Australian/New Zealand Standard™

Parking facilities

Part 1: Off-street car parking

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee CE-001, Parking Facilities and supersedes AS 2890.1—1993, *Parking facilities*, Part 1: *Off-street car parking*.

It is one of a series of Standards on parking facilities as follows:

AS/NZS
2890 Parking facilities
2890.1 Part 1: Off-street car parking (this Standard)
2890.6 Part 6: Off-street parking for people with disabilities*

AS
2890 Parking facilities
2890.2 Part 2: Off-street commercial vehicle facilities
2890.3 Part 3: Bicycle parking facilities
2890.5 Part 5: On-street parking

The objective of this Standard is to provide planners, designers and regulatory bodies with requirements and recommendations for the design and layout of off-street parking facilities.

The following lists the principal changes and additions to this edition of the Standard:

(a) Publication as a Joint Australia/New Zealand Standard. Where requirements or recommendations apply only to Australia or only to New Zealand, these are indicated in the text or on illustrations.

(b) Addition of two new user classes, the first aimed at relaxing manoeuvre space requirements to reach parking spaces in residential properties and the second, to increase aisle width requirements at certain high turnover parking areas.

(c) Expanded detail on parallel parking in parking aisles.

(d) Changes in ramp grade requirements for private/residential car parks and for parking on domestic properties.

(e) A reappraisal of design vehicle characteristics and dimensions which includes an increase in the minimum vehicle ground clearance from 100 mm to 120 mm.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

* In preparation. See footnote to Clause 1.2.

CONTENTS

FOREWORD

As an integral part of transportation, provision for car parking is vital to the economic life of communities, whether it is in city central business districts, town business centres, shopping centres, hospitals, department stores, entertainment and sporting facilities, or other traffic generators. Parking areas must also cater for bicycles, motorcycles, pedestrians, and other legitimate users.

The basic dimensions for parking spaces, aisles, circulation roadways and other manoeuvring areas given in this Standard have been determined firstly by an examination of the dimensions of vehicles in the current range, and the selection of an 85th percentile and a 99.8th percentile vehicle (see Appendix A). Following this, a set of base dimensions based on requirements for the so-called B85 and B99 vehicles has been established, and a set of design dimensions has been derived by the addition of working clearances (see Appendix B). The concept of 'parking module' has been adopted to ensure that parking space width and length are properly related to aisle width.

The success of a parking development requires an efficient design. It must represent a balance between function, economics, safety and aesthetics. Consideration must be given to the speed and quality of parking service, the traffic circulation, access to and from the street, the external traffic network, car manoeuvring, and convenience for the drivers and pedestrians, including people with disabilities.

Although it provides minimum requirements, this Standard cannot be taken as a textbook for the design of parking stations. The services of a qualified person experienced in designing car parking facilities should be sought in the application of this document. Moreover, its use does not remove the need to comply with regulatory requirements of local government.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Parking facilities

Part 1: Off-street car parking

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out the minimum requirements for the design and layout of off-street parking facilities, including multi-storey car parks for motor cars, light vans and motorcycles. It includes access and egress requirements for both public and private car parks, and car parking on domestic properties.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1348 Glossary of terms—Road and traffic engineering

1680 Interior lighting
1680.2.1 Part 2.1: Circulation spaces and other general areas

1742 Manual of uniform traffic control devices
1742.1 Part 1: General introduction and index of signs
1742.2 Part 2: Traffic control devices for general use
1742.10 Part 10: Pedestrian control and protection
1742.13 Part 13: Local area traffic management

1744 Forms of letters and numerals for road signs

2890 Parking facilities
2890.3 Part 3: Bicycle parking facilities

AS/NZS

1158 Road lighting
1158.3.1 Part 3.1: Pedestrian area (Category P) lighting—Performance and installation design requirements

1170 Structural design actions
1170.1 Part 1: Permanent, imposed and other actions

AS/NZS
2890 Parking facilities
2890.6 Part 6: Off-street parking for people with disabilities*

4586 Slip resistance classification of new pedestrian surface materials

ADR
43 Australian design rules for vehicle configuration and dimensions

Land Transport Safety Authority, New Zealand and Transit New Zealand
Manual of Traffic Signs and Markings

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 1348 and the following apply.

1.3.1 Access driveway

A roadway extending from the edge of the frontage roadway to the property boundary to connect with the first ramp, circulation roadway, parking aisle or domestic driveway encountered, and carrying one- or two-way traffic (see Figure 2.1).

1.3.2 Accessible entrance

An entrance to a facility or establishment served by the car park, suitable for pedestrian or wheelchair use by people with disabilities.

1.3.3 Accessible travel path

An uninterrupted path of travel to or within a building providing pedestrian or wheelchair access for people with disabilities from a parking space to all required facilities.

1.3.4 Base dimension

The value of a particular design dimension before any operating clearances have been added.

1.3.5 Blind aisle

A parking aisle closed at one end.

1.3.6 B85 vehicle

The design motor car whose physical dimensions represent the 85th percentile class of all cars and light vans on the road (see Appendix B, Paragraph B2).

1.3.7 B99 vehicle

The design motor car whose physical dimensions represent the 99.8th percentile class of all cars and light vans on the road (see Appendix B, Paragraph B2).

1.3.8 Circulation clearance

The clearance required in addition to manoeuvring clearances, when a vehicle is moving at speeds greater than those applicable to manoeuvring.

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* In preparation. This edition of this Standard has been published without the inclusion of requirements for parking facilities for people with disabilities. As these requirements are to be referenced in the proposed Disability Standards for Access to Premises (the Premises Standard), to be released for public comment by the Australian Building Codes Board (ABCB) at about the time of publication of this Standard, Standards Australia has been advised by that Board to delay publication of those requirements in the Australian/New Zealand Standard until its public comment process has been completed. These requirements are therefore expected to be published at an appropriate later date as a separate Standard to be numbered AS/NZS 2890.6. Pending such publication it is intended that existing requirements for parking for people with disabilities in AS 2890.1—1993, which has been made 'available superseded', will be observed. Subject to further confirmation from New Zealand interests, Part 6 may be published as an Australian only standard.

1.3.9 Circulation roadway

A roadway within an off-street car park which is used solely for circulation and to gain access to parking aisles, and on which there is no parking (see Figure 2.1).

1.3.10 Collector road

A non-arterial road which collects and distributes traffic in an area, as well as serving abutting properties.

1.3.11 Control point

A point at or near the entrance to or exit from a car park at which the flow of traffic is retarded by the existence of a boom barrier, with or without ticket or cashier operation, or the location of the first of any spaces on a parking aisle at which parking or unparking may cause traffic flow to be retarded.

1.3.12 Domestic driveway

A vehicular path within a domestic property.

1.3.13 Domestic property

A property comprising three or less domestic units.

1.3.14 Front overhang

The distance between the centre-line of the front axle of a vehicle and the front extremity of the bodywork.

1.3.15 Local road

A road or street used primarily for access to abutting properties.

1.3.16 Parking aisle

A roadway or an area of pavement used by vehicles to gain access to, and to manoeuvre into and out of parking spaces.

1.3.17 Parking module

A parking aisle together with a single row of parking spaces on one or both sides (see Figure 2.1), but excluding any ramps or circulation roadways which take off within the module.

1.3.18 Parking space

The area of pavement required to park one vehicle.

1.3.19 Queuing area

The area of a circulation roadway between the property boundary and the vehicle control point, available for the queuing of vehicles.

1.3.20 Ramp

A circulation roadway which connects an access driveway to an off-street car park on a substantially different level, or which connects two levels in a multi-level car park (see Figure 2.1).

1.3.21 Rear overhang

The distance between the centre-line of the rear axle of a vehicle and the rear extremity of the bodywork.

1.3.22 Residential property

A property having more than three domestic units.

1.3.23 Road

The entire width of a right-of-way between property boundaries, and including footpaths.

1.3.24 Roadway

Any one part of the width of a public road or a vehicular traffic path in an off-street car park devoted particularly to the use of vehicles, inclusive of shoulders and auxiliary lanes, but exclusive of parking spaces.

1.3.25 Shall

Indicates that a statement is mandatory.

1.3.26 Should

Indicates a recommendation.

1.4 CLASSIFICATION OF OFF-STREET CAR PARKING FACILITIES

Off-street parking facilities shall be classified according to the user classes listed in the first column of Table 1.1. Dimensional requirements for parking spaces in each user class are specified in Clause 2.4.1.

User Class 1A parking shall be restricted to residential, domestic and employee parking.

User Class 4 parking shall be restricted to use by people with disabilities (see AS/NZS 2890.6*).

* In preparation. See footnote to Clause 1.2.

TABLE 1.1

CLASSIFICATION OF OFF-STREET CAR PARKING FACILITIES

User class	Required door opening	Required aisle width	Examples of uses (Note 1)
1	Front door, first stop	Minimum for single manoeuvre entry and exit	Employee and commuter parking (generally, all-day parking)
1A	Front door, first stop	Three-point turn entry and exit into 90° parking spaces only, otherwise as for User Class 1	Residential, domestic and employee parking
2	Full opening, all doors	Minimum for single manoeuvre entry and exit	Long-term city and town centre parking, sports facilities, entertainment centres, hotels, motels, airport visitors (generally medium-term parking)
3	Full opening, all doors	Minimum for single manoeuvre entry and exit	Short-term city and town centre parking, parking stations, hospital and medical centres
3A	Full opening, all doors	Additional allowance above minimum single manoeuvre width to facilitate entry and exit	Short term, high turnover parking at shopping centres
4	Size requirements are specified in AS/NZS 2890.6 (Note 2)		Parking for people with disabilities

NOTES:

1 Except for the requirements specified in Clause 1.4 relating to User Classes 1A and 4, the examples of uses are intended to be flexible and allow for progressive improvement both in the ease of manoeuvring into and out of parking spaces, and in leaving and re-entering the vehicle as one progresses up the user class scale from 1 to 3A. The modelling of vehicle manoeuvring into Class 1A spaces shows however, that many drivers may have difficulty driving into and out of such spaces, especially those with vehicles larger than the B85 vehicle. Furthermore, they may have difficulty entering and leaving the vehicle in the narrower spaces. Safety issues associated with delays and congestion caused by manoeuvres into and out of Class 1A spaces in large parking areas should also be taken into account. See also Appendix B, Paragraph B4.8.

2 In preparation, see footnote to Clause 1.2.

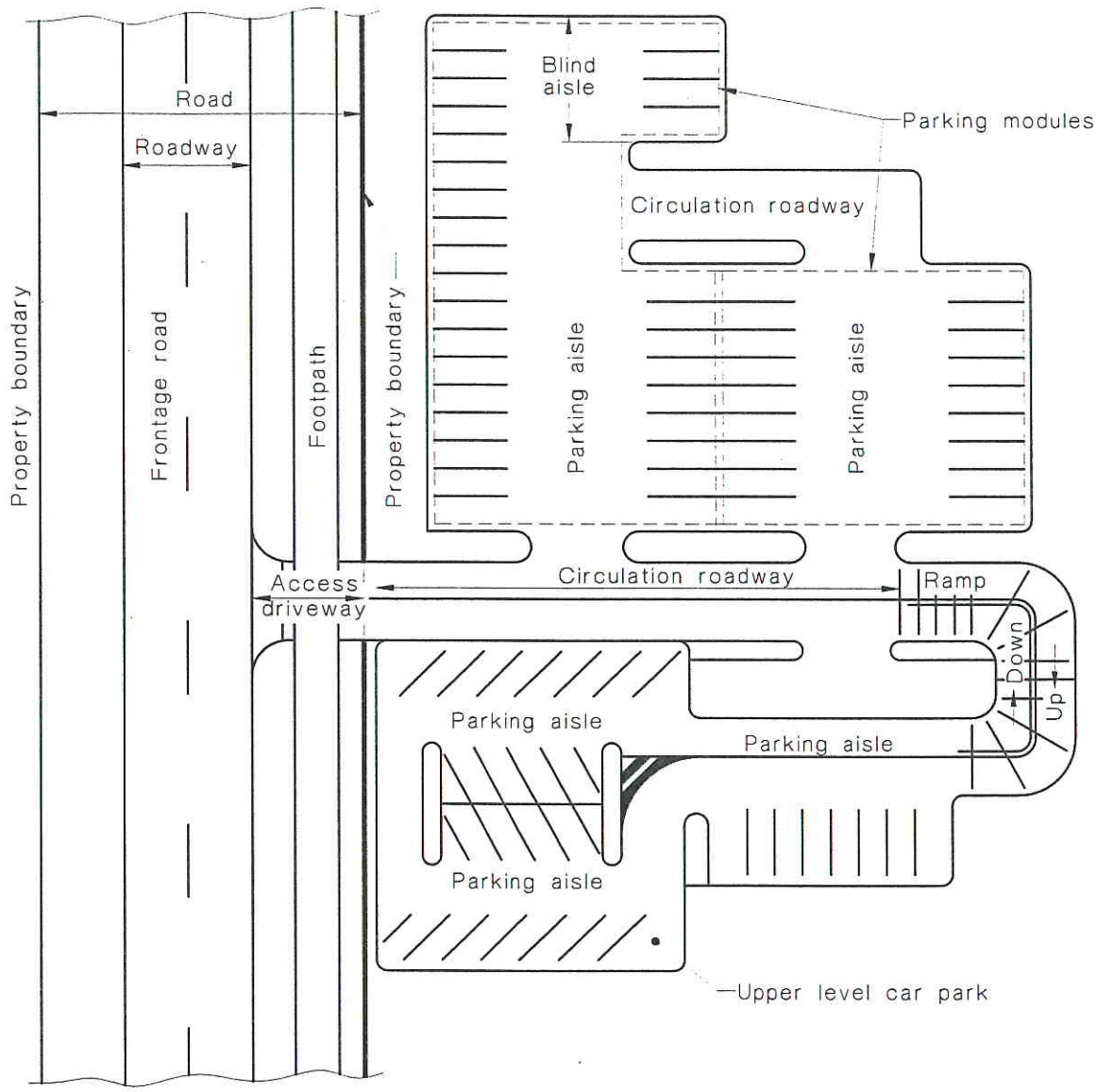
SECTION 2 DESIGN OF PARKING MODULES, CIRCULATION ROADWAYS AND RAMPS

2.1 GENERAL

This Section gives requirements and recommendations to be used in the design of parking modules and circulation roadways within off-street car parking facilities in accordance with the vehicle characteristics discussed in Appendix A and the base dimensions specified in Appendix B.

2.2 GENERAL DESCRIPTION

An example of an off-street car park illustrating the various elements which make up the parking modules and access paths, together with the terms used to describe each of the elements, is shown in Figure 2.1.



NOTE: A proportion of parking spaces for people with disabilities is required to be located near the accessible entrance to the development the car park serves.

FIGURE 2.1 EXAMPLE OF AN OFF-STREET CAR PARK

2.3 PRELIMINARY DESIGN CONSIDERATIONS

2.3.1 Design coordination

The layout design of an off-street car park shall consider the entire facility, including parking modules, circulation roadways, access driveways and, if necessary, frontage road access, as an integrated and co-ordinated design. Provision for traffic within a parking facility shall take into account the following:

(a) The need for traffic to move to and from the frontage road with minimum disruption to through traffic and maximum pedestrian safety.

(b) Provision of adequate capacity in circulation roadways and parking aisles to handle peak period movements.

(c) Arrangement of internal roadways to avoid, as far as practicable, conflicts between intersecting streams of circulating traffic.

(d) Provision of minimum length travel paths between entry/exit points and parking spaces.

(e) Safe treatment of points of conflict with pedestrians and other road users.

(f) Provision of parking spaces and accessible pedestrian paths for people with disabilities (see AS/NZS 2890.6*).

2.3.2 Parking angle

Parking angles used in off-street car parks shall be as follows:

(a) *90 degree angle parking*

Parking aisles for 90 degree parking shall be designed for two-way movement even though one-way movement may need to be imposed in some instances.

NOTE: 90 degree parking will in most cases be found to be the most efficient use of space in a large area.

(b) *30, 45 or 60 degree angle parking*

Where space is limited or does not lend itself to 90 degree parking, 30, 45 or 60 degree parking may be used instead. Aisles serving such spaces shall be one-way (except where parallel parking is allowed on one side, see Clause 2.4.4) with forward entry into the spaces only.

NOTE: Such arrangements can have advantages for high turnover parking provided drivers are discouraged from entering aisles the wrong way and reversing into parking spaces.

(c) *Parallel parking*

Parallel parking shall be provided as set out in Clause 2.4.4.

2.3.3 Parking aisle length

If a parking aisle exceeds 100 m in length, (i.e. more than about 40 × 90 degree parking spaces on either side) traffic control devices such as speed humps (see Clause 4.9) shall be placed along the parking aisle to control vehicle speeds. Where vehicle negotiation of such devices may lead to structural damage, compliance with this requirement may be waived.

NOTE: To limit traffic volumes and consequent congestion in parking aisles to acceptable levels it is good practice not to have parking aisles provide access for circulating traffic to other parking aisles where those aisles together have more than 50 parking spaces for a Class 3 or 3A facility, 75 for a Class 2 facility or 100 for a Class 1 or 1A facility. Circulation roadways should be provided in lieu.

2.4 DESIGN OF PARKING MODULES

2.4.1 Angle parking spaces

Dimensions of angle parking spaces shall be as shown in Figure 2.2 subject to the following exceptions:

(a) *Length* The nominal length of a parking space in a parking module shall be 5.4 m min except as follows:

(i) *End overhang* Where a vehicle may overhang the end of a space, e.g. at a kerb, provided the first 600 mm immediately behind it is unobstructed, is not another parking space and is not required as a footway or for some similar purpose, space lengths measured parallel to the parked vehicle may be reduced by 600 mm. Ends of bays shall be provided with wheel stops if the requirements specified in Clause 2.4.5.4 apply.

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* In preparation. See footnote to Clause 1.2.

(ii) *In New Zealand* The space may be marked to a shorter length (nominally 5.0 m) as specified in Clause 4.4.1. There shall be no consequential reduction in the combined length of space and width of parking aisle from that given in Figure 2.2.

(iii) *Spaces for small cars* In certain circumstances it may be appropriate to provide a space smaller than specified above for small cars. It shall be designated as a space for small cars.

NOTE: The size of such spaces is based on small car vehicle dimensions recommended in Appendix A, Paragraph A6.

The minimum dimensions shall be as follows:

(A) In Australia—2.3 m wide × 5.0 m long.

(B) In New Zealand—2.3 m wide × 4.5 m long.

(b) *Width* The minimum width of parking spaces required for each user class is shown in Figure 2.2 except as follows:

(i) *Spaces for small cars* The specified minimum width is given in Item (a)(iii).

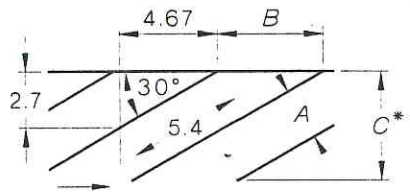
(ii) *Adjacent obstruction* If the side boundary of a space is a wall or fence, or if there are obstructions such as columns placed so as to restrict door opening, 300 mm shall be added to the width of the space.

(iii) *Parking spaces for people with disabilities* See AS/NZS 2890.6*.

Attention is also drawn to the reduced width requirement for 30 degree parking as shown in Figure 2.2.

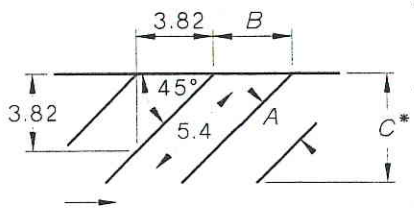
In the design of buildings or parts of buildings to be used exclusively as parking stations, the location of obstructions such as columns shall be in accordance with Clause 5.2.

* In preparation. See footnote to Clause 1.2.



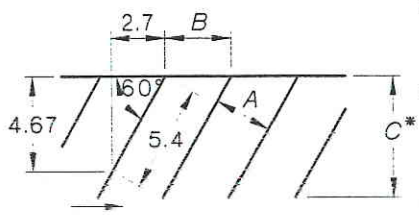
(a) Bays at 30°

User class (Note 1)	A (Notes 2 & 3)	B	C_1	C_2	C_3	Aisle width
1,1A	2.1	4.2	4.4	4.1	4.5	3.1
2	2.3	4.6	4.4	4.1	4.7	3.0
3	2.5	5.0	4.4	4.1	4.9	2.9
3A	2.5	5.0	4.4	4.1	4.9	3.45



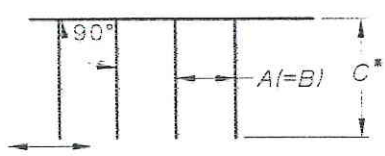
(b) Bays at 45°

User class (Note 1)	A (Note 3)	B	C_1	C_2	C_3	Aisle width
1,1A	2.4	3.4	5.2	4.8	5.5	3.9
2	2.5	3.5	5.2	4.8	5.6	3.7
3	2.6	3.7	5.2	4.8	5.7	3.5
3A	2.6	3.7	5.2	4.8	5.7	4.2
4	(See Note 5)					



(c) Bays at 60°

User class (Note 1)	A (Note 3)	B	C_1	C_2	C_3	Aisle width
1,1A	2.4	2.75	5.7	5.1	5.9	4.9
2	2.5	2.90	5.7	5.1	6.0	4.6
3	2.6	3.00	5.7	5.1	6.0	4.3
3A	2.6	3.00	5.7	5.1	6.0	5.1
4	(See Note 5)					



(d) Bays at 90°

User class (Note 1)	A (Note 3)	B	C_1	C_2	C_3	Aisle width (Note 4)
1	2.4	2.4	5.4	4.8	5.4	6.2
1A	2.4	2.4	5.4	4.8	5.4	5.8
2	2.5	2.5	5.4	4.8	5.4	5.8
3	2.6	2.6	5.4	4.8	5.4	5.8
3A	2.6	2.6	5.4	4.8	5.4	6.6
3A	2.7	2.7	5.4	4.8	5.4	6.2
4	(See Note 5)					

*Dimension C is selected as follows (see Note 6):

C1—where parking is to a wall or high kerb not allowing any overhang.

C2—where parking is to a low kerb which allows 600 mm overhang in accordance with Clause 2.4.1(a)(i).

C3—where parking is controlled by wheelstops installed at right angles to the direction of parking, or where the ends of parking spaces form a sawtooth pattern, e.g. as shown in the upper half of Figure 2.4(b).

For Notes—see over.

DIMENSIONS IN METRES

FIGURE 2.2 LAYOUTS FOR ANGLE PARKING SPACES

NOTES TO FIGURE 2.2:

1 User class is defined in Table 1.1. The two Class 3A options given for 90 degree parking are alternatives of equal standing.

2 30 degree parking spaces can be made narrower than spaces at other angles because of the reduced chance of open doors hitting adjacent vehicles.

3 The design envelope around each parking space, to be kept clear of obstructions, is shown in Figure 5.2.

4 Dimensions for 90 degree parking aisles are for two-way aisles. These dimensions are required to be observed even though one-way movement along aisles is imposed for other purposes, see Clause 2.3.2(a).

5 Space dimensions for User Class 4 spaces (for people with disabilities) are specified in AS/NZS 2890.6*. Aisle widths shall be the same as applicable to adjacent other-user spaces or in the absence of such spaces, 5.8 m minimum.

6 The values for dimension C have been calculated as follows:

$$C_1 = 5.4 \sin \theta + 1.9 \cos \theta$$

$$C_2 = C_1 - 0.6 \sin \theta$$

$$C_3 = C_1 + (A - 1.9) \cos \theta$$

where

θ = parking angle

A = space width, in metres

2.4.2 Angle parking aisle

The width of angle parking aisles is determined from either the width needed for circulating traffic or the width needed to manoeuvre into and out of a parking space. In the latter case, the width will vary according to the width of the parking spaces, wider spaces needing less aisle width for the parking manoeuvre. Minimum aisle widths shall be as shown in Figure 2.2. These widths will cater both for the angle parking manoeuvre or for circulating traffic, two-way in the case of 90 degree parking and one-way in the case of 30, 45 and 60 degree parking. For aisles where there is parallel parking on one or both sides, see Clause 2.4.4.

When designing for turns between an aisle and a ramp or circulation roadway, or between two aisles, adequate area shall be provided for the turning movements (see Clause 2.5.2(c)).

The following additional requirements shall apply:

(a) *Class 1A aisles* Class 1A aisles apply to 90° parking only. Minimum aisle widths are shown in Figure 2.2.

NOTE: These may be of lesser width than those for user Class 1 aisles and may not allow access into parking spaces in a single manoeuvre by some vehicles, see Appendix B, Paragraph B4.8.

(b) *Class 3A aisles* To cater for expected higher turnover than other User Class 3 parking areas, User Class 3A parking spaces or aisle widths shall be increased in size as shown in Figure 2.2.

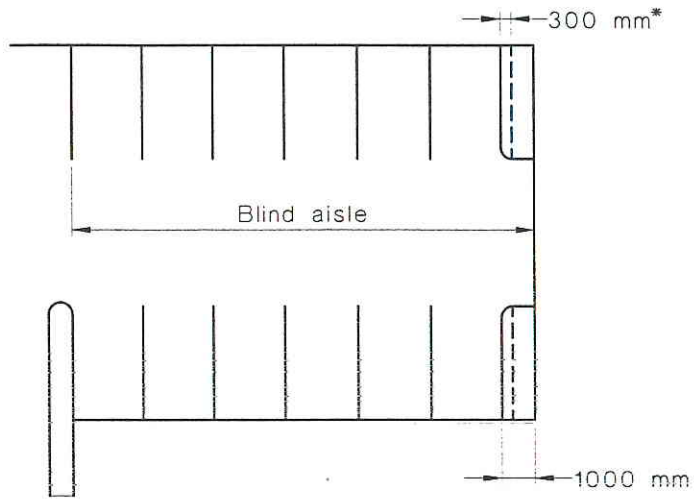
(c) *Blind aisles* At blind aisles, the aisle shall be extended a minimum of 1 m beyond the last parking space, as shown in Figure 2.3, and the last parking space widened by at least 300 mm if it is bounded by a wall or fence.

NOTE: Where practicable the space should be widened by the same amount as the aisle is lengthened.

In car parks open to the public, the maximum length of a blind aisle shall be equal to the width of six 90 degree spaces plus 1 m, unless provision is made for cars to turn around at the end and drive out forwards.

* In preparation. See footnote to Clause 1.2.

(d) *Single-sided aisles* Where there is angle parking on one side of an aisle only and the other side is confined by a wall or other high vertical obstruction closer than 300 mm to the nominal edge of the aisle, to provide manoeuvring clearance, the aisle width shall be increased by 300 mm, measured to the vertical obstruction.



*Additional widening required if there is a wall or fence at the side of the last space, see Clause 2.4.1(b)(ii).

DIMENSIONS IN MILLIMETRES

FIGURE 2.3 BLIND AISLE EXTENSION

2.4.3 Angle parking module layout

Layouts of typical angle parking modules are shown in Figure 2.4.

2.4.4 Parallel parking in parking aisles

Where parallel parking is to be provided on one or both sides of a parking aisle the following shall apply:

(a) *Parallel parking one or both sides, one-way or two-way aisle*

Layout requirements for parallel parking on one or both sides of a one-way aisle shall be as set out in Figure 2.5.

Where the aisle is two-way but parking is on one side only, its width shall be increased by 3.0 m minimum.

Where parallel parking is provided on both sides of a two-way aisle, the aisle widths shown in Figure 2.5 shall be provided on each side of the aisle centre-line.

For parallel parking on both sides of a one-way aisle the aisle width shall be at least twice that shown in Figure 2.5.

(b) *Parallel parking one side, angle parking the other, one-way or two-way aisle* Requirements shall be as follows:

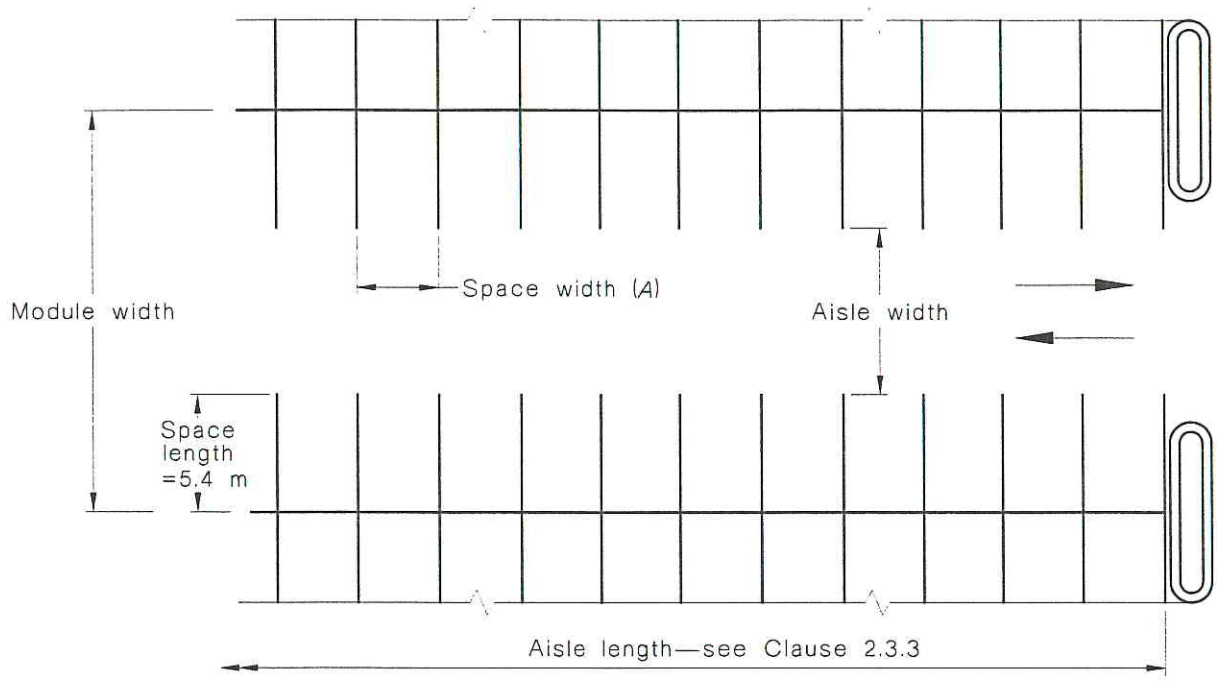
(i) Angle parking space depths shall be as shown for dimension C on Figure 2.2.

(ii) Parallel parking space dimensions shall be as shown on Figure 2.5.

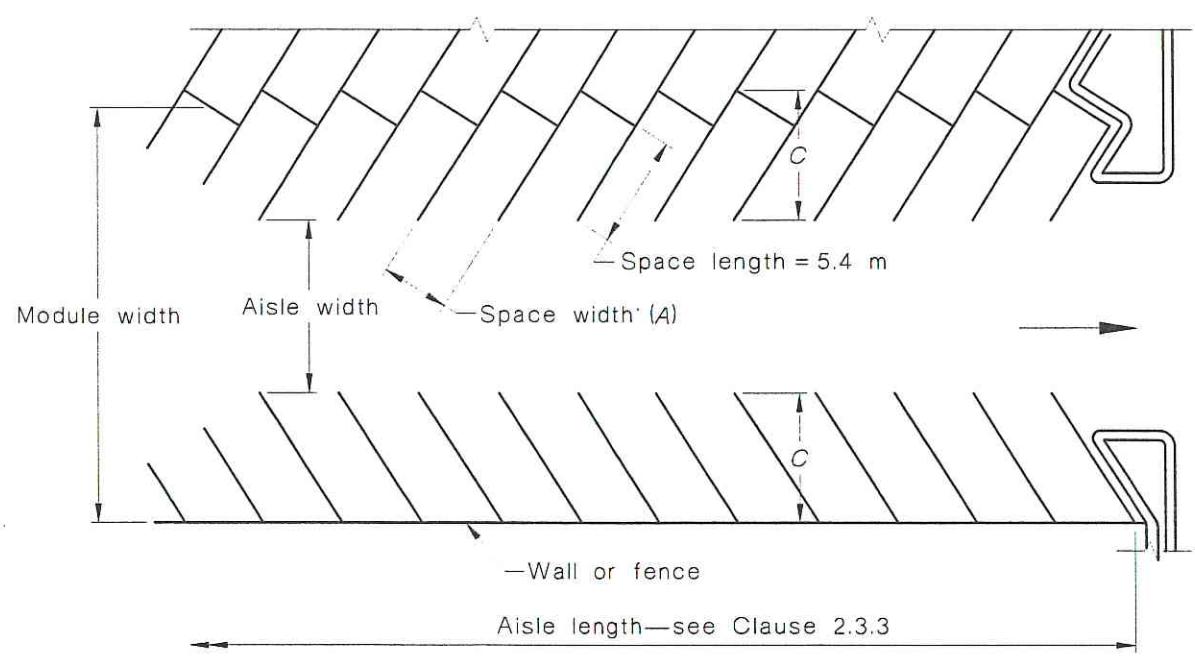
(iii) Aisle width shall be that shown on Figure 2.2 plus a further 0.5 m.

(iv) Steps shall be taken to discourage reverse-in parking where the angle parking angle is other than 90 degrees.

NOTE: Suitable steps might include making the aisle one-way or signposting the angle parking spaces as front-in only.



(a) 90 degree parking

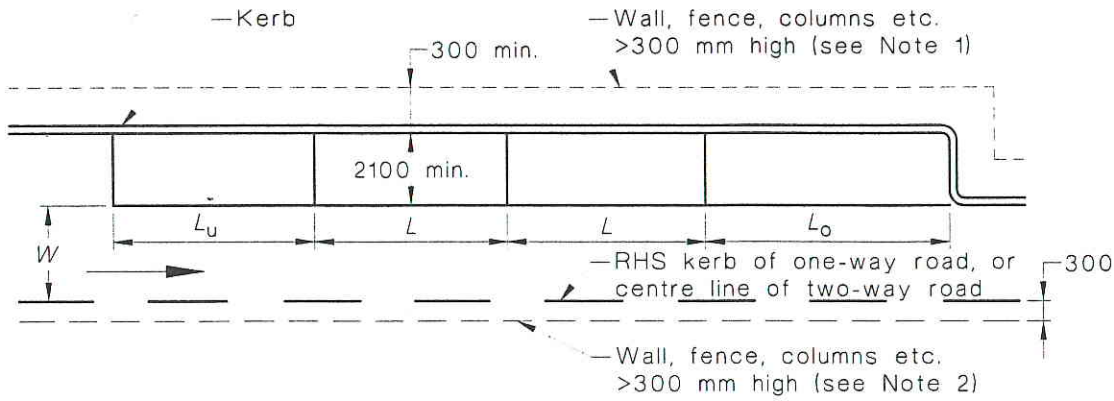


(b) Parking angle other than 90 degrees

Dimensions A and C are as shown in Figure 2.2

NOTE: See also Clause 4.4.1 regarding marking of spaces.

FIGURE 2.4 ANGLE PARKING MODULE LAYOUTS



metres

Aisle width (one-way), *W*	Space length, *L*	Space length obstructed end spaces, L_o	Space length unobstructed end spaces, L_u (Note 4)
3.0	6.3	6.6	5.4
3.3	6.1	6.4	5.4
3.6	5.9	6.2	5.4

NOTES:

1 Spaces shall be located at least 300 mm clear of obstructions higher than 150 mm such as walls, fences and columns.

2 Where the opposite side of the aisle is bounded by obstructions higher than 150 mm, Dimension W shall be increased by at least 0.3 m.

3 If a single space is obstructed at both ends, a further 0.3 m shall be added to dimensions in this column.

4 In New Zealand only, space lengths in this column may be reduced to 5.0 m.

FIGURE 2.5 MINIMUM SPACE LENGTH AND AISLE WIDTH COMBINATIONS FOR PARALLEL PARKING MANOEUVRE

2.4.5 Physical controls

2.4.5.1 *General description*

The need for the following physical controls shall be considered:

(a) *Kerbs*—on one or more sides of a parking space to protect pedestrian walkways, landscaped areas, and any other non-trafficable areas generally at or just above pavement level, from encroachment.

(b) *Barriers*—to contain vehicles at the edges of platforms or decks, or to prevent encroachment onto pedestrian facilities.

(c) *Wheel stops*—to limit the travel of vehicles when manoeuvring into a parking space.

NOTE: Wheel stops should be avoided in any situation where they may be in the path of pedestrians or wheelchairs moving to or from parked vehicles, or crossing a car park for any other purpose.

(d) *Other protective devices*—to prevent damage to structural elements or other unwanted vehicle encroachment.

Physical controls shall not obstruct accessible travel paths for people with disabilities.

All kerbs, wheel stops, low barriers and other obstructions that could be a tripping hazard to pedestrians shall be surfaced in a colour contrasting with their surroundings.

2.4.5.2 *Kerbs*

Vehicles may be allowed to park overhanging a kerb at the rear of a parking space, provided that—

(a) the kerb is not more than 150 mm high;

(b) the area up to 1.2 m behind the kerb does not slope up from the kerb; and

(c) the walkway behind the kerb would not be obstructed. (See also Clause 2.4.1(a)(i).)

If overhang cannot be tolerated, wheel stops (see Clause 2.4.5.4) shall be provided. Kerbs in vulnerable locations may require additional devices such as bollards to make them visible to car drivers.

2.4.5.3 *Barriers*

Barriers shall be constructed to prevent vehicles from running over the edge of a raised platform or deck of a multi-storey car park including the perimeter of all decks above ground level. They are required wherever the drop from the edge of the deck to a lower level exceeds 600 mm. At drops between 150 mm and 600 mm, wheel stops (see Clause 2.4.5.4) shall be provided. Barriers shall comply with the following requirements:

(a) They shall be designed structurally for the loading requirements of AS/NZS 1170.1.

(b) If at the end of a parking space, they shall be at least 1.3 m high so that drivers of cars backing into the space can see the barrier above the rear of the car.

NOTE: The upper portion of such a barrier may be a light structure provided for sighting purposes only.

(c) They shall not be made from brickwork, unreinforced concrete or other materials likely to shatter on impact.

2.4.5.4 *Wheel stops*

Wheel stops may be provided where it is considered necessary to limit the travel of a vehicle into a parking space. If used they shall meet the requirements given below.

NOTES:

1 Typical uses of wheel stops are as follows:

(a) Control of kerb overhang where inconvenient or hazardous for pedestrians.

(b) Inhibiting contact with an end barrier or high kerb.

(c) Inhibiting encroachment into an opposing parking space.

2 Wheel stops should be avoided in any situation where they may be in the path of pedestrians moving to or from parked vehicles, or crossing a car park for any other purpose.

Wheel stops shall be between 90 and 100 mm in height, and 1650 ±50 mm in width.

Where reverse-in parking is unlikely, e.g. at 30, 45 and 60 degree angle parking modules with one-way aisles, or where occasional minor encroachment (up to about 400 mm) by a reverse-in vehicle can be tolerated, e.g. over a kerb, wheel stop positions shall be set at the *front-in* position. If reverse-in parking is likely and encroachment over the end of the parking space cannot be tolerated, wheel stop positions shall be set at the *rear-in* position and all vehicles required to back in. Location of wheel stops with respect to the front of parking spaces is given in Table 2.1 and illustrated in Figure 2.6.

If wheel stops are provided to restrain vehicle contact with a kerb higher than 150 mm or a wall, a further 200 mm shall be added to the wheel stop distance to cater for the B99 vehicle, as illustrated in Figure 2.6(c) and (d).

TABLE 2.1

WHEEL STOP DISTANCES

millimetres

Parking direction	Wheel stop distance to front of parking space			
	Parking to kerb ≤150 high		Parking to kerb >150 high or wall	
	Wheel stop height		Wheel stop height	
	90	100	90	100
Front-in	630	620	830	820
Rear-in	910	900	1110	1100

NOTE: The distances in this table are calculated from the formula:

$$S = C + O - \sqrt{r^2 - (r - d - H)^2}$$

where

S = wheel stop distance (measured to point of contact with vehicle tyre)

C = clearance (to low kerb—nil; to high kerb or wall—200 mm)

O = overhang of B85 vehicle (front—820 mm; rear—1100 mm)

r = radius of wheel (225 mm)

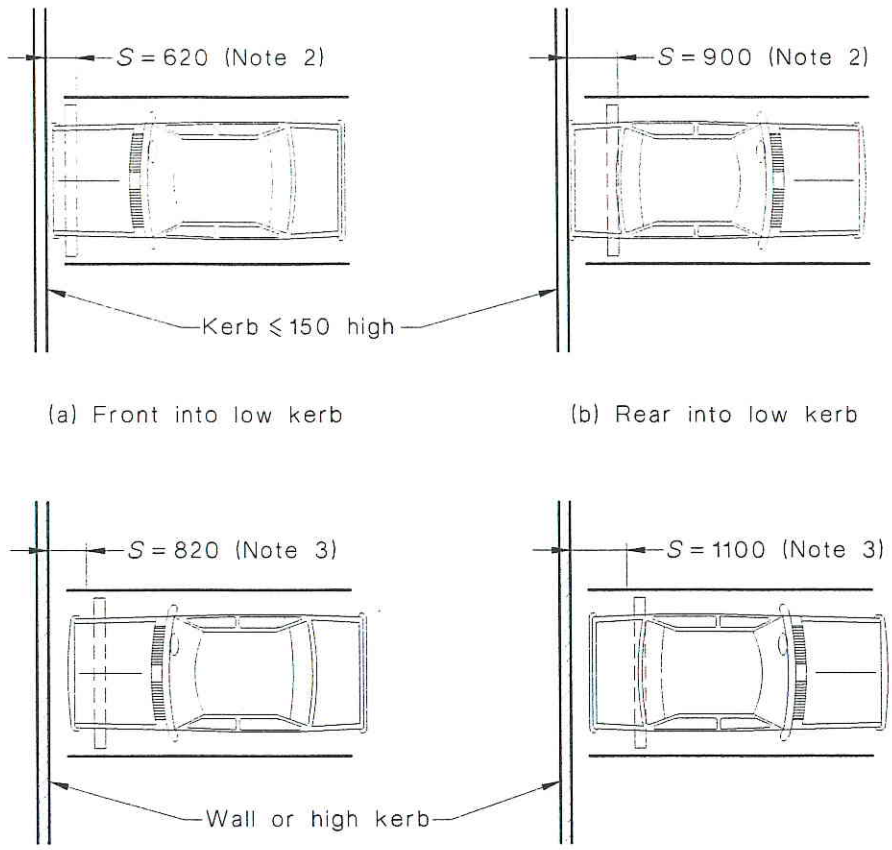
d = tyre deflection under load (20 mm)

H = wheel stop height

2.4.5.5 *Other protective devices*

Protective devices shall be provided as necessary to protect parts of the building or other fixed objects or equipment from damage by vehicles. Such protection shall include devices to prevent vehicle encroachment into pedestrian ways, stairs, doorways, lifts and the like. Appropriately located bollards are suitable for these purposes. Protective devices shall be clearly visible to drivers when in their normal driving position.

NOTE: Design impact forces are given in AS/NZS 1170.1.



S = wheel stop distance (measured to point of contact with vehicle tyre).

NOTES:

1 Wheel stop distances shown in this Figure are for 100 mm high wheel stops (see also Table 2.1).

2 Wheel stop distances are set for the B85 vehicle. Some kerb overlap may occur if either a longer vehicle or, in the case of Figure 2.6(a), an occasional reverse-in vehicle, uses the space.

3 Wheel stop distances are set to allow 200 mm clearance to the wall for the B85 vehicle. The clearance will be almost zero for the B99 vehicle.

FIGURE 2.6 LOCATION OF WHEEL STOPS

2.4.6 Gradients within parking modules

2.4.6.1 *Maximum gradients*

The maximum gradients within a parking module including a motorcycle parking area shall be as follows:

(a) Measured parallel to the angle of parking—1 in 20 (5%).

(b) Measured in any other direction—1 in 16 (6.25%).

(c) Within parking spaces for people with disabilities—see AS/NZS 2890.6*.

2.4.6.2 *Minimum gradients*

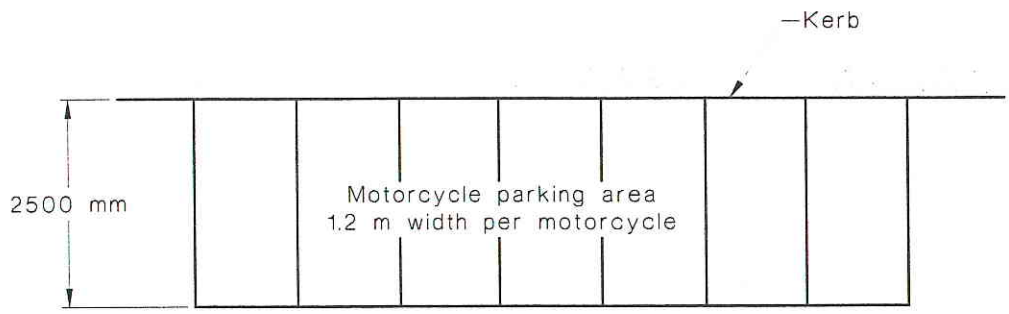
So that parking floors will drain adequately, the minimum gradient shall be 1 in 100 (1.0%) for outdoor areas and 1 in 200 (0.5%) for covered areas.

* In preparation. See footnote to Clause 1.2.

2.4.7 Provision for motorcycles

The recommended minimum provision for motorcycles is shown in Figure 2.7.

Motorcycle parking areas should not be located so that parked motorcycles are vulnerable to being struck by a manoeuvring car.



NOTE: Transverse bay markings will usually be needed to control space usage and parking angle.

FIGURE 2.7 MOTORCYCLE PARKING PROVISION

2.5 DESIGN OF CIRCULATION ROADWAYS AND RAMPS

2.5.1 General

Circulation roadways and ramps provide access between the car park entry/exit points and parking modules. They also provide for traffic circulating between parking modules. In small car parks, not larger than 50 parking spaces, access from a frontage road may be direct to the parking module.

NOTE: Parking aisles should not be used to provide access to other parking aisles where the restrictions recommended in the Note to Clause 2.3.3 apply.

2.5.2 Layout design of circulation roadways and ramps

Cross sections of circulation roadways and ramps shall be as illustrated in Figure 2.8. Design requirements and dimensions shall be as follows:

(a) *Straight roadways and ramps*—as follows:

(i) One-way roadways or ramps—3.0 m minimum between kerbs (see also Item (c)).

(ii) Two-way roadways or ramps—5.5 m minimum between kerbs (see also Item (c)).

(iii) Double roadways or ramps—where there are to be two parallel roadways or ramps, separated by a raised median or separator, each roadway or ramp shall be designed as a one-way roadway or ramp, and the median or separator shall be 600 mm minimum in width and between 125 mm and 150 mm in height, the preferred height being 125 mm.

Where there is to be a kerb or barrier higher than 150 mm and closer than 300 mm from one edge of the roadway or ramp, the roadway or ramp shall be widened to provide a minimum of 300 mm clearance to the obstruction. If there is to be a high kerb or barrier on both sides, the width increase shall be sufficient to provide 300 mm on both sides.

(b) *Curved roadways or ramps* Curved roadways and ramps will usually be designed as circular curves. Limiting dimensions shall be as shown in Table 2.2 and Figure 2.9. A separator or median shall be provided on two-way curved roadways or ramps where

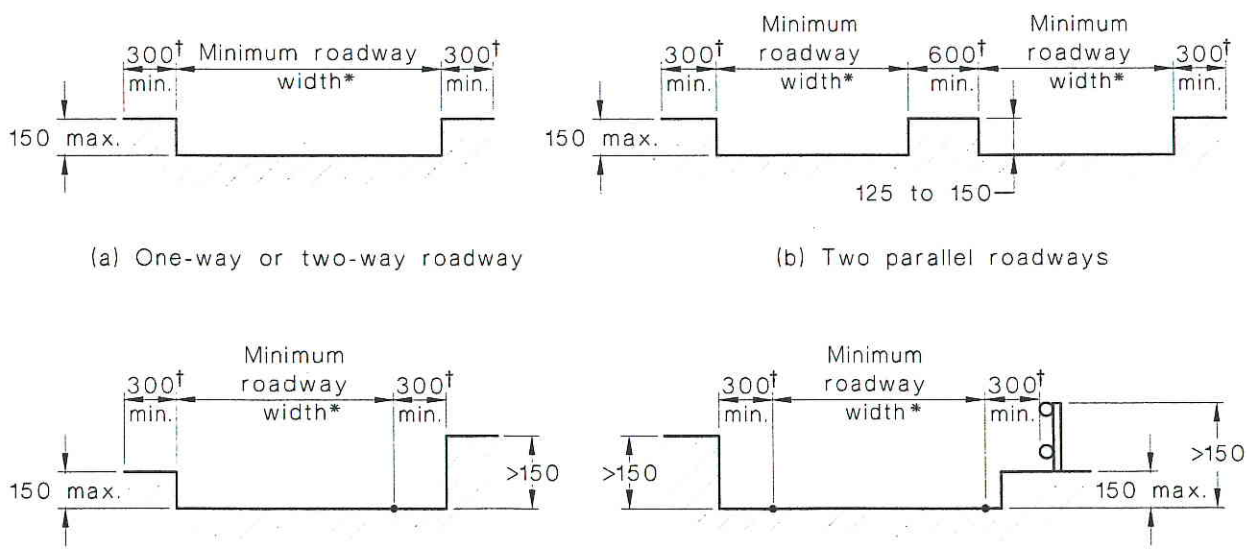
the radius to the outer kerb (dimension R_0 on Figure 2.7(b)) is less than 15 m. A separator or median is optional at larger radii but if not provided, a centre-line pavement marking shall be provided on ramps serving User Class 2 and 3 facilities (see Table 1.1).

(c) *Intersections* Intersections between circulation roadways and ramps, and with parking aisles shall be designed so that both the approach roadways and the intersection area are wide enough to accommodate turning vehicles and there is adequate intersection sight distance.

Intersection areas designed for use by one vehicle at a time shall be designed for use by the B99 vehicle. Areas in which it is necessary for two vehicles to pass one another shall be designed for a B85 vehicle to pass a B99 vehicle. In both cases areas shall be checked using single turn swept path templates for the B99 vehicle and the B85 vehicle, generated in accordance with Appendix B, Paragraph B3.1, which include the swept path clearances specified in Paragraph B3.2. The swept path clearances shall clear any kerbs at the boundary of the intersection area.

NOTE: A B99 swept path template is used to check areas designed to be used by one vehicle at a time using outer lines on the template e.g. as shown in Figures B1 and B2, which incorporate both the manoeuvring and circulation clearances. Where there is to be provision for two vehicles to pass, B99 and B85 swept path templates with clearances incorporated are used in combination. The turn radii need not be the same.

If a boundary of the intersection area is an obstruction such as a wall, barrier or kerb higher than 150 mm a further clearance of 300 mm shall be provided where the swept path template approaches the obstruction.



* Minimum roadway width: One-way roadway—3000 mm
Two-way roadway—5500 mm
On curve—see Table 2.2

† Increase clearance to 500 mm if on the outside of a curve.

DIMENSIONS IN MILLIMETRES

FIGURE 2.8 CIRCULATION ROADWAY AND RAMP CROSS SECTIONS

TABLE 2.2

MINIMUM ROADWAY WIDTHS ON CURVED ROADWAYS AND RAMPS

metres

Turn radius R_o (Note 1)	Single lane		Two-way, no separator All cases (Note 3)
	Public facilities (Note 2)	Domestic property	
7.6 to 11.9	3.9	3.6	—
12.0 to 19.9	3.4	3.1	6.7 (Note 4)
20.0 to 50.0	3.2	3.0	6.3
>50.0	3.0	3.0	5.5

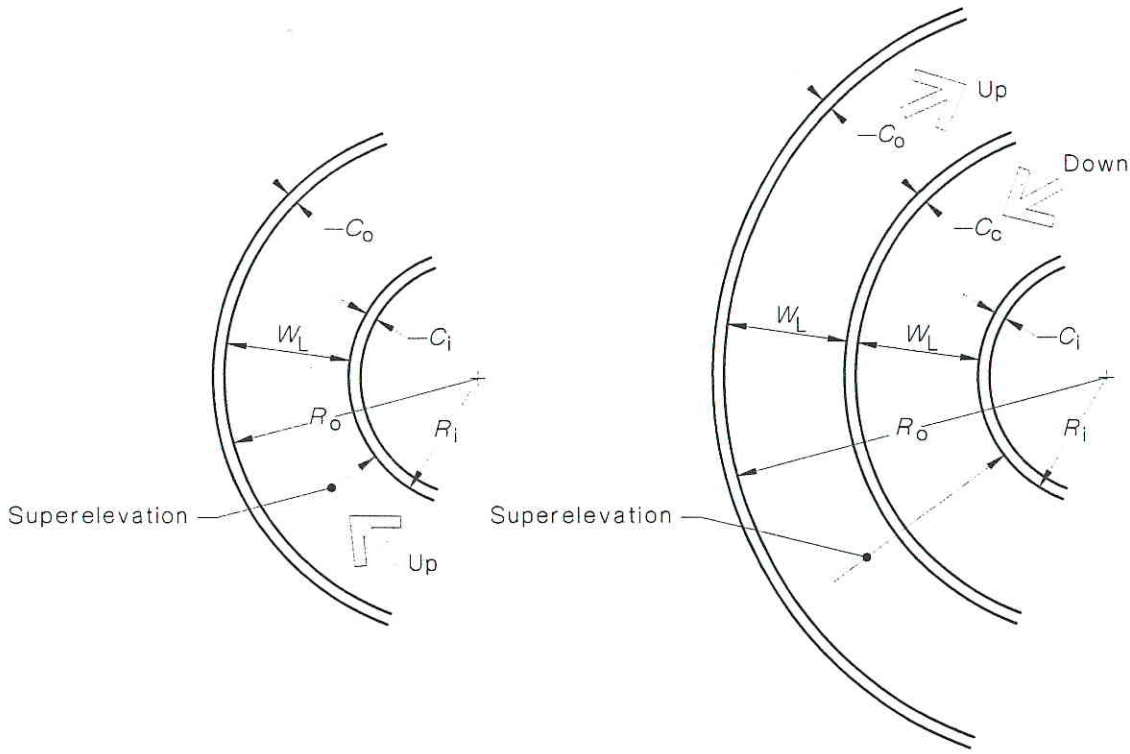
NOTES:

1 See Figure 2.9 for Dimension R_o.

2 In New Zealand only, the widths shown for domestic property shall apply also to public facilities.

3 For parallel roadways with a median or separator, each roadway width shall be determined separately as a single lane.

4 Applies to R_o range 15.0 m to 19.9 m only (see Clause 2.5.2(b)).



(a) Single (b) Double (with separator)

Characteristic	Limiting dimensions, m	
	One-way	Two-way
Outside radius, R_o	7.6 min.	11.8 min.
Inside radius, R_i	4.0 min.	4.0 min.
Lane width, W_L	See Table 2.2	See Table 2.2
Clearance to obstruction—		
(a) inside, C_i	0.3 min.	0.3 min.
(b) outside, C_o (see Note)	0.5 min.	0.5 min.
(c) between paths, C_c	—	0.6 min.
Superelevation	1 in 20 (5%) max.	1 in 20 (5%) max.

NOTE: This clearance will be sufficient to allow the outside front wheel to touch the kerb before the vehicle body can contact the obstruction.

FIGURE 2.9 DIMENSIONS OF CURVED CIRCULATION ROADWAYS AND RAMPS

2.5.3 Circulation roadway and ramp grades

Limiting requirements for grades on circulation roadways and ramps shall be as follows:

(a) *Straight ramps: public car parks*—as follows:

(i) Longer than 20 m—1 in 6 (16.7%) maximum.

(ii) Up to 20 m long—1 in 5 (20%) maximum. Grade change transitions will usually be required (see Item (d)). The allowable 20 m maximum length shall include any parts of grade change transitions at each end that exceed 1 in 6 (16.7%).

(iii) A stepped ramp comprising a series of lengths each exceeding 1 in 6 (16.7%) grade shall have each two lengths separated by a grade not more than of 1 in 8 (12½%) and at least 10 m long.

(b) *Straight ramps: private or residential car parks (other than domestic driveways, see Clause 2.6)*—as follows:

(i) Longer than 20 m—1 in 5 (20%) maximum.

(ii) Up to 20 m long—1 in 4 (25%) maximum. The allowable 20 m maximum length shall include any parts of grade change transitions at each end that exceed 1 in 5 (20%).

(iii) A stepped ramp comprising a series of lengths each exceeding 1 in 5 (20%) grade shall have each two lengths separated by a grade of not more than 1 in 8 (12½%) and at least 10 m long.

Grade change transitions will be required in both cases where grades are at or near the maximum, see Item (e).

(c) *Curved ramps*—as for straight ramps, except that the grade shall be measured along the inside edge, i.e. the line marked with radius R_i in Figure 2.9.

(d) *Changes of grade*—To prevent vehicles scraping or bottoming, changes in grade in excess of—

(i) 12.5 percent algebraically (1 in 8) for summit grade changes; or

(ii) 15 percent algebraically (1 in 6.7) for sag grade changes;

require introduction of a grade transition between the main grade lines as illustrated in Figure 2.10.

(e) *Grade transitions*—Transitions of 2.0 m in length will usually be sufficient to correct bottoming or scraping at grade changes up to 18 percent. They may be in the form of a simple chord with grade calculated as half the algebraic sum of the two adjacent grades, as illustrated, but for vehicle occupant comfort may be constructed as short vertical curves. Grade changes shall be checked using the method at Appendix C in any of the following circumstances:

(i) Grade changes of 18 percent or more.

(ii) Where there are successive grade changes less than 3 m apart.

(iii) Where vehicles with unusually low ground clearances are to be catered for. A modified ground clearance template to suit the particular vehicle characteristics will be required.

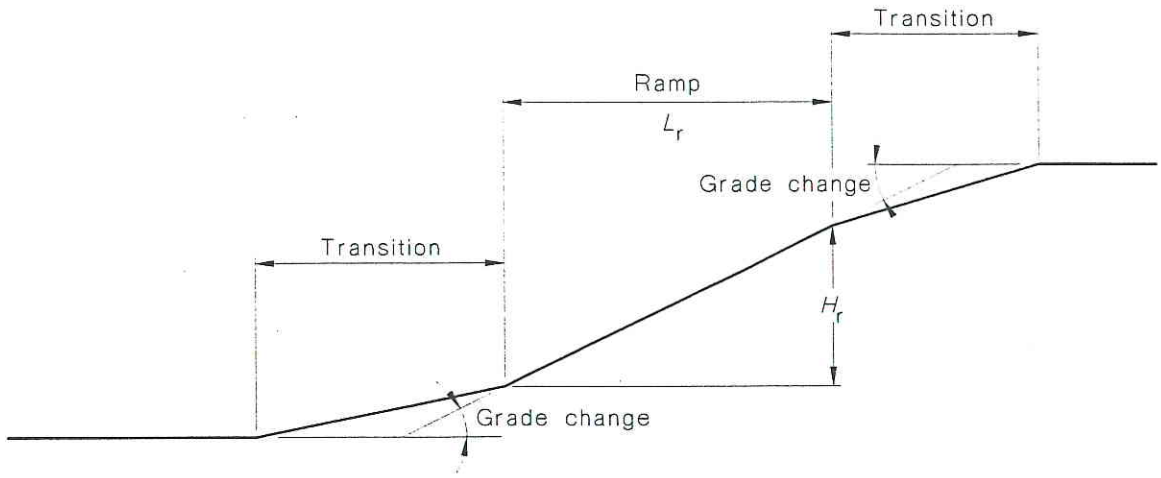
(iv) Any other case where there may be doubt as to whether adequate ground clearance has been provided (e.g. along the kerb lines of a curved ramp).

Longer transitions or other adjustments to the grade line may be required in these cases.

(f) *Sloping floors*—In some parking structures the floor is sloped to provide the connection between parking levels. Maximum gradients for such floors shall be as specified in Clause 2.4.6.1.

(g) *At and near access driveways*—Limiting grades across footpaths and property boundaries, and at vehicular control points and queuing areas near entry and exit points are specified in Clause 3.3.

(h) *Domestic driveways*—see Clause 2.6.



L_r = length of ramp, in metres

H_r = height of ramp, in metres

$$\text{Ramp grade} = \frac{H_r \times 100}{L_r} \text{ percent}$$

The grade change is computed by subtracting one grade from the adjacent grade, both expressed as percentages and taking account of algebraic sign which, for a given direction of travel, is either uphill—positive or downhill—negative.

FIGURE 2.10 CHANGES OF GRADE ON RAMPS

2.6 DESIGN OF DOMESTIC DRIVEWAYS

2.6.1 Width

The minimum width of domestic driveways shall be 3.0 m. On curved driveways other than at turns into garages or parking spaces the width shall be increased as given for domestic property in Table 2.2.

For apron widths at turns into enclosed garages, see Clause 5.4.

Minimum aisle or apron widths for turns into open sided parking shall be as for user Class 1 or 1A requirements in Figure 2.2.

2.6.2 Gradients

The maximum gradient of domestic driveways shall be 1 in 4 (25%). The maximum gradient of the associated access driveway across a property line or building alignment shall be 1 in 20 (5%) and across a footpath as specified in Clause 3.3(d).

Grade changes across a footpath and within the property shall be designed and checked in accordance with Appendix C to ensure that vehicles will not scrape their undersides when negotiating them. Transitions may be required (see Clause 2.5.3(d)). Checks may be required along one or both edges of a driveway as well as along the centre line if there are changes in the cross slope at or near a grade change.

NOTE: It is recognized that limiting domestic driveway grades to 25 percent maximum may not be practicable in some particularly hilly residential locations. The services of a professionally qualified person with appropriate experience may be required to make a judgement as to whether a particular grade line design is safe and environmentally sustainable.

SECTION 3 ACCESS FACILITIES TO OFF-STREET PARKING AREAS AND QUEUING AREAS

3.1 GENERAL

3.1.1 Access design principles

All accesses to off-street car parks from frontage roads shall be formed in such a way as to be clearly recognized by road users as *either* an access driveway *or* as an intersection.

For access driveways, kerbs and footpaths shall be continuous through the junction with the frontage road. The appearance and character of the driveway shall be such that it will be clear to vehicle drivers that pedestrians and frontage road traffic have priority of movement.

If intended as an intersection, the entry and exit shall be designed as if for a public roadway, with all necessary traffic control devices and intersection geometric design requirements.

Category 5 facilities in Table 3.1 shall be provided as intersections. Category 3 and 4 facilities may also be considered for provision as intersections.

NOTE: Guidance on capacity provision at entry and exits at large car parks is given in Appendix D.

Where the frontage road is two-way and has more than two lanes, any provision for right turns, either into or out of an access driveway, shall be subject to special design.

3.1.2 Categories of access facilities

To determine the access facility type and for access driveways, widths and restrictions on their location along frontage roads, this Section categorizes accesses according to—

(a) the class of parking facility as shown in Table 1.1;

(b) the frontage road type, either arterial (including sub-arterial) or local (including collector); and

(c) the number of parking spaces served by the access facility.

These categories are set out in Table 3.1.

3.2 ACCESS DRIVEWAYS—WIDTH AND LOCATION

3.2.1 Access driveway widths

Except as specified in Clause 3.2.2, where traffic flow data on an access driveway is either known or can be determined by separate means more accurately than by use of the categories in Table 3.1, such data may be used to determine driveway widths by accepted design procedures. In the absence of such data the widths given in Table 3.2 shall be used.

Access driveways may require widening where they meet the frontage roadway to allow turning movements from the kerbside lane without adversely affecting traffic flows in the frontage roadway.

Where separate entry and exit roadways are provided, they shall be at least 1 m apart.

TABLE 3.1

SELECTION OF ACCESS FACILITY CATEGORY

Class of parking facility (see Table 1.1)	Frontage road type	Access facility category				
		Number of parking spaces (Note 1)				
		<25	25 to 100	101 to 300	301 to 600	>600
1.1A	Arterial	1	2	3	4	5
	Local	1	1	2	3	4
2	Arterial	2	2	3	4	5
	Local	1	2	3	4	4
3.3A	Arterial	2	3	4	4	5
	Local	1	2	3	4	4

NOTES:

1 When a car park has multiple access points, each access should be designed for the number of parking spaces effectively served by that access.

2 This Table does not imply that certain types of development are necessarily suitable for location on any particular frontage road type. In particular, access to arterial roads should be limited as far as practicable, and in some circumstances it may be preferable to allow left-turn-only movements into and out of the access driveway.

TABLE 3.2

ACCESS DRIVEWAY WIDTHS

metres

Category	Entry width	Exit width	Separation of driveways
1	3.0 to 5.5	(Combined) (see Note)	N/A
2	6.0 to 9.0	(Combined) (see Note)	N/A
3	6.0	4.0 to 6.0	1 to 3
4	6.0 to 8.0	6.0 to 8.0	1 to 3
5	To be provided as an intersection, not an access driveway, see Clause 3.1.1.		

NOTE: Driveways are normally combined, but if separate, both entry and exit widths should be 3.0 m min.

3.2.2 Width requirements at low volume (Category 1) access driveways and connecting roadways

Where the circulation roadway leading from a Category 1 access driveway is 30 m or longer, or sight distance from one end to the other is restricted, and the frontage road is an arterial or sub-arterial road, both the access driveway and the circulation roadway for at least the first 6 m from the property boundary shall be a minimum of 5.5 m wide. In other cases subject to consideration of traffic volumes on a case-by-case basis, lesser widths, down to a minimum of 3.0 m at a domestic property, may be provided. As a guide, 30 or more movements in a peak hour (in and out combined) would usually require provision for two vehicles to pass on the driveway, i.e. a minimum width of 5.5 m. On long driveways, passing opportunities should be provided at least every 30 m.

Reversing movements to public roads shall be prohibited wherever possible.

3.2.3 Access driveway location

To keep conflicts between frontage road traffic and car park traffic to an acceptable minimum, the following requirements and recommendations apply:

(a) *Driveway Categories 1 and 2* At unsignalized intersections of sub-arterial, collector or local streets with each other or with an arterial road, access driveways in Categories 1 and 2 (see Table 3.1) shall not be located in the sections of kerb shown by heavy lines in Figure 3.1. This requirement shall not apply to accesses to domestic driveways in the kerb section opposite the entering road at any intersection including signalized intersections. Furthermore, it shall not apply to any access driveway serving a property which would otherwise be denied access due to the physical impossibility of meeting the requirement.

At signalized intersections, the minimum distance from the intersection, measured from the property boundary along both legs, shall be increased as necessary to locate access driveways beyond the influence of normal queue lengths at the intersections. If this is not practicable, it may be necessary to provide—

(i) an arrangement which confines traffic to turning left when either entering or leaving the car park;

(ii) a signalized driveway with signals coordinated with the intersection signals; or

(iii) other traffic management means of providing for safe and efficient operation of the driveway.

(b) *Driveway Categories 3 and 4* Driveways in categories 3 and 4 (see Table 3.1) shall not be located—

(i) on arterial roads unless entrances and exits are designed and constructed as intersection treatments catering adequately for all projected traffic flows;

(ii) closer to intersections than permitted for Category 1 and 2 driveways (see Item (a));

(iii) opposite other developments generating a large amount of traffic, unless all projected traffic flows are provided for in a properly designed and constructed intersection treatment, including the installation of signals if necessary;

(iv) where there is a heavy and constant pedestrian movement along the footpath, unless this can be adequately catered for by some form of positive control, e.g. traffic signals;

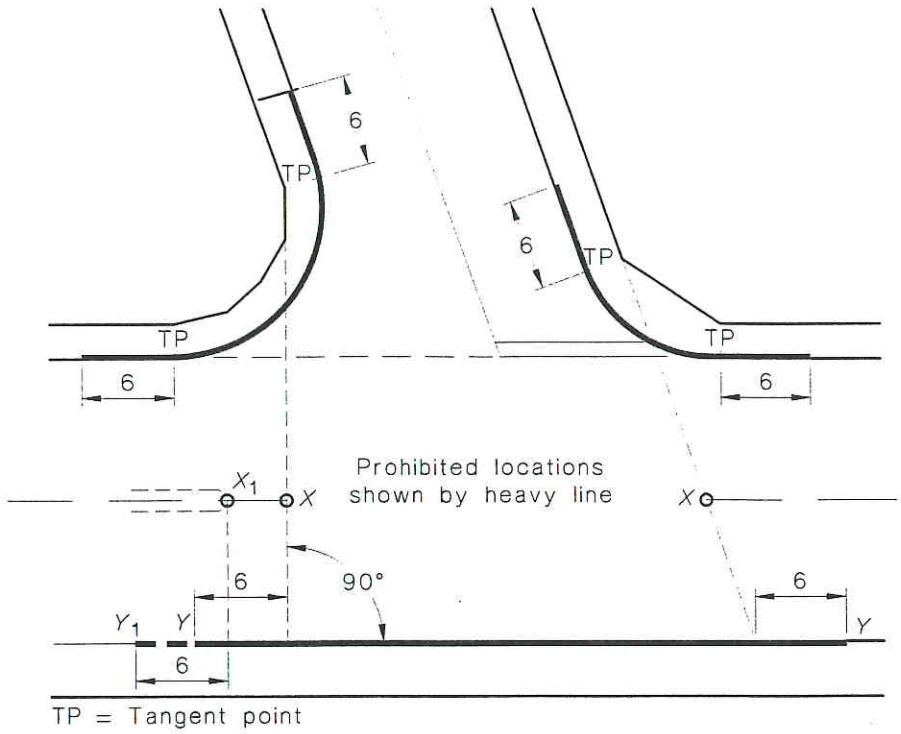
(v) where right turning traffic entering the facility would obstruct through traffic; or

(vi) where traffic using the driveways will interfere or block the operations of bus stops, taxi ranks, loading zones or pedestrian crossings.

NOTE: In these instances, it may be appropriate to move the bus stop or other facility, if this would result in the best overall design.

Entry for left turning vehicles into driveways in Categories 3 and 4 should be gained by the first vehicular driveway reached, and by using the kerbside lane.

NOTE: Guidance on capacity provision at entry and exits at large car parks is given at Appendix D.



NOTES:

1 Accesses to domestic driveways are excluded from the prohibition in respect of the kerb section marked *Y-Y* (see Clause 3.2.3(a)).

2 The points marked X_1 and *X* are respectively at the median end on a divided road and at the intersection of the main road centre-line and the extensions of the side road property lines shown as dotted lines. on an undivided road. On a divided road. dimension *Y-Y* extends to Point Y_1.

DIMENSIONS IN METRES

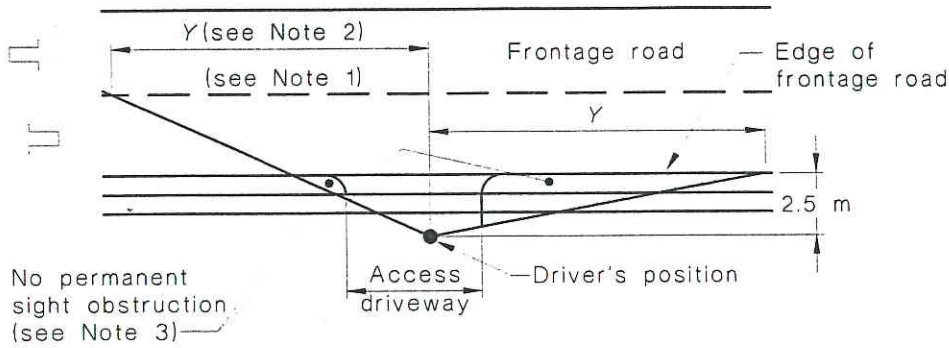
FIGURE 3.1 PROHIBITED LOCATIONS OF ACCESS DRIVEWAYS

3.2.4 Sight distance at access driveway exits

Access driveways need to be located and constructed so that there is adequate entering sight distance to traffic on the frontage road and sight distance to pedestrians on the frontage road footpath for traffic entering the frontage road, as follows:

(a) *Entering sight distance* Unsignalized access driveways shall be located so that the intersection sight distance along the frontage road available to drivers leaving the car park or domestic driveway is at least that shown in Figure 3.2.

(b) *Sight distance to pedestrians* Clear sight lines as shown in Figure 3.3 shall be provided at the property line to ensure adequate visibility between vehicles leaving the car park and pedestrians on the frontage road footpath.



Frontage road speed (Note 4) km/h	Distance (Y) along frontage road m		
	Access driveways other than domestic (Note 5)		Domestic property access (Note 6)
	Desirable 5 s gap	Minimum SSD	
40	55	35	30
50	69	45	40
60	83	65	55
70	97	85	70
80	111	105	95
90	125	130	Use values from 2nd and 3rd columns
100	139	160	
110	153	190	

NOTES:

1 Centre-line or centre of road (undivided road), or right hand edge of right hand through lane (divided road).

2 A check to the left is not required at a divided road where the median is wide enough to shelter a vehicle leaving the driveway.

3 Parking on this side of the frontage road may need to be restricted on either side of the driveway so that the sight distance required by the above table to an approaching vehicle is not obstructed.

4 This is the posted or general speed limit unless the 85th percentile speed is more than 5 km/h above the limit in which case the tabulated speed nearest the 85th percentile shall be adopted.

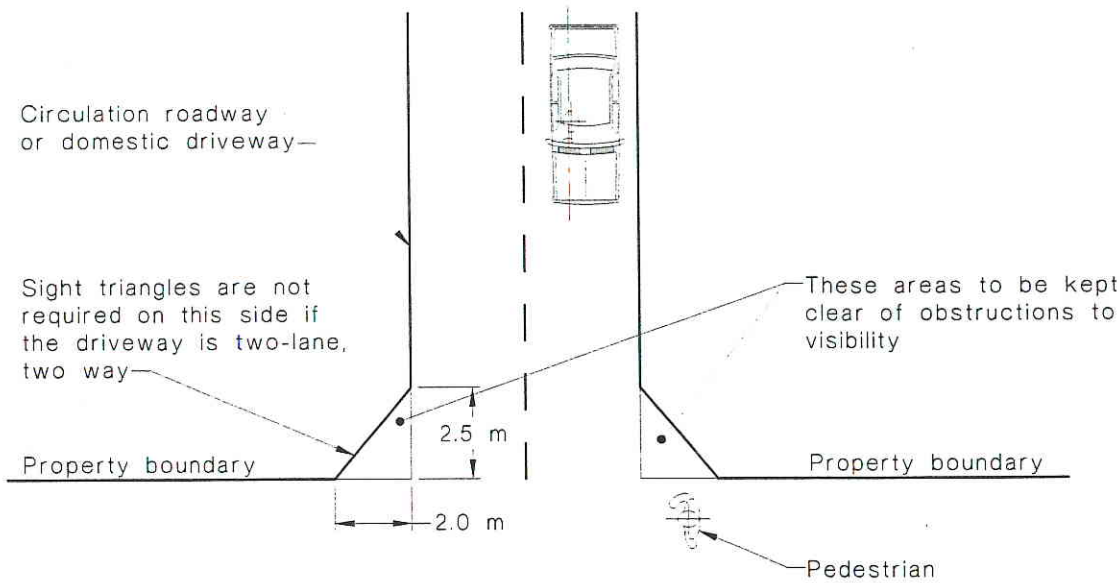
5 The values in the table apply only to left turn and right turn manoeuvres into two-way roads up to four lanes wide and one-way streets regardless of width, either for a 5 s gap, desirable at lower frontage road speeds, or minimum stopping sight distance based on 2 s reaction time.

Crossing manoeuvres (e.g. from an access opposite the steam of a T-junction) over four lanes or more, and turning manoeuvres into a six lane two-way road would require longer gaps unless there was a median wide enough to store a vehicle and allow a two stage manoeuvre.

6 These distances are based on stopping sight distances with reaction time of 1.5 s for traffic approaching along the frontage road and are applicable to a frontage road speed of up to 80 km/h only. Wherever practicable sight distance provided at domestic property accesses should meet the values given in the second or third columns of the Table.

7 When checking sight distance the driver's eye height and the height of the object (approaching vehicle) are to be taken as 1.15 m above the road surface.

FIGURE 3.2 SIGHT DISTANCE REQUIREMENTS AT ACCESS DRIVEWAYS



DIMENSIONS IN METRES

FIGURE 3.3 MINIMUM SIGHT LINES FOR PEDESTRIAN SAFETY

3.3 GRADIENTS OF ACCESS DRIVEWAYS

At entry and exit points, the access driveway should be graded to minimize problems associated with crossing the footpath and entering the traffic in the frontage road.

Maximum gradients on and near access driveways, other than at domestic properties (see Clause 2.6), shall be as follows:

(a) *Property line/building alignment/pedestrian path*—max. 1 in 20 (5%) between edge of frontage road and the property line, building alignment or pedestrian path (except as provided in Item (d)), and for at least the first 6 m into the car park (except as provided below).

The grade of the first 6 m into the car park may be increased to 1 in 8 (12.5%) under the following conditions:

(i) The grade is a downgrade for traffic leaving the property and entering the frontage road.

(ii) The user class is Class 1, 1A or 2 only.

(iii) The maximum car park size is—

(1) for entry into an arterial road—25 car spaces, or

(2) for entry onto a local road—100 car spaces.

The maximum grade across the property line shall remain at 1 in 20 (5%).

(b) *Vehicular control points*—max. 1 in 20 (5%) for at least 6 m prior to the control point.

(c) *Queuing area*—max. 1 in 10 (10%) for not less than 0.8 of the queue length determined in Table 3.3.

(d) *Across footpaths*—where the driveway crosses a footpath, the driveway grade shall be 1 in 40 (2.5%) or less across the footpath over a lateral distance of at least 1.0 m.

NOTE: The advice of the relevant regulatory authority should be sought to obtain grade requirements for footpaths.

(e) For ramps and circulation roadways at locations other than in Items (a) to (d), see Clause 2.5.3.

(f) For domestic driveways, see Clause 2.6.

3.4 QUEUING AREAS

At an entry point, the queuing area to be provided between the vehicular control point and the property boundary shall be sufficient to allow a free influx of traffic which will not adversely affect traffic or pedestrian flows in the frontage road. No parking space manoeuvres shall be allowed to take place within the queuing area.

The size of the queuing area may be determined from consideration of the following:

(a) Traffic volume in surrounding streets.

(b) The number of parking spaces in the car park.

(c) Anticipated peak entry/exit flow.

(d) Rate of entry/exit at control points.

(e) Hourly parking accumulation and turnover.

(f) Freedom of movement beyond the control point.

In the absence of more specific guidance, the size of the queuing area shall be calculated from Table 3.3, for a car park with boom gates and ticket issuing devices at entry points, and based on the proposed size of the parking station and anticipated peak hourly inflow of traffic.

TABLE 3.3

MINIMUM QUEUING LENGTH AT A CAR PARK WITH CONTROL POINTS AT ENTRANCES

Capacity of car park (Note 1)	Peak hourly in-flow of traffic	
	Up to 75% of capacity (Note 2)	More than 75% of capacity (Note 3)
Not more than 100 cars	The greater of a minimum of 2 cars or 3% of capacity	The greater of a minimum of 2 cars or 4% of capacity
More than 100 cars	1st 100 cars: 3% of capacity 2nd 100 cars: 2% of capacity Additional cars: 1% of capacity A minimum queuing length of 3 cars/lane	1st 100 cars: 4% of capacity 2nd 100 cars: 2% of capacity Additional cars: 1.5% of capacity A minimum queuing length of 3 cars/lane

NOTES:

1 Equal to the total number of parking spaces served by the entrance (proportioned where several entrances service a common parking area).

2 Generally casual (short-staying) and mixed patronage.

3 Tidal traffic typical of car parking for a special event.

The number of cars calculated from Table 3.3 shall be rounded up to the next whole number and a length of 6.0 m per vehicle allowed for in each lane.

In addition, the following shall be observed:

(i) The queuing area in car parks using attendant parking shall be at least twice as large as that given in Table 3.3.

(ii) An adjoining breakdown lane/strip 2.0 m wide shall be provided on one side of a single queuing lane.

(iii) Multiple queuing lanes shall be a minimum 2.7 m wide each.

(iv) Queuing areas in a multiple entry car park shall be based on the expected volume of traffic served by each entry point.

3.5 ACCESS TO MECHANICAL PARKING INSTALLATIONS

Access to mechanical parking installations such as car stackers, shall be by means of access driveways and circulation roadways designed in accordance with this Standard, and providing sufficient vehicle storage to ensure that queues of vehicles awaiting service by the installation do not extend beyond the property boundary of the parking facility under normally foreseeable conditions.

When determining the amount of vehicle storage required, queue lengths shall be calculated by applying conventional queuing theory to estimated mean arrival rates during normal peak periods, and mean service rates under continuous demand, determined as closely as possible from observing the operation of similar facilities. The storage area shall be designed to accommodate the 98th percentile queue under such conditions. The queue lengths given in Table 3.3. shall not be used in this case.

SECTION 4 OTHER CONSIDERATIONS

4.1 PEDESTRIAN SERVICE

4.1.1 General

Parking areas shall be designed so that through-traffic is excluded, and pedestrian entrances and exits are separate from vehicular entrances and exits.

Where pedestrians must cross busy circulation roadways, they shall be guided to a safe crossing point which shall have adequate sight distance and shall be provided with appropriate signs and pavement markings (see AS 1742.10 (in Australia) or NZ Manual of Traffic Signs and Markings (in New Zealand)).

4.1.2 Parking structures

NOTE: Requirements for pedestrian access and egress including stairs, lifts and exits are given in relevant building codes and Standards.

In split-level car parks, a stairway or pedestrian ramp shall be located at the split-level for pedestrian access between levels and so that pedestrians do not have to use vehicular ramps.

4.1.3 Surface car parks

When considering pedestrian provisions in the planning of surface car parks, the following principles apply:

(a) Pedestrians shall be directed and encouraged to cross circulating aisles and roadways at right angles at points were there is acceptable sight distance to circulating traffic.

NOTE: Crossing points should be provided at locations remote from the major concentrations of vehicular movement.

(b) Service yards shall be accessed separately from the car park.

4.2 BICYCLE PARKING

Guidance on provision for the parking and safe storage of bicycles at a car park, is given in AS 2890.3.

4.3 SIGNPOSTING

4.3.1 General

All operations in a car park shall be directed by suitable directional, informative, regulatory or warning signs.

NOTE: The term 'regulatory signs' relates to the descriptions and functions of these types of sign given in AS 1742.1 and The Manual of Traffic Signs and Markings (NZ).

Signs are required for the following purposes:

(a) To control traffic movement and driver behaviour (e.g. speed).

(b) To warn against hazards to personal safety or potential damage to vehicles.

(c) To identify sections or rows of parking spaces so that pedestrians can easily find their parked vehicles.

(d) To direct and inform drivers entering and circulating within the car park about vehicular entry points, exits and parking locations.

(e) To direct pedestrians to lifts, stairs, amenities and other parts of the building.

NOTE: This Clause does not cover EXIT signs required for emergency evacuation of buildings.

Where possible, the design and usages of signs should be consistent with those used for the street network in accordance with AS 1742 (in Australia) or the NZ Manual of Traffic Signs and Markings (in New Zealand). Subject to the requirements of Clause 4.3.6, it is acceptable to use signs smaller than those used on the roads.

As signs for the main vehicle routes within a car park are a vital part of the traffic control system especially at locations where confusion is likely to arise, they shall be clearly visible, easy to read and simple to follow. An excessive number of signs can be an unnecessary distraction, and may lead to confusion.

Sign numbers are shown against most of the signs as follows:

(i) Numbers marked '(Aust.)' or '(Aust. only)'—as specified in AS 1742.1.

(ii) Numbers marked '(NZ)'—as specified in the NZ Manual of Traffic Signs and Markings.

4.3.2 Vehicular guide signs

Guide signs for vehicular traffic shall in both description and use, be generally as indicated by the examples given below. Subject to the minimum sign size requirements of Clause 4.3.6, the layout and dimensional proportions may be adjusted to suit the site. The colour, basic shape, letter style and symbol used (if any) shall conform to the principles in AS 1742 and the Manual of Traffic Signs and Markings (NZ), and be in accordance with the following functional categories:

(a) *Entry to parking area*

G7-3-1 (white on blue) (Aust. only)

This sign is used on a public street to indicate the entrance to a car park. If the entrance is in a side street, the sign is also to be repeated at the main street intersection.

(b) *Entrance and exit instruction*

G9-54 (Aust. only)

(Black on white)

This sign advises drivers of any action required of them at point of entry or exit to or from the park. The legend is varied to suit.

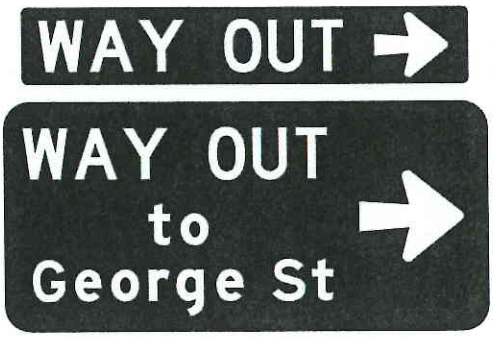
(c) *Circulation direction*

G7-11 (Aust. only)

(white on blue)

This sign indicates the route a driver should take while searching for a vacant space. It is located at each point where a driver is confronted with a choice of routes, or has to make a turn.

(d) *Way Out*



G9-55 (Aust. only)

G9-56 (Aust. only)

(white on green)

This sign indicates the route the driver is to take when leaving the car park. A direction name is added at any location where there is a choice of routes leading to different exits. Way Out signs shall be located so as to be readily visible to a driver in a parking aisle, circulation aisle or roadway.

NOTE: The word EXIT should be reserved for use on emergency evacuation signs only.

4.3.3 Pedestrian direction signs

These may be provided as follows:

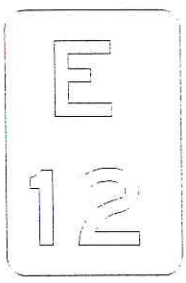
(a) *General direction sign*

G5-8 (white on blue) (Aust. only)

These signs are used to indicate lifts, stairs, directions to facilities being served by the car park, disabled user facilities and the like. Where there are no standard symbols for a particular message, words should be used.

NOTE: The word EXIT should be reserved for use on emergency evacuation signs.

(b) *Location identification signs*



Example only

These signs are used to mark parking modules to help drivers find their vehicle. One unique identification number for each parking module of standard size or less (approx. 40 spaces, see Clause 2.3.3), should be provided. Numbering of modules should be arranged in a logical progression which is apparent to users on foot inside the car park.

4.3.4 Regulatory and warning signs

As a general rule, it is preferable to design a car park to avoid the need for regulatory signs, as reliance on their efficiency in controlling driver behaviour is doubtful. A typical example is the use of speed limit signs, especially where the posted speed is considerably lower than that adopted by most drivers.

Whether regulatory signs have their usual legal status when installed in an off-street location depends on State laws and any conditions relating to a particular site.

Regulatory and warning signs are used as follows:

(a) *Low clearance signs* Low clearance signs shall be used at all locations where vehicles first enter an undercover area or encounter an overhead obstruction where the clearance in either case is—

(i) 3 m or less—if only cars or light vans are likely to use the facility; or

(ii) 4.6 m or less—in all other cases.

The sign to be used shall take either one of the following forms or be rearranged to suit a particular site. If rearranged, the colour and legend shall always be as shown below.

R6-11 (Aust only)

R6-16 (Aust only)

(black on white)

The height shown shall be the measured minimum clearance (see Clause 5.3) *rounded down* to the nearest 0.1 m. The height shown shall be adjusted whenever roadway resurfacing or other activity reduces the clearance.

(b) *STOP* and *GIVE WAY* signs

R1-1 (Aust)
RG-5 (NZ)

R1-2 (Aust)
RG-6 (NZ)

These are normally required where an access driveway meets a frontage roadway and there are no traffic signals. They shall be used in accordance with the relevant requirements of AS 1742.2.

NOTE: They may also be required within the car park at any intersecting roadway at which hazards could arise if right of way is not assigned or approach speed controlled. Stop or give-way lines alone may be adequate in many cases. Layouts should be designed to avoid such situations wherever practicable.

(c) *Speed limit signs*

R4-1 (Aust. only)

As far as practicable a car park layout shall be designed so that it does not encourage excessive speed, and if excessive speeds are a particular problem at any location, traffic management devices such as speed humps (see Clause 4.9) shall be used.

Speed limit signs may be used to indicate the general speed limit desired in a car park. The limit should not be unrealistically low, and as a guide should approximate the average speed of drivers using the car park. Speed limit signs will not generally be effective in controlling excessive speeds.

(d) *Hump warning sign*

W5-10 (Aust)
PW-39 (NZ)

This sign shall be used at a road hump if there is some doubt as to whether the hump will be visible in time for a driver to slow down to negotiate it.

(e) *Steep grade warning signs*

W5-12 (Aust)
PW-27 (NZ)

W5-13 (Aust)
PW-27/1 (NZ)

These signs shall be used in public car parks at the beginning of steep ramps, up or down, where drivers may find the ramps to be unexpectedly steep.

NOTE: Grades in the order of 1 in 6 (16.6%) or steeper may require such signs.

4.3.5 Signs for people with disabilities

Signs for people with disabilities are specified in AS/NZS 2890.6*.

4.3.6 Sign size

Signs shall be made large enough so that they meet the following provisions:

(a) They shall be sufficiently conspicuous to attract the attention of car park users at the distances at which they need to be seen. Whether a sign is sufficiently conspicuous will depend upon its design (e.g. use of colour), size, illumination, and the amount of visual distraction in its vicinity. These factors can generally be only judged subjectively but conspicuity is enhanced if the sign is on or close to the observer's line of sight.

(b) They shall have legends large enough to be legible to users at the distances at which they need to be read. Minimum required letter size can be calculated by determining the maximum distance at which the sign needs to be read and allowing 10 mm of letter height for each 5 m of legibility distance required. This calculation applies to letters which are no narrower than Series D capital letters as specified in AS 1744 and for signs having no more than four message elements, either words, symbols or a combination. Legibility distances for other letter types and widths are given in AS 1742.1.

* In preparation. See footnote to Clause 1.2.

4.3.7 Sign location

Signs shall not be placed in positions where they may obstruct sight lines to approaching or crossing traffic or to pedestrians.

4.3.8 Variable message signs

Variable message signs are typically provided at public car parks for the following purposes:

(a) Guiding drivers to locations where there are vacant spaces.

(b) Indicating the number of spaces vacant at the particular time.

(c) Providing other information of use to users of the facility.

The following requirements relate to the use of variable message signs displayed to vehicle drivers:

(i) Symbols other than arrows shall not be used on signs unless they meet minimum public comprehension requirements in the form they are presented on the variable sign.

(ii) Signs with words only shall be limited to not more than four words on any one screen.

(iii) Scrolling of messages shall be limited to a maximum of two screens. Running messages shall not be used.

(iv) Changing messages shall not be displayed to drivers within or approaching a vehicle or pedestrian conflict area.

4.4 PAVEMENT MARKINGS

4.4.1 Marking of parking spaces

Parking spaces other than those for people with disabilities shall be delineated by means of white or yellow lines 80 to 100 mm wide, or white or yellow pavement markers in one or other of the forms and patterns illustrated in Figure 4.1 for angle parking or Figure 4.2 for parallel parking. Pavement markers, if used, shall be substantially flush i.e. not higher than 3 mm.

NOTES:

1 Marking of parking spaces for people with disabilities is specified in AS/NZS 2890.6*.

2 Raised pavement markers more than 3 mm in height may cause a tripping hazard for pedestrians.

Dimension *C* in Figure 4.1 shall be as follows:

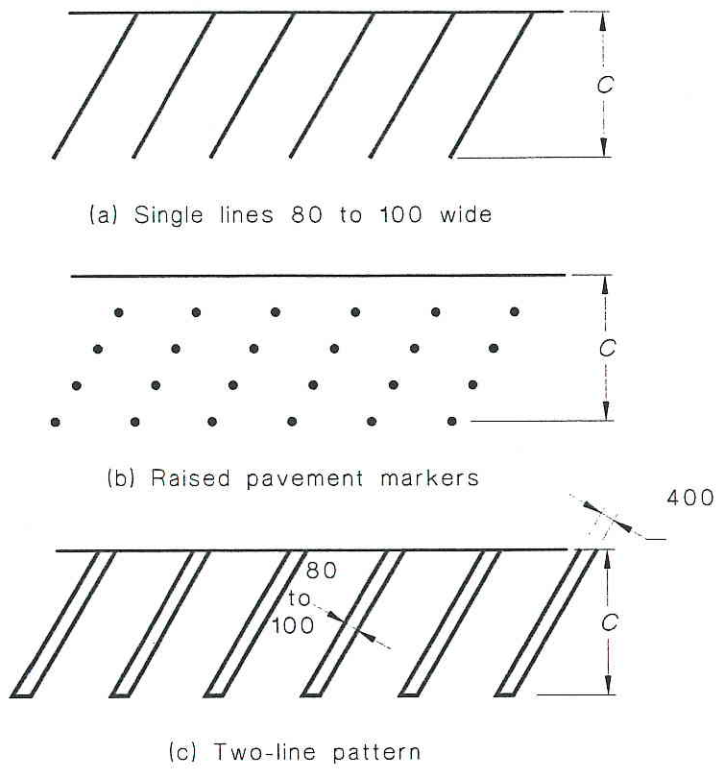
(a) *In Australia*—as specified in Figure 2.2.

(b) *In New Zealand*—as specified in Figure 2.2 but for the purposes of pavement marking may be multiplied by a factor of 0.92 (i.e. reducing the nominal length of space from 5.4 m to 5.0 m). There shall be no consequential reduction in the combined length of space and width of parking aisle from that given in Figure 2.2.

In any one car park, all parking spaces of the same type shall be marked in the same way.

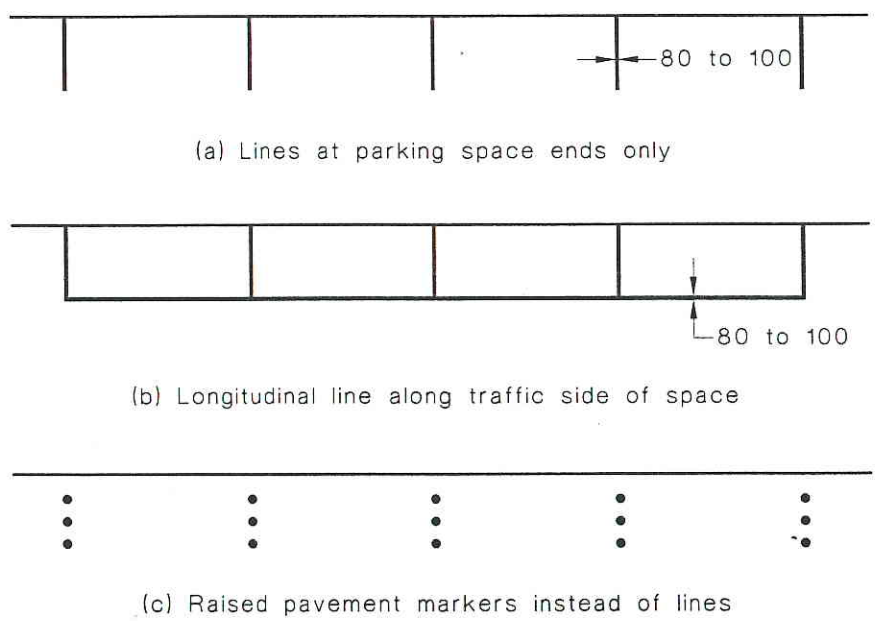
Use of two lines to separate adjacent angle parking spaces is desirable whenever users appear not to be centring vehicles satisfactorily in the spaces. It should be considered for high turnover situations, especially where minimum width spaces have been used. Where used, the nominal width of the parking space shall be measured from the centre-line of the pair of marked lines.

* In preparation. See footnote to Clause 1.2.



DIMENSIONS IN MILLIMETRES

FIGURE 4.1 MARKING OF PARKING SPACES—ANGLE PARKING



NOTE: A longitudinal line as in (b) shall be used where edge delineation for moving traffic is required.

DIMENSIONS IN MILLIMETRES

FIGURE 4.2 MARKING OF PARKING SPACES—PARALLEL PARKING

4.4.2 Pedestrian crossing markings

Pedestrian crossing markings shall comprise a series of white or yellow bars 300 to 450 mm wide by up to 3.5 m long with gaps between them not less than their width and up to 750 mm wide to form a 'zebra' crossing marking. The bars shall be placed parallel to the direction of approaching vehicular traffic. The markings shall be slip resistant.

NOTE: The slip resistance of the marking should be no worse than Class W (wet pendulum test) as specified in AS/NZS 4586 if the crossing is on an accessible travel path for people with disabilities, or Class X in other cases.

The corresponding slip resistances (British Pendulum Number) are: Class W—45 to 54; Class X—35 to 44.

Requirements for the location of pedestrian crossings are specified in Clause 4.1.

4.4.3 Pavement arrows

Recommended shapes and sizes for pavement arrows for the control and direction of circulating traffic within a car park and associated circulating roadways are illustrated in Figure 4.3.

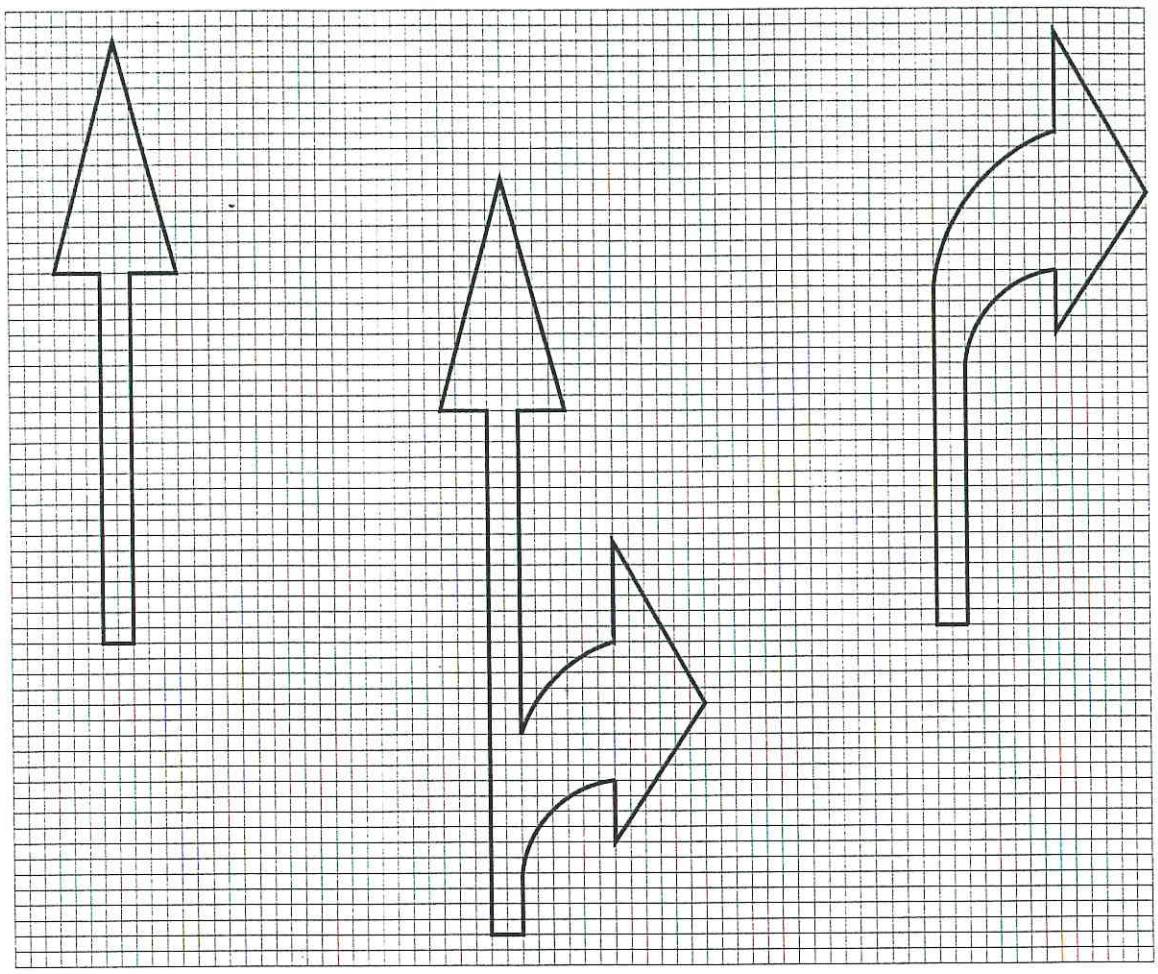
4.5 PARCEL PICK-UP

Parcel pick-up areas shall be designed so that queues do not interrupt the flow of vehicles in the circulation roadways. Pedestrians shall be able to move freely around vehicles in the pick-up zone without being endangered by traffic entering or leaving the parcel pick-up area.

4.6 SHOPPING TROLLEY REQUIREMENTS

To assist in the orderly operation of parking areas in large retail centres, free from the nuisance of trolleys in aisles or in spaces, areas shall be set aside for trolleys to be stored.

Facilities for the easy manoeuvring of trolleys should be provided in the major pedestrian paths such as lipless kerb crossings and the like.



(a) Straight ahead (b) Combination—straight ahead and turn (c) Exclusive turn

NOTE: Minimum length of arrows:

(a) Straight ahead and turn arrow = 3.0 m

(b) Combined arrow = 3.75 m.

FIGURE 4.3 PAVEMENT ARROWS FOR USE IN CAR PARKS

4.7 LIGHTING

Parking areas and circulation areas, together with pedestrian pathways including those used by people with disabilities shall be adequately lit.

NOTES:

1 Minimum lighting levels for roofed car parks should be as specified in AS 1680.2.1.

2 Minimum lighting levels for open air, including roof-top, car parks should be as specified in AS/NZS 1158.3.1.

4.8 LANDSCAPING

When providing trees and shrubs, safety aspects such as sight distances to both pedestrians and other vehicles shall not be compromised at any time during the life of the plantings.

NOTE: As well as improving the appearance of an area, the judicious placement of trees provides shade and screening for both surface car parks and structures, and is to be encouraged. Landscaping also assists in delineating pavement areas.

4.9 HUMPS

Where positive speed control is necessary within a car park road humps as specified below shall be used.

Humps may be either of the following two types depending on their location and the range of speed reduction required. They are illustrated in Figure 4.4 and used as follows:

(a) *Type 1* Appropriate for use on long aisles (see Clause 2.3.3) and circulating roadways as in large outdoor surface car parks, where it is desired to reduce speeds generally in excess of 30 km/h to about 25 km/h or less.

NOTE: Type 1 humps are usually formed in bituminous concrete. If so they may be unsuitable for installation on Portland cement concrete surfaces.

(b) *Type 2* Appropriate for use in relatively confined areas of covered and multi-storey car parks where it is desired to further check the speed of vehicles mostly travelling at 30 km/h or less.

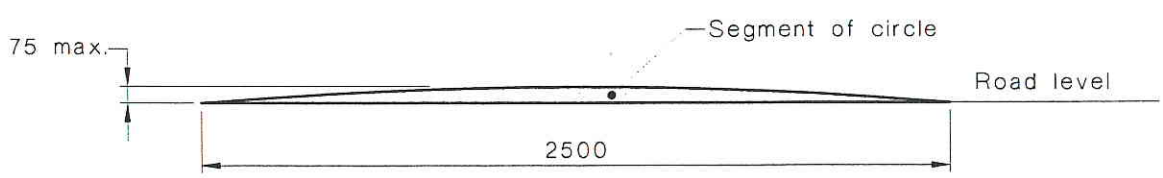
If a greater level of control is required on longer roadways, the road hump specified in AS 1742.13 for local area streets may be more appropriate.

If delineation of the hump is required, Types 1 and 2 shall be delineated by means of the marking illustrated in Figure 4.5. If the larger AS 1742.13 hump is used, the markings specified in that Standard shall be used. Hump markings shall be either white or yellow.

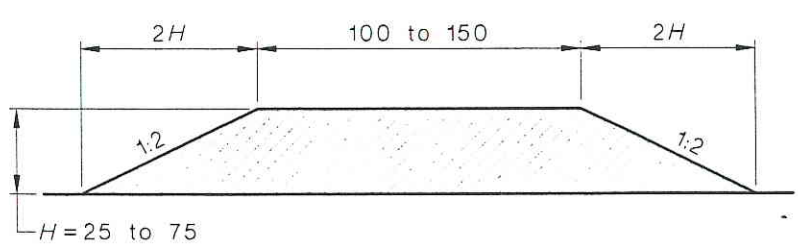
Road humps shall be spaced at not less than 30 m for Type 1, or 10 m for Type 2, along any one aisle or roadway. Maximum spacing where required to control speeds continuously along a roadway should be about 50 m. Humps should be located clear of intersections and curved roadways.

Humps shall not impede pedestrian or wheelchair traffic on any accessible travel path provided for people with disabilities.

NOTE: An accessible path of travel needs to be a minimum of 1 m wide.



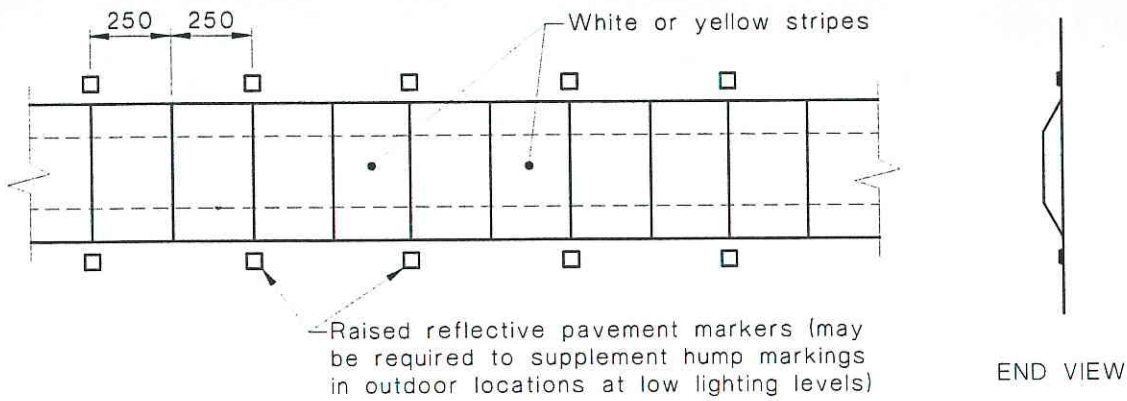
(a) Type 1 road hump



(b) Type 2 road hump

DIMENSIONS IN MILLIMETRES

FIGURE 4.4 CROSS SECTIONS OF ROAD HUMPS FOR USE IN CAR PARKS



DIMENSIONS IN MILLIMETRES

FIGURE 4.5 MARKINGS FOR ROAD HUMPS USED IN CAR PARKS

4.10 SPECIAL LOADING/UNLOADING PARKING SPACES

Special spaces for loading and unloading purposes may be required as indicated below. Where they are to be provided for the indicated purpose, they shall meet the specified minimum size requirements as follows:

(a) *Unloading/loading of prams, strollers, bulky parcels and the like* The space shall be a minimum of 0.5 m wider than the standard space for the relevant user class and a minimum of 2.0 m longer. The added width may be shared with a footway, parking aisle or other adjacent unobstructed space.

NOTE: Parking spaces provided for these purposes need to be located where they best serve the purpose and the usage limited to short-stay, e.g. 5 minutes maximum.

(b) *Ambulance spaces at medical centres* Parking spaces shall be as specified for people with disabilities in AS/NZS 2890.6*.

NOTE: Control to limit the usage of such spaces to ambulances may be required.

* In preparation. See footnote to Clause 1.2.

SECTION 5 ADDITIONAL REQUIREMENTS FOR CAR PARKING STRUCTURES

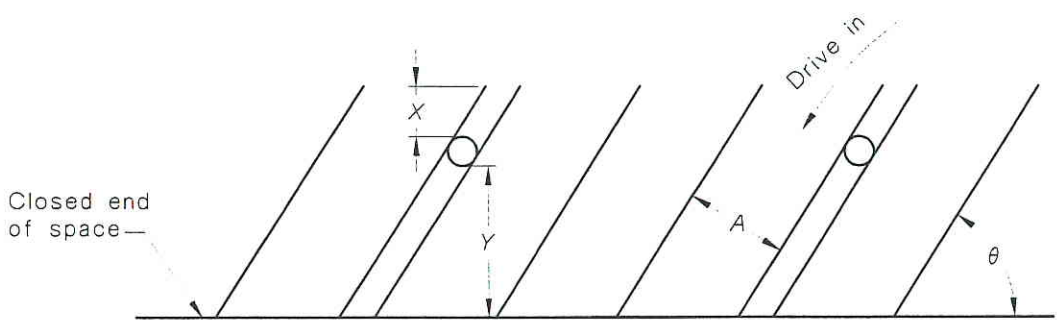
5.1 GENERAL

This Section specifies particular requirements for the design of car parks in structures. They are additional to requirements of this Standard which are relevant to all car parks.

5.2 COLUMN LOCATION AND SPACING

The dimensions for locating columns in a short span structure shall be as given in Figure 5.1. The design envelope around a parked vehicle which is to be kept clear of columns, walls or other obstructions, is shown in Figure 5.2. If this requirement is met, the dimensions in Figure 5.1 will also be achieved.

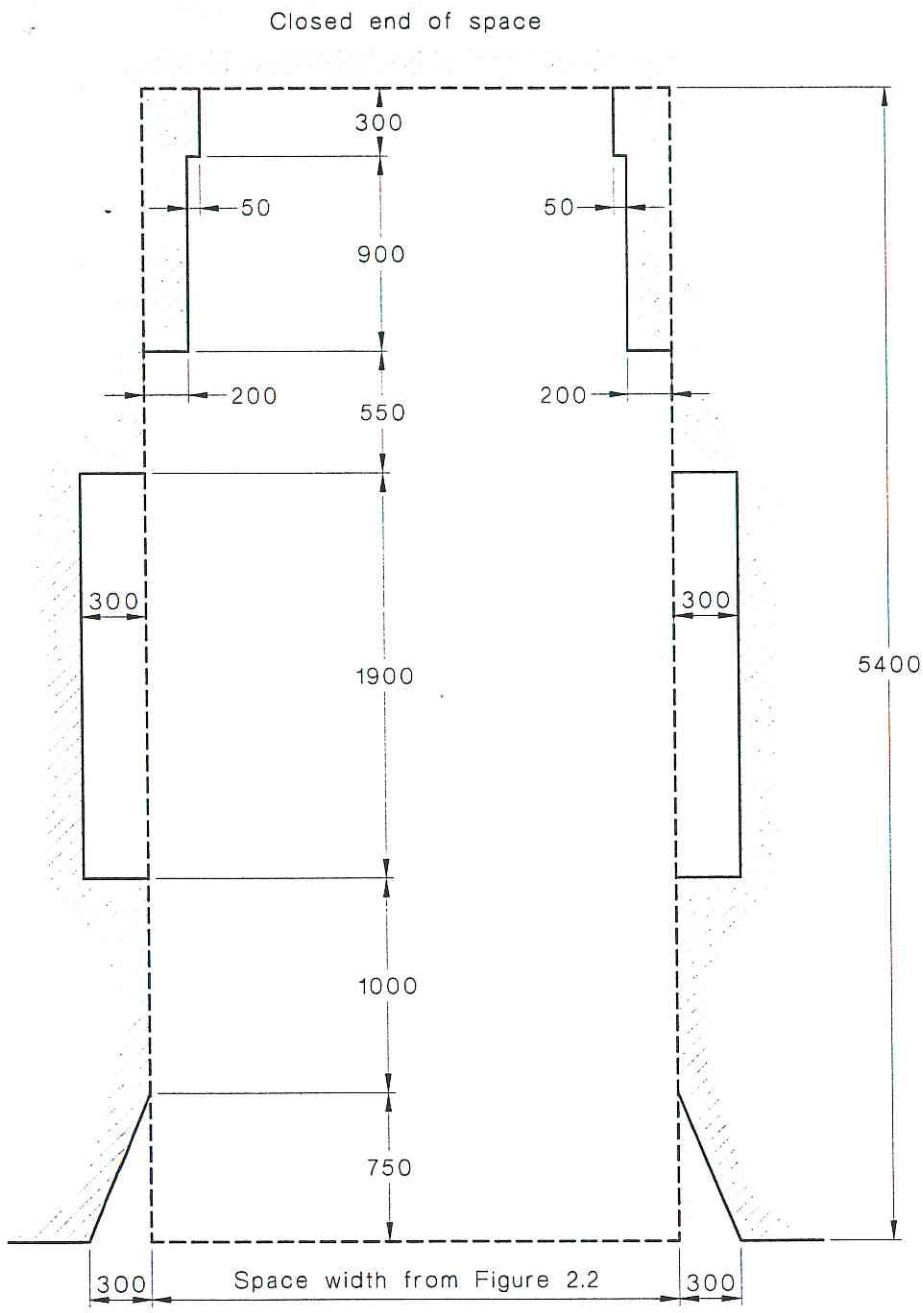
NOTE: Columns should not be located at the edge of a parking aisle. The difficulty of manoeuvring into a parking space is increased by such a location. It is also desirable to avoid locating a column directly opposite a car door.



A = parking space width (see Figure 2.2)

Parking angle, θ, degrees	Dimensions, mm	
	X, min.	*Y*, min.
30	375	1825
45	530	2581
60	650	3161
75	724	3526
90	750	3650

FIGURE 5.1 COLUMN LOCATION



NOTE: The design envelope provides for structural elements to be clear of all four side doors.

DIMENSIONS IN MILLIMETRES

FIGURE 5.2 DESIGN ENVELOPE AROUND PARKED VEHICLE TO BE KEPT CLEAR OF COLUMNS, WALLS AND OBSTRUCTIONS

5.3 HEADROOM

5.3.1 General requirements

To permit access for both cars and light vans, the height between the floor and an overhead obstruction shall be a minimum of 2200 mm.

NOTE: AS/NZS 2890.6* requires that any vehicular path of travel to or from a parking space for people with disabilities has a clearance of 2300 mm.

* In preparation. See footnote to Clause 1.2.

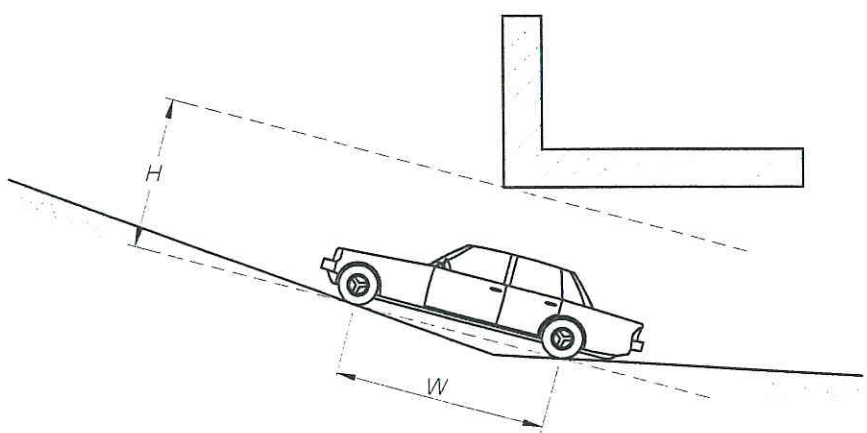
The minimum available clearance shall be signposted at all entrances. Appropriate warning devices such as flexible striker bars shall be provided in conjunction with the signs wherever the clearance shown on the signs is less than 2.3 m. Low clearance signs are specified in Clause 4.3.4(a).

Clearances shall be measured to the lowest projection from the roof, e.g. fire sprinkler, lighting fixture, sign.

NOTE: A considerable amount of inconvenience can be caused by collisions with overhead appurtenances such as fire sprinklers. Care should be exercised in the location of these devices where headroom is limited.

Headroom at a 'sag' type grade change shall be measured as illustrated in Figure 5.3. It shall be measured perpendicular to a chord of length equal to the wheelbase of the B99 vehicle (see Appendix B) located longitudinally such that the dimension *H* is a minimum.

NOTE: Road humps should not be located near points where the headroom is critical.



H = Headroom
W = Wheelbase of design (B99) vehicle

FIGURE 5.3 CRITICAL HEADROOM MEASUREMENT AT A GRADE CHANGE

5.3.2 Parking spaces and vehicular access for people with disabilities

Headroom above parking spaces for people with disabilities and above vehicular access paths to and from those spaces is specified in AS/NZS 2890.6*.

5.4 DESIGN OF ENCLOSED GARAGES

Fully enclosed car garages shall meet the plan dimension requirements given below. These requirements are also applicable to garages within domestic properties. (See also Clause 2.6 for requirements for domestic driveways.)

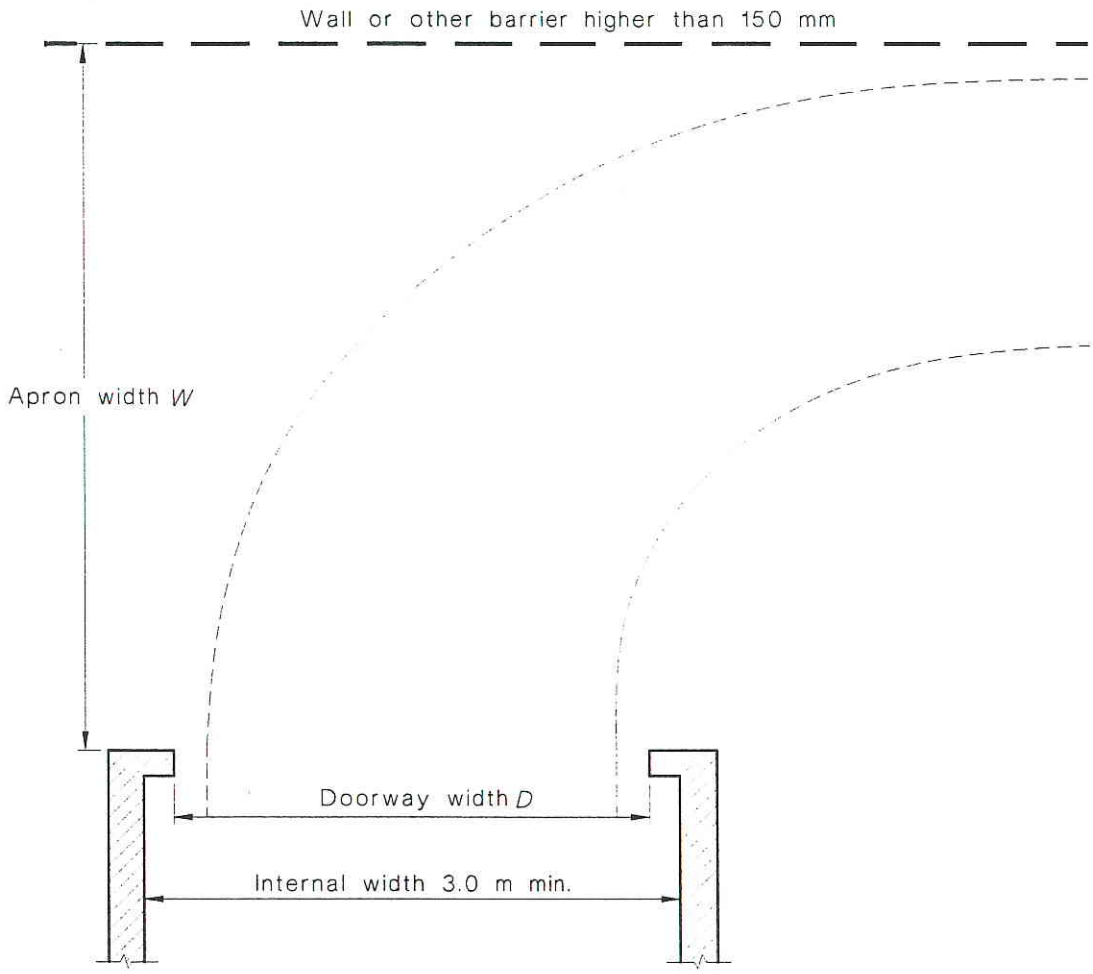
(a) *Single vehicle garage* The overall internal width shall be 3.0 m minimum and the internal space shall conform to the design envelope shown in Figure 5.2 except that the entry splays shown on Figure 5.2 may be omitted. A doorway of 2.4 m minimum width shall be provided. For right angle access to a garage, the required width of apron for manoeuvring purposes is shown in Figure 5.4. Single manoeuvre front-in entry may not be possible for some vehicles larger than the B85 vehicle at the apron widths shown in Figure 5.4.

NOTE: For user classes other than Class 1A, it is recommended that the apron widths shown in Figure 5.4 be increased by at least 0.6 m.

(b) *Multiple vehicle garage with no internal walls* Parking spaces shall be 2.4 m wide minimum. These shall be spaced as follows:

(i) *Single door for all spaces*—the spaces shall be contiguous with a further car door clearance of 300 mm minimum on the outside of each outer space, and the door width shall be the space width times the number of spaces (in metres). Apron widths for angled entry shall be at least equal to the aisle widths specified in Figure 2.2 for the corresponding parking angle and user class.

(ii) *Separate door for each space*—both parking space and door width shall be 2.4 m minimum. A further car door clearance of 300 mm minimum shall be provided on the outer side of each end space. Apron widths for right angle access shall be as specified in Item (a) above for single garages.



metres

Doorway width (*D*)	Apron width (*W*) (See Note)
2.4	7.0
2.7	6.3
3.0	5.6

NOTE: Vehicles larger than the B85 vehicle (see Appendix B) may need to make a 3-point turn at the apron widths shown. The apron width may be reduced by 0.3 m where the edge opposite the doorway is a kerb 150 mm or less in height with a clearance of at least 0.3 m behind the kerb.

FIGURE 5.4 APRON WIDTHS FOR RIGHT ANGLE ACCESS TO SINGLE VEHICLE GARAGES

APPENDIX A

DESIGN VEHICLE CHARACTERISTICS AND DIMENSIONS

(Informative)

A1 SCOPE

This Appendix provides data on design vehicle characteristics and dimensions on which the base dimensions given in Appendix B have been determined and subsequently developed into design criteria. The base dimensions are considered to apply to both Australia and New Zealand unless otherwise indicated.

NOTE: This Appendix is based on a study of the Australian motor vehicle fleet. It is presumed that except as noted in Paragraph A6.2, the characteristics of the New Zealand fleet would be substantially the same.

A2 STUDY OF VEHICLE DIMENSIONS

A study has been made of the significant characteristics of all sedans, station wagons and light commercial vehicles that operate on Australian roads. The light commercial vehicle category was included because it contained a significant number of four wheel drive vehicles that are used primarily as passenger vehicles. Most other (but not all) light commercial vehicles that were included in the data, such as utilities and most vans would still make regular use of car parking facilities.

Firstly, vehicle sales data for the year 2000 were analysed and the individual models ranked in order of vehicle length. This enabled the 85th percentile vehicle and a small number of vehicles which could constitute the 99.8th percentile vehicle to be identified. The 85th percentile vehicle is defined as the vehicle which is larger than or equal to 85% of the passenger and light commercial vehicles that operate on Australian roads. Similarly, the 99.8th percentile vehicle is defined as the vehicle which is larger than or equal to 99.8% of the passenger and light commercial vehicles that operate on Australian roads.

Even though it was recognized that the year 2000 data would best reflect the short to medium term future vehicle population (similar to what was done in the original study for the 1986 edition of this Standard), vehicle registration data for the 1989 to 1999 period was analysed to see if different vehicle sizes would then apply to the 85th percentile and 99.8th percentile vehicles. The following findings resulted:

(a) Holden Commodore vehicles were smaller than the equivalent Ford Falcon vehicles for this period.

(b) There was no Holden Statesman model between 1984 and 1990. It is only since 1999 that the Statesman has been longer than the Ford Fairlane.

(c) Significant body changes to the Ford Falcon sedans and station wagons only occurred in 1979, 1988 and 1998. However, the dimensions for the 1998 models were virtually the same as those of the 1988 models.

(d) Changes in market share during the period were insufficient to change the Falcon sedan's position as the 85th percentile vehicle*. All that occurred was a change where the post-1988 vehicle supplanted the slightly smaller pre-1988 vehicle.

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* The Ford Falcon sedan will occupy a higher position in the New Zealand fleet than the 85th percentile. It has however, been adopted for the purposes of this Standard as the B85 vehicle (see Paragraph A3) for both countries.

(e) The number of vehicles (in terms of both model and sales) that were larger than the Ford Falcon station wagon was small. The station wagon has a longer wheelbase and overall length than the sedan.

A3 THE B85 VEHICLE

The 85th percentile vehicle was found to be represented by the Ford Falcon sedan in all key dimensions (other than height and turning circle) and is referred to as the B85 Vehicle. Compared with the 1979 model which represented the 85th percentile vehicle in previous editions of this Standard, there has been an increase in overall length (167 mm), front overhang and rear overhang, but a slight decrease in wheel base. There has also been a slight (10 mm) increase in width. Whereas such increases in dimension would normally result in an increase in swept path during turns, this has been avoided by the rounding of the front and rear of the vehicle.

The dimensions of the B85 Vehicle which have now been adopted for the purposes of this Standard are for a vehicle 4910 × 1870 mm overall. The fully dimensioned design vehicle is shown in Appendix B, Figure B2. These dimensions have been rounded slightly in order to avoid any undue attribution of precision to the actual Ford Falcon dimensions. Furthermore, the concept of effective front and rear overhang dimensions for determining swept path has been introduced.

The minimum turning circle diameter (kerb to kerb) for the B85 vehicle is 11.5 m. This is based on a maximum angle turned by the inner front wheel of 40 degrees. Some modern four wheel drive wagons that are within the scope of the B85 vehicle have a slightly smaller maximum angle of turn (about 37.5 degrees) but are accommodated by their slightly smaller wheelbase and/or width. The maximum angle of turn is applicable only to parking manoeuvres.

NOTE: The swept path of the new B85 vehicle is virtually the same as that of the previous B85 vehicle (within 5 mm maximum width). The wheelbase, effective front overhang and effective rear overhang are essentially the same as those dimensions for the previous B85 vehicle.

A4 THE B99 VEHICLE

The 99.8th percentile vehicle is referred to as the B99 Vehicle. From the year 2000 sales data for sedans, station wagons and light commercial vehicles, a possible candidate for the 99.8th percentile vehicle was the Ford Transit medium wheelbase (MWB) van. This was on the basis of effective length, wheelbase, width and height. However, its dimensions (in particular width and height) tend to put this vehicle above the light commercial category. This is even more so for the long wheelbase (LWB), high roofed version. When the analysis was restricted to predominantly passenger carrying vehicles, it was found that the B99 Vehicle could not be readily represented by a single vehicle model as was possible for the B85 Vehicle and for the B99 vehicle in previous editions of this Standard. This is primarily due to the width (1847 mm) of the vehicle which represents the 99.8th percentile length (the 1999 model Holden Statesman) being less than the width of the B85 vehicle. The 99.8th percentile vehicle width is 1940 mm (Toyota 100 Series Land Cruiser). The height of the 99.8th percentile vehicle also needs to reflect the heights of relevant vans and four wheel drive wagons (see Paragraph A5).

The dimensions of the B99 vehicle which have been adopted for the purposes of this Standard are for a vehicle 5200 × 1940 mm overall. The fully dimensioned design vehicle is shown in Appendix B, Figure B1.

Since the B99 vehicle has to accommodate manoeuvres in critical areas (see Appendix B), its dimensions were derived through an analysis of the swept paths of the Holden Statesman, Ford Fairlane, Toyota 100 Series Land Cruiser, Chrysler Voyager, Ford Falcon utility and Mercedes MB140. Also, the Ford Transit MWB and LWB vans were checked

and found that they could be accommodated by the normal operating clearances that are applied to the B99 vehicle. The B99 vehicle has effectively decreased in size from the B99 vehicle in previous editions of this Standard.

NOTES:

1 The B99 vehicle adequately covers all of the vehicles that were examined in section A4, including the Ford Transit MWB. Even vehicles such as the Ford Transit LWB, the Holden Suburban (now discontinued) and the Rolls Royce Silver Seraph have swept paths that are no more than 0.4 m wider than the new B99 vehicle in the worst case.

2 The new B99 vehicle has a swept path that is 0.15 m narrower than that of the old B99 vehicle in the worst case.

The minimum turning circle diameter (kerb to kerb) for the B99 vehicle is 12.5 m. This is based on a maximum angle turned by the inner front wheel of 40 degrees. Some four wheel drive wagons that are within the scope of the B99 vehicle have a smaller maximum angle of turn (most are now about 37.5 degrees but the Toyota 78 series Land cruiser is about 34 degrees). These vehicles are usually accommodated by their smaller wheelbase and/or width but some may have to turn in a confined space means of a three-point turn. The maximum angle of turn is applicable only to parking manoeuvres. Turns on circulating roadways and ramps should not have a radius less than 8 m so that the angle turned by the inner front wheel is less than 30 degrees.

A5 VAN HEIGHTS

Most vans and four wheel drive vehicles that are commonly used as passenger vehicles have a height less than 2000 mm. The most common vans or four wheel drive vehicles with a height greater than 2000 mm are the Toyota 78 Series Land Cruiser with a height of 2115 mm and the Ford Transit van with optional heights of 2055 mm, 2365 mm and 2587 mm. Whereas there is a model within the Toyota 78 Series Land Cruiser range that is used as a passenger vehicle, most of the Ford Transit vans are used for commercial purposes. Furthermore, the 'mid' and 'full' height Ford Transit models should be considered as being larger than light commercial vehicles. There is however, a bus version with the mid roof height. The Toyota Hiace commuter bus has a height of 2215 mm.

A6 SMALL VEHICLES

A6.1 The Australian fleet

In previous editions of this Standard, the length of the 50th percentile vehicle in the Australian fleet was used as the basis for the small car space. The 50th percentile vehicle of that time (the Mitsubishi Sigma) was in the medium size category. However, over the last 15 years, vehicles in the medium size category have become both longer and wider. For example, the Toyota Corona has become the much larger Toyota Camry and the Mitsubishi Sigma has become the much larger Mitsubishi Magna. Similarly, vehicles in the small size category have become both longer and wider. There is now a light car category that more closely represents the size of vehicles that were originally in the small car category.

With the size of most vehicles that are now in the small car category being close to the size of the 50th percentile vehicle that was used in the previous editions of this Standard, the light car category should now be used as the basis of the small car space. The representative dimensions of the light car are a length of 4450 mm and a width of 1700 mm. The length is the same as that of the previous 50th percentile vehicle and the width is 40 mm wider. No change to the minimum specified dimension for a small car space (2.3 m × 5.0 m) in the previous edition of this Standard has been made.

The light car now represents the 35th percentile vehicle in the Australian fleet.

A6.2 The New Zealand fleet

A survey of the New Zealand fleet conducted by the Land Transport Safety Authority in 1994 indicated that the 50th percentile is 4.23 m long. This is considered to warrant specifying a small car space of 2.3 m × 4.5 m for New Zealand conditions.

A7 SOURCES OF DATA

The following lists the sources of data used in reaching the above conclusions:

(a) VFACTS segment data for 2000 from the Federal Chamber of Automotive Industries.

(b) Queensland Transport summary registration reports for November 2000.

(c) Dimensional data from vehicle manufacturer's internet sites.

(d) Actual measurement of key vehicles, in particular, front overhang, rear overhang, front and rear corner rounding.

APPENDIX B

BASE DIMENSIONS AND DESIGN STANDARDS

(Normative)

B1 SCOPE

This Appendix gives the derivation and specifies the use of base dimensions by indicating the clearances which are to be added to the base dimensions to create design standards, in the following cases:

(a) Swept path (Paragraph B3).

(b) Parking spaces and parking aisles (Paragraph B4).

(c) Ground clearance (Paragraph B5).

(d) Headroom (Paragraph B6).

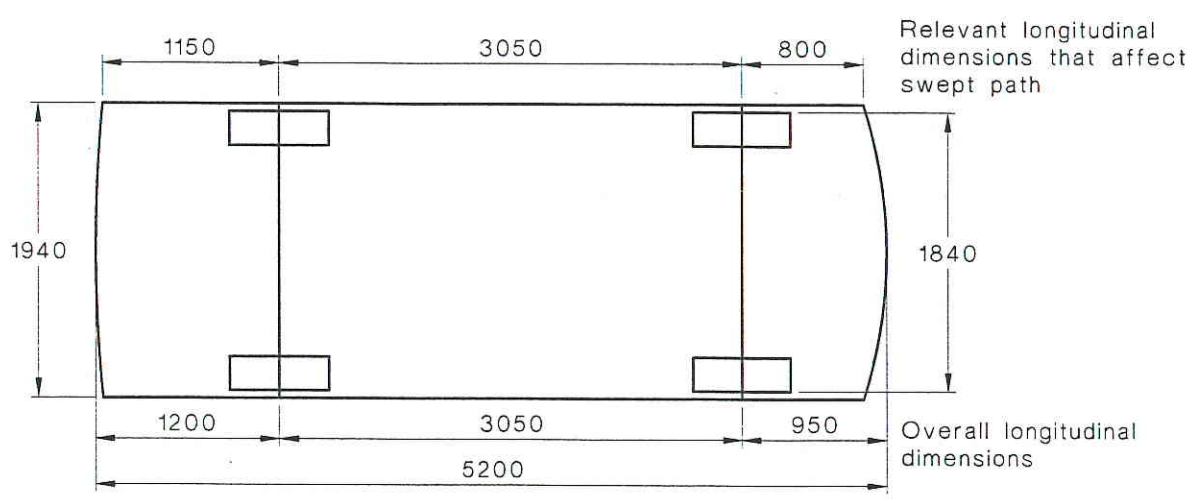
B2 THE BASE DIMENSION

B2.1 General

The base dimension for the B99 and B85 vehicles referred to in this Standard shall be as specified in Figures B1 and B2.

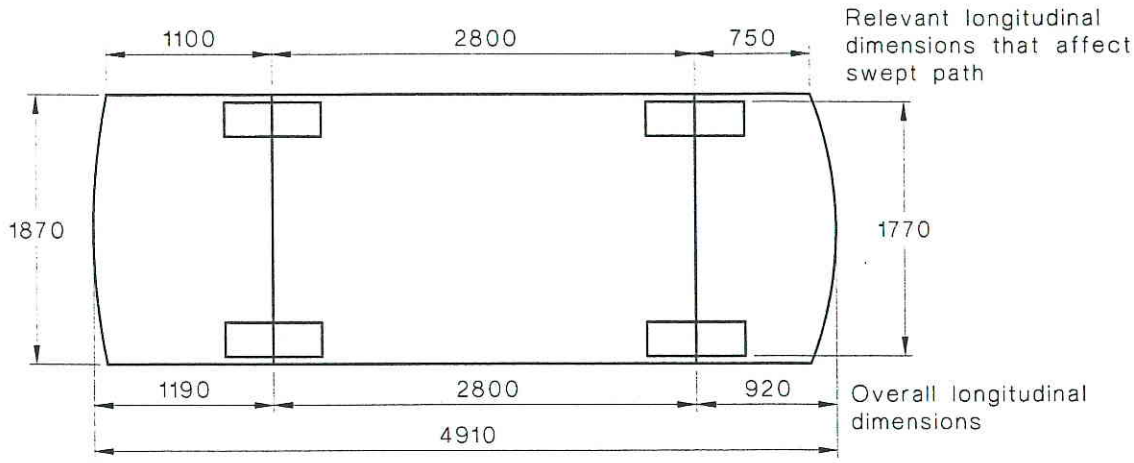
NOTE: These base dimensions have been developed from the vehicle survey in Appendix A.

Design dimensions are derived from these base dimensions by the incorporation of operating clearances. These clearances have been determined from various trials, and allow for different levels of driver skill combined with other factors such as frequency of turnover, type of facility and clientele served. They are applicable to those dimensions in which the driver is required to make a judgment such as turning, manoeuvring and parking, or where slight variations in mechanical or structural attributes of vehicles require a safety margin to be allowed.



DIMENSIONS IN MILLIMETRES

FIGURE B1 B99 (99.8TH PERCENTILE) VEHICLE



DIMENSIONS IN MILLIMETRES

FIGURE B2 B85 (85TH PERCENTILE) CAR

B2.2 The B99 vehicle

Design dimensions based on the B99 vehicle are required at all locations where failure of a vehicle to be able to physically fit into the facility would occasion intolerable congestion and possible hazard. Such locations shall include all access driveways, ramps and circulation roadways, unless there are special circumstances of severe space limitation coupled with relatively low traffic volumes in which case the B85 vehicle dimensions may be used.

B2.3 The B85 vehicle

Except as permitted in Clause 2.5.2(c) and Paragraph B2.2, design dimensions based on the B85 vehicle shall be limited to parking spaces and parking aisles.

NOTE: This is based on the philosophy that the statistical chance of two or more longer vehicles seeking to occupy adjacent parking spaces at the one time is relatively low, and where this does occur, a driver can divert to an alternative space with only minor disruption to other users.

B3 SWEPT PATHS

B3.1 Standard single turn swept path templates

The following specifies the standard single turn swept path templates to be used for design purposes:

(a) *The B99 design templates* The B99 template comprises an inner pair of unbroken lines representing the B99 base dimension swept path, and an outer pair of broken lines which include both the manoeuvring clearance (see Paragraph B3.2(a)) and the circulation clearance (see Paragraph B3.2(b)). The broken line templates shall be used in the design of all access roadways, ramps and, circulation roadways, except where otherwise indicated in Paragraph B2.2. Examples are shown in Figure B3 for a 6.3 m radius turn and in Figure B4 for an 8 m radius turn.

(b) *The B85 design templates* The B85 template comprises an inner pair of unbroken lines representing the B85 base dimension swept path, and an outer pair of broken lines which includes the manoeuvring clearance (see Paragraph B3.2(a)). These templates shall be used only in the special circumstance described in Paragraph B2.3. Examples are shown in Figure B5 for a 5.8 m radius turn and in Figure B6 for an 8 m radius turn.

Templates for other turn radii may be generated using a recognized program provided that—

(i) the base vehicle dimensions shown in Figures B1 and B2 for the B99 and B85 car are used;

(ii) the swept path clearances in Paragraph B3.2 are added; and

(iii) the turn radii are not less than 6.3 m for the B99 vehicle and 5.8 m for the B85 vehicle.

B3.2 Swept path clearances

Clearances to be added to the base swept path templates in Paragraph B3.1 to provide the required design standard are as follows:

(a) *Manoeuvring clearance* To cater for slow moving vehicles travelling within parking aisles or manoeuvring into parking spaces, i.e. at 10 km/h or less, a clearance of *300 mm* shall be added to *both* sides of the turning path.

(b) *Circulation clearance* Circulating vehicles travelling at speeds higher than 10 km/h, i.e. those travelling on access roadways, ramps, circulation roadways and circulation aisles, require a further clearance of *300 mm* added to *one side only*.

B4 PARKING SPACES AND PARKING AISLES

B4.1 Angle parking space design

Angle parking space dimensions are derived from the base dimensions of the vehicle by adding door opening widths to the base width. Minimum door opening width will be sufficient to meet manoeuvring clearance requirements. Different amounts of door opening will be required to provide differing levels of service (i.e. ease of access into a vehicle) for various user classes (see Table 1.1).

Parking space width is based on the B85 vehicle. Table B1 sets out the overall space width requirements for various door openings.

Where there is an obstruction adjacent to a space, e.g. a wall, column, shrubs or landscaped area, an additional 300 mm clearance is to be provided to the obstruction to achieve the designated level of service.

TABLE B1

SPACE WIDTHS RELATED TO DOOR OPENINGS

(B85 VEHICLE)

Open door position	Space width, m
Front door —first stop	2.4
All doors —full open	2.6

B4.2 Angle parking space length

The base lengths of the design vehicles are—

(a) B85—4.91 m; and

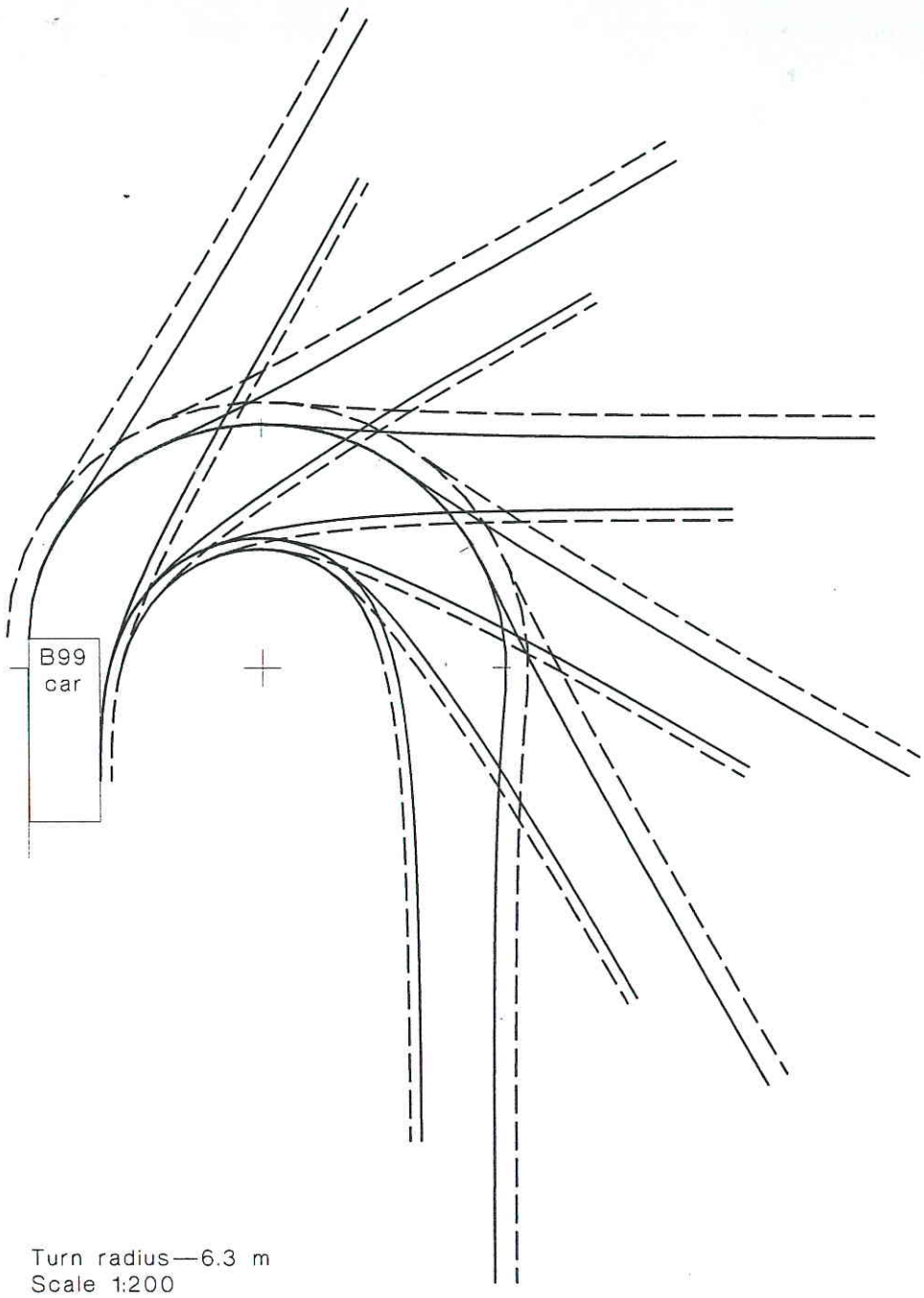
(b) B99—5.20 m.

The angle parking space length of 5.4 m has been derived by adding a 0.2 m positioning tolerance to the length of the B99 vehicle.

NOTE: Clause 4.4.1 provides that in New Zealand, only 5.0 m of the space need be pavement marked.

B4.3 Reverse-in parking

Figures B7 and B8 show typical swept paths for 90 degree reverse-in manoeuvres for B99 and B85 vehicles respectively. These templates are intended for use only at residential or domestic car parks to cater for unusually shaped manoeuvre areas in front of parking spaces. Use of each template is described on each Figure. A 300 mm manoeuvring clearance shall be added to both sides of each swept path. It should also be noted that it is a requirement when applying the templates that the full depth of parking space corresponding to the angle of turn prior to reverse in, be provided.



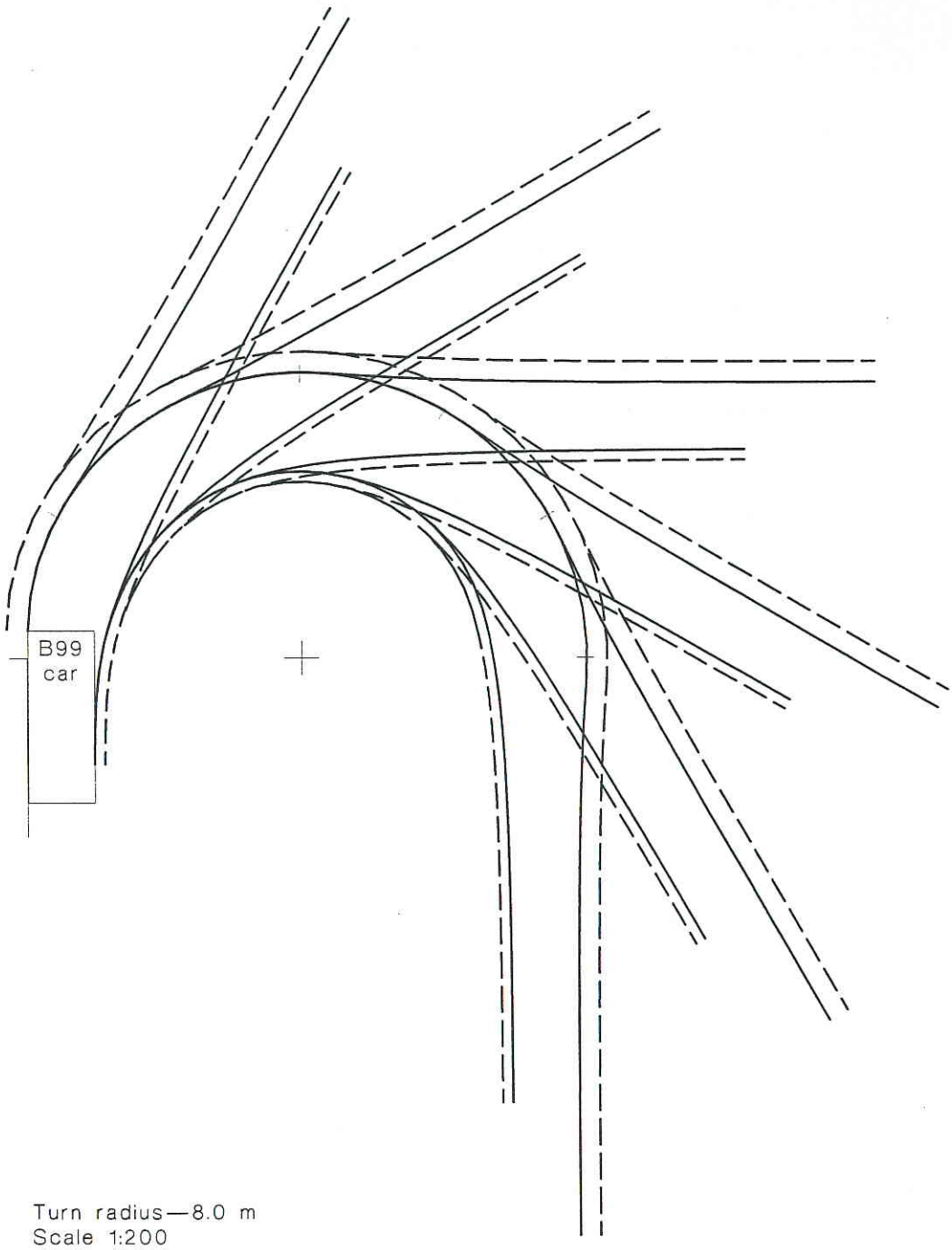
LEGEND:

——— = Denotes the B99 base dimension swept path

— — — = Denotes the B99 design template which includes manoeuvring and circulation clearances, 300 mm on the inside and 600 mm on the outside

NOTE: This is the minimum radius turn for a B99 vehicle.

FIGURE B3 EXAMPLE OF THE B99 DESIGN TEMPLATE—6.3 m RADIUS TURN

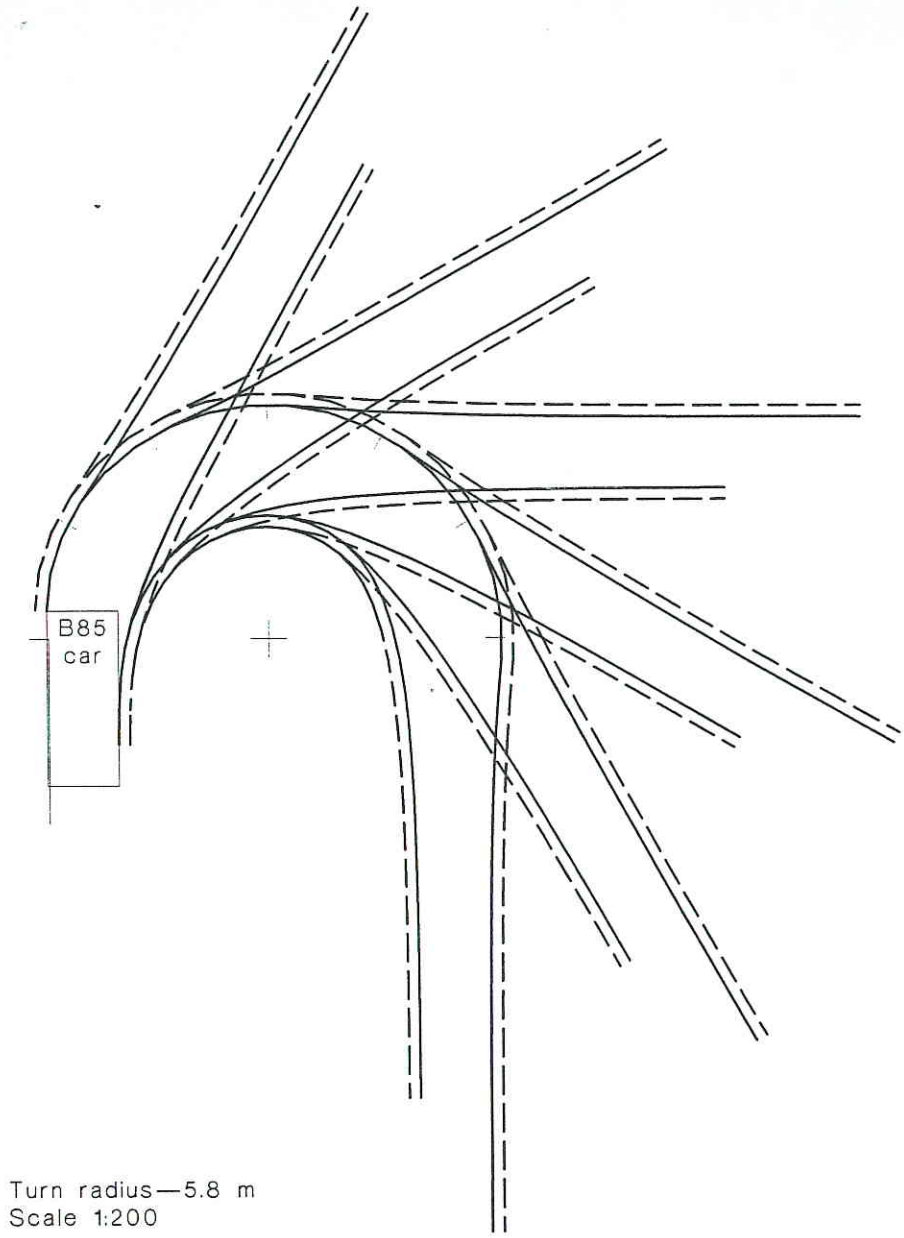


LEGEND:

——— = Denotes the B99 base dimension swept path

— — — = Denotes the B99 design template which includes manoeuvring and circulation clearances, 300 mm on the inside and 600 mm on the outside

FIGURE B4 EXAMPLE OF THE B99 DESIGN TEMPLATE—8.0 m RADIUS TURN



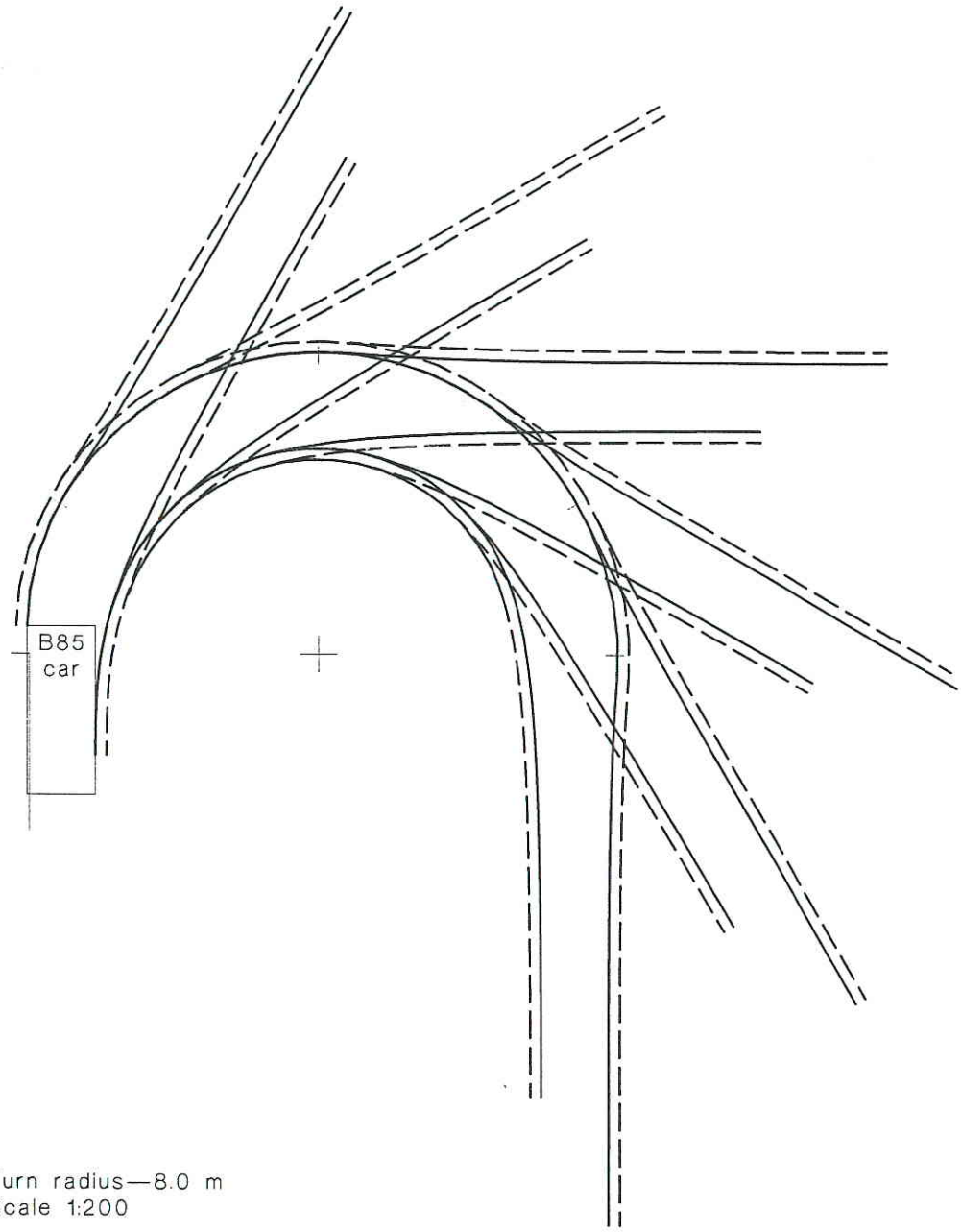
LEGEND:

——— = Denotes the B85 base dimension swept path

— — — = Denotes the B85 design template which includes 2 x 300 mm manoeuvring clearances only

NOTE: This is the minimum radius turn for a B85 vehicle.

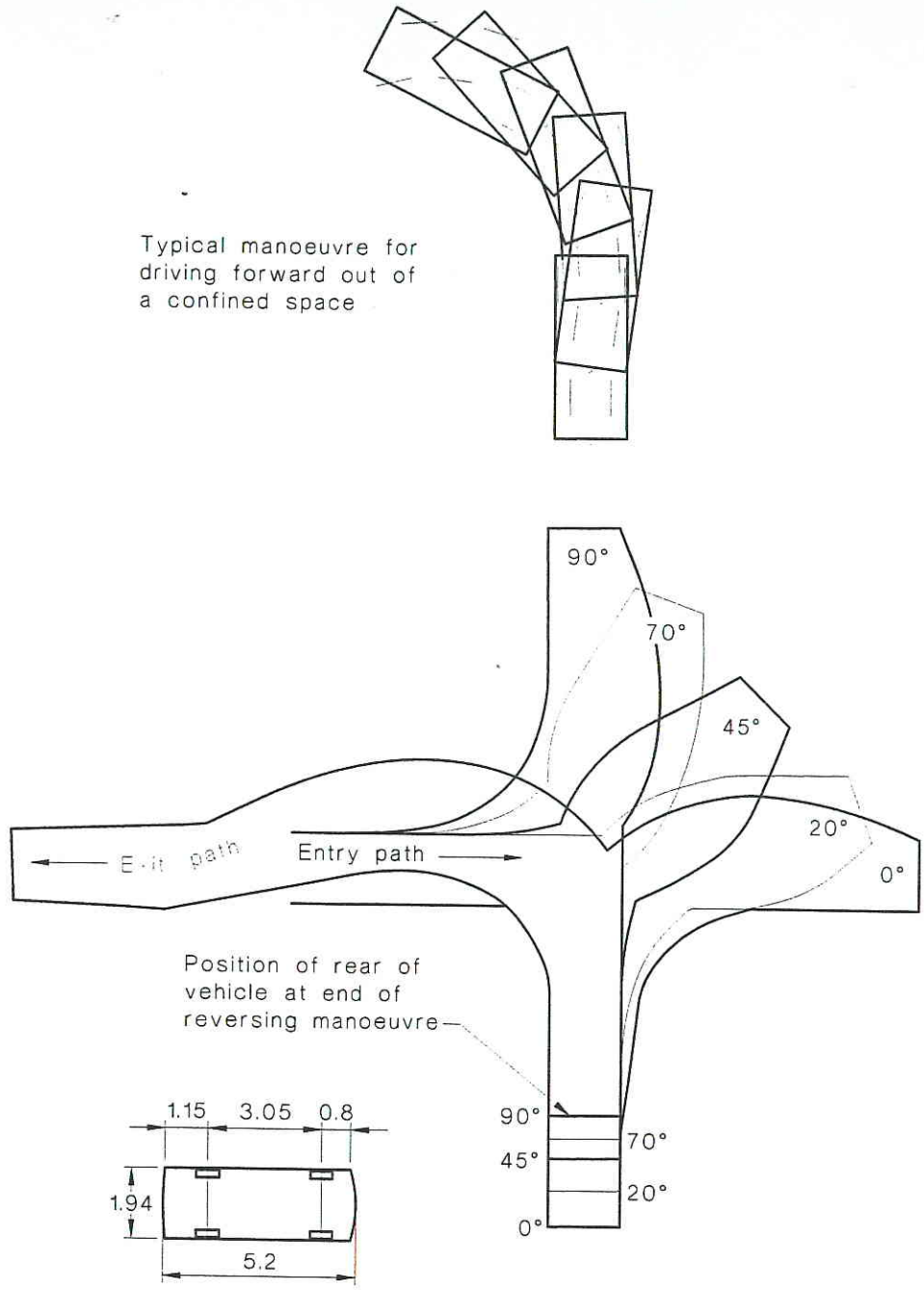
FIGURE B5 EXAMPLE OF THE B85 DESIGN TEMPLATE—5.8 m RADIUS TURN



LEGEND:

——— = Denotes the B85 base dimension swept path
— — — = Denotes the B85 design template which includes 2 x 300 mm manoeuvring clearances only

FIGURE B6 EXAMPLE OF THE B85 DESIGN TEMPLATE—8.0 m RADIUS TURN

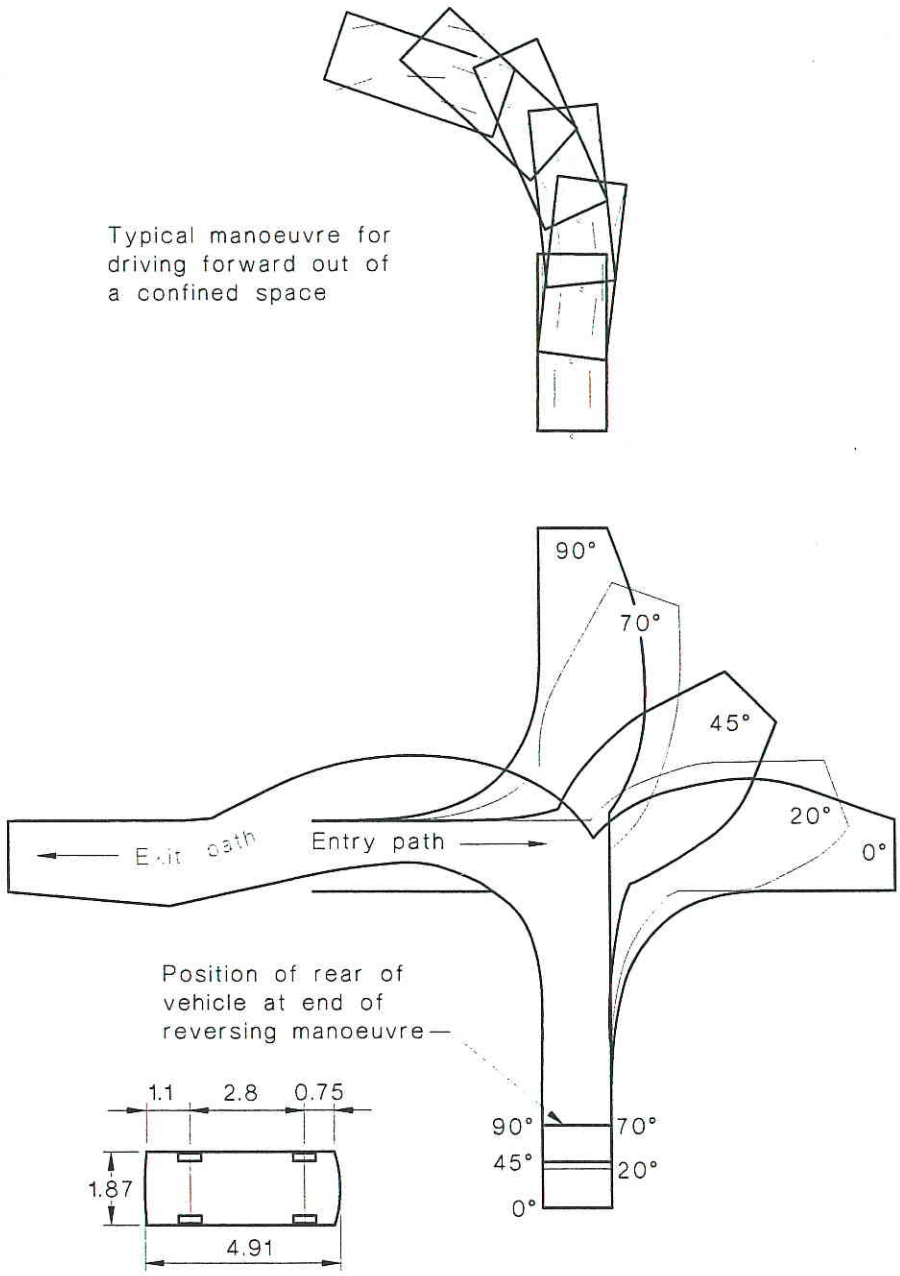


SCALE 1:200

Vehicle enters by driving forward then turns left until it is aligned at the desired angle (e.g. 45°). It then reverses into a position so that it is aligned at 90 degrees to the entry path. It then drives out by turning slightly to the right then left, then right so that it exits in the opposite direction to the entry.

NOTE: These templates do not include the 300 mm manoeuvring clearances, see Paragraph B4.3.

FIGURE B7 REVERSE-IN MANOEUVRE TEMPLATE—B99 CAR



SCALE 1:200

Vehicle enters by driving forward then turns left until it is aligned at the desired angle (e.g. 45°). It then reverses into a position so that it is aligned at 90 degrees to the entry path. It then drives out by turning slightly to the right then left, then right so that it exits in the opposite direction to the entry.

NOTE: These templates do not include the 300 mm manoeuvring clearances, see Paragraph B4.3.

FIGURE B8 REVERSE-IN MANOEUVRE TEMPLATE—B85 CAR

B4.4 Design of parking aisle for manoeuvring

Constant radius swept turning paths, based on the design vehicle's minimum turning circle are not suitable for determining the aisle width needed for manoeuvring into and out of parking spaces. Drivers can manoeuvre vehicles within smaller spaces than swept turning paths would suggest. Wider parking spaces require slightly smaller aisle width.

A field study involving a B85 vehicle with experienced driver was therefore carried out to determine minimum aisle widths for a range of three parking space widths encompassing those in Table B2. The B85 vehicle was used for the reasons given in Paragraph B2.3.

The study involved marking parking spaces, and parking vehicles in the centre of adjacent spaces so that the distance between adjacent vehicles was equal to the required door opening. All vehicles were parked so that either the front or the rear extremity of the vehicle was located at the extremity of the space nearest the aisle, to provide for the worst situation. Similarly, vehicles were parked at the extremity of spaces on the opposite side of the aisle to simulate the minimum aisle width.

The aisle width was varied until the design vehicle could just be satisfactorily parked in the space in one manoeuvre. Both drive-in and reverse-in manoeuvres were checked for each parking space/aisle combination.

The combination of parking space width and aisle widths required for the parking manoeuvres is shown in Table B2. The dimensions in Table B2 are based on a parking space length of 5.4 m.

NOTE: The figures in Table B2 cannot be extrapolated to other space width/aisle width combinations.

The aisle width in Table B2 may not allow for—

(a) requirements for circulating vehicles (see Paragraph B4.6); or

(b) room to make a small radius turn into or out of a circulation roadway, from or to the end of the parking aisle (this has to be checked if necessary as specified in Clause 2.5.2(c)).

TABLE B2

AISLE WIDTHS FOR 90 DEGREE ANGLE-PARKING MANOEUVRES (B85 VEHICLE)

metres

Nominated parking space width	Base aisle width	Minimum aisle width including manoeuvring clearance (2 × 300 mm)
2.4	5.6	6.2
2.5	5.2	5.8
2.6	4.8	5.4*

* Applies only to one-way aisles. The Standard requires aisles for 90 degree parking to be always two-way, i.e. 5.8 m wide, see Figure 2.2. Note also that Figure 2.2 provides for some greater aisle width and space width options than in this Table for some user classes.

B4.5 Angle parking at other than 90 degrees

The field trials referred to in Paragraph B4.3 also encompassed parking angles other than 90 degrees. Table B3 shows as an example, the aisle widths that are required for a parking space width of 2.5 m.

TABLE B3

BASE DIMENSIONS FOR ANGLE PARKING OTHER THAN 90 DEGREES

Parking angle degrees	Space width m	Base aisle width, m	Aisle width including manoeuvring clearances (2 × 300 mm), m
30	2.5	2.2	2.8
45	2.5	3.1	3.7
60	2.5	4.0	4.6

B4.6 Circulating traffic in the parking aisle

In addition to determining the required width of parking aisles for manoeuvring, a check is needed to ensure that there is sufficient width for circulating traffic. The required minimum aisle widths for circulating traffic are as shown in Table B4.

TABLE B4

PARKING AISLE WIDTHS FOR CIRCULATING TRAFFIC

(Applies also to ramps and circulation roadways)

Aisle direction	Base width m	Width including manoeuvring and circulation clearances, m
One-way	2.0	2.9 (Note 1)
Two-way	4.0	5.8 (Note 2)

NOTES:

1 Includes two manoeuvring clearances (2 × 300 mm) and one circulation clearance (1 × 300 mm) (see Paragraph B3.2).

2 Includes clearances as in Note 1 for both directions of travel.

The one-way value applies only to aisles with other than 90 degree parking. The two-way value applies only to aisles with 90 degree parking. In most cases, the width required for manoeuvring will be greater than those shown in Table B4.

B4.7 Ramp and circulation roadway widths

The same principles apply to the determination of ramp and circulation roadway widths as apply to widths required for circulating traffic in parking aisles (see Paragraph B4.5). The widths given in Table B4 are therefore appropriate in this case also.

B4.8 Parking in residential and domestic car parks

A reduction in aisle width from 6.3 m to 5.5 m has been allowed in Figure 2.2 at User class 1A developments (see Clause 1.4) for 90 degree turns into parking spaces. This concession which is designed to be of assistance where space is limited, recognizes that such developments will have low turnover and users generally prepared to accept some inconvenience when entering or leaving the parking space. Tests have shown that most vehicles larger than the B85 vehicle will need to make a 3-point turn if the manoeuvring space is the minimum allowable. Some very large vehicles may need to make a 5-point turn.

B5 GROUND CLEARANCE

A base dimension for ground clearance based on measurements of actual vehicles has been adopted as 120 mm (fully loaded vehicle). The following additional base dimensions have been adopted:

(a) The vehicle is to be capable of negotiating a sharp 8 degree grade change, positive or negative, without any part of the underside between axles grounding (adopted from ADR 43).

(b) The departure angle is 10 degrees (determined by measurement of actual vehicles).

NOTE: Approach angles for most vehicles will be greater than 10 degrees, but for practical purposes it has been adopted as 10 degrees.

This means in effect that if a grade change of more than 8 degrees (or 14 percent) is required, it needs either to be effected in two or more stages, each separated by at least the longest wheelbase among vehicles using the facility, or by design of a vertical curve which will achieve the same objective. This grade change has been reduced to 12.5 percent in the Standard (see Clause 2.5.3(d)) to provide an additional clearance margin. The wheelbase of the B99 vehicle is 3.05 m.

NOTE: It has been established that despite the foregoing, some of the more exotic sports cars can have significantly lower ground clearances. If it is desired to provide a facility for this type of vehicle, designers should consider modifying the design aids given in this Standard to suit.

B6 HEADROOM

The height of all passenger cars and station wagons is below 1.5 metres. The clear height between floors must also cater for persons walking with reasonable comfort and safety. The 99th percentile height of the Australian male is 1.88 m.

Vans and off-road vehicles used as private passenger vehicles need to be catered for. As noted in Paragraph A5, whilst the majority of these are below 2000 mm in height, there are some commonly used vehicles whose height is approaching 2200 mm. Furthermore, vehicles in this category are commonly used by people with disabilities who require headroom for a vehicle of up to 2200 mm in height.

Taking these factors into account the general minimum headroom requirement specified in Clause 5.3.1 has been set at 2.2 m with a further requirement that warning gauges be provided when the headroom is less than 2.3 m.

NOTE: A blanket requirement of 2.3 m minimum headroom applies to all travel paths to and from parking spaces for people with disabilities, together with additional headroom above such spaces for unloading roof-mounted wheelchairs, see AS/NZS 2890.6*.

* In preparation. See footnote to Clause 1.2.

APPENDIX C

GROUND CLEARANCE TEMPLATES

(Normative)

C1 GENERAL

The templates shown in Figure C1 shall be used to check that adequate ground clearance is provided—

(a) for the B99 car at all car parks other than those on domestic properties; and

(b) for the B85 car at car parks on domestic properties;

on ramps, circulation roadways, access driveways or other vehicular paths where there is a grade change or an irregularity in the vertical alignment, e.g. a hump, dip or gutter.

NOTE: These templates provide for a minimum ground clearance of 120 mm. Where it is desired to provide for a lesser clearance (see Appendix B, Paragraph B5), the template should be adjusted by lowering the level of the underside of the vehicle.

C2 METHOD OF USE

The templates are used as follows:

(a) Prepare a longitudinal section of the grade change or irregularity to natural scale, and to the same scale as the template.

(b) Apply the template to the longitudinal section plot so that the two knife edges representing the vehicle wheels sit on the plot. Move the template back and forth along the plot, ensuring that the heavy line, representing the underside of the design vehicle, does not fall below the plot at any point.

NOTE: It will normally be necessary to photocopy Figure C1 onto transparent film.

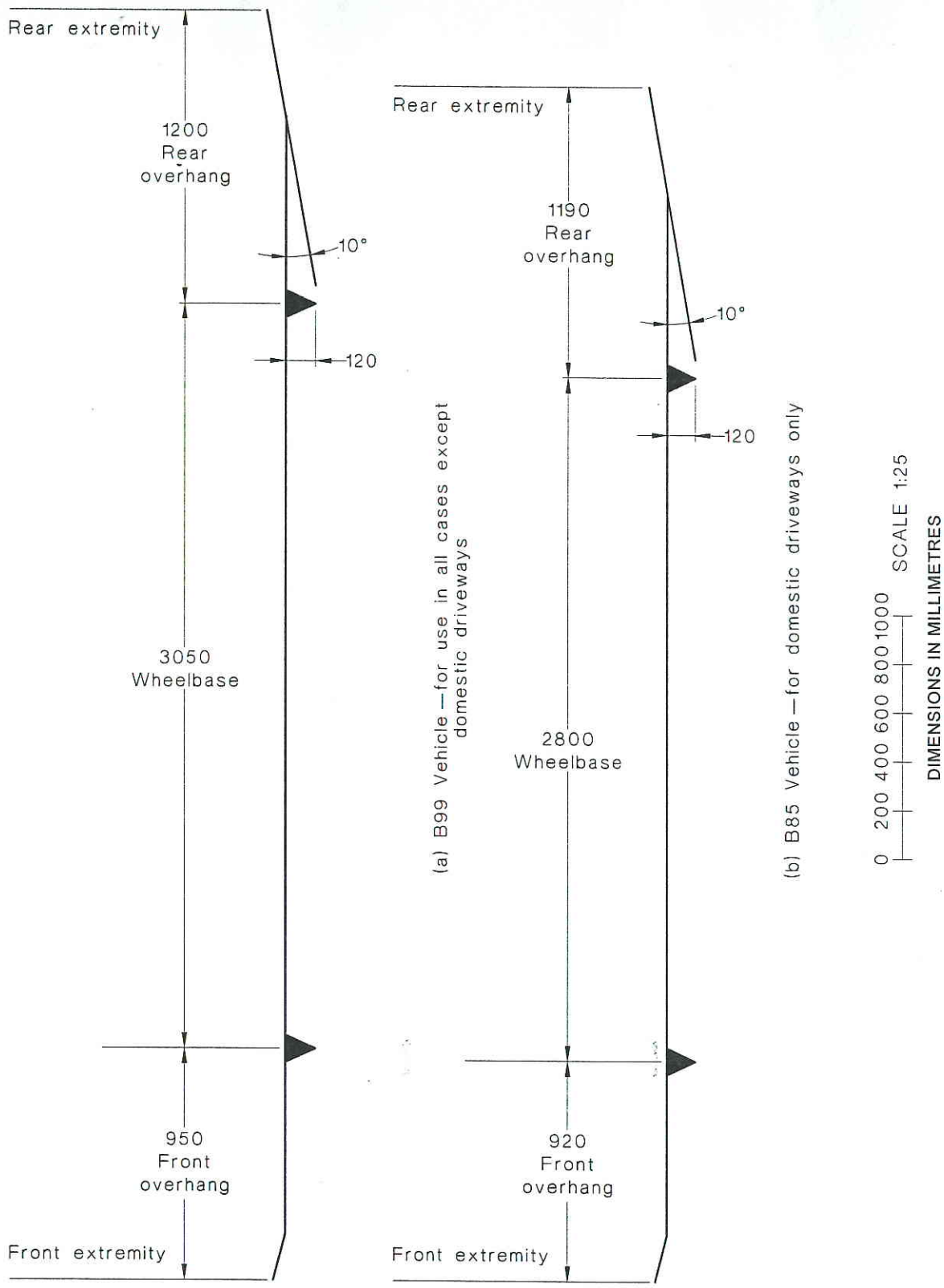


FIGURE C1 GROUND CLEARANCE TEMPLATES

APPENDIX D

CAPACITY PROVISION AT ENTRY AND EXITS AT LARGE CAR PARKS

(Informative)

It has been established that large car parks operate most efficiently if they are planned in such a way that they operate in units of up to about 500 cars. Entry and exit points should be designed so that the facility can be adequately serviced in the peak period of the car park.

The number of entry and exit lanes required in a large car park will depend on the following:

(a) The total number of peak hour vehicle movements, estimated from the total number of parking spaces in the car park multiplied by the mean expected turnover per parking space.

(b) The proposed number of entry/exit locations.

(c) The vehicular capacity of the lanes at the entry/exit point (see below).

(d) Any additional lanes needed to meet capacity requirements at the access driveway/frontage road intersection.

In the absence of alternatively researched data, the following maximum lane capacities should be used in determining the number of entry or exit lanes required:

(i) Entry point—

(A) free flow—600 vehicles/hour/lane;

(B) card reader—400 vehicles/hour/lane;

(C) automatic ticket issue and boom gate—300 vehicles/hour/lane;

(D) manually controlled—250 vehicles/hour/lane.

(ii) Exit point—

(A) free flow—600 vehicles/hour/lane;

(B) ticket or token acceptance unit and boom gate—300 vehicles/hour/lane;

(C) cashier controlled—200 to 250 vehicles/hour/lane, depending on the parking fee structure.

Locations where high volume entry and exit points join frontage roads, i.e. generally, driveways or intersections in Categories 3 to 5, should be analysed to ensure that traffic operating characteristics are satisfactory. In particular, unsignalized driveways and intersections should be checked to ensure that the absorption capacity for traffic entering or crossing the frontage road stream is adequate during times of peak activity. Likewise the capacity of signalized intersections should be checked using accepted techniques. Failure of a proposed entry or exit point to meet projected traffic capacity requirements could require either redesign, duplication, relocation or reduction in the number of parking spaces serviced by that entry or exit point.