Shoalhaven City Council

Engineering Design Specifications

Supplement to Development Control Plan 100

City Administrative Centre, Bridge Road, Nowra
Telephone (02) 4429 3111 • Fax (02) 4429 3178 • Post: PO Box Nowra 2541
Southern District Office, Deering Street, Ulladulla
Telephone (02) 4429 8999 • Fax (02) 4429 8939 • Post: PO Box 737 Ulladulla 2539
council@shoalhaven.nsw.gov.au • www.shoalhaven.nsw.gov.au

CONTENTS

ENGINEERING DESIGN SPECIFICATION

D1

GEOMETRIC ROAD DESIGN (Urban and Rural)

Table of Contents

Table of Figures

ENGINEERING DESIGN SPECIFICATION D1

GEOMETRIC ROAD DESIGN (Urban and Rural)

GENERAL

D1.01 SCOPE

1. This section sets out design specifications to be used in the subdivision of land.

2. All relevant design principles must be integrated in the development of the road network. A careful balance is required between maximising amenity, safety considerations and those related to legibility and convenience.

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 DOCUMENTS

1. Joint Venture for More Affordable Housing – 1989: Australian Model Code for Residential Development.

2. Dept of Environment and Planning Technical Bulletin 12 – 1981 – 2nd Edition: Residential Roadwidths.

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

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

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

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

7. Colman, J 1978, ARRB: Streets for Living.

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

9. Roads and Traffic Authority NSW – 1988: Road Design Guide.

RTA Form No. 892.

10. Austroads – 1993: Interim Guide to the Geometric Design of Rural Roads.

11. Austroads – 1993: Guide to Traffic Engineering Practice – Part 5 Intersection at Grade.

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

13. Dept of Housing Road Manual, June 1987.

14. Austroads 1993: Guide to Traffic Engineering Practice Roundabouts – Part 6.

15. Austroads 1993: Guide to Traffic Engineering Practice Local Area Traffic Management Part 10.

16. AS 2890.1 – Parking Facilities: Standards Australia 1993. Off Street Car Parking.

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.

D1.05 PLANNING CONCEPTS

Road Hierarchy

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.

2. The road pattern and width must be in conformity with that shown on any relevant area Development Control Plan. In areas not covered by these plans, the pattern and width(s) will be determined by Council on their merits and as detailed in Council's Subdivision Code and or development consents issued.

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

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

Legibility

5. Wherever possible distinct landmark features such as watercourses, mature vegetation or ridge lines should be emphasised within the structural layout so as to enhance the legibility.

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.

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

D1.06 PLAN 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. Plan 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

Permanent Record

1. Plans are to be presented on A1 sheets unless otherwise authorised. They are to be clear and legible and prepared in consistent lettering and draftsman style. Council has the authority to refuse plans that do not meet these drafting requirements. Plans copied from other works will not be accepted. All plans 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, plans 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.

d. Certification

Design Consultant

1. Plans 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 D12) and in accordance with conditions of development consent. The certificate shall be in the format detailed by Design Specification DQS.

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.

ROAD TYPES

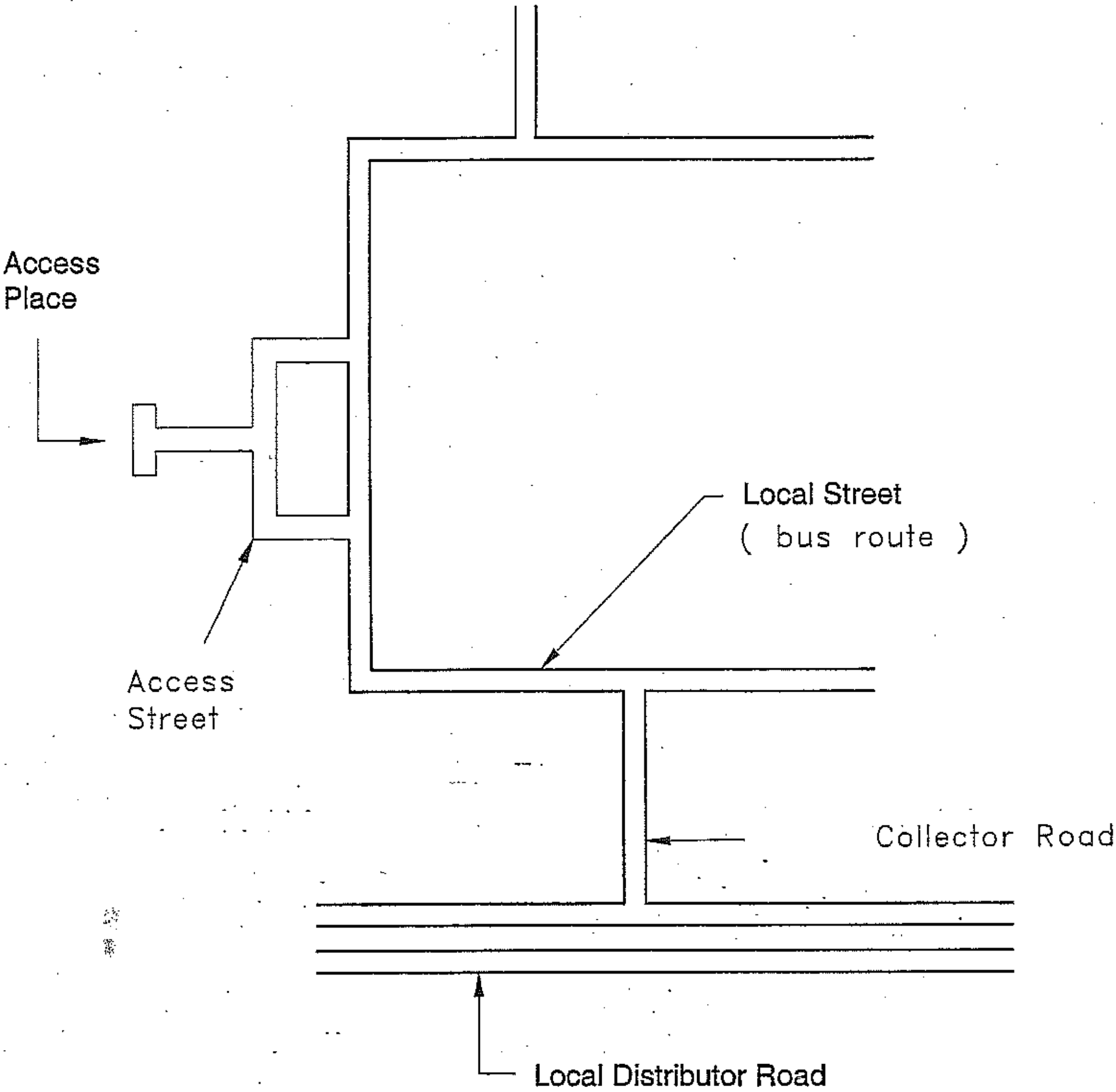


Figure D1.1 - Road Hierarchy

2. Four distinct levels of roads are:
   - Access Street
   - Local Street
   - Collector Street
   - Local Distributor Road.

3. The lowest order road (access street) 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 street are shown in Figure D1.2. The dimensions of a typical cul-de-sac are shown in Fig D1.3 and D1.4. ***Access Street***

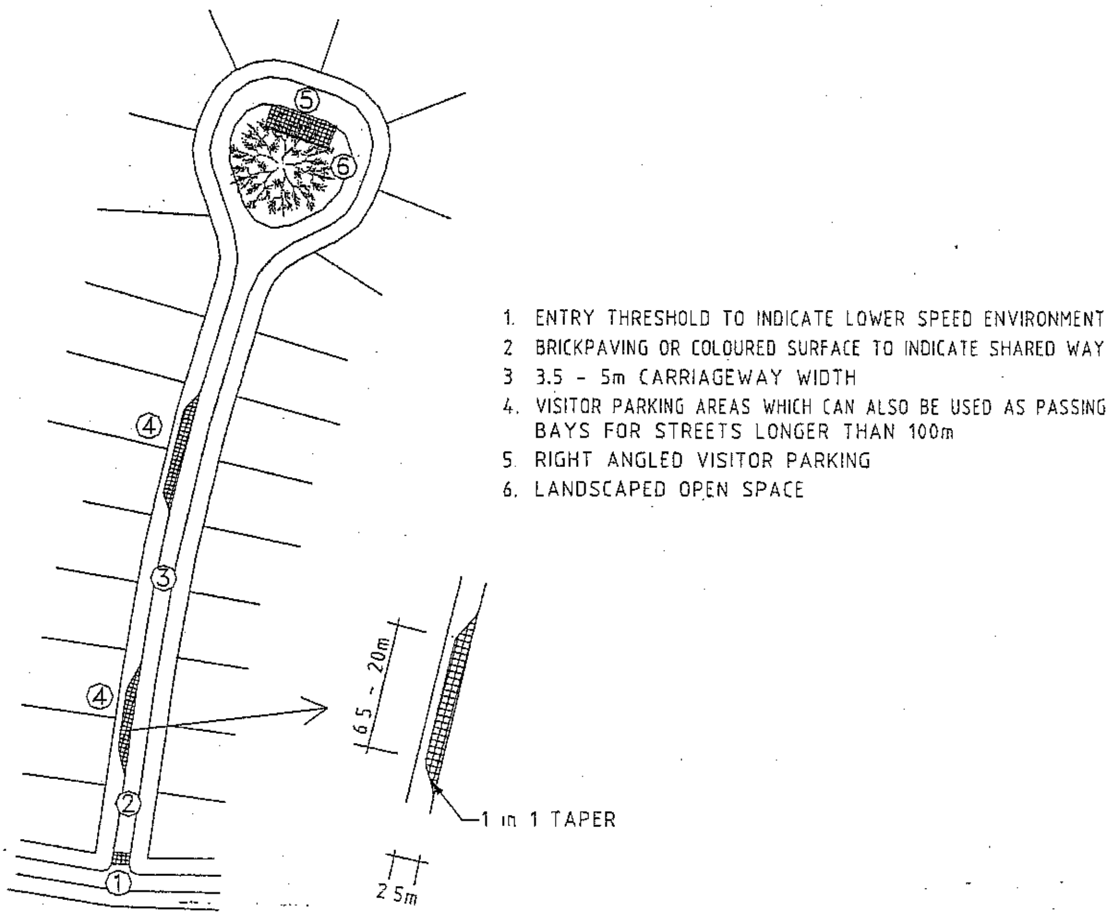


Figure D1.2 - Access Street

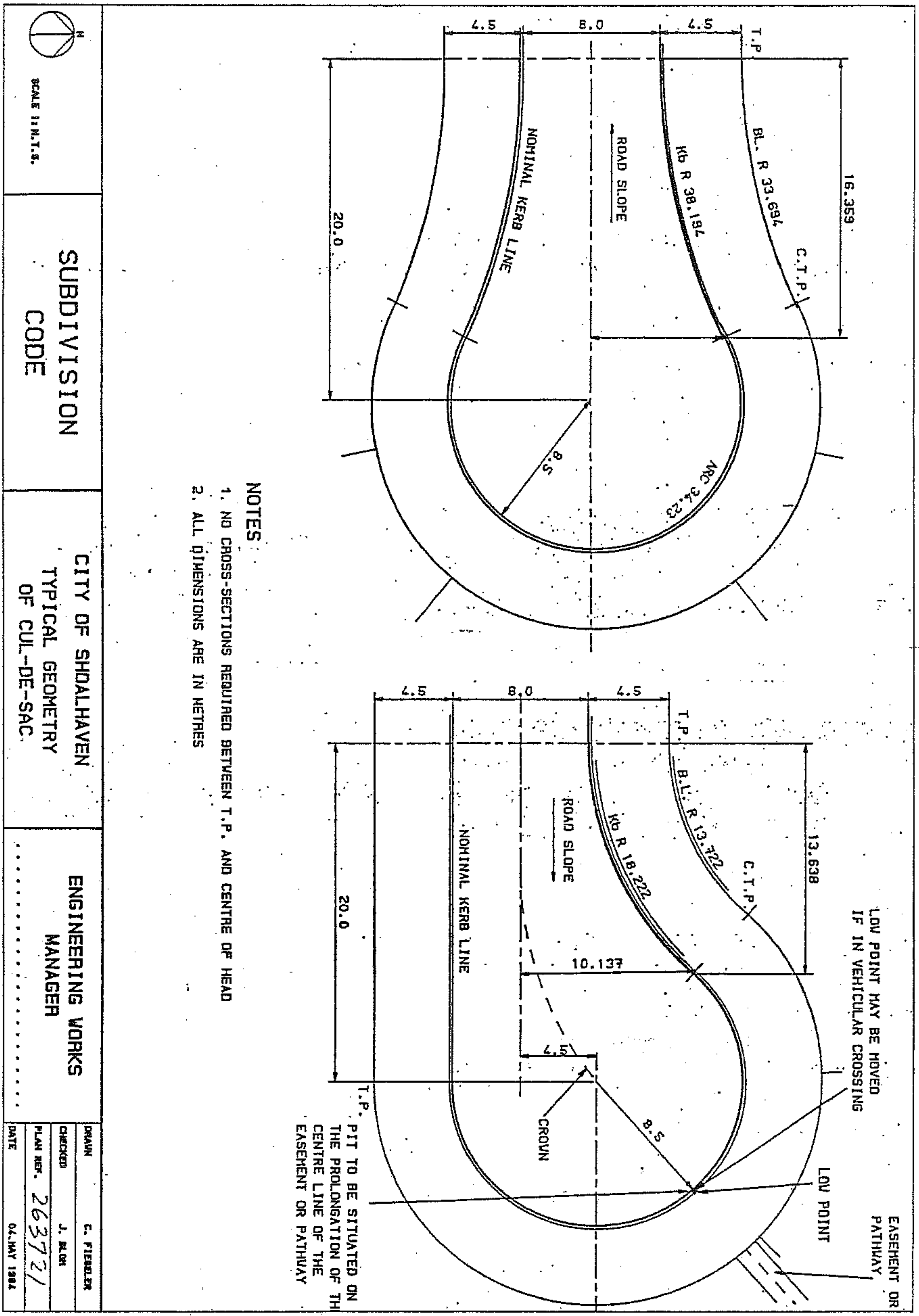


Figure D1.3 -Geometry of a Cul-de-sac

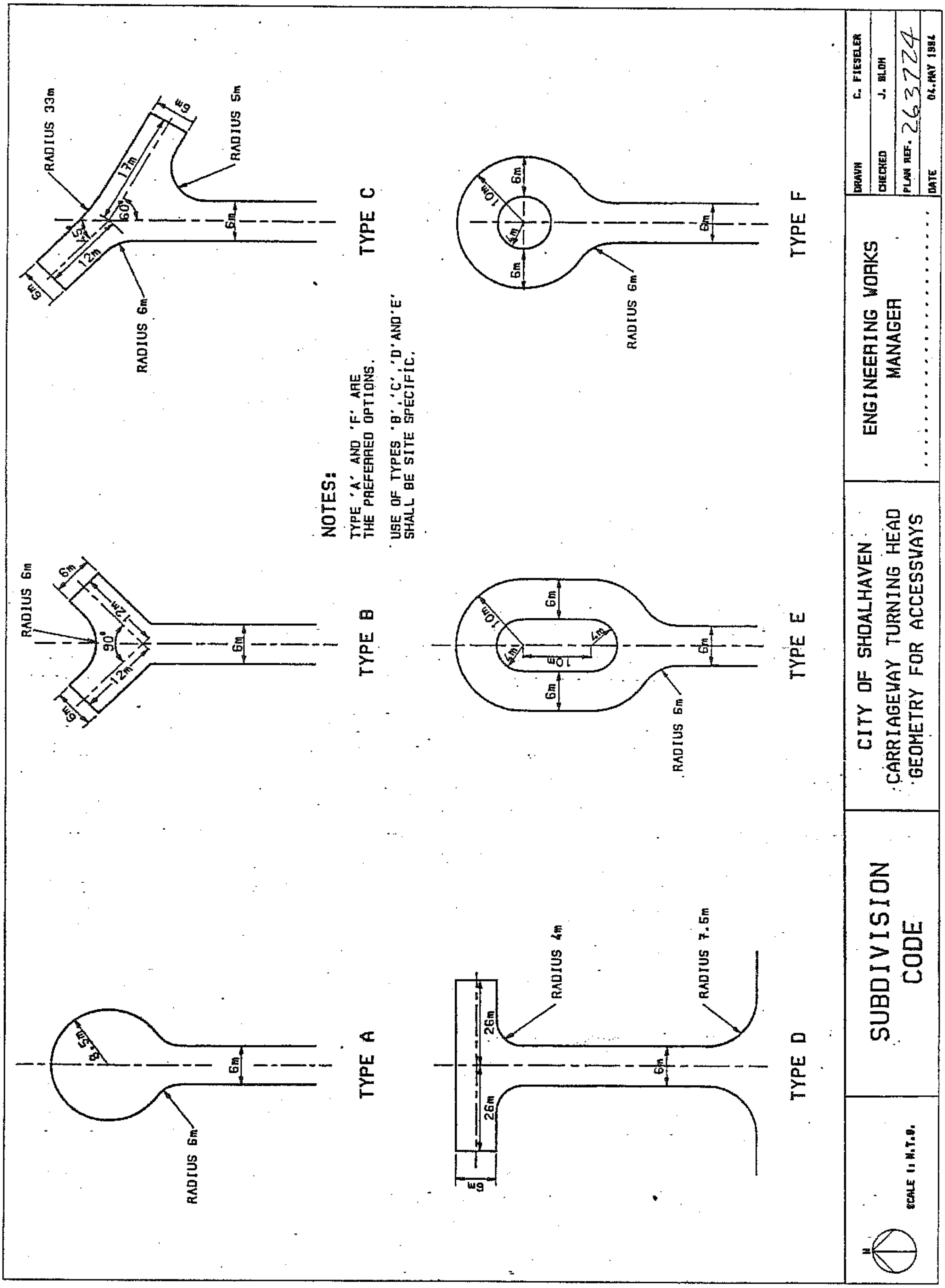


Figure D1.4 - Carriageway Turning Head Geometry for Accessways

4. The next level road (local street) 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 streets. A typical local street is illustrated in Figure D1.5. ***Local Street***

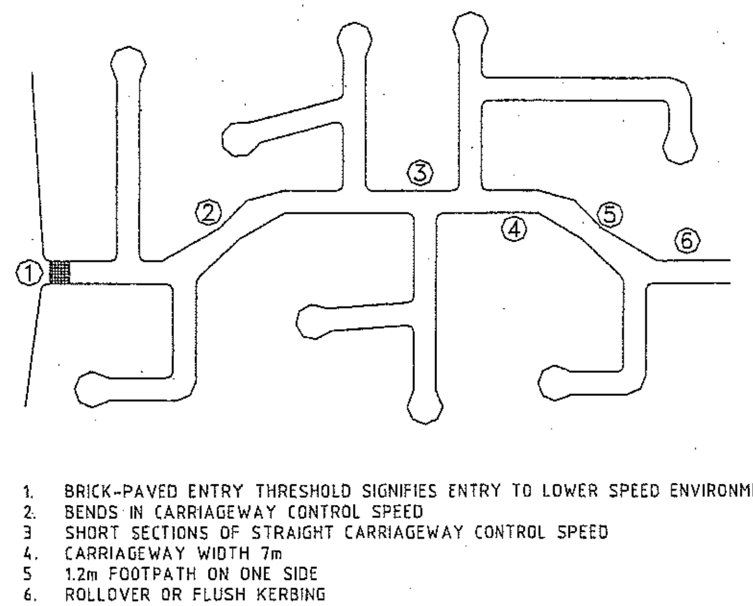


Figure D1.5 - Local Street

5. The second highest order road (collector street) 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 or access streets. A typical collector street is shown in Figure D1.6. ***Collector Street***

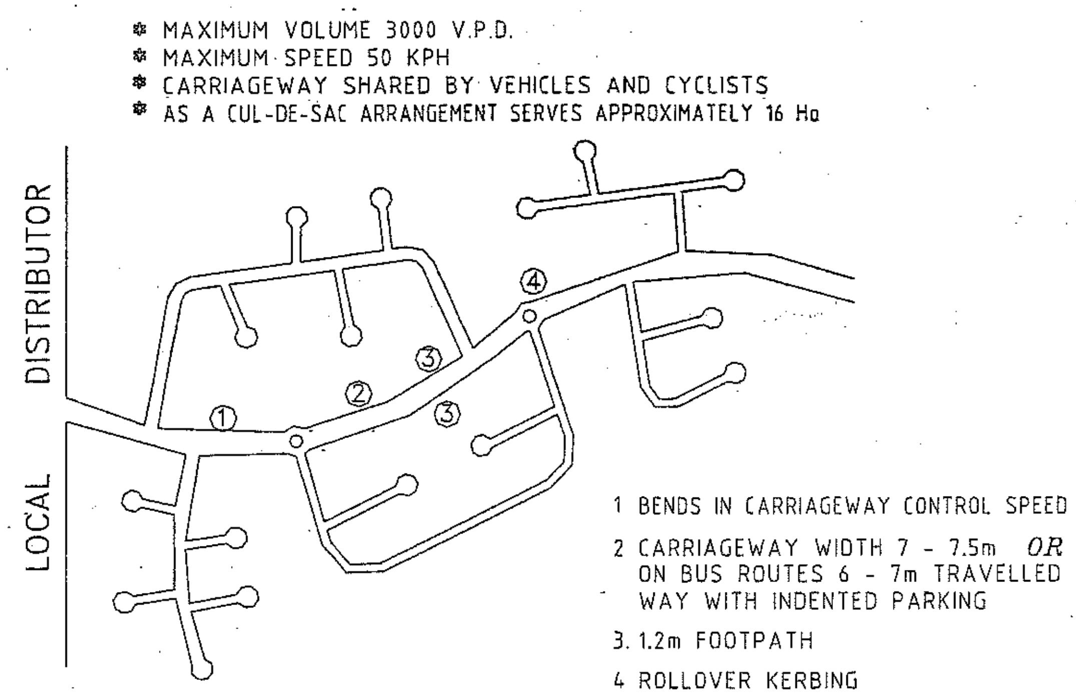


Figure D1.6 - Collector Street

6. The highest order road (local distributor road) within a residential development should have as its main function the convenient and 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 distributor should serve only the development and should not attract through traffic. Figure D1.7 shows the layout of a local distributor road. **_Distributor Road_**

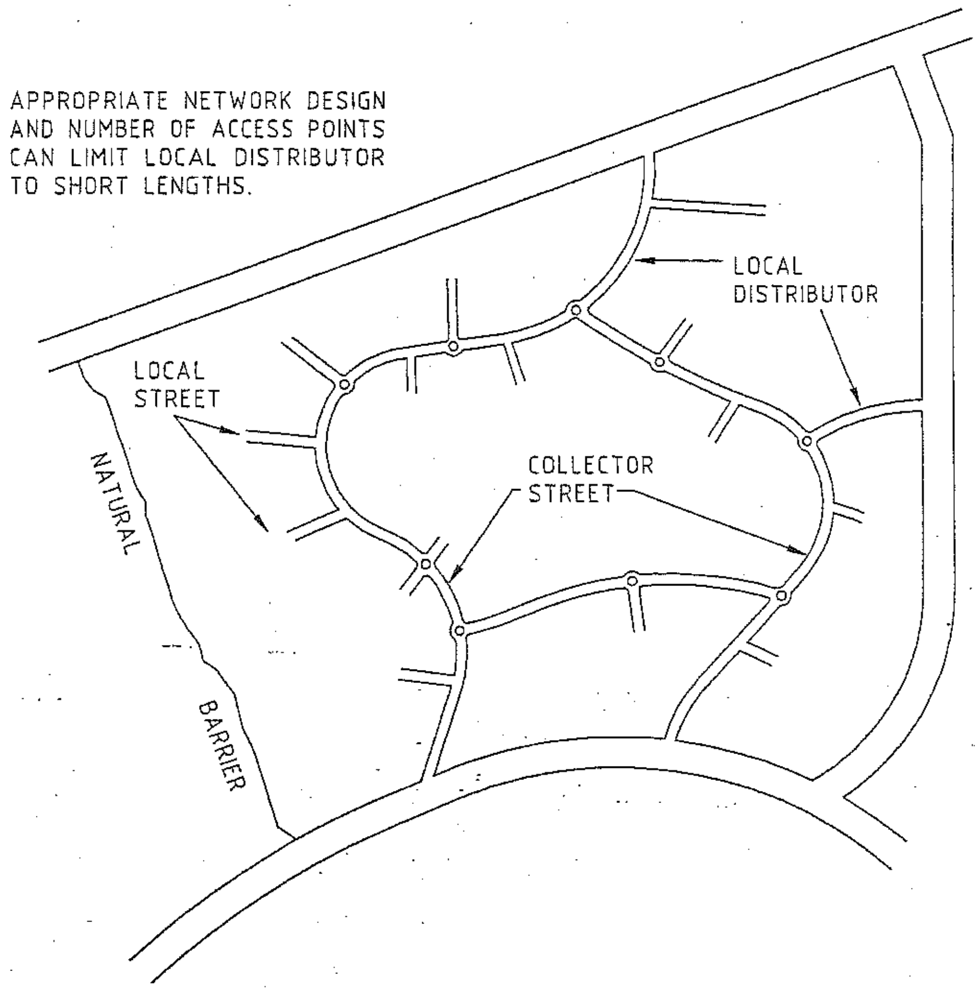


Figure D1.7 - Distributor Road

D1.08 ROAD NETWORK

1. The design features of each type of road convey to the motorist its primary functions and encourage appropriate driver behaviour (refer Figure D1.2 to D1.7).

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

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, cycle and vehicular movements. This length will also ensure that residential convenience is not unduly impaired as a result of speed restraints.

4. The length of local distributor within a development should be minimised.

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

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

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 street or local street should have access to an access-controlled arterial road. ***Road Links***

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

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

10. The external road network should be designed and located to provide routes which are more convenient for potential through local road network. Major roads should be provided at intervals of no more than 1.5 km/h and should be complete and of adequate capacity to accommodate project 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. The NSW Roads and Traffic Authority bases its 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 (see RTA Form No. 892 for further details). The maximum speed limit in NSW for built-up areas is 60 km/h and this should be used in calculating design values which depend on speed, (eg collector and 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. ***RTA 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***

3. Generally the following design speeds should be adopted:

Access Place	15 km/h
Access Street	30 km/h
Local Street	40 km/h
Collector Road	40/50 km/h
Local Distributor Road	60/80 km/h

4. The principle design means for achieving speed limitation in residential streets are either:

- limiting street leg length or
- curved alignment

For Access Streets and Places designing a continuously curved alignment is difficult due to the tight radius required (30m maximum radius for 30km/h). therefore for lower speed streets, limiting the street leg length is the more appropriate means of achieving speed limitation criteria.

Other than in the case of a short cul-de-sac where the total street length can be limited, this usually means introducing a sharp bend (eg 90 degrees) in the alignment, or some form of speed control device.

The ideal is for Speed control Devices to be used as sparingly as possible due to their cost and possibly intrusive nature and therefore it is essential that speed control requirements be considered from the inception of the subdivision layout design process, to maximise speed control by street alignment.

5. The relationship of street length and design speed is provided in Table D1.1.

Design Speed km/h	Street Leg length metres
30	45
40	100
60	165

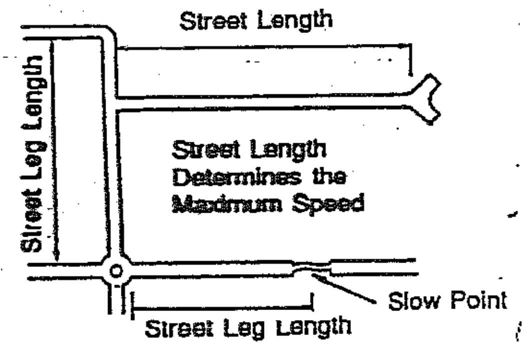


Table D1.1

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. 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 D1.2. *Flat Terrain*

	Local Access	Collector	Distributor	Rural	Right of Way
Desirable maximum percentage	12*	10*	8*	16%	16%
Absolute maximum percentage	16*–20%	12*	10*	20%	25%
Minimum all streets	0.5%	0.5%	0.5%	0.5%	0.3%

* maximum length 150 m on straight alignment.

* bus route absolute maximum

Table D1.2

2. Longitudinal grade through intersections 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 side street is undesirable if vehicles have to stand waiting for traffic in the priority road. Turning circles in cul-de-sacs on steep grades should have grades less than 5 per cent.

D1.11 HORIZONTAL CURVES AND TURNING MOVEMENTS.

Transition Curves

1. The Horizontal Alignment of a road is normally a series of tangents and curves which may be connected by transition curves. For design speeds up to 60 km/h the use of transition curves is not considered necessary. In practice, curve radii on urban roads range from right angled bends to large radius curves. The radius of horizontal curves should be the largest attainable. The minimum deflecting angle for which a curve is necessary is 1 degree. The minimum radius of horizontal curves are shown in Table D1.3.

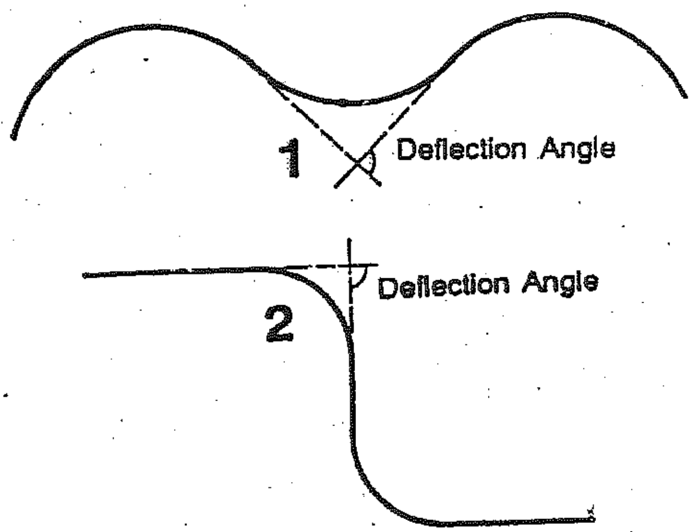
Minimum Deflection Angle	Minimum Radius (m)
75^0	20
60^0	33
40^0	65
30^0	75
20^0	100

Table D1.3

Speed Control

2. For a residential low speed environment see Tables D1.4 and D1.5 and Figures D1.8 to Fig D1.10. There is a reasonable limit to the time for which drivers may be expected to tolerate the low-speed conditions sought to be attained in residential streets. This time is generally considered to be between 68 seconds and 90 seconds. This limitation may require acceptance of rather higher design speeds on the residential streets serving larger traffic catchments. However, 40km/h is considered to be the highest design speed desirable for residential streets with direct frontage access, from consideration of residential amenity, and pedestrian and cyclist safety.

BENDS OR CURVES



Notes: *Radii on carriageway centre line
*May not be effective with deflection angles less than (say) 60 degrees

Figure D1.8 - Speed Control - Bends or Curves

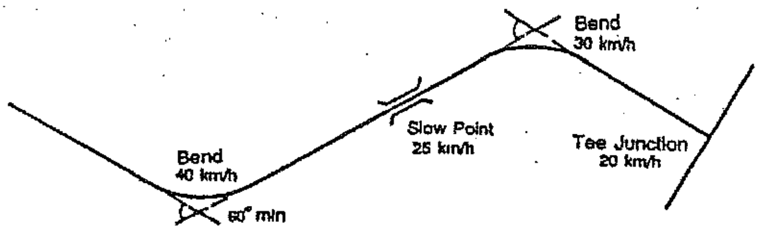
Desired Max Vehicle Speed (km/h)	Curve	Radii
	Continuous Series of Bends (1) (m)	Isolated Bends or in a Chicane (2) (m)
20	15	10
25	20	15
30	30	20
35	50	30
40	90	40
45	105	50
50	120	60
55	140	70
60	160	80

(1) Based on field surveys (Stapleton 1998)

(2) E + F = 0.35 Amcord D15 Page 54

Table D1.4

COMBINATION ALIGNMENT



NEGOTIATION SPEED OF BEND ETC., (Km/h)

LENGTH OF STRAIGHT(m) BETWEEN RESTRICTIONS TO LIMIT DESIGN SPEED TO (Km/h).

Figure D1.9 - Speed Control - Combination Alignment

Negotiation Speed of Bend (km/h)	Length of Straight (m) between Restrictions to Limit Design Speed to (km/h)						
	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

(Amcord – D17 page 56 – modified)

Table D1.5

Example. What is maximum allowable straight between bends of 30 metre radius, to maintain design speed of 50km/h? From Table D1.4 negotiation speed of 30 metre radius bends is 35km/h. From Table D1.5 for negotiation speed of 35km/h maximum length of straight for design speed of 50km/h is 100 metres. Where adjacent speed restricting devices have different negotiation speeds use the mean of the two negotiation speeds.

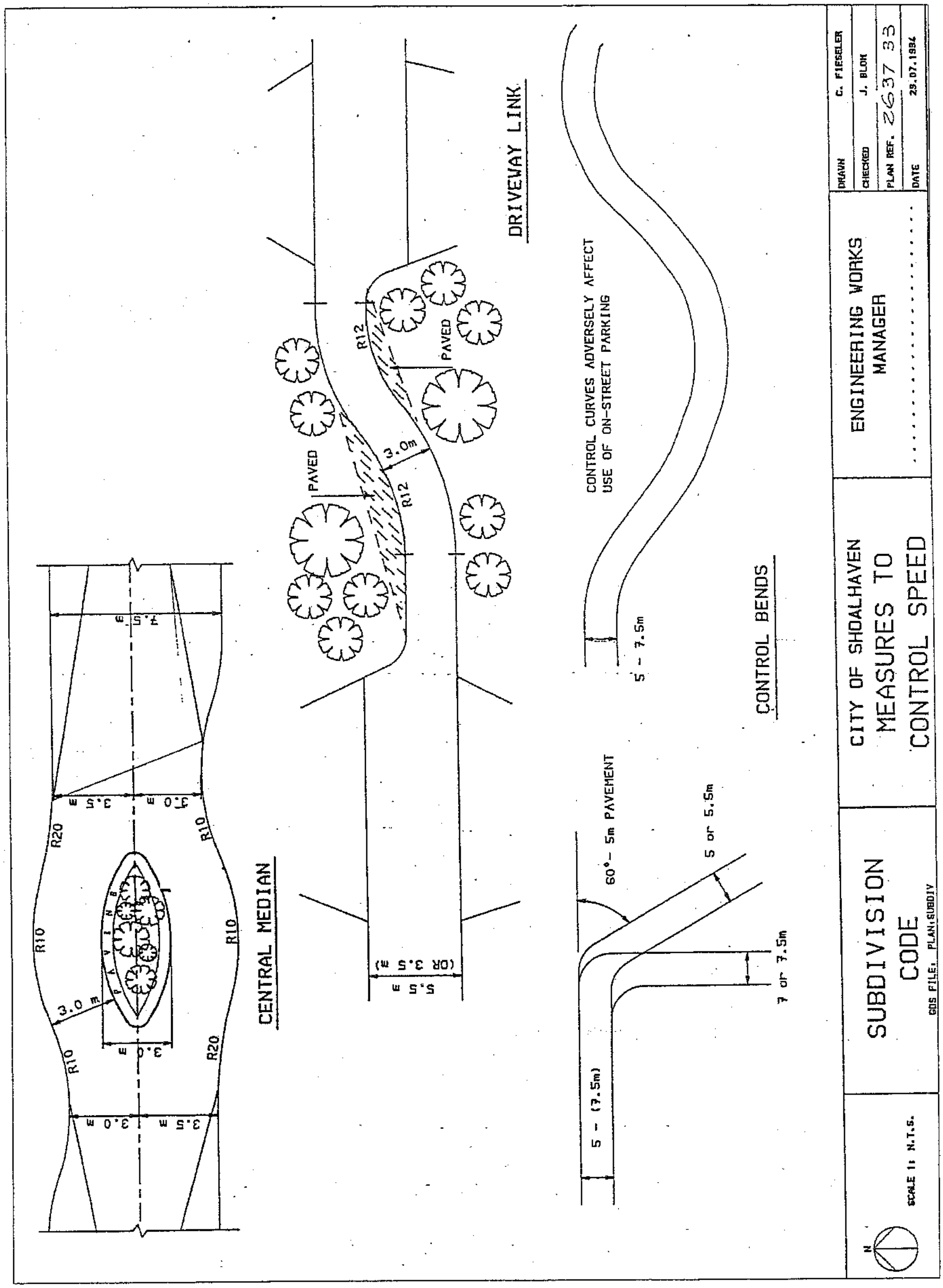
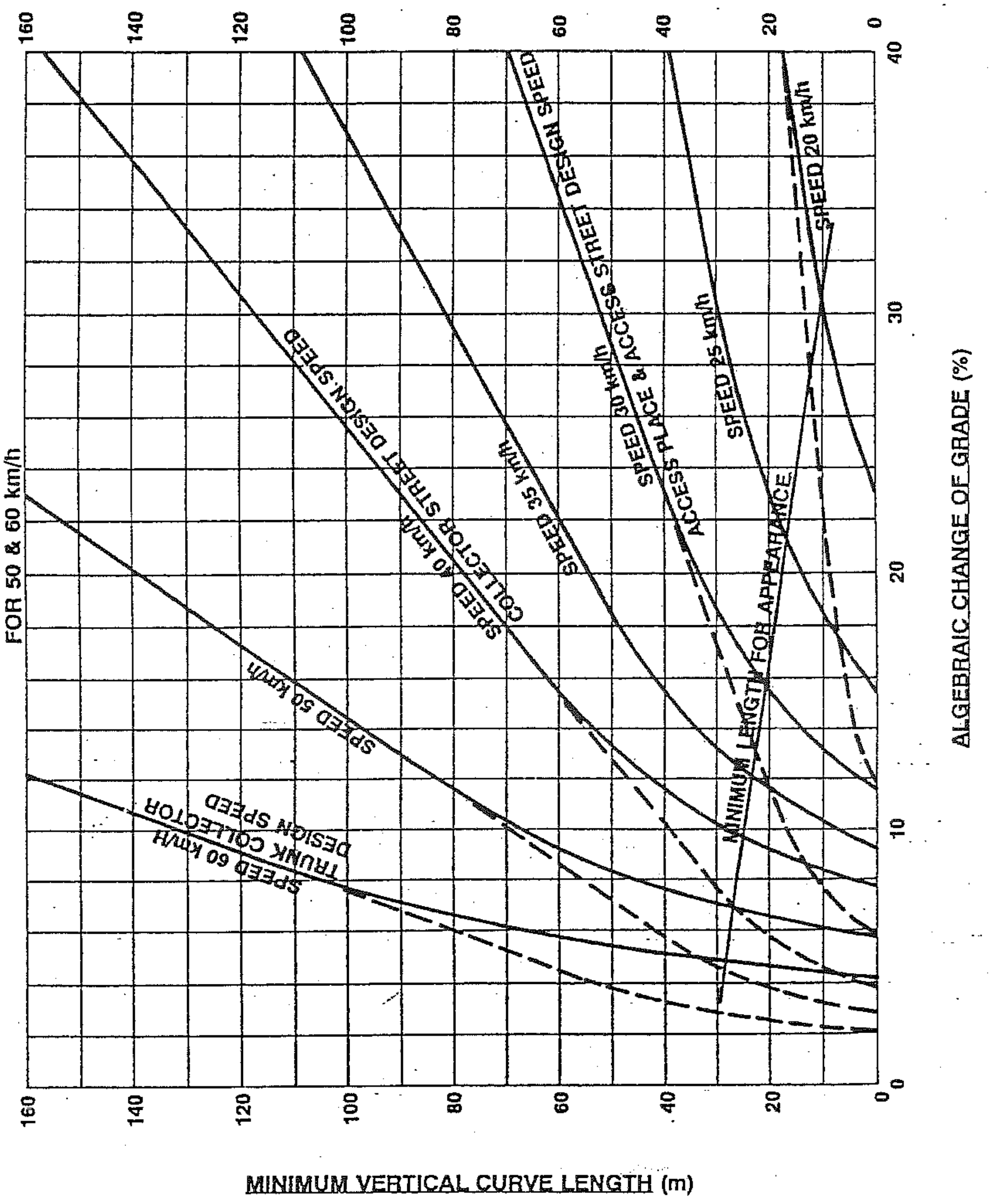


Figure D1.10 - Measures to Control Speed

D1.12 VERTICAL CURVES

1. Vertical curves will be simple parabolas and should be used on all changes of grade exceeding 0.5 per cent. The length of the crest vertical curve for stopping sight distance should conform with Table D1.6 to D1.10. 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.



SIGHT DISTANCE TWICE STOPPING DISTANCE MEASURED 1.15m to 1.15m ————

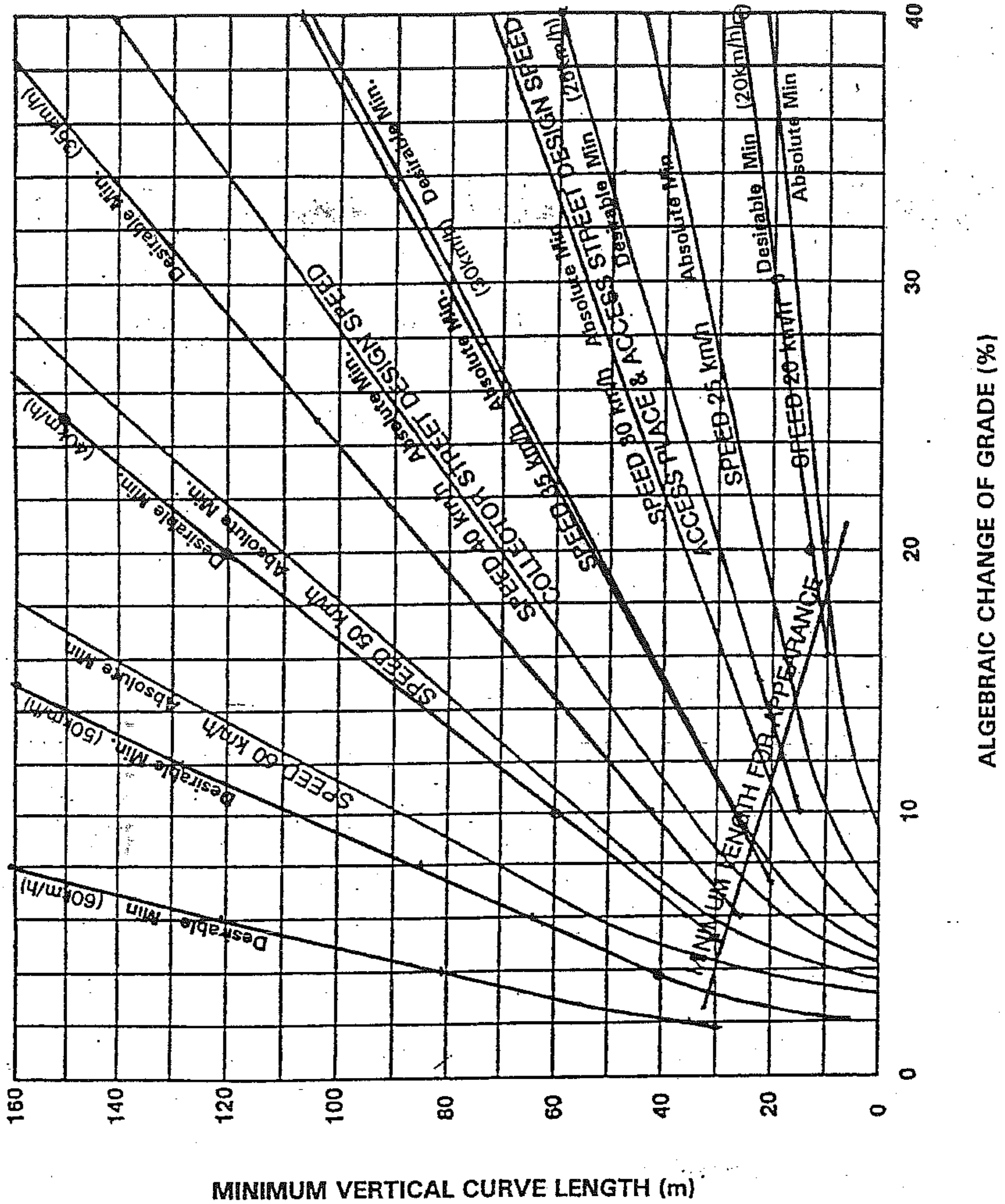
SIGHT DISTANCE = STOPPING DISTANCE MEASURED 1.15m to 0.00m

(a) CURVE LONGER THAN SIGHT DISTANCE ————

(b) CURVE SHORTER THAN SIGHT DISTANCE — — — —

MINIMUM LENGTH OF CREST VERTICAL CURVE

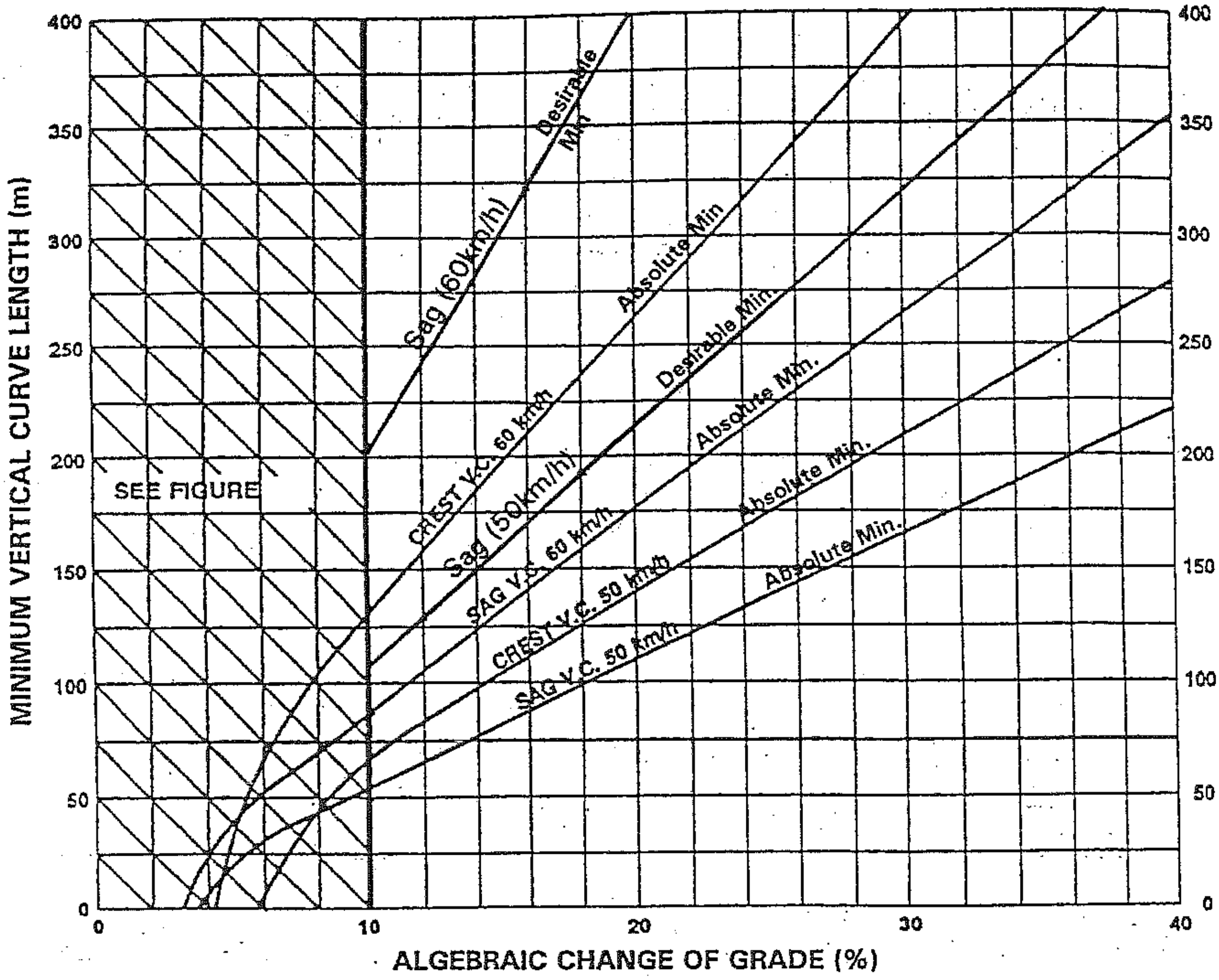
Table D1.6



Curve lengths are "Absolute Minimum" or "Desirable Minimum" as shown.

LENGTH OF SAG VERTICAL CURVE FOR STOPPING DISTANCE WITHIN HEADLIGHT BEAM

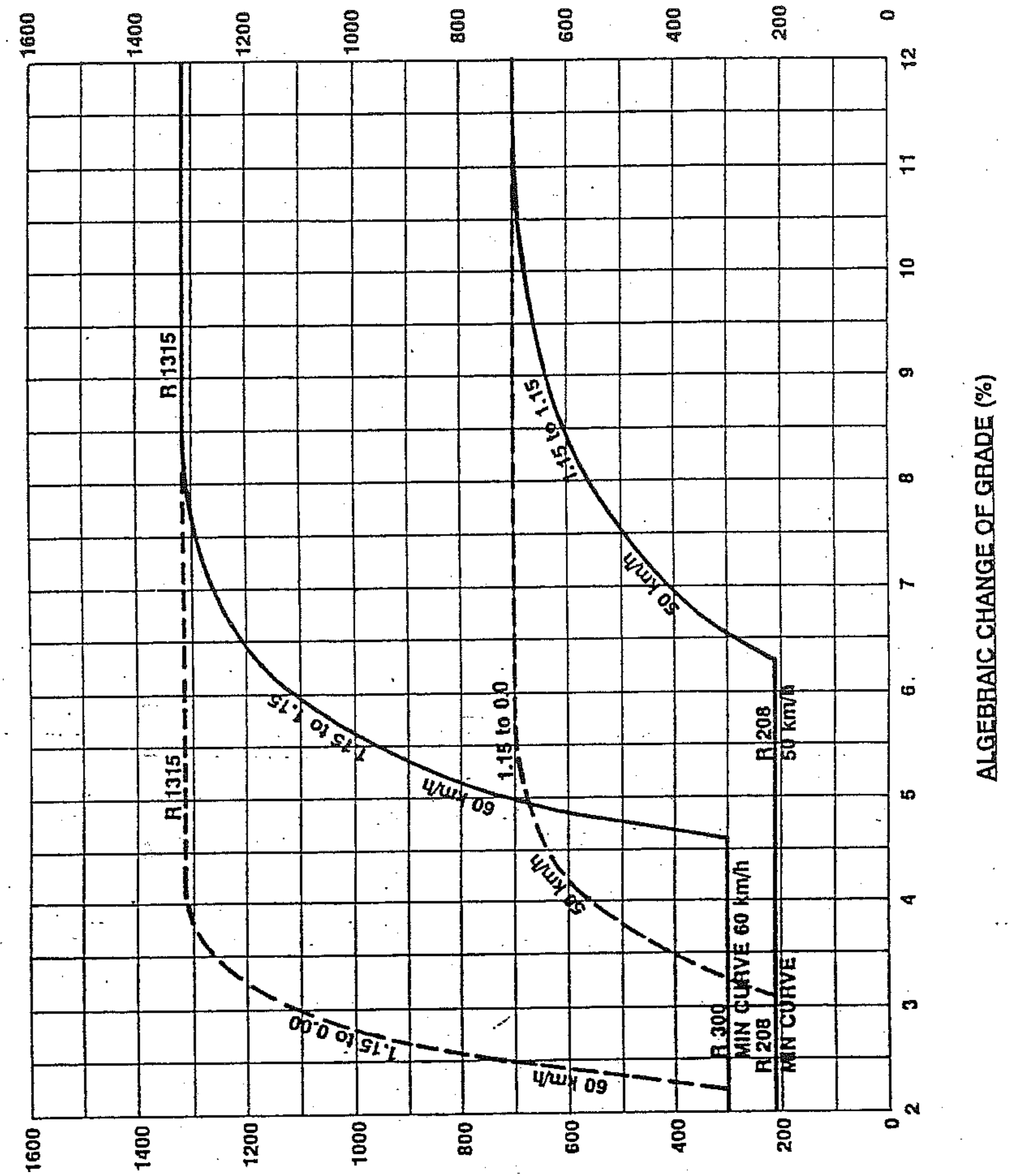
Table D1.7



Curve lengths are "Absolute Minimum" or "Desirable Minimum" as shown.

MINIMUM LENGTH OF VERTICAL CURVES FOR 50 km/h & 60 km/h DESIGN SPEEDS

Table D1.8

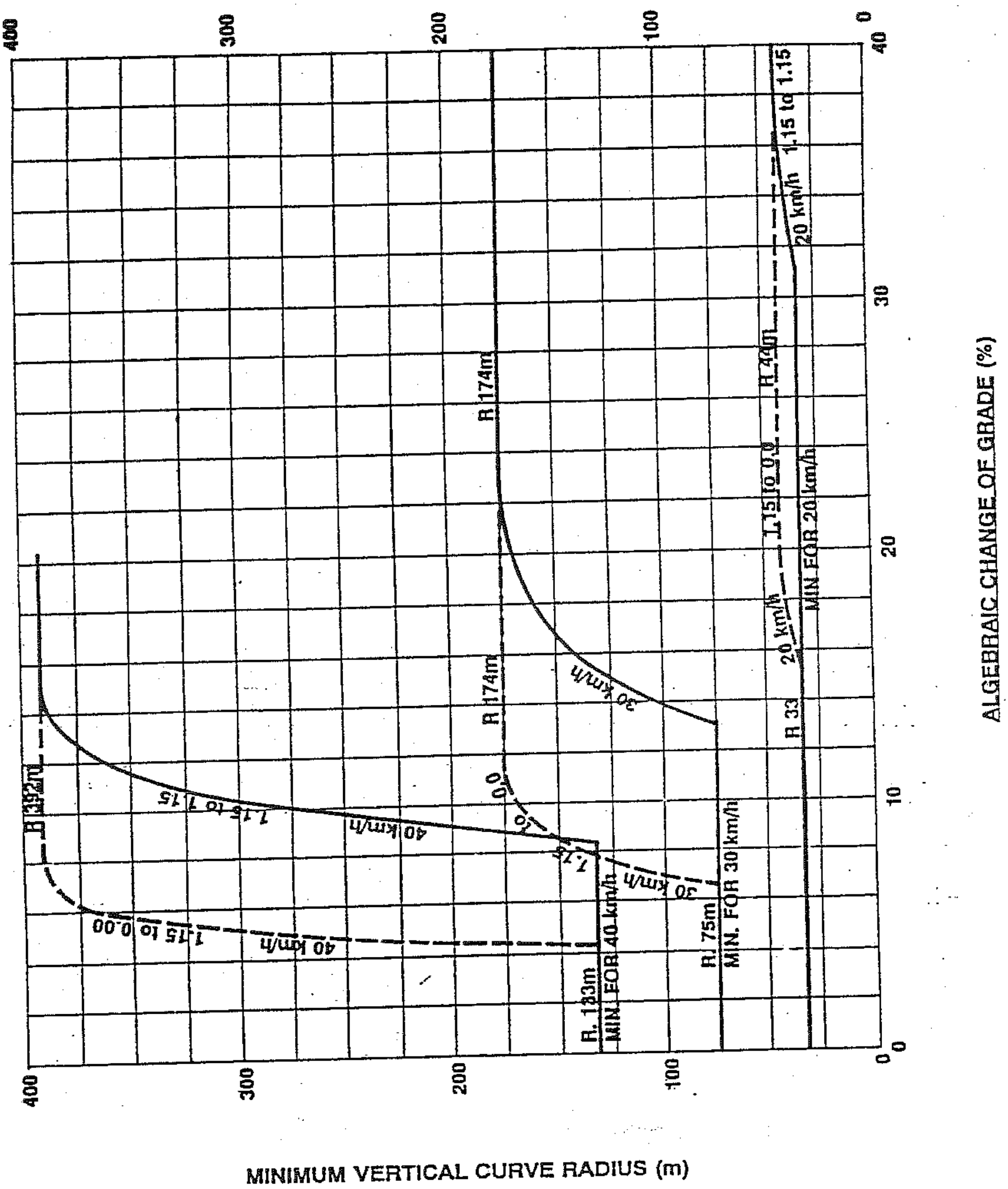


SIGHT DISTANCE TWICE STOPPING DISTANCE MEASURED 1.15m to 1.15m ————

SIGHT DISTANCE = STOPPING DISTANCE MEASURED 1.15m to 0.00m — — — —

MINIMUM RADIUS OF CREST VERTICAL CURVE FOR 50 km/h & 60 km/h DESIGN SPEEDS

Table D1.9



SIGHT DISTANCE TWICE STOPPING DISTANCE MEASURED 1.15m to 1.15m ————

SIGHT DISTANCE = STOPPING DISTANCE MEASURED 1.15m to 0.00m — — — —

MINIMUM RADIUS OF CREST VERTICAL CURVE FOR 20, 30 & 40 km/h DESIGN SPEEDS

Table D1.10

2. For adequate riding comfort, lengths of sag vertical curves should conform with RTA Form No. 892. 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 1.10g for minimum riding comfort. The minimum length of vertical curves are shown in Table D1.11.

Riding Comfort Minimum Vertical Curve

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

Table D1.11

4. Road junctions 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. For the special case of vertical curves on the non-priority streets adjacent to an intersection (ie the leg of a 'T' intersection, or any street at a roundabout) the following criteria are applicable:

Side Road

Minimum crest VC in accordance with Fig D1.6 for Stopping Distance 1.15m to zero. The speed should be the design speed for the relevant street, unless the horizontal layout is such as to warrant a lower spot speed being adopted, or the vertical geometry is such that a driver can see the intersection before reaching it eg roller coaster approach. In such case, an intersection speed of 25km/h may be assumed and the VC length based on this speed.

Crest VC

In the case of a sag VC it may be assumed that the driver has visual warning of the intersection and will slow to intersection speed of 25km/h. It may also be assumed that the intersection will have adequate street lighting and in any case the turning vehicle path will largely negate headlight usefulness. Therefore riding comfort criteria will control.

Sag VC

For 0.10g vertical acceleration at 25km/h, the minimum length of curve (m) per 1% change in grade (K) is 0.50.

eg for Change of Grade = 10%
    Maximum curve length = 5m

However, a longer curve should be used wherever possible, both for improved riding comfort and for appearance.

5. An entry treatment can help to indicate a change of street status and is achieved by:

Entry Treatment

- change of carriageway paving material
- section of block paving, stamped concrete or concrete strip

Such treatment can also assist the legibility of the subdivision layout and reinforce traffic priority, by the major route continuing through the intersection without a change of pavement, while the minor streets have an appropriate entry treatment applied. Entry treatment may also be applied where appropriate at roundabouts.

6. 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 and gutter. A minimum grade of 0.5 per cent should be maintained in the kerb and gutter. This may require some warping of road cross sections at sag points. ***Sag Curves Drainage***

7. 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:

- 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 – URBAN ROADS

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 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.

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. ***Negative Crossfall***

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 and the pavement, and on speed. ***Coefficient of Side Friction***

4. Recommendations for minimum curve radii (in metres) on collector and trunk urban roads under varying superelevation/crossfall are shown in Table D1.12. ***Curve Radii Urban Streets***

	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, Guide policy for the geometric design of major urban roads.)

Table D1.12

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 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 per cent, a crossfall of 63 mm in a 450 mm wide gutter may be adopted. ***Curve Transition Urban***

D1.14 CARRIAGEWAY WIDTH

1. The cross section of the road reserve must cater 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 D1.13 details carriageways and footpath widths and road reserve widths. ***Functions***

Table D1.13 – Characteristics of Roads in Residential Subdivision Road Networks

Road Type	Maximum Traffic Volume (vpd) [1]	Maximum Speed [2] (kph)	Carriageway Width (m)[3] Minimum	Maximum	Parking Provisions Within Road Reserve [3]	Kerbing [4]	Footpath Requirement	Cycle-path Requirement	Verge Width (each side)
Access Place	<150	15	Single Lane [5] 3.5	3.7	1 verge space per 2 allotments with scope for additional space	Layback/ Flush	No	No	4.0 min
Access Street (minor)	500	30	Two Lane: 5.0	6.0	Carriageway	As Above	No	No	As above except no provision for widening
Local Street	2,000	40	7.0 (up to 1,000 vpd) 7.0	7.5 [6] 9.0	Carriageway Carriageway	As Above As Above		No No	Minimum 4.5m Minimum 4.5m or as determined from Fig.2.8
Collector Street	3,000 (with access to residential allotments)	50 [8]	7.0 (up to 3,000 vpd) On bus routes 9.0m maximum (7.0m minimum) travelled way with 2.0m wide indented parking and bus bays defined by kerbed protuberances at no more than 75m apart [10].	9.0	Carriageway Indented parking and bus bays on bus route to provide minimum 6.0m travelled way	Barrier	1.2m wide [7] footpath	No 1.0m gap in protuberances required for cyclists (10)	As above provided adequate road reserve width for widening for future bus route required
Local Distributor	3,000 to 6,000 (no access to	60 [10]	9.0 Plus cycle lanes if	11.0 [13]	Parking not permitted on	Barrier	If required 1.2m wide	Minimum 3.0m	

Road Type	Maximum Traffic Volume (vpd) (1)	Maximum Speed (2) (kph)	Carriageway Width (m)(3)		Parking Provisions Within Road Reserve (3)	Kerbing (4)	Footpath Requirement	Cycle-path Requirement	Verge Width (each side)
			Minimum	Maximum					
Road	single dwelling residential allotments		required. 9.0m minimum with indented bus bays on bus route		carriageway (11)		footpath, and/or 2.0m cycle path one side only, or two 1.5m wide cycle lanes marked on carriageway (12)		
Laneways	150	-	-	-	-	-	-	-	-

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 guidelines on designing for specific operating speeds.
3. Widening required at bends to allow for wider vehicle paths (using NAASRA 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 parking provision and provision for widening to 5.0m if necessary in the future.
6. See specification provisions for minimum verge width for different speeds, or provide minimum for services if more. Add additional width on one side for future widening of carriageway to 5.0m if 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/cycle crossing. A speed of 20 kph is desirable, achieved by the road design principles outlined in this specification.
9. Where cycle way can be anticipated, a cycle lane is required along the kerb.
10. Speed on trunk collector road not to exceed legal limit.
11. If required, to be provided in parking areas which can be exited in a forward direction.
12. Required only if part of a pedestrian/cycle network.
    - Many elements are inter-related. Therefore variations from any particular recommended characteristic may require changes to others
13. If fewer widths are to be used need to demonstrate how on street parking can be restricted

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. (See Table D1.13 for bus routes.) *Vehicles*

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

4. The carriageway width should also provide for unobstructed access to individual allotments. Motorists 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. *Reversing*

5. The design of the carriageway should discourage motorists 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.

6. Appropriate road reserve width should be provided to enable the safe location, construction and maintenance of required paths 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. *Road Reserve*

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. *Verge*

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

D1.15 CROSSFALLS

1. Desirably, roads should be crowned in the centre. 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, Guide policy for geometric design of major urban roads.)

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 cross falls. 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 30 m for through traffic; 8 per cent per 30 m for free flowing turning movements; or 12 per cent per 30 m for turning movements for which all vehicles are required to stop. *Offset Crown Changes*

3. The crossfall on a collector or distributor road should take precedence over the grade in side streets. Standard practice is to maintain the cros'sfall on the priority road and adjust the side road 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. *Priority Road*

D1.16 FOOTPATH AREAS

1. A suitable design for the footpath will depend on utility services, the width of pathways, access to adjoining properties, likely pedestrian usage and preservation of trees. Low level paths are undesirable but may be used if normal crossfalls are impracticable. Crossfalls in footpath paving should not exceed 4 per cent, as above this paving can be slippery. Longitudinal grade usually parallels that of the road and this may be steeper than 5 per cent. ***Utility Services***

2. Differences in level across the road between alignments may be accommodated by: ***Options***

   - Cutting at the alignment on the high side and providing the footpath at normal level and crossfall.
   - Battering at the alignment over half the footpath width with the half against the kerb constructed at standard crossfall.
   - A uniform crossfall across the carriageway.
   - The lower footpath being depressed below the gutter level.

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

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 local distributor roads. ***Traffic Volumes***

2. Intersection design for the junction of subdivision roads with existing main rural, main urban and state highways should generally be designed in accordance with the publication AUSTROADS Interim Guidelines for the Design of Intersections at Grade 1993. ***Main Roads***

3. Intersections with main roads, tourist roads or state highways are to be designed and constructed in accordance with the requirements of the Roads and Traffic Authority and the Council. ***Tourist Roads State Highways***

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.

5. Direct intersection of minor streets onto major streets or roads is undesirable due to:

   - increased number of intersections to major roads
   - excessive difference in design speeds between the minor street and the major road eg 30–80km/h

   The higher design speeds of the Collector Street and Trunk Collector Street provide a graduation of speed environment between minor street and the major road system. In general, streets should intersect with streets of the same or immediately adjacent classification, eg:

   Access Place – only to access Place or access Street

Access Street – only to access Street, Access Place or Collector Street

Collector Street – only to Collector Street, Access Street or Trunk Collector Street

Trunk Collector – only to Trunk collector (unusual) Collector Street or external Road

Intersection Spacing

Intersections should be sufficiently far apart to separate traffic movements at each intersection and provide a reasonable time interval between driver decisions. Desirable minimum intersection spacings/centre line to centre line are provided in Table D.14.

	Access Street and Collector Street	Trunk Collector Street
On same side through street	60m	100m
On opposite sides of through street	40m	60m

Table D.14

A number of round-a-bouts in close succession can be unduly "fussy" and about 70 metres is the recommended general minimum distance between round-a-bouts where there are three or more in proximity.

Criteria

6. Intersections should be generally located in such a way that:

- The streets intersect preferably at right-angles and not less than 70^0.
- 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.
- Right turn manoeuvre between the streets is likely to occur frequently.

Splay Corners

- 90^o corners are to be provided with corner splays of 4 metres or truncated where intersection sight distance cannot be maintained of the approach streets are curved. Verge width at the intersection is reduced, or the geometry is otherwise abnormal, the sight distance should be checked and the property boundary truncated if necessary to clear the right triangle. The sight distances required is measured along the vehicle path in Fig D1.11.

ANGLE OF SKEW φ°	A
0 - 2.5	7.62
2.5 - 7.5	9.15
7.5 - 12.5	9.15
12.5 - 17.5	10.06
17.5 - 22.5	10.06
22.5 - 27.5	10.06
27.5 - 30	10.06

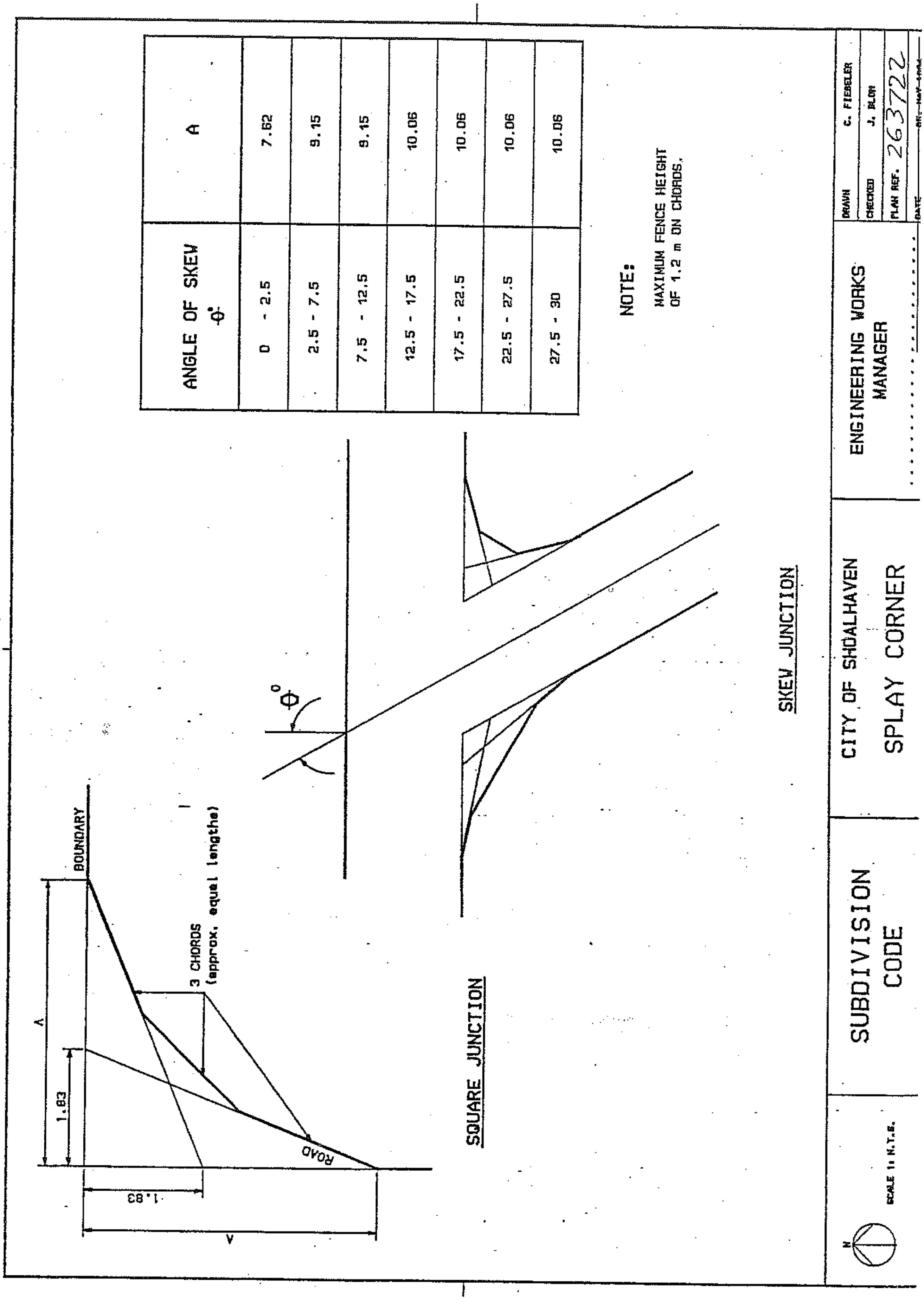


Figure D1.11 - Splay Corner

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

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

9. In cul-de-sac streets adequate provision should be made at the end of the road for vehicle types which frequently use the streets to turn around. The likelihood of parked vehicles obstructing turns should be minimal.

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

Turning Movements

11. All vehicle turning movements are accommodated utilising NAASRA Design Vehicles and Turning Templates, as follows:

- For turning movements involving local distributor roads, the "design semi-trailer" with turning path radius 15.0 m.
- For turning movements involving local streets or collector streets, but not distributor roads, the "design single unit" bus with turning path radius 13.0 m.
- For turning movements on access streets but not involving distributor 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 streets 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 60 m for the "design car" to make a three-point turn. Where driveway enhances are to be used for turning movements, the required area is constructed and design to withstand the relevant loads.

Turning Radii

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

Bus Routes

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

14. Combined entry and exit driveways on local distributor roads are 6.0 m wide and separate entry and exit driveways are 3.0 m wide.

Kerb Returns

15. Kerb returns are to be designed in accordance with the detail shown in Fig D1.12.

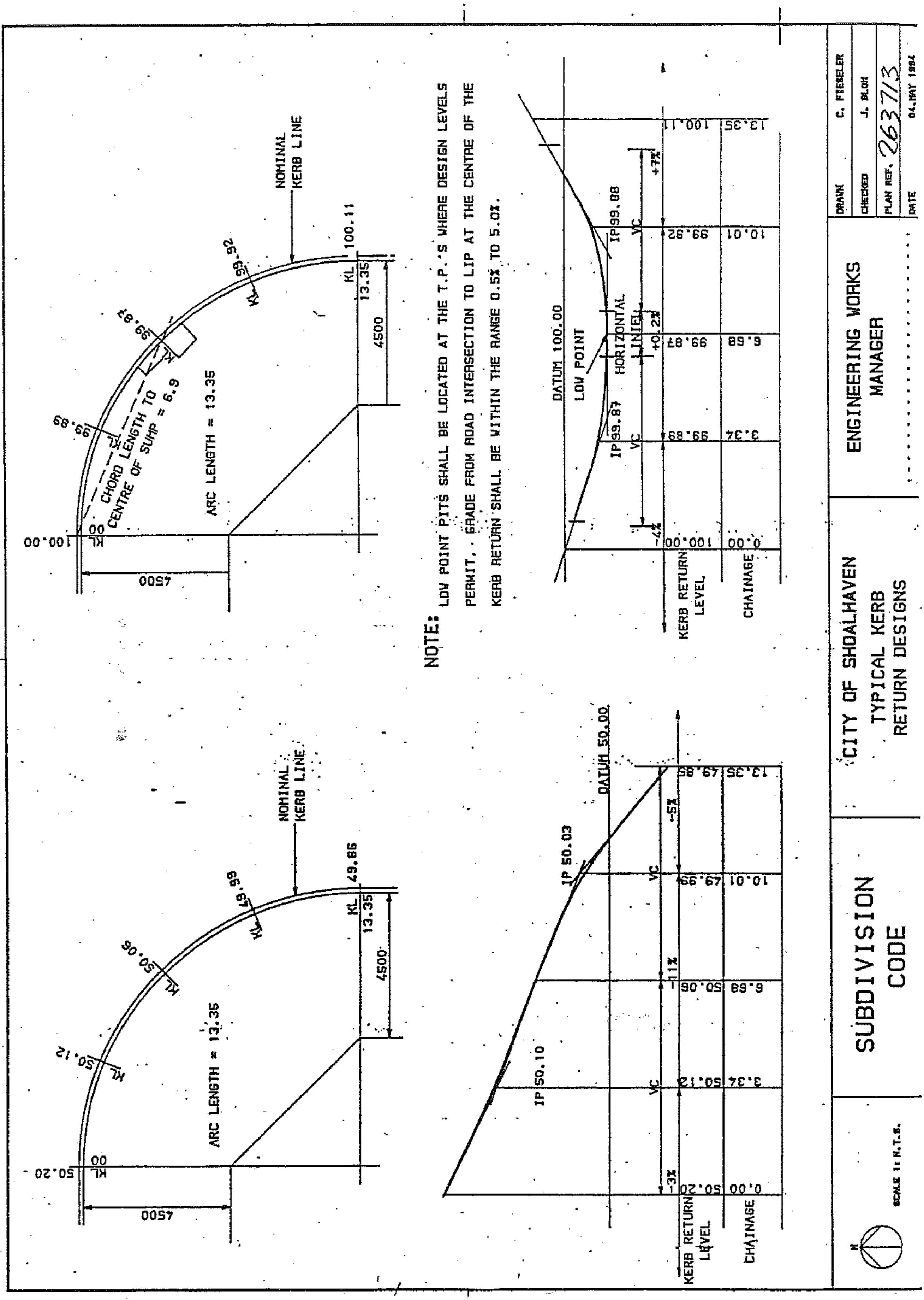


Figure D1.12 - Kerb Return Designs

D1.18 ROUNDABOUTS

1. Roundabouts are to be approved by the Council and the Roads Traffic Authority.

2. Roundabouts should generally be designed in accordance with the requirements of the publication "AUSTROADS Guide to Traffic Engineering Practice – Roundabouts 1993". Designs adopting alternative criteria will be considered on their merits. Roundabout design should generally comply with the following:

Circulation

- entry width to provide adequate capacity
- adequate circulation width, compatible with the entry widths and design vehicles e.g. buses, trucks, cars.

Approach Speed

- 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. Calming devices such as thresholds, slowpoints, chicanes and splitter islands are to be approved by Council. See Fig D1.9 to D1.10. Devices designs should generally comply with the following:

(a) **Streetscape**

- reduce the linearity of the street by segmentation
- avoid continuous long straight lines (e.g. 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 generally consistent with streetscape requirements
- existing street lighting, drainage pits, driveways, and services may decide the exact location of devices
- slowing devices are optionally located at spacings of 100–150m.

(c) **Design Vehicles**

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 NAASRA 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 catered for.

(d) **Control of Vehicle Speeds**

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)

Visibility

- 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.

(f) Critical Dimensions

Many devices will be designed for their normal use by motor 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

- bicycle lanes (including adjacent to pavement narrowings) – 1.35m minimum
- 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.

D1.20 PARKING

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

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

Resident Parking

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.

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.

5. On single lane access streets parking spaces should be provided within the verge. Such parking should be well defined and an all-weather surface provided.

6. Parking spaces provided on the verge or carriageway should be of adequate dimensions, convenient and provide 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). ***Tandem***

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

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.

11. On single lane carriageway one space for each two allotments is constructed on the verge within 25 metres 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. ***Multi Unit Development***

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

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.

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

15. Right-angled parking is provided only on access streets and local streets where speeds do not exceed 40 kph.

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 BUS ROUTES

1. 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 D1.15 details minimum criteria for bus route design. ***Buses***

Road	Carriageway Width (min)	Stops (Spacing)	Bays
Collector*	9m	400 metre **	Single
Distributor	11m	400 metre	Shelters***
Arterial	13m	400 metre	Shelters and Bays

* Collector roads not identified as bus routes may have 7m carriageways (see Table D1.13)

** Loop roads with single entry/exit only require stops and bays on one side road.

*** Shelters are subject to Council's requirements.

Table D1.15

D1.22 RIGHTS OF WAY – RESIDENTIAL

1. Rights of way are distinct from public roads in that they are held in private ownership. Rights of way are to be constructed of sufficient width to carry likely future traffic. *Rights of way*

Minimum widths of accessways are shown in Table D1.16.

Number of Dwelling Units Serviced	Minimum Clear Width	Passing Bays Required
1 to 2	3.0m	No
3 to 4	3.5m	Yes
5 to 6	5.5m	No

Table D1.16

Due consideration is to be given to the provision of drainage, utility services and any retaining structures.

Rights of way are to be constructed as follows: *Rights of way*

- Minimum longitudinal gradient 1%.
- Consideration may be given to grades up to 25% for access to individual lots and where turning movements are not expected.
- Drainage on rights of way require to be contained in kerbs or a central dish and conveyed to the public road or piped drainage system.
- Accessways are to be designed to allow for turning movements of the 98% design car at all times.
- Accessways longer than 150m or serving 5 or more allotments are to incorporate a turning head.
- A minimum concrete slab thickness of 125mm reinforced with single layer of F72 Fabric, 25 Mpa concrete, over a base of 75mm of DGB20 compacted to 98% modified density.

D1.23 DRIVEWAY CROSSINGS

1. Concrete dirveway crossings where required are to be in accordance with Fig D1.17 to D1.19. ***Gutter Crossing***

RURAL DESIGN CRITERIA

D1.24 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 homesites 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 "Geometric Design of Rural Roads" (AUSTROADS 1993). ***Design Speed***

3. Where appropriate superelevation, widening and centreline shift and their associated transitions are to comply with Main Road Form No. 892 or AUSTROADS 1993.

4. Where the table drain is likely to scour a RTA Type SH dish drain, or similar structure is to be constructed along the invert. Also for grades of less than 0.5%, the inverts of the drain are to be lined to prevent siltation. ***Table Drain***

5. All rural subdivisions should be designed to deny access to major roads.

6. All rural residential subdivisions will be required to provide piped drainage. ***Drainage***

7. Access should be limited to one point on to local, arterial or main road networks. ***Access***

D1.25 SIGHT DISTANCES

1. Stopping and minimum sight distances. Stopping sight distance should be provided at all points on the road. The stopping distance is measured from an eye height of 1.2 m to an object height of 0.25 m, using a reaction time of 1.5 seconds. A minimum sight distance measured from a height of 1.2 m to a height of 1.2 m is preferable for speeds of 60 km/h and over. Tables are provided on RTA Form No. 892. ***Stopping Distance*** ***Sight 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: Policy for geometric design of rural roads, NAASRA.)

3. Recommended sight distances (based on RTA Form No. 892 and adjusted to include lower speeds and minimum site distances using the above formula) are shown in Table D1.17.

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

Table D1.17

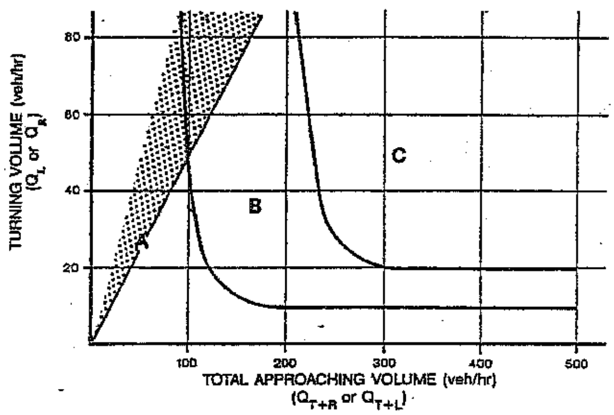
4. These figures may apply on crest vertical curves only where there are straight alignments. Adjustments should be calculated for steep grades.

D1.26 HORIZONTAL AND VERTICAL ALIGNMENT

1. Horizontal and vertical curves are to be designed generally to the requirements of AUSTROADS 1993 – 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.

D1.27 INTERSECTIONS

1. Intersections should generally be designed in accordance with the publication Guide to Traffic Engineering Practice – Part 5 Intersections at Grade AUSTROADS 1993. Generally intersections with existing main and local roads will conform to the layouts shown in Figures D1.13 and D1.14 below. The type of intersection required will depend on existing and planned connecting roads.

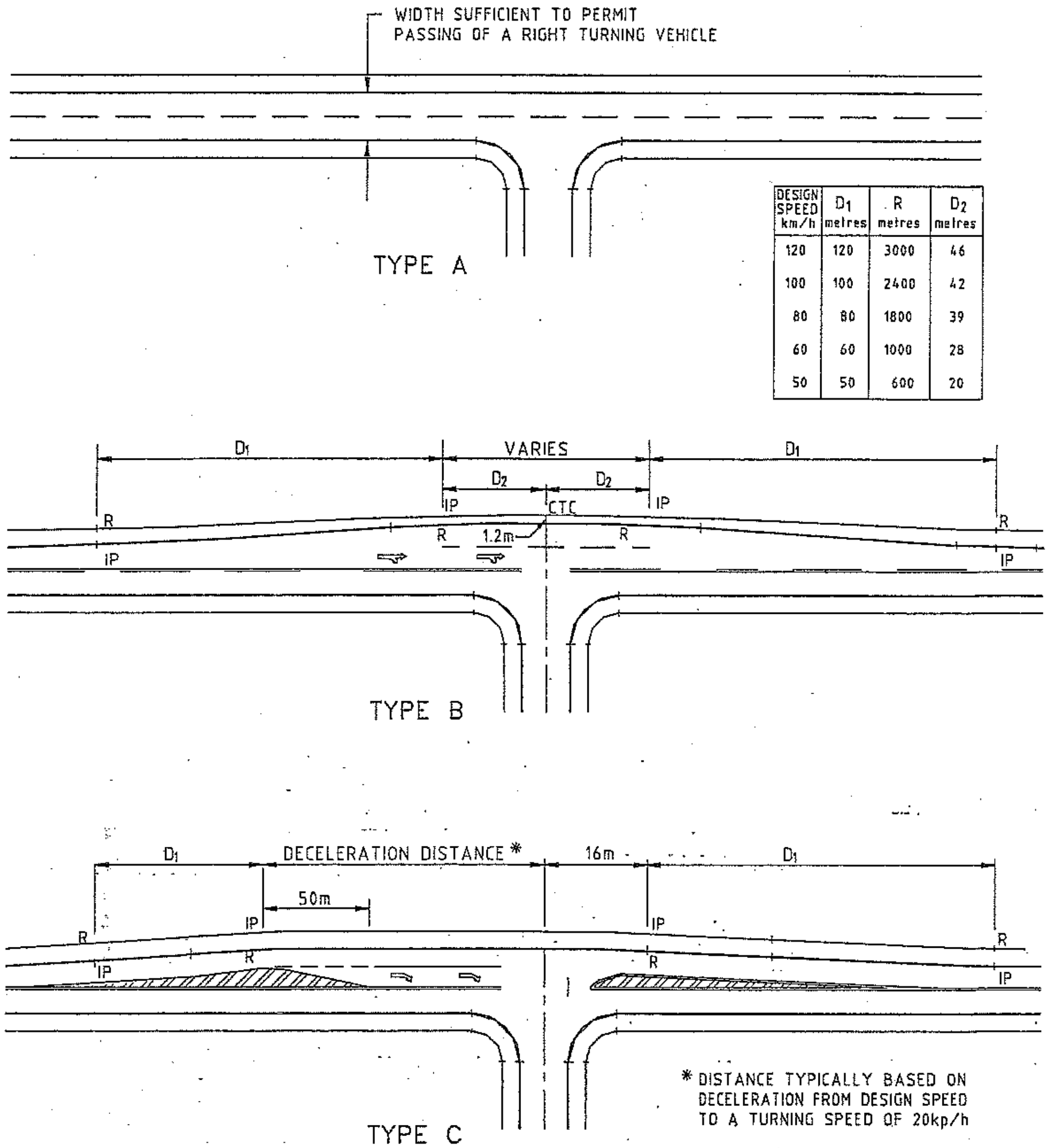


Notes: (i) Warrants are interim only and are currently under review.

(ii) Where peak hour volumes are not available, assume the design peak hour volume equals 10% to 15% of the AADT.

In this region more than 50% of the approaching traffic turns. Hence consideration needs to be given to possible realignment of the intersection to suit the major traffic movement.

Fig. D1.13 -Rural Intersection Treatments



DESIGN SPEED km/h	D_1 metres	R metres	D_2 metres
120	120	3000	46
100	100	2400	42
80	80	1800	39
60	60	1000	28
50	50	600	20

Figure D1.14 - Rural Intersection Treatments

(Source: AUSTROADS 1993)

2. Type "BAL" (Basic Left Turn) treatment is the minimum form of treatment that should be applied to a rural left turn and as shown in Fig D1.15.

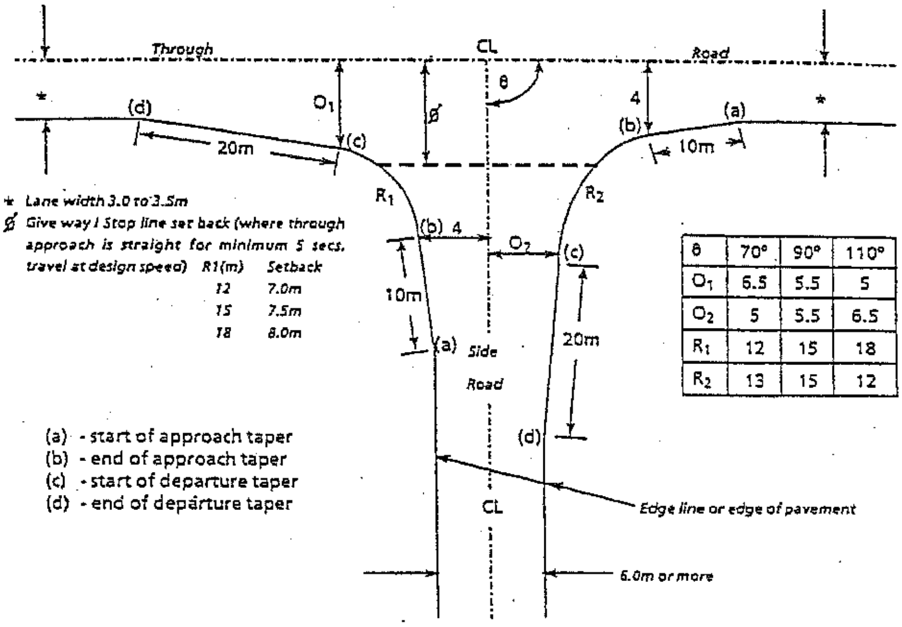


Figure D1.15 - Type "BAL" layouts for Rural Sites

3. Type "BAR" (Basic Right Turn) treatment is the minimum form of treatment for right turn movements from a through road to a side road and as shown in Fig D1.16.

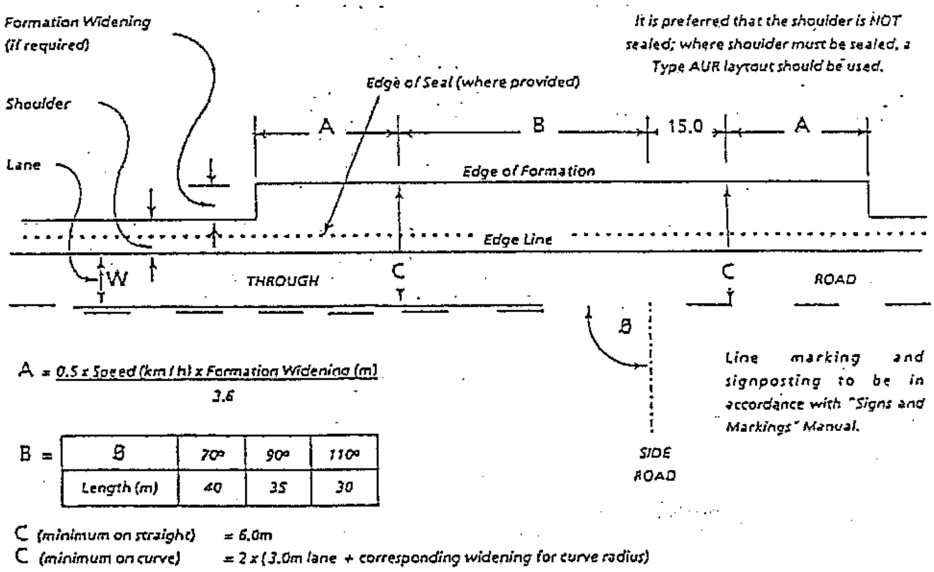


Figure D1.16 - Type "BAR" Right Turn Treatment on the Through Road

4. Adequate sight distance should be provided at intersections and junctions. The intersection sight distances required by stopped vehicles in the following tables D1.18 to D1.19 should be applied from a point on the minor road 5 m outside, the edge of the running lanes of the major road:

MORE IMPORTANT ROAD HAS TWO RUNNING LANES		
Design Speed of more important road (km/h)	Sight Distance (1.2 m to 1.2 m) from driver of stopped car (m)	Sight Distance (1.8 m to 1.2 m) from driver of stopped car (m)
40	80	110
50	100	140
60	120	170
70	140	200
80	160	220

Table D1.18

MORE IMPORTANT ROAD HAS FOUR RUNNING LANES		
Design Speed of more important road (km/h)	Sight Distance (1.2 m to 1.2 m) from driver of stopped car (m)	Sight Distance (1.8 m to 1.2 m) from driver of stopped car (m)
40	90	125
50	115	155
60	140	185
70	160	215
80	185	245

Stagged T junction should be separated as far as practicable. Desirable distances are shown in Table D1.10.

(Source: Interim guide for the design of intersections, AUSTROADS 1993.)

Table D1.19

Design Speed of through road (km/h)	Separation for right/left stagger* (m)	Separation for right/left stagger** (m)
40	80	80
50	100	120
60	120	160
70	140	200
80	160	220

* approx. 7 secs travel time

** twice stopping distance

(Source: Interim guide for the design of intersections, AUSTROADS 1993.)

Table D1.20

5. An absolute minimum spacing of 20 m should be adopted for staggered junctions. The intersection angle between two roads should preferably be 900, and variations to this should be within +/- 200 band**. *Staggered Junctions*

D1.28 PLAN TRANSITIONS

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. *Widening of Curves*

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 centre line 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. *Crossfall Changes*

D1.29 CARRIAGEWAYS

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

Major road over 1,000 AADT	6 metre seal 2 x 1 metre shoulder
Minor road up to 1,000 AADT	5 metre seal 2 x 0.5 metre shoulders
Minor no-through road up to 150 AADT	3.5 metre seal 2 x 0.5 metre shoulders
Rural Residential street with concrete edge strip	
up to 250 AADT	5 metre
over 250 AADT	7 metre

D1.30 SUPERELEVATION – RURAL

1. The amount of superelevation will depend on vehicle speed, curve radius and pavement surface characteristics. The rate to be adopted is chosen for the aspects of safety, comfort and appearance. Curves of 3000m radius and over may be superelevated but this is not generally necessary except for appearance reasons.

2. Values of desirable superelevation are shown in Table D1.21:

Desirable Elevation

Radius	Superelevation
50 – 330	7%
330 – 550	6%
550 – 750	5%
750 – 950	4%
> 950	3%

Table D1.21

D1.31 SCOUR PROTECTION

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 to determine the level and extent of any protection works prior to proceeding to final design stage. As a minimum the following table drain stabilisation should be provided:

a) Table drains with grades less than 5%: Rehabilitation to be carried out within 10 working days of the completion of work. Shape drain to a uniform dish shape. Place 75–100mm of topsoil in the drain, seed and fertilise.

b) Table drains with grades between 5% and 10%: In addition to the above, place a layer of "Jutemaster TM" or Fibre Mulch" over the topsoil, seed and fertilise and peg to the ground. Alternatively lay kikuyu turf and peg to bed.

c) Table drains with grades greater than 10%: Shape drain and line with a hard artificial liner, such as concrete, rock and cement grout, shotcrete, "Fabriform", rubber matting or some other approved material. The pavement bitumen seal to be widened to the edge of lining.

Seed Mix Required –

Japanese Millet	20kg/ha
Kangaroo Valley Ryegrass	5kg/ha
Hafia White Clover	5kg/ha
Seaton Park White Clover	5kg/ha
Carpet Grass	5kg/ha
Fertilizer with Grower 11 at	400kg/ha

D1.32 DRIVEWAYS

1. Driveway crossings where required are to be in accordance with Fig D1.17 to D1.20.

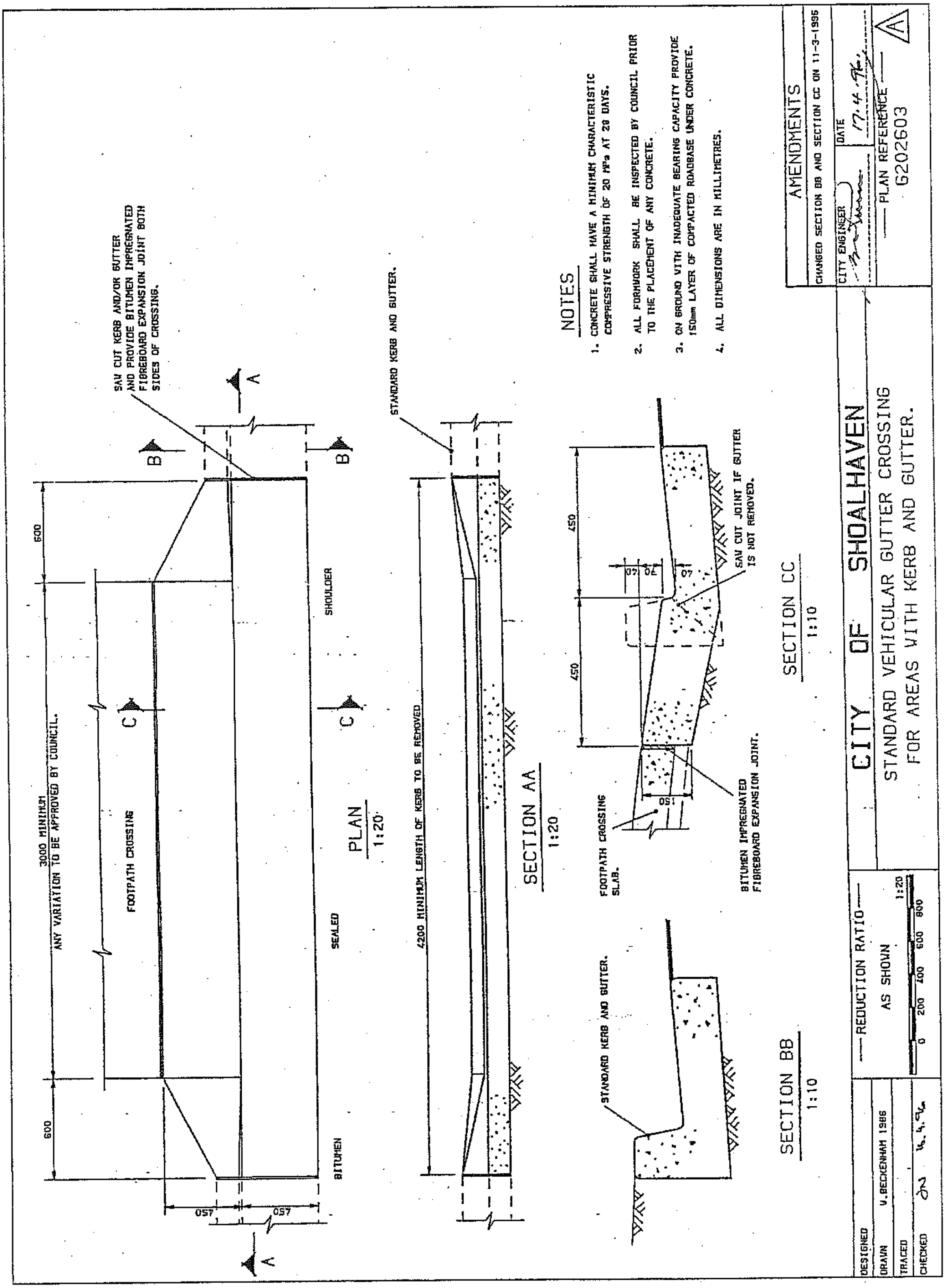


Fig. D1.17 - Standard Vehicular Gutter Crossing for Areas with Kerb and Gutter

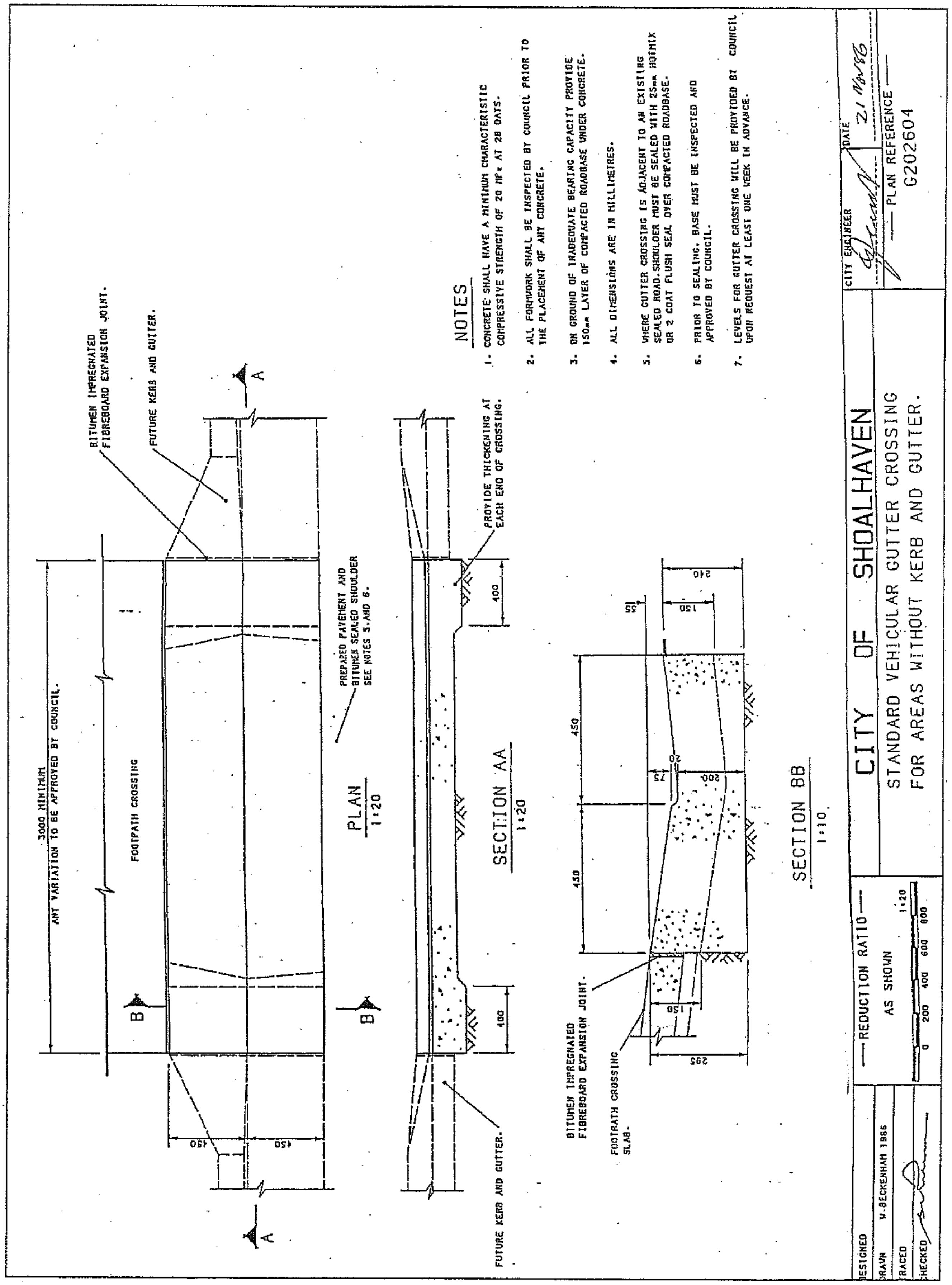


Fig. D1.18 - Standard Vehicular Gutter Crossing for Areas Without Kerb and gutter

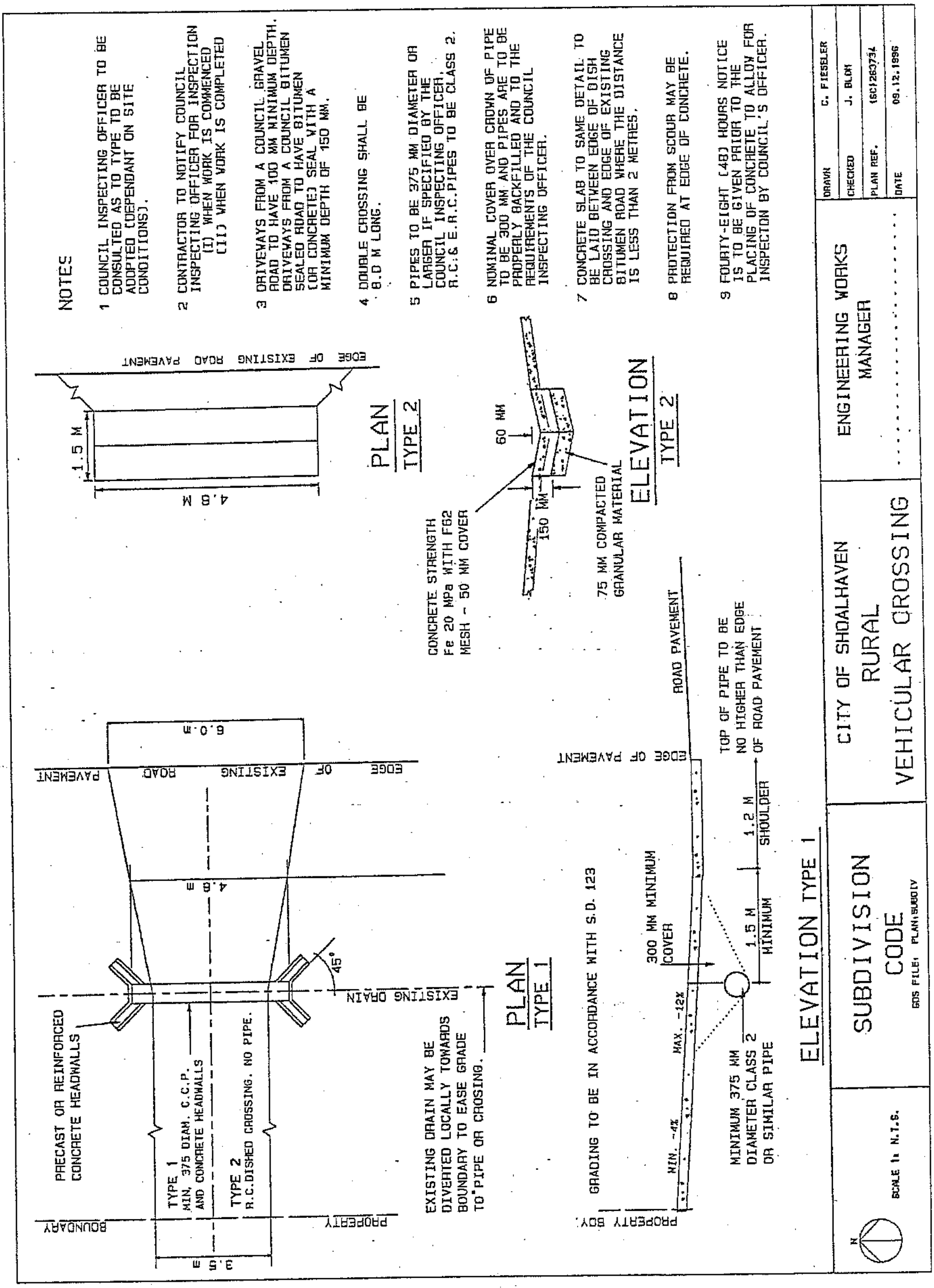


Fig. D1.19 - Rural Vehicular Crossing

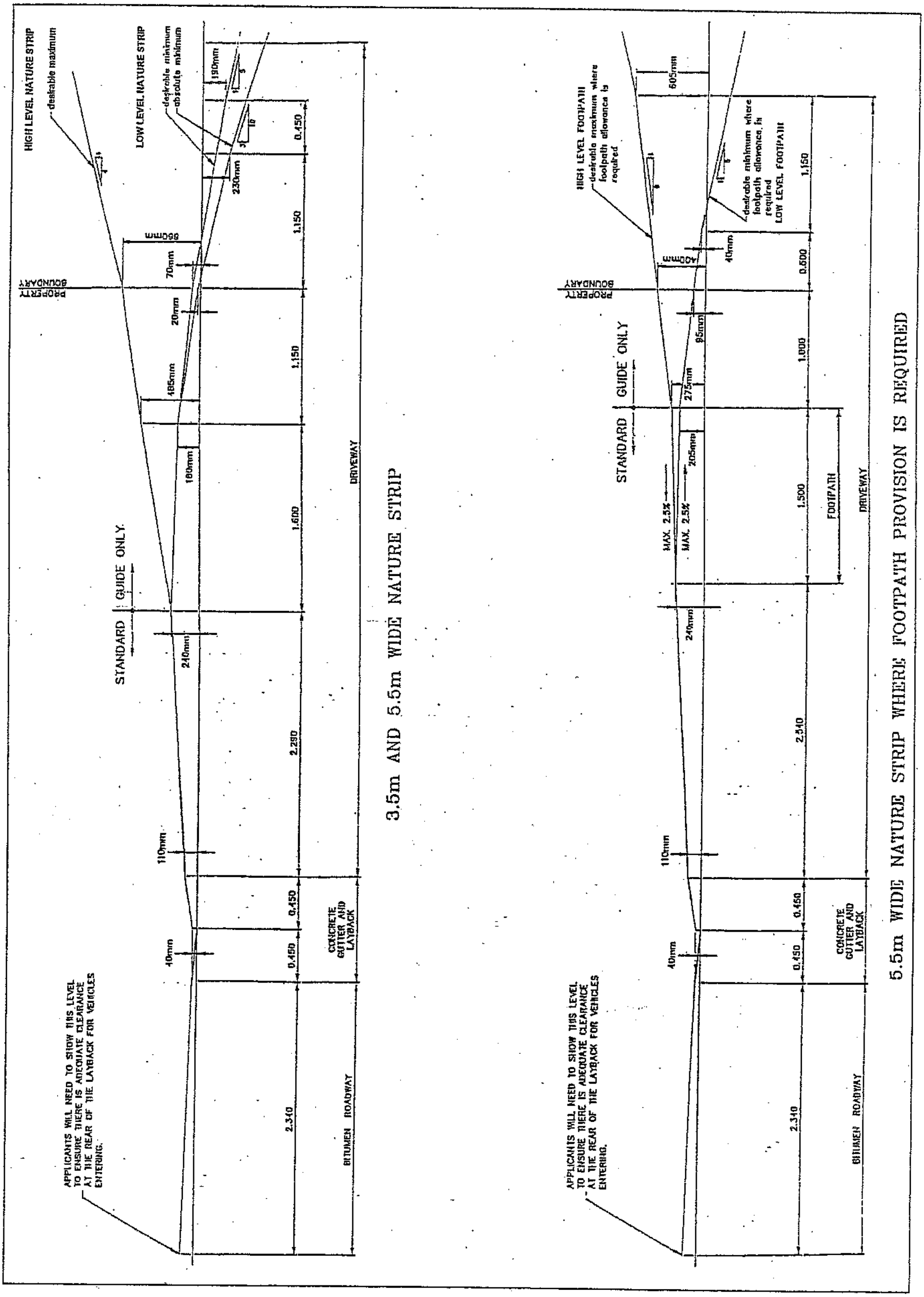
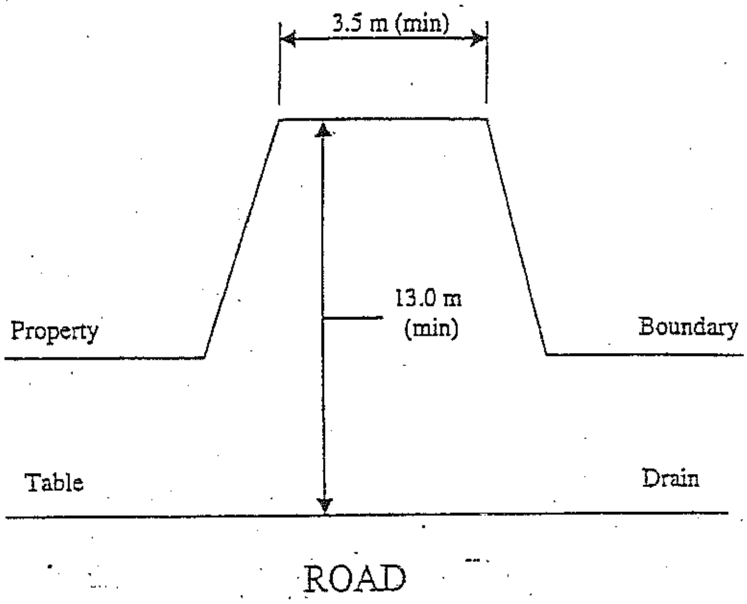


Fig. D1.20 - 5.5m Nature Strip where Footpath Provision is Required



An indented access is required when the distance between the road table drain and the property gate is less than 13.0 metres.

Fig D1.21 - Access to Rural Allotments