Standards

2. Designers need to ensure that verge widths can accommodate the desired level of infrastructure while maintaining adequate safety standards for all road users. Verge widths should also allow for the economic construction and maintenance of verge facilities.

3. Verges shall be provided and have sufficient width for the provision of trunk and reticulation services to properly service the adjoining properties.

Verge Gradients

4. Verges should be graded at a slope of 2% - 3% upwards to the property boundary from the top of the kerb. Verges on roads with a pavement width of 7.4 metres or less, may have a verge grading of 2% - 3% upwards from the top of kerb for the first 3 metres, then ranging up to 10% to the property boundary where the verge would be in a cut at the boundary if a 2% - 3% slope was to be used for the full width.

5. The verge should in general terms be parallel to the slope of the road

Median

6. The maximum slope across a median for a kerbed dual carriageway road should be 10% (1 in 10). Where it is considered that pedestrian access crossing the median is warranted then maximum grades at these locations shall be minimised to 1 in 14 whereever possible.

7. Where designers seek to use alternative gradients, they shall demonstrate that their proposed design meets acceptable standards in terms of vehicular access, pedestrians and cyclists and people with disabilities.

Alternative Design

8. As suggested in the Aus-Spec document, the City may consider the use of a lower rate of traffic generation based on available data and demographic projections.

Traffic Generation

WD1.15 CROSSFALLS (See AusSpec D.1.15)

WD1.16 VERGES AND PROPERTY ACCESS

All footpaths must meet the Disabled Access requirements as outlined in AS 1428.1

The following criteria has traditionally been applied to footpaths throughout the City;

Council Standards

- Cross-fall in footway paving should generally be less than 2% but should not exceed 3%. Footpath crossfalls should generally be consistent with the requirements of the Austroad Guidelines
- Longitudinal grade usually parallels that of the road and this may be steeper than 5 per cent.
- Footpaths shall have a minimum width of 1.5 m.
- Footpaths: 100mm deep concrete
- Joint Spacing :- Contraction Joint 1.25m Expansion Joint 5m
- Surface Irregularities :- <2mm
- Level of Path in verge :- 2% verge level
- Vertical Alignment :- <10mm in 3m

WD1.17 INTERSECTIONS

5. The provision of left or right-turn auxiliary lanes at intersections will be based on traffic volume, traffic movement predictions and the surrounding landuse environment. Intersection spacings will be governed by this requirement. However where auxiliary turning lanes are not required, T-junction spacings along Neighbourhood connectors shall be a minimum of 40 metres.

Intersection Spacings

<u>Cul de sacs</u>

Culs de sac

a) Culs-de-sac shall have a minimum head radius of 9 metres with 15 metre radius tapers.

b) Cul-de-sac head design should avoid the use of driveways as part of the turning manoeuvre.

c) The cul-de-sac head must be able to accommodate turning manoeuvres from those trucks undertaking the City's Rubbish collection service.

d) Culs-de-sac are generally not supported in rural and industrial subdivisions. However should they be approved they shall meet the following requirements :

Industrial and Rural Areas

- For rural subdivisions - a minimum head radius of 12.5 metres with 1.2m shoulders and 20 metre transitions.
- For industrial subdivisions - a minimum head radius of 15 metres with 20 metre transitions.

WD1.18 ROUNDABOUTS (See AusSpec D1.18)

Linemarking and Signage

Main Road Western Australia approval is required for line marking and signage.

Deflection Radius

The deflection radius for roundabouts should be designed to limit the speed through the roundabout to 40kph in a 60kph speed environment. The City has traditionally applied a maximum deflection radius of 80 metres for roundabouts in residential areas and has proved effective.

MRWA Standards

In the case of large dual lane roundabouts, the design must meet MRWA roundabout standards as the linemarking requirements has a major influence on the design.

WD1.19 TRAFFIC CALMING (See AusSpec D1.19)

2 (d) Control of Vehicle Speeds

Vertical Displacement Traffic Calming Devices

The use of vertical displacement traffic calming devices (eg. speed humps) are generally not supported along streets within the City. It is considered that there are many other less hazardous methods available which can be explored to reduce vehicle speeds. It is also considered that the installation of traffic calming devices are generally reactionary measures to improve poorly designed road networks. There should not be the need to consider traffic calming devices in new subdivisions if these were planned and designed appropriately. The road network and lot layout in new subdivisions therefore must be designed appropriately to address this issue.

2 (f) Critical Dimensions

Designers should refer to Austroad standards, Australian Standards and Guidelines to determine acceptable dimensions for traffic calming devices.

2 (g) Other

Semi-Mountable Kerbing

- Semi-mountable kerbing shall be provided:
  - (i) Around the truncation of all corner properties at an intersection or junction,
  - (ii) Adjacent to school sites,
  - (iii) Adjacent to Public Open Spaces,
  - (iv) On primary roads abutting lots with rear access lanes.

Linemarking & Signage

- All line marking and associated signage to be installed in accordance with Main Roads WA approval and requirements.

WD1.20 PARKING

1. Parking requirements for development should be obtained from Council's Planning Department.

Rear Laneway developments

3. Refer to WD1.08 For specific requirements for the provision of car parking embayments specific to the development of lots with rear access lanes.

Right-angled parking

15. Early consultation with the City in regards to right-angled parking is recommended as these are generally not supported in new subdivisions.

Embayments adjacent School Sites

18. Car parking embayments shall be provided along the entire street frontage of all school sites. The number bays shall be maximised wherever possible.

19. Car parking embayments shall also be provided along street frontages of all Recreational Reserves and Public Open Spaces (P.O.S.) particularly adjacent Parks planned for active recreational and sporting activities. ***Embayments adjacent P.O.S.***

WD1.21 BATTLEAXE ENTRY ROADS

1. Battleaxe entry roads provide private access to battleaxe or flag lots. The access ways are to be designed to provide safe and convenient access and of suitable material to ensure future maintenance for residents is minimised. Designers should incorporate standards similar to those proposed for lanes. Consideration must also be given to the provision of sufficient drainage facility for the access legs such that the stormwater surface runoff is contained on site and will not impact adversely on the street drainage system. ***Battleaxe Standards***

2. Battleaxe entry legs shall have a minimum width of 4.0 metres with a 3.0 metre paved and drained battleaxe entry road. This allows for a 0.5 metre wide verge on either side of the battleaxe entry pavement for clearance of vehicles to fences and services. This generally applies to single battleaxe lots. For two or more battleaxe lots sharing a common access, the width of the access leg and pavement will need to be widened appropriately. Refer also the IMEA (W.A.) Guideline for Subdivisional Development. ***Pavement widths***

3. Battleaxe entry roads shall be constructed in accordance with normal road pavements within this specification and may be constructed of in-situ concrete, brick or block paving or flexible granular pavements with an asphaltic sealed surface. The battleaxe entry road may be kerbed or have flush kerbing with a central draining configuration. ***Pavement Standards***

4. Designers must make allowance for the provision of future services by providing a suitable service duct or making arrangements for the placement of services along the full length of the battleaxe entry leg. ***Services***

5. The battleaxe entry road should have a vertical alignment to suit a 5.0 metre wide road. Horizontal alignment and pavement thickness should also meet a 5.0 metre wide road specification. ***Vertical & Horizontal Alignment***

RURAL DESIGN CRITERIA

WD1.22 GENERAL

1. The Rural Road Hierarchy has been divided into the following categories ***Rural Road Hierarchy***

   a. **Arterial Roads :** which carry the major traffic flows between regional centres usually with high volume, high speed traffic. The ultimate road standard may be of dual carriageway standard and all design should be undertaken to account for the ultimate configuration of the road

   b. **Collector Roads :** transfer traffic from the local road network to the Arterial roads. Collector roads are usually single carriageway construction and may allow direct lot access.

   c. **Local Roads :** have a primary access function and incorporate low traffic link roads and culs-de-sac.

2. Rural road reserves shall be of suitable width to provide for the required carriageways, verges, stormwater, public utilities and earthworks associated with the safe design requirements in accordance with the Austroads Design Guidelines. ***Road Reserve widths***

The following road reserve widths have been successfully applied throughout the City :-

- Arterial Roads - To suit the Ultimate Carriageway (min 45m)
- Collector Roads - Min 25m
- Local Roads - Min 20m

Culs-de-sac are generally not supported in rural subdivisions. However should they be approved they shall have a minimum head radius of 12.5 metres with 1.2m shoulders and 20 metre transitions.

3. Rural roads generally have higher traffic speed than urban roads, therefore, the requirements on design speed selection and matching the geometric elements of the road to the design speed are critical, especially for higher speed values. ***Design Speed***

WD1.23 SIGHT DISTANCES (See AusSpec D1.23)

WD1.24 HORIZONTAL AND VERTICAL ALIGNMENT (See AusSpec D1.24)

WD1.25 INTERSECTIONS (See AusSpec D1.25)

WD1.26 PLAN TRANSITIONS (See AusSpec D1.26)

WD1.27 CARRIAGEWAYS

1. Carriageway widths should be designed to meet the design traffic volume and speed environment likely to be encountered in the rural environment. Designers should take into account amenity standards expected by the community and the future maintenance requirements that narrow width pavements will present.

2. Carriageway widths for rural roads should generally be as follows:

Major road over 1,000 AADT : 2 x 3.5m lanes + 1.5m shoulders

Minor road up to 1,000 AADT : 2 x 3.0 to 3.5m lanes + 1.5m shoulders

Minor no-through roads up to 150 AADT : 1 x 3.5m lane +0.6m shoulders

Rural Residential streets with kerbing and drainage

up to 250 AADT : 6.0 metre

over 250 AADT : 7.4 metre

AADT – Annual Average Daily Traffic

3. In rural developments the minimum battleaxe access leg width, pavement width and standards shall be in accordance with the following : ***Battleaxe legs***

For Special Rural or Special Residential Batlleaxe legs ;

Lot size	1000 m^2 – 2 Ha	2 Ha – 5 Ha	> 5 Ha
Minimum **Access Leg** Width (Single Lot)	4.0 m	5.0 m	6.0 m
Minimum **Pavement** Width (Single Lot)	3.0 m with 500mm shoulders either side		
Minimum **Access Leg** Width (Two or more Lots)	5.0 m	6.0 m	8.0 m
Minimum **Pavement** Width (Two or more Lots)	4.0 m with 500mm shoulders either side		
Minimum Pavement Standard	bitumen aggregate seal		

Special Rural & Special Residential

For battleaxe legs in Rural areas;

Rural Battleaxe legs

a) The minimum access leg width shall be 10 metres with a pavement width ranging from 3.5 metres to 5.0 metres depending on the number of lots serviced by the access leg. Pavement shoulders of 500 mm shall also be provided.

b) Where the access leg services a single lot and there is not a requirement for dust suppression, the minimum construction requirement shall be 150mm thick limestone, 3.5 metres wide, compacted and graded in accordance with the City's specifications.

c) Where the access leg services a two or more lots, the minimum construction requirement shall be 150mm thick limestone sub-base and 75mm thick emulsion stabilised limestone roadbase (rock base may be approved) and a 10mm aggregate seal constructed to the City's specifications.

WD1.28 SUPERELEVATION (See AusSpec D1.28)

WD1.29 SCOUR PROTECTION (See AusSpec D1.29)

INDUSTRIAL DESIGN

WD1.30 GENERAL

1. In addition to the foregoing sections this section specifically applies to all those sites identified as being suited to industrial subdivisions.

2. The City has traditionally applied the additional classifications to the road hierarchy network to meet the special needs of industrial / commercial subdivisions.

Additional Road Hierarchy Classification

- Class 1 Roads:- Class 1 roads refer to those areas where the abutting land use is zoned "General and Composite light Industrial".
- Class 2 Roads:- Class two roads are those in "Service and Trade" areas

3. Culs-de-sac are generally not supported in Industrial / Commercial subdivisions due to overlength / overwidth and large turning radii requirements of commercial type vehicles. However should they be approved they shall have a minimum head radius of 15 metres with 20 metre transitions.

Cul de sacs

4. The following carriageway widths and reserve widths have traditionally been prescribed for Industrial subdivisions. Designers who wishing to submit alternative widths should support their application with suitable information highlighting acceptable performance in the following elements

Road Reserve Widths

- Technical Standards
- Safety
- Amenity
- Technical standard (Design standards & Public utility)
- Economy (Construction and asset maintenance)

Hierarchy Classification	Industrial Road Class	Carriageway Width	Reserve Width (Minimum)	Horizontal Curve Min	Verge Width (Minimum)
Collector	Class1	12.0m	30m	150m	5.0m
	Class2	10.0m	25m	150m	5.0m
Local	Class1	10.0m	25m	150m	5.0m
	Class2	10.0m	20m	150m	5.0m

WESTERN AUSTRALIA

DEVELOPMENT DESIGN SPECIFICATION

D1

GEOMETRIC ROAD DESIGN (Urban and Rural)

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. Traditional standards are added at the rear of the Aus-Spec specification (white pages) and are transcribed onto yellow paper for ease of identification.

The requirements of the yellow pages are to be read as additional to those prescribed in the relevant section of the Aus-Spec document.

The following outline amendments to the Aus-Spec document that brings that document in line with industry practice in Western Australia. Amendment code indicated below are 'M' for modification to script, 'A' for additional Clause added and 'O' for omission of script.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
01	Certificate in the format detailed in DQS while desirable is not essential	D1.06(d)	M	GFM	03-07-00
02	Carriageway widths indicated in Fig D1.2 to D1.5 are to be modified to suit the requirements of those outlined in the WAPC Policy and "Liveable Neighbourhoods" Community Codes.	D1.07	M	GFM	03-07-00
03	D1.14 & Table D.1.5 has been amended and incorporated into WD1.14 of the yellow pages. Table brought in line with IMEA (W.A) requirements.	D1.14 & Table D.1.5	M	GFM	03-07-00
04	Industrial Design criteria incorporated into specification.	WD1.30	A	GFM	03-07-00

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DEVELOPMENT DESIGN SPECIFICATION D1
GEOMETRIC ROAD DESIGN (Urban and Rural)

GENERAL

D1.01 SCOPE

1. This section sets out the specifications developed specifically for the design of subdivision roadworks using principles of street design to ensure safety and improved amenity and to reduce pedestrian/vehicular conflicts.

Subdivision Roadworks

2. A fundamental requirement of the design process is for designers to determine the vehicle speed which is deemed acceptable for a particular subdivision or section of road. The concept of designing to regulatory street speeds is contrary to the current principles of subdivision road design.

Acceptable Vehicle Speed

3. All relevant design principles must 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.

Integrated Design Principles

4. The words "street" and "road" are interchangeable throughout all parts of this Specification.

5. For the purpose of this Specification the definition of terms used to define the components of the road reserve shall be in accordance with AS 1348.1 and AMCORD.

Road Reserve Component Definitions

AS 1348.1 terms:

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 (verge).

Pathway - A public way reserved for the movement of pedestrians and of manually propelled vehicles (AMCORD 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.

AMCORD term:

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.

D1.02 AIMS

1. The provision of a road system within a subdivision is to be designed so as to achieve the following aims:

- Provide convenient and safe access to all allotments for pedestrians, vehicles and cyclists.
- Provide safe, logical and hierarchical transport linkages with existing street system.
- Provide appropriate access for buses, emergency and service vehicles.
- Provide for a quality product that minimises maintenance costs.
- Provide a convenient way for public utilities.
- Provide an opportunity for street landscaping.
- Provide convenient parking for visitors.
- Have appropriate regard for the climate, geology and topography of the area.

D1.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

All Specifications for Design and Construction.

(b) Australian Standards

AS 1348.1	-	Road and traffic engineering – Glossary of terms, Road design and construction.
AS 2890.1	-	Parking facilities: Off-street car parking.
SAA HB69.14	-	Guide to traffic engineering practice - Bicycles.
AS/NZS 3845	-	Road safety barrier systems.

(c) WA State Authorities

Western Australian Planning Commission Policies

DC1.4	-	Functional Road Classification for Planning (July, 1988)
Guidelines	-	The Design and Geometric Layout of Residential Roads (Nov, 1989)
DC1.5	-	Bicycle Planning (Feb, 1990)
DC2.6	-	Residential Road Planning (Dec, 1992)
DC4.1	-	Industrial Subdivisions

Policy for Installation by Public Utility Authorities within the Road Reserve

(d) Other

AUSTROADS	RURAL ROAD DESIGN - Guide to the Geometric Design of Rural Roads.
	Guide Policy for the Geometric Design of Major Urban Roads.
	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

The Institute of Municipal Engineering Australia, Qld Division - 1993: Design Guidelines for Subdivisional Streetworks.

ARRB Special Report No. 33, L E Comerford: A Review of Subdivision Road Design Criteria.

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

Stapleton, C 1984: Streets Where We Live - A Manual for the Design of Safer Residential Estates.

Stapleton, C 1988, Dept of Transport South Australia: Planning & Road Design for New Residential Subdivisions.

Brindle, R 1988, ARRB: Planning & Design of the Local Distributor.

Colman, J 1978, ARRB: Streets for Living.

Pak-Poy Kneebone - 1989: Research Study into Road Characteristics for Residential Development.

D1.04 CONSULTATION

1. Designers are encouraged to consult with the Council and other relevant authorities prior to or during the preparation of design. Designers should in addition to requirements of this Specification ascertain specific requirements of these authorities as they relate to the designs in hand. ***Council, Other Authorities***

2. Public consultation on designs shall be provided where such action is required by Council's current policy. ***Public Consultation***

3. The Designer shall obtain service plans from all relevant public utility authorities and organisations whose services may exist within the area of the proposed development. These services are to be plotted on the relevant drawings including the plan and cross-sectional views. ***Public Utilities***

D1.05 PLANNING CONCEPTS ***Differentiation***

1. 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 related physical design standards. Routes should differ in alignment and design standard according to the volume of traffic they are intended to carry, the desirable traffic speed, and other factors. ***Road Hierarchy***

2. The road pattern and width must be in conformity with that shown on any relevant Approved Subdivision Plan. In areas not covered by these plans, the pattern and width(s) will be determined by Council on their merits. ***Conformance with ASP***

3. The road network for residential developments should have clear legibility. ***Legibility***

4. The road network should reinforce legibility by providing sufficient differentiation between the road functions. ***Differentiation***

5. Distinct landmark features such as watercourses, mature vegetation or ridge lines should be emphasised within the structural layout so as to enhance the legibility. ***Landmark Features***

6. 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.

Introduced Features

7. 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.

Intersection Turning Movements

D1.06 DRAWING REQUIREMENTS

(a) Reduction Ratios

1. All plans for urban design are to be reduced to 1:500. Rural designs may be reduced to 1:1000.

Longitudinal Sections	1:500 H 1:100 V
Cross Sections	1:100 Natural

(b) Drawing Sheets

1. Separate sheets should be provided for

a. Cover sheets
b. Plan views
c. Longitudinal sections
d. Cross sections
e. Structural details
f. Standard drawings

(c) Plan Presentation

1. Drawings are to be presented on A1 sheets unless otherwise authorised. They are to be clear and legible and prepared in consistent lettering and style. Council has the authority to refuse drawings that do not meet these drafting requirements. Drawings copied from other works will not be accepted. All drawings shall be clearly referenced with notations and tables as appropriate. The Designer should always be mindful that apart from being a permanent record and legal document, drawings should be easily read and understood by the Contractor, and others involved in the construction of the Works. Terminology should be kept in 'plain English' where possible.

Clear and Legible, Permanent Record, Legal Document

2. The scope and sequence of drawing sheets shall comply with the example provided in Annexure DQS-B of the Specification for QUALITY ASSURANCE REQUIREMENTS FOR DESIGN.

Compliance

(d) Certification

1. Drawings shall bear the signature of the design consultant and shall where required by the Council be certified as complying with the appropriate design specifications (D1 to D10). The certificate shall be in the format detailed in Annexure DQS-A of the Specification for QUALITY ASSURANCE REQUIREMENTS FOR DESIGN.

Design Consultant

URBAN DESIGN CRITERIA

D1.07 ROAD HIERARCHY

1. 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 on Figure D1.1. ***Functionality***

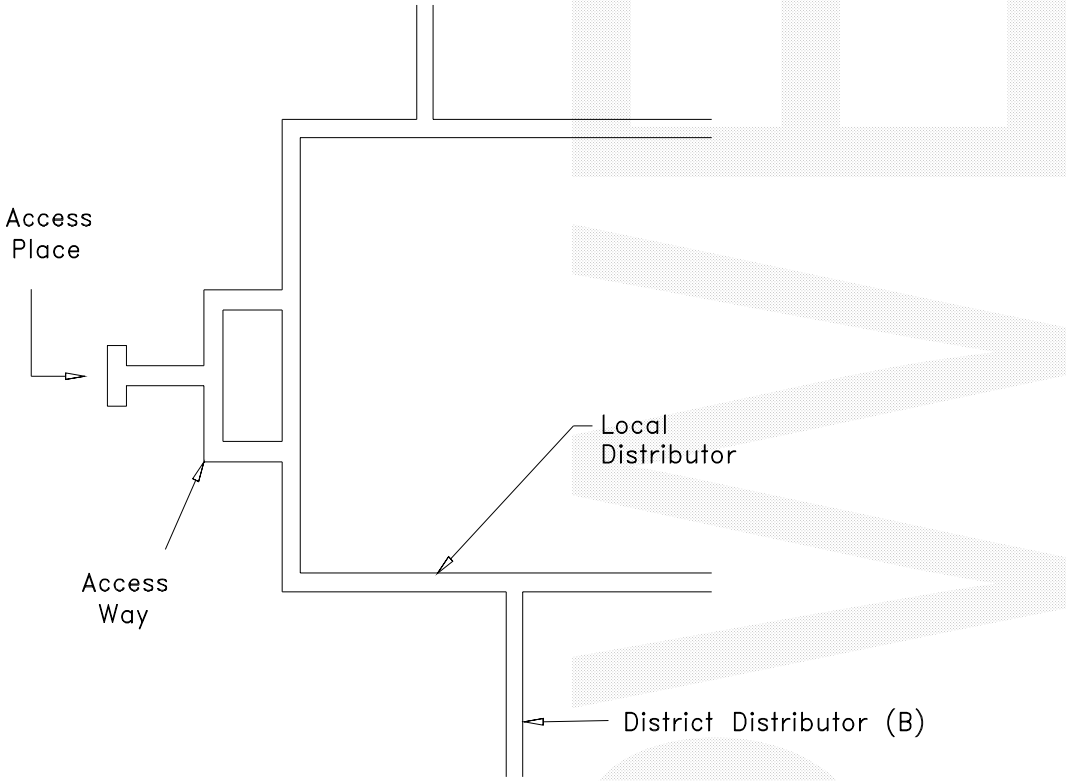


Figure D1.1
Typical Road Hierarchy

2. Four distinct levels of roads are:

- Access Place
- Access Way
- Local Distributor
- District Distributor (B).

Access Place

3. The lowest order road (access place) having as its primary function, residential space - amenity features which facilitate pedestrian and cycle movements, and where vehicular traffic is subservient in terms of speed and volume, to those elements of space, amenity, pedestrians and cyclists. The features of a typical access place are shown in Figure D1.2.

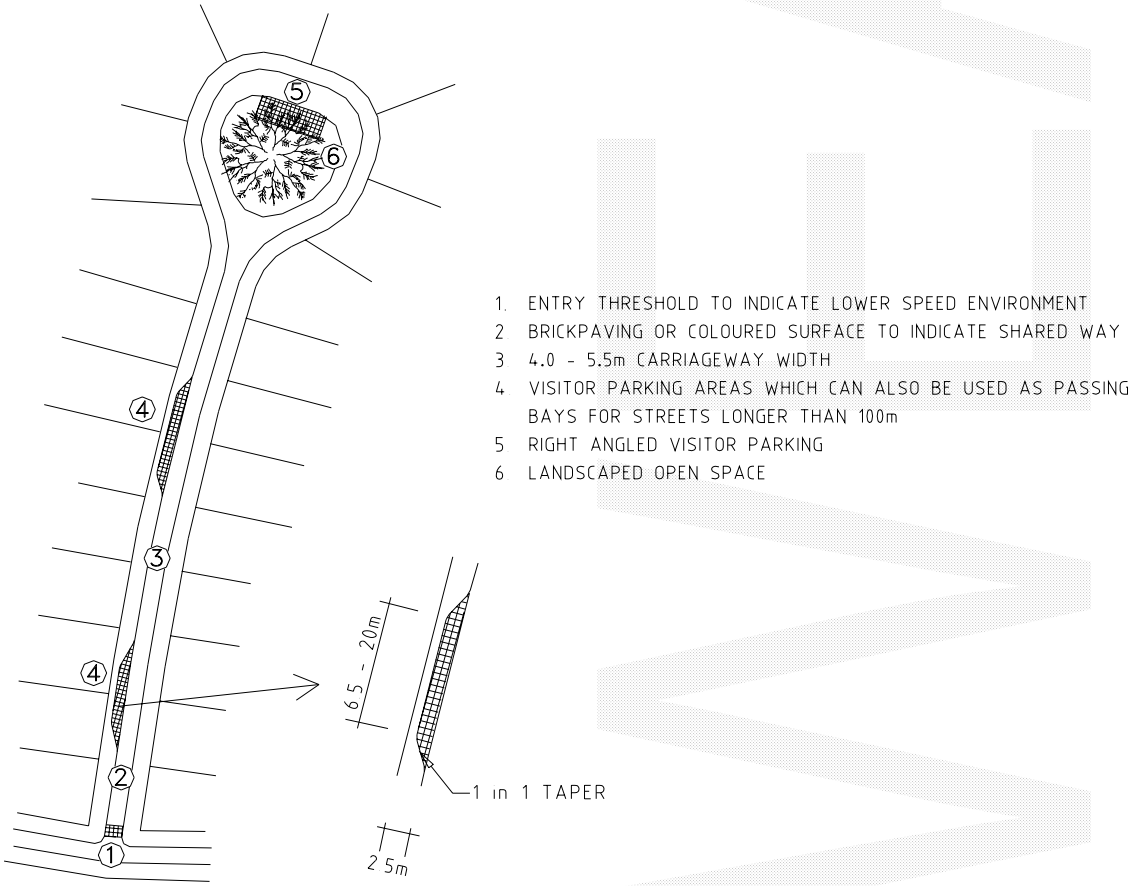
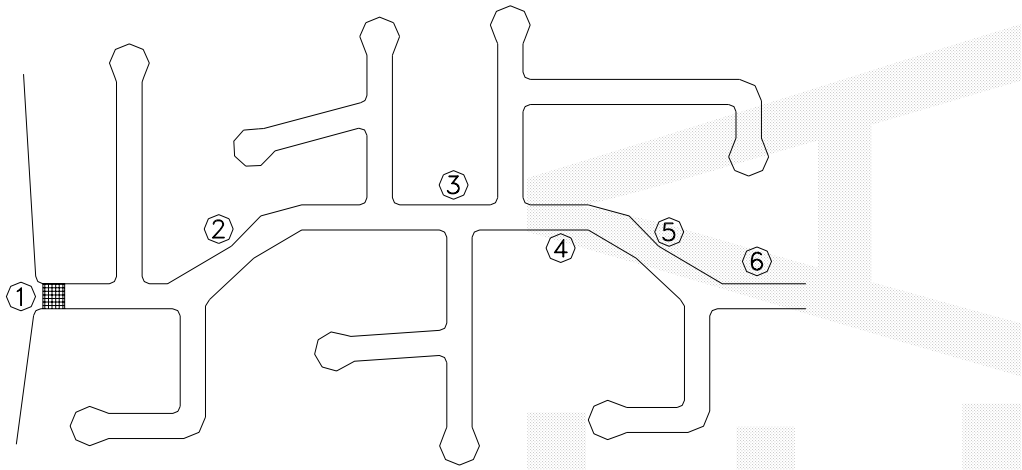


Figure D1.2
Access Place

Access Way

4. The next level road (access way) as a local residential street 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 places. A typical access way is illustrated in Figure D1.3.



1. BRICK-PAVED ENTRY THRESHOLD SIGNIFIES ENTRY TO LOWER SPEED ENVIRONMENT
2. BENDS IN CARRIAGEWAY CONTROL SPEED
3. SHORT SECTIONS OF STRAIGHT CARRIAGEWAY CONTROL SPEED
4. CARRIAGEWAY WIDTH 5.5 - 6.0m
5. 1.2m FOOTPATH ON ONE SIDE
6. SEMI MOUNTABLE / MOUNTABLE / FLUSH KERBING

Figure D1.3
Access Way

Local Distributor

5. The second highest order road (local distributor) 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 place and access way. A typical local distributor is shown in Figure D1.4.

- MAXIMUM VOLUME 3000 VPD WITH DIRECT ACCESS TO INDIVIDUAL DRIVEWAY, 6000 VPD OTHERWISE
- MAXIMUM SPEED 50 KPH WITH DRIVEWAYS, 60 KPH OTHERWISE
- CARRIAGEWAY SHARED BY VEHICLES AND CYCLISTS
- AS A CUL-DE-SAC ARRANGEMENT SERVES APPROXIMATELY 16 Ha

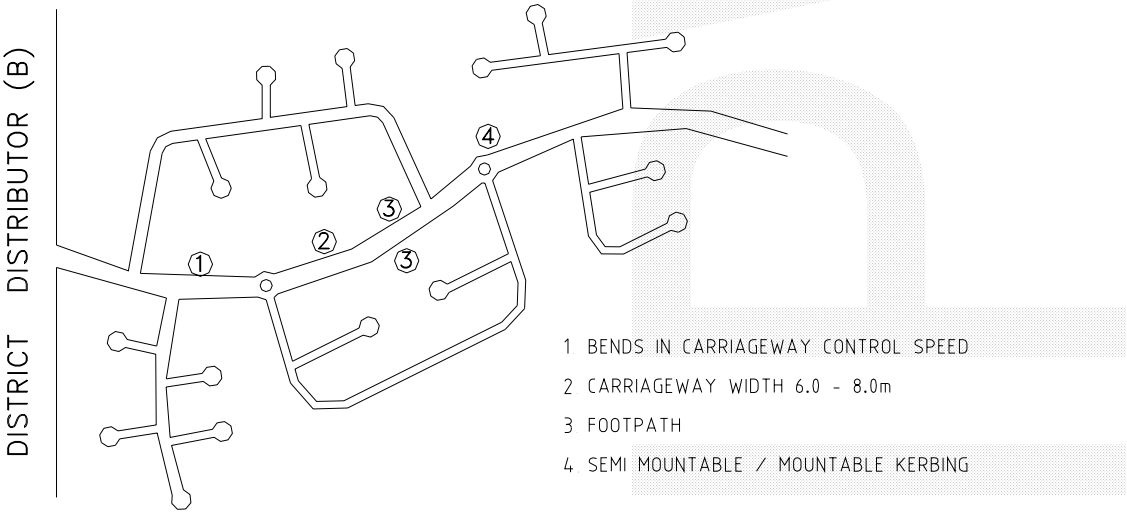


Figure D1.4

6. The highest order road (district distributor (B)) within a residential development 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 district distributor (B) should serve only the development and should not attract through traffic. Figure D1.5 shows the layout of a district distributor (B) road. ***District Distributor (B)***

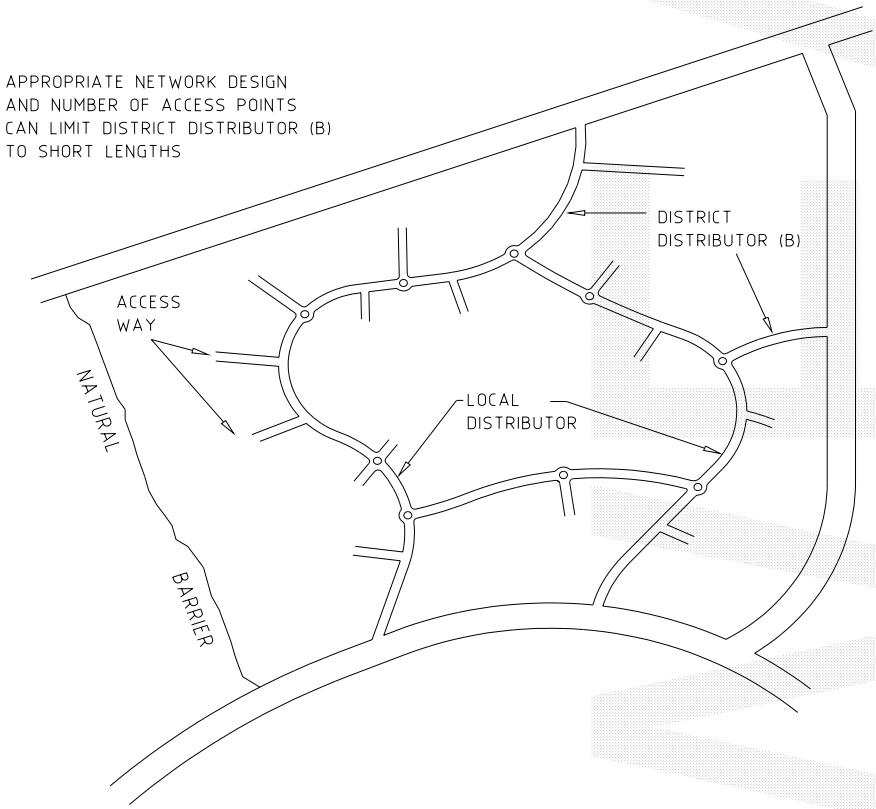


Figure D1.5
District Distributor (B)

D1.08 ROAD NETWORK

1. The design features of each type of road convey to the driver its primary functions and encourage appropriate driver behaviour (refer Figure D1.2 to D1.5).

2. Traffic volumes and speeds on any road should be compatible with the residential functions of that road. ***Compatibility***

3. The maximum length of an access place should ensure its status as a residential place is retained, where the traffic, in terms of speed and volume will enable the integration of pedestrian, bicycle and vehicular movements. This length will also ensure that residential convenience is not unduly impaired as a result of speed restraints. ***Access Place***

4. The length of district distributor (B) within a development should be minimised. ***District Distributor (B)***

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

6. Where access places form part of a pedestrian or bicycle network, access links should provide suitable connectivity with adjoining access places or open space systems so as to ensure such pedestrian and bicycle network are functionally efficient.

Pedestrian or Bicycle Network

7. The road network should ensure that no road links with another road which 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, however, no access place or access way should have access to an access-controlled arterial road.

Road Links

8. Connections between internal roads should be T-junctions or controlled by roundabouts.

Internal Road Connections

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

Transport Provisions

10. The external road network should be designed and located to provide routes which are more convenient for potential through traffic within the network. Major roads should be provided at intervals of no more than 1.5 km and should be complete and of adequate capacity to accommodate through network movements. The internal road system should not provide through routes that are more convenient than the external road network.

External Road Network

D1.09 DESIGN SPEED

1. Design speed is generally used as the basic parameter in the specification of design standards, determining the minimum design value for other elements. 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. The standard speed limit in WA for built-up areas is 60 km/h and this should be used in calculating design values which depend on speed, (eg local and district distributor roads) however, 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.

Main Roads WA Guidelines

2. 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 standard roads, operating speeds will tend to be in excess of arbitrary speed standards. Attention should be given to ensuring that potentially hazardous features are visible to the driver and adopting traffic engineering measures which will help a driver avoid errors of judgement.

Low Speeds

Hazardous Features

3. Generally the following design speeds should be adopted:

Access Place	40 km/h
Access Way	40 km/h
Local Distributor	60 km/h
District Distributor (B)	70 km/h

4. The need for road safety barriers shall be assessed and designed in accordance with AS/NZS 3845.

Road Safety Barriers

D1.10 LONGITUDINAL GRADIENT

1. A general minimum gradient of 0.5 per cent should be adopted. In very flat conditions it may be reduced to 0.3 per cent. Variable crossfall may be necessary to produce the required grade in the gutter. Maximum recommended grades are shown in Table D1.1.

Flat Terrain

Table D1.1 Maximum Recommended Longitudinal Grades

	Access Place/Way	Local Distributor	District Distributor (B)	Rural
Desirable maximum percentage*	12	10	8	10
Absolute maximum percentage*	16	12	10	12

* maximum length 150 m on straight alignment.

Intersections

2. Longitudinal grade of the minor street on the approach to an intersection should not exceed 4 per cent, 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

3. Turning circles in cul-de-sacs on steep grades should have grades less than 5 per cent.

D1.11 HORIZONTAL CURVES AND TANGENT LENGTHS

Speed/Radius Relation

1. The horizontal alignment of a road is normally in a series of tangents (straights) and curves which may be 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 as described in Clause D1.09. 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 which progressively tighten produce an uncomfortable sense of disorientation and alarm. Sudden reverse curves which drivers cannot anticipate also have a potential to cause similar conditions.

Speed Restriction

2. Where speed restriction is provided by curves in the street alignment the relationship between the radius of the curve and the desired vehicle speed is given in Table D1.2(a).

Tangent Length

3. To determine appropriate lengths for tangents between speed restrictions, which may be curves, narrow sections or other obstructions, Table D1.2(b) is recommended.

4. Sight distance on curves is determined by formula, values of which are tabulated in AUSTROADS Guide to the Geometric Design of Rural Roads.

Table D1.2(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	15	10
25	20	15
30	30	20
35	50	30
40	90	40
45	105	50
50	120	60
55	140	70
60	160	80

Table D1.2(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						
	25	30	35	40	45	50	60
20 or less	40	75	100	120	140	155	180
25	-	45	75	100	120	140	165
30	-	-	45	80	100	120	150
35	-	-	-	50	80	100	135
40	-	-	-	-	55	80	120
45	-	-	-	-	-	60	105

NOTE:
Tables D1.2(a) and D1.2(b) are derived from AMCORD.

D1.12 VERTICAL CURVES

Criteria

1. Vertical curves will be simple parabolas and should be used on all changes of grade exceeding 1 per cent. The desirable minimum design speed is 60 km/h. The length of the crest vertical curve for stopping sight distance should conform with AUSTROADS Guide to the Geometric Design of Rural Roads. These standards are based on 1.5 seconds reaction time which provides a reasonable safety margin for urban conditions, where drivers' reaction time is usually considered to be lower than in rural conditions.

Riding Comfort

2. For adequate riding comfort, lengths of sag vertical curves should conform with the AUSTROADS Guide to the Geometric Design of Rural Roads. 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 length for sag vertical curves are shown in Table D1.3.

Table D1.3
Minimum Length of Sag Vertical Curves

	Access Place/Way (m)	Local Distributor (m)	District Distributor (B) (m)
Minimum length of vertical curve	25	35	50
Absolute minimum length of vertical curve (to be applied at road junctions only)	6	12	20

Side Road Junctions

3. 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

4. Drainage poses a practical limit to the length of sag curves and a maximum length (in metres) of 15 times the algebraic sum of the intersecting vertical grades (expressed as a percentage) has been suggested. This is to avoid water ponding in excessively flat sections of kerb. A minimum grade of 0.5 per cent should be maintained in the kerb. This may require some warping of road cross sections at sag points.

5. The three dimensional coordination of the horizontal and vertical alignment of a road should be aimed at improved traffic safety and aesthetics. Economic considerations often require a compromise with aesthetic considerations. The following principles should be applied:

Horizontal and Vertical Alignment Coordination

- 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 gradeline between sag curves may adversely affect the road's symmetry and appearance.

D1.13 SUPERELEVATION

1. 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 places and ways which are designed for speeds of 40 km/h or less and with curves of 60m 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.

Low Design Speed, Crowned Pavement

2. The maximum superelevation for urban roads of higher design speeds should be 6 per cent. 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 per cent.

High Design Speed

3. 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.

Criteria

4. Recommendations for minimum curve radii (in metres) on major urban roads under varying superelevation/crossfall are shown in Table D1.4.

Table D1.4
Minimum of Radius of Curvature

	Design Speed km/h	60	70	80
Minimum Superelevation (%)	5	145	195	255
	4	150	205	265
	3	160	215	280
	2	170	230	300
	1	180	245	315
Maximum Crossfall (%)	0	190	260	340
	1	260	355	460
	2	285	390	505
	3	315	430	560

(Source: NAASRA (Now AUSTROADS), Guide policy for the geometric design of major urban roads.)

Transitions, Offset Crowns

5. 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 2m 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.

D1.14 ROAD RESERVE CHARACTERISTICS

Cross Section Provisions

1. 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 D1.5 details characteristics of the road reserve.

Table D.1.5 Characteristics of Roads in Residential Subdivision Road Networks

Road Type	Maximum Traffic Volume (vpd) [1]	Maximum Speed [2] (km/h)	Carriageway Width (m)[3] Minimum	Maximum	Parking Provisions Within Road Reserve [3]	Kerbing [4]	Footpath Requirement	Bicycle-path Requirement	Verge Width (each side)
Access Place	200	20	4.0 [5]	5.5	1.0 widened parking strips	Semi Mountable/ Mountable/ Flush	No	No	4.0 - 4.5[6]
Access Way	800	30	5.5	6.0	On Carriageway Off Carriageway in widened parking strips	As Above	One side [7]	No	4.0 - 4.5[6]
Local Distributor	3,000 with access to residential allotments, 6,000 otherwise	50 [8] with access to driveways, 60 otherwise	6.0	8.0	As above	Semi Mountable/ Mountable[9]	At least one side	Most likely [10]	4.2 - 6.3
District Distributor (B)	8,000	70	7.4	10.0	As above	Semi Mountable/ Barrier	At least one side	Yes	5.0 - 6.3

Derived from AMCORD

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 Clauses D1.09 and D1.11 on designing for specific operating speeds.

3. Widening required at bends to allow for wider vehicle paths (using AUSTROADS Turning Templates). Widths exclude parking areas.

4. Maximum carriageway widths required if barrier kerbing used.

5. Requires parking provision and provision for widening to 5.0m if necessary in the future.

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 5.0m 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 Specification.

9. Barrier kerbing may be used if required for drainage purposes without reducing the carriageway width.

10. Where bicycle way can be anticipated, a bicycle lane is required along the kerb.

* Many elements are inter-related. Therefore variations from any particular recommended characteristic may require changes to others.

Operational Aspects

2. The carriageway width must 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.

Pedestrians, Cyclists

3. 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

4. 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.

Discourage Speeding

5. 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

6. 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

7. 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.

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

D1.15 CROSSFALL

1. Desirably, roads should be crowned in the centre. However, in narrow access roads, inverted roads with central drainage may be permitted. Typical pavement crossfalls on straight roads are:

Pavement Type	*Crossfall*
Bituminous seal coat	3 per cent
Bituminous concrete pavement	2.5 per cent
Cement concrete pavement	2 per cent

(Source: NAASRA (Now AUSTROADS), Guide policy for geometric design of major urban roads.)

Offset Crown Lines

2. There are many factors affecting levels in urban areas which 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 per cent, although up to 6 per cent may be used where unavoidable. The rate of change of crossfall should not exceed: 6 per cent per 30m for through traffic; 8 per cent per 30m for free flowing turning movements; or 12 per cent per 30m for turning movements for which all vehicles are required to stop.

Rate of Change

Precedence

3. The crossfall on a local distributor or district distributor (B) 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 per cent in the kerb line of the side street relative to the centre line grading is a reasonable level.

D1.16 VERGES AND PROPERTY ACCESS

Criteria

1. A suitable design for the verge will depend on utility services, the width of footpaths, 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 per cent, in accordance with AUSTROADS Guide to Traffic Engineering Practice, PART 13, Pedestrians. Longitudinal grade usually parallels that of the road and this may be steeper than 5 per cent.

Options

2. 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 half the verge width with the half against the kerb constructed at standard crossfall.
- A uniform crossfall across the carriageway.
- The lower verge being depressed below the gutter level.

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

4. 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. ***Driveway Profile***

D1.17 INTERSECTIONS

1. 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 district distributor (B) roads. ***Traffic Volumes***

2. Intersection design for the junction of subdivision 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, Intersections at Grade. ***State Roads, National Higways***

3. Intersections with state roads, or national highways are to be designed and constructed in accordance with the requirements of the Main Roads of WA. ***Approval of MRWA***

4. Where major intersections are required to serve a development complete reconstruction of the existing road pavements will be necessary where the speed environment and irregularity of the existing road pavement may endanger the safety of traffic in the locality. ***Existing Road Pavements***

5. Intersections should be generally located in such a way that: ***Criteria***

- The streets intersect preferably at right-angles and not less than 70°.
- 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 left-right staggered pattern should have a minimum centreline spacing of 50m to provide for a possible right-turn auxiliary lane on the major street.
- A right-left manoeuvre between the staggered streets is preferable, avoiding the possibility of queuing in the major street.

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

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

8. The drainage function of the carriageway and/or road reserve must be satisfied by the road reserve cross-section profile. ***Drainage***

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

- For intersection turning movements involving district distributor (B) roads, the "design semi-trailer" with turning path radius 15.0m.
- For intersection turning movements involving access ways or local distributor roads, but not district distributor (B) roads, the "design single unit" bus with turning path radius 13.0m.
- For intersection turning movements on access places but not involving district distributor (B) roads, local distributor or access ways, the garbage collection vehicle used by the local authority.
- For turning movements at the head of cul-de-sac access places sufficient area is provided for the "design single unit" truck to make a three-point turn or where the length of the cul-de-sac is less than 60m for the "design car" to make a three-point turn. Where driveway entrances are to be used for turning movements, the required area is to be designed and constructed to withstand the relevant loads.

10. Turning radii at intersections or driveways on district distributor (B) road accommodate the intended movements without allowing desired speeds to be exceeded. ***Turning Radii***

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

D1.18 ROUNDABOUTS

1. Roundabouts are to be approved by the Council and the MRWA. ***Approval***

2. Roundabouts should generally be designed in accordance with the requirements of the publication AUSTROADS Guide to Traffic Engineering Practice - PART 6 Roundabouts. Designs adopting alternative criteria will be considered on their merits. Roundabout design should generally comply with the following: ***Criteria***

- 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.

D1.19 TRAFFIC CALMING

1. Traffic calming devices are to be approved by the Council. ***Approval***

2. Calming devices such as thresholds, slowpoints, speed humps, chicanes and splitter islands should be designed in accordance with the requirements of the publication AUSTROADS Guide to Traffic Engineering Practice - PART 10, Local Area Traffic Management (LATM). Devices designs should generally comply with the following:

Criteria

(a) 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.

(b) 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 100-150m.

(c) Design Vehicles

- emergency vehicles must be able to reach all residences and properties
- access ways with a 'feeding' function between arterial roads and minor access ways 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 LATM principles, building construction traffic must be provided for.

(d) 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 300m), using appropriate devices, streetscapes, or street alignment to create short sight lines

(e) 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.

(f) 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 3.50m between kerbs
  - 3.75m between obstructions
  - two lane 5.50m minimum between kerbs
- bicycle lanes (including adjacent to pavement narrowings) – 1.2m absolute minimum (1.0m in special circumstances in accordance with AUSTROADS Guide to Traffic Engineering Practice – PART 14, Bicycles.)
- 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
  - 1.0m maximum

  (ie. 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.

D1.20 PARKING

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

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

3. 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. Such parking is to be convenient to dwellings. ***Road Reserve Parking***

4. 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. ***Obstruction***

5. On single lane access places parking spaces should be provided within the verge. Such parking should be well defined and an all-weather surface provided. Such parking shall not restrict the safe passage of vehicular and pedestrian traffic. ***Verge Parking***

6. Parking spaces provided on the verge or carriageway should be of adequate dimensions, convenient and safe to access.

7. For non-residential land uses the opportunity for joint use of parking should be maximised by being shared by a number of complementing uses. ***Joint Use***

8. Two car parking spaces (which may be in tandem) are provided on-site for each single dwelling allotment. ***2 Spaces***

9. Three spaces are provided on-site for each two dwelling units for multi-unit residential developments. ***3 Spaces***

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

11. On single lane carriageways one space for each two allotments is constructed on the verge within 25m 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. ***Future Spaces***

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

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

14. 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. ***Verge Spaces, Indented Parking***

15. Right-angled parking is provided only on access places and access ways where speeds do not exceed 40 km/h. ***Right-angled Parking***

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

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

D1.21 RESERVED

RURAL DESIGN CRITERIA

D1.22 GENERAL

1. 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.

2. Design speed is to be generally used as the basic parameter of design standards and the determination of the minimum design value for other elements in rural subdivisions is to be based on the concept of a "speed environment" as outlined in AUSTROADS Guide to the Geometric Design of Rural Roads. ***Design Speed***

3. Where appropriate superelevation, widening and centreline shift and their associated transitions are to comply with the AUSTROADS Guide to the Geometric Design of Rural Roads.

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

5. Access should be limited to one point on to local distributor or district distributor (B) road networks. ***Access***

D1.23 SIGHT DISTANCES

1. Stopping sight distance should be provided at all points on the road. The stopping distance is measured from an eye height of 1.15m to an object height of 0.20m, using a reaction time of 1.5 seconds. A table is provided in the AUSTROADS Guide to the Geometric Design of Rural Roads. ***Stopping Distance***

2. 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: ***Braking Distance***

$$d = 0.42V + \frac{V^2}{254f}$$

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,)

3. Recommended sight distances (based on the above formula) are shown in Table D1.6.

Table D1.6
Stopping Sight Distance

Travel Speed km/h	Coefficient of * longitudinal friction	Stopping sight distance (m)
40	0.52	30
50	0.52	40
60	0.48	55
70	0.45	75
80	0.43	95

* bituminous or concrete surfaces

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

D1.24 HORIZONTAL AND VERTICAL ALIGNMENT

Criteria

1. 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.

D1.25 INTERSECTIONS

Criteria

1. Intersections should generally be designed in accordance with the publication AUSTROADS Guide to Traffic Engineering Practice - PART 5, Intersections at Grade. Generally intersections with existing main and local roads will conform to the layouts shown in Figure D1.6 below. The type of intersection required will depend on existing and planned connecting roads.

Sight Distance

2. 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 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 Part 5 of the AUSTROADS Guide, Intersections at Grade. Repositioning of an intersection may be required to obtain conformance with the sight distance criteria.

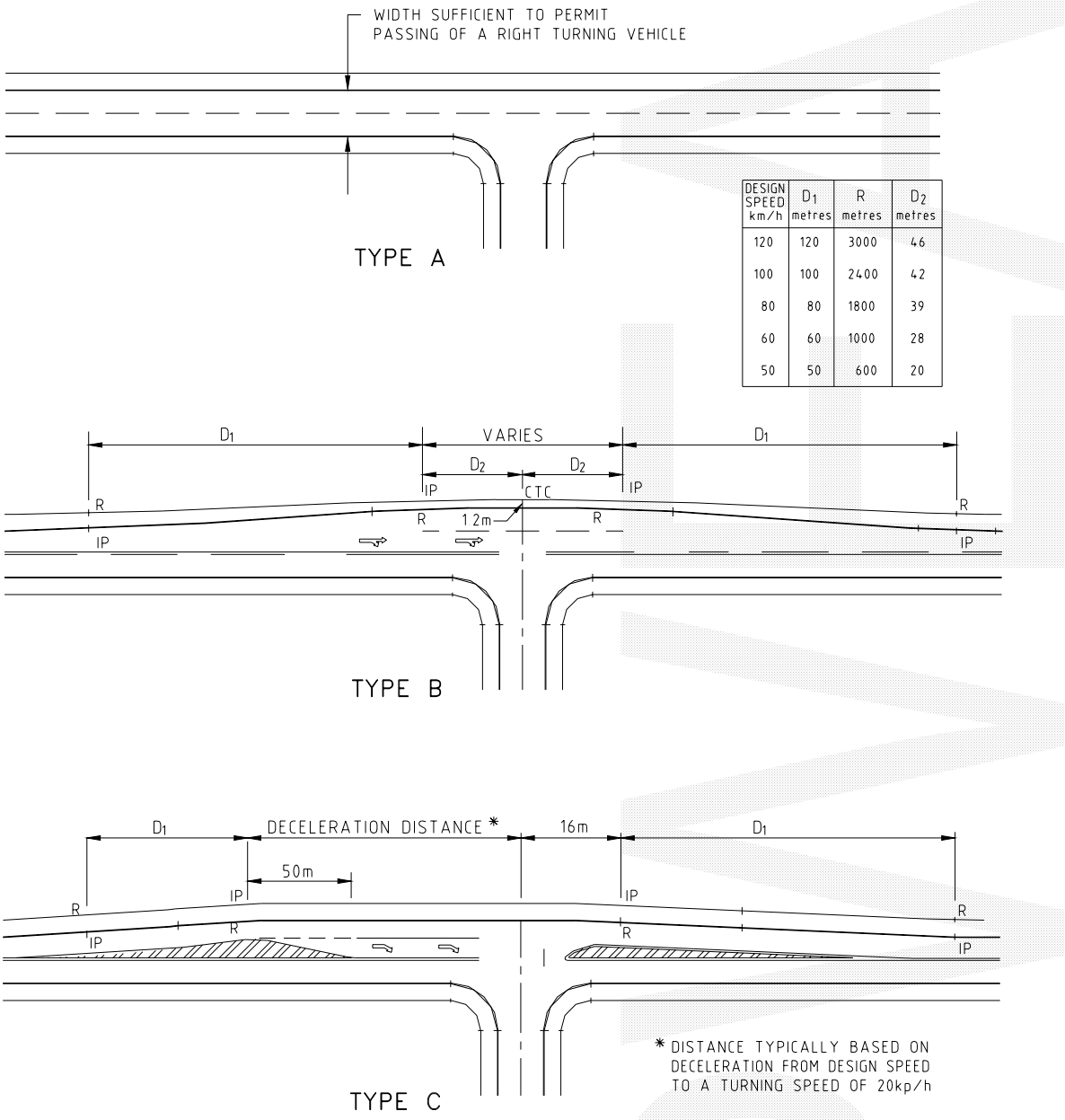


Figure D1.6
Typical Rural Intersection Treatments
Source: AUSTROADS Guide to Traffic Engineering Practice PART 5, Intersections at Grade.

Staggered-T Intersections

3. 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 Part 5 of the AUSTROADS Guide, Intersections at Grade.

D1.26 PLAN TRANSITIONS

Widening and Shift on Curves

1. A plan transition is the length over which widening and shift is developed from the "tangent-spiral" point to the "spiral-curve" point; ie, 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

2. 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 per cent 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.

D1.27 CARRIAGEWAYS

1. Carriageway widths for rural roads should generally be as follows:

Major road over 1,000 AADT	2 x 3.5m lanes
Minor road up to 1,000 AADT	2 x 3.0m - 3.5m lanes
Minor no-through road up to 150 AADT	1 x 3.5m lane
Rural Residential street with kerb	
up to 25O AADT	5 metre
over 250 AADT	7 metre

D1.28 SUPERELEVATION

Design Speed

1. Use of maximum superelevation will 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 for superelevation calculation. At low and intermediate ranges of design speed (ie below 80 km/h) it is desirable to superelevate all curves at least to a value equal the normal crossfall of straights.

D1.29 SCOUR PROTECTION

Roadside Drainage and Table Drains

1. 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.

SPECIAL REQUIREMENTS

D1.30 RESERVED

D1.31 RESERVED

D1.32 RESERVED