

4. DESIGN GUIDELINES

4.1 Applicable Standards and Control Plans

The following section presents the key criteria that should be adopted by designers (architects, developers, planners, engineers) in designing functional and safe parking areas for accommodation of vehicles associated with new developments.

South Sydney City Council has adopted the *Australian Standard 2890 Parking Facilities* series as the basis for its design criteria. This section highlights the key areas from these and embellishes certain issues in need of clarification. The standards are comprised of 5 parts:

- AS 2890.1 *Part 1 - Off-street car parking*
Covers minimum dimensions of parking spaces, aisles, ramps, driveways, sight distance requirements, headroom, vehicle templates and provision for people with disabilities
- AS 2890.2 *Part 2 - Commercial vehicle facilities*
Service vehicle and area dimensions, grade and height dimensions, manoeuvring and circulating templates, access driveways
- AS 2890.3 *Part 3 - Bicycle parking facilities*
Storage area requirements and facilities, security, location and access considerations, examples of parking
- AS 2890.4 *Part 4 - Bus parking* (not yet published)
- AS 2890.5 *Part 5 - On-street car parking*

The guidelines should be considered in conjunction with other documents such as:

DCP No. 1, soon to be replaced by *South Sydney City Council DCP 1996 - Urban Design**

*DCP No. 10 - Guidelines For Disabled Access, South Sydney City Council, 1993**

Guide To Traffic Generating Developments, RTA, 1993

Copies of the above documents are available for viewing at Council and RTA libraries outlined in Section 2.3.

Documents marked with an asterisk above are available for purchase at Council's administrative offices in Zetland. Copies of the standards are available for purchase through Standards Australia at Homebush (Tel: 746 4700) while the RTA Guidelines are obtainable from RTA Public Relations Section at 260 Elizabeth St, Surry Hills (Tel: 218 6888).

4.2 Parking Bay Dimensions

Parking bay width and length, and aisle widths are inter-related dimensions. Parking bay widths can vary with different types of user, and aisle width can vary depending on whether the aisle is primarily serving an access or circulation function and on the width of bay.

4.2.1 Length of Parking Spaces

All bays shall be a minimum 5.4m long with the exception of:

- Spaces with an overhang into adjacent landscaped areas may be reduced to 4.8m;
- Small car spaces which can be reduced to 5.0m (refer to Section 4.3);
- Parallel spaces which are required to be 6.0m normally, or 6.3m in an end space.

4.2.2 Width of Parking Spaces

The minimum width of car parking spaces for the various categories of users is set out in the table below. The widths are based on considerations of door opening requirements and frequency of use.

Use category	Examples of typical users	Space width
Low turnover	All day and commuter parking	2.4m
Medium turnover	Duration of stay between 2 hours and all day, eg; tenant parking in residential buildings, sports facilities, hotel parking	2.5m
High Turnover	Short term parking, visitor parking, parking where children and goods are frequently loaded, eg; shopping centres	2.6m
Disabled user	Parking spaces reserved for use by the disabled	3.2m
Small Car Space	Refer Section 4.2.3	2.3m
Parallel Parking	Normal conditions	2.3m
	Restricted roadway width	2.1m
	Trucks and buses	2.6m

Spaces adjacent to walls or fences, or obstructions such as columns will need to be made 0.3m wider to allow doors to open adequately. A template is provided in AS2890.1 Figure 5.2 that outlines the areas of a parking bay that should be kept obstruction free.

4.2.3 Small Car Spaces

In certain circumstances it may be appropriate to provide a smaller than standard car space due to design and site constraints. The minimum dimensions for small car spaces will be 2.3m wide by 5.0m long.

The number of small car spaces will be kept to a minimum - generally no more than 5 -10 percent of total spaces. In residential developments where parking is strata-titled, small car spaces will generally not be allowed for tenant spaces and will be limited to no more than 20 percent of visitor spaces. If provided, small car spaces should be clearly identified and located so that their abuse will not cause an obstruction to traffic circulation.

Motorcycle spaces should measure 2.5m long by 1.2 m wide and be on a near level surface.

4.3 Aisle Dimensions

Differentiation is made between aisles primarily used for manoeuvring into and out of spaces and aisles substantially used for circulation of traffic also. This is because manoeuvring vehicles generally travel at a slow speed which requires lesser clearances than faster moving circulating vehicles and are thus able to turn in a smaller space than suggested by conventional turning paths (refer Section 4.5). Also wider parking spaces allow slightly smaller aisle width.

4.3.1 Manoeuvring vs. Circulation Aisle Widths

AS2890.1 gives the various combinations of bay width and manoeuvring aisle for parking at 90 degrees to the aisle. These apply whether traffic movement is one-way or two-way. For circulation aisles, aisle widths should be increased by 5 percent with a lower limit of 5.5m. The combinations are summarised below.

Width of Space	Aisle Width For Manoeuvring (including 2x0.3m Manoeuvring Clearances)	Aisle Width For Circulation (including 5 percent widening)
2.4m	6.2m	6.5m
2.5m	5.8m	6.1m
2.6m	5.4m	5.8m
2.7m	5.0m	5.5m

At bends, splays should be provided or the aisle widened to at least 6.6m to allow for two way simultaneous movement of turning vehicles. The design should be checked with the swept path templates referred to in Section 4.5.

For one and two-way internal roadways to which parking is not provided, the minimum dimensions are 2.9m and 5.5m respectively, and 3.6m and 6.6m on bends.

AS2890.1 Section 2.4 refers to dimensions associated with angle parking which is one option to be investigated if space constraints do not permit a full size aisle and traffic circulation can be directed one-way.

4.3.2 Dead-End Aisles

Dead-end aisles are permissible so long as they are limited to tenant only areas or, in the case of public car parks, limited in length to the equivalent of 6 parking bay widths (approx 15m). Parking spaces at the end of dead end aisles will need to be made 1.0m wider than dimensions specified in Section 4.2.2 to enable easier manoeuvring.

4.4 Grade and Ramp Dimensions

Grades of carpark floors should generally be a maximum of 1 in 20 with the exception of disabled parking spaces at a slope of 1 in 40.

Ramp widths on straights should be 2.9m minimum between kerbs for one-way flow and 5.5m between kerbs for two way flow. On curves, the respective dimensions are 3.6 and 7.8m (Refer AS2890.1 Section 2.5). Kerbs of 0.3m width should be added to each side of the aisle.

Ramp grades are 1 in 5 absolute maximum on straight sections under 20m and 1 in 6 absolute maximum over 20m. On curves, the grade is measured along the inside edge. Changes of grade in excess of 1 in 8 will require a 2.0m transition at half the value of the two intersecting grades. A template is provided in AS2890.1 to check clearances to prevent bottoming out.

4.5 Swept Paths of Vehicles

The minimum practical turning circles of vehicles are provided in Appendix D for use in checking the practicality of design.

The B99 design template, based on the 99th percentile vehicle such as a Ford LTD, should be used in the design of all access roadways, ramps, circulation aisles, ie; in locations where failure of a vehicle to physically fit into such a facility would cause intolerable congestion.

The B85 design template based on an 85th percentile size vehicle such as an XD Ford Falcon Sedan, is for use in checking manoeuvring aisles and parking spaces or in circumstances where space limitations prevent the larger template being used. If this is the case, the subject facility should have low traffic volumes only.

Allowances of 0.3m should be added each side of the templates for manoeuvring with an additional 0.15m being added each side for higher speed circulation.

4.6 Access Considerations

4.6.1 Urban Design

South Sydney City Council DCP 1996 - Urban Design lays out urban design considerations and design details such as vents, grilles, gates, etc that will need to be taken into account during design. Generally, vehicle entrances should be located at the rear or side of the front facade, although this will depend on factors such as physical constraints, competing urban design interests and structural aspects if buildings are being recycled. Pedestrian amenity and safety, and vehicle safety on the access roads are other factors to be considered.

Garages, carports and open hard stand parking areas will not be permitted in front of terrace houses in any circumstances in Conservation Areas and only in exceptional circumstances in other areas where such parking would not be out of character, the quality of the streetscape is not compromised and there would not be adverse effects on on-street parking supply due to clearances for driveways and sight distances.

4.6.2 Undesirable Driveway Locations

Safety of pedestrians and motorists and siting of the access to the most appropriate location to suit the prevailing traffic conditions are the main objectives to be addressed. The following conditions, mostly derived from RTA guidelines, should be met:

- all vehicles should enter and leave in a forward direction;
- a site's entry and exit should generally be located to cause least interference to vehicular and pedestrian activity on the frontages roads and surrounding residential areas;
- direct access should not be provided to designated arterial and sub-arterial roads wherever an alternate access can be provided;
- driveways should not be located:-

- within 25m of the property boundary adjacent to a signalised junction;
 - within 60m of the approach side of an intersection on a State Road and within 30m on its departure side;
 - within 12m of a "Stop" or "Give Way" sign/hold line at intersections;
 - opposite a busy side road or busy driveway for a distance of 6m beyond the adjacent property boundary or driveway edge;
 - within 6m of a median opening;
 - within 15m of the alignment of any intersection for any service vehicles, and preferably 30m should there be more than 2 loading spaces;
 - where there is insufficient "weaving" distance to or from a nearby road which could reasonably be used by the development's traffic.
 - closer than 1.0m from the adjoining site boundaries;
- all driveways should be located to provide maximum sight distances (see Section 4.6.3) and preferably not positioned on curves or crests;
 - no driveway should be at an angle that is less than 60 degrees to the kerbline.

In exceptional circumstances, when property boundaries render the attainment of the above guidelines impossible, access may still be possible but it is the responsibility of the applicant to prove that proposed arrangements are both necessary and acceptable. Care will need to be taken in the design and location of driveways with safety and sight distance being of paramount importance. The absolute minimum distance on the approach to an intersection shall be 6.0m.

4.6.3 Sight Distance

Adequate sight distance is primarily required for a vehicle emerging from a driveway to adequately judge an acceptable gap in the approaching traffic for the prevailing speed conditions so as not to cause a hazard when turning and accelerating. Ideally, it should allow the same opportunity for an approaching vehicle to sight one emerging and take avoiding action if necessary.

Desirably, all driveways should be located and constructed so as to provide sight distances not less than recommended in AS2890.1 (summarised below). However, it is recognised that in built-up and sometimes constrained areas such as South Sydney, achievement of these theoretical distances will be difficult if not impractical to attain due to street trees, on-street parking, fences, building lines etc.

Driveways may be approved with sight distances less than those specified in AS2890.1 where it can be satisfactorily demonstrated that there is no practical alternative, and that safety will not be unreasonably compromised.

As a guide, driveways providing access to up to 50 spaces from a minor road only (lanes, local and collector roads) should be located and/or parking and landscaping restrictions imposed to provide sight distances measured from a point 1.5m outside the through carriageway. No Standing restrictions of not less than 9 metres (including driveway) may be sought when the speed environment is 40km/hour or less (the clearance typically provided on the approach to a pedestrian crossing). Greater travel speeds and roads of greater status may require more stringent No Standing (or other) set-backs.

Speed is obviously a major determinant of sight distance. Where the relocation of a driveway or parking restrictions are not possible, an alternative could be to reduce the travel speed of vehicles (on minor roads at least) by providing traffic management devices such as raised platforms and landscaped chicanes. Such schemes should be discussed with Council, designed in accordance with Council's design specifications and would be subject to approval by South Sydney Council's Traffic Committee. Depending on the circumstances, all or a proportion of

any costs associated with such a proposal including design, landscaping and supervision would be at the applicant's expense.

4.6.4 Driveway Dimensions

AS2890.1 refers to access driveway types 1 to 5 for light vehicles. Entry and exit widths and separation between the two are given in Table 1. The type of driveways appropriate to various levels of parking spaces are given in Table 2. Users requiring a fuller explanation of design requirements of access driveways are referred to the source document.

Selection of Access Driveway Category

		Access Driveway Category				
		Number of Parking Spaces				
		< 25	25 to 100	101 to 300	301 to 600	> 600
Low Turnover	Arterial	1	2	3	4	5
	Local	1	1	2	3	4
Medium Turnover	Arterial	2	2	3	4	5
	Local	1	2	3	4	4
High Turnover	Arterial	2	3	4	4	5
	Local	1	2	3	4	4

Recommended Access Driveway Widths

Category	Entry Width	Exit Width	Separation of Driveways
1	3.0 to 6.0	Usually combined	Not applicable
2	6.0 to 9.0	Usually combined	Not applicable
3	6.0	4.0 to 6.0	1.0 to 3.0
4	6.0 to 8.0	6.0 to 8.0	1.0 to 3.0
5	Direct feed from a dedicated public roadway via an intersection controlled by Stop or Give Way signs, traffic signals or a roundabout.		

4.7 Design For Service Vehicles

The Guideline Rates (Section 3) provide suggested provision for service vehicles. It is the onus of the applicant to demonstrate the service vehicle requirements and provide adequate facilities. However, a degree of flexibility in provision and design is recommended to cater for potential future changes of use and ownership.

AS 2890.2 Off-Street Parking - Part 2:Commercial Vehicle Facilities provides guidelines, dimensions and vehicle templates for the design of service areas and should be referred to in full for anything but simple designs.

4.7.1 Appropriate Choice of Vehicle Sizes and Types

The design for service vehicles will need to reflect the size, type and frequency of service vehicles anticipated to use the site within the life of the development. In general, long haul, transport of bulk goods and multiple destination - chain store deliveries (eg; supermarkets) tends to encourage maximum size vehicles. Local deliveries and small consignments tend to be delivered in vans, wagons and small/medium trucks. Business parks, which are becoming increasingly prevalent in South Sydney, tend to attract the same but also attract occasional single containers delivered by small prime movers with short length trailer.

AS2890.1 outlines the needs of cars, vans and wagons. AS2890.2 provides details of:

Small Rigid Vehicles (SRV's) - covering small trucks to 6.9 t gross vehicle mass (GVM) and a large number of short wheelbase medium sized trucks to 12 t GVM. The design turning circle of SRV's is 14.2 m;

Large Rigid Vehicles (LRV's) - covering long wheelbase medium size trucks to 12 t GVM and larger vehicles to approximately 20 t GVM. The design turning circle of LRV's is 17.7 m;

Articulated Vehicles (AV's) - covering a full size prime mover plus a two container length trailer to a combined total length of 17m. The design turning circle of AV's is 22 m.

Templates are provided in AS2890.2 for designing for circulation at low speed and manoeuvring into loading docks for each of the SRV, LRV and AV categories. The templates for SRV's are replicated in Appendix D. Bus templates may be found in the RTA's *Guide To Traffic Generating Developments*.

4.7.2 Loading Bay Sizes and Dock Design

Service bays at a loading dock should have a minimum width of 3.0 m for SRV's, a width which should also allow for side loading at vans, and 3.5 m for larger vehicles (refer AS2890.2 Table 2.3). The length of loading bays should be 6.0m for vans and wagons, 6.7 m for SRV's, 11.0m for LRV's, 17.2m for AV's and 12.5m for single container AV's. Courier spaces may be the same dimensions as car spaces.

The height of loading dock should be 1.0 - 1.1m above ground for SRV's and 1.2 -1.4 m for LRV's and AV's.

4.7.3 Manoeuvring/Apron Areas, Aisles and Driveways

A manoeuvring area (apron width) not less than twice the overall length of the longest vehicle anticipated to use the loading dock is recommended in front of the loading dock. A clear area of 20-30 m surrounding the dock is desirable. The exact dimensions and clearances needed should be ascertained with the use of the templates referred to above, as it will depend on design vehicles and their length and turning radii, direction of approach and reversal, and width of dockways.

For internal aisles/roads between the driveway and loading dock/service area, the minimum carriageway width shall be 4.5m for one-way operation and 6.5m for two-way operation. If parallel parking to the aisle is sought, 2.4 m is added for each lane of car parking and 3.0 m for each lane of truck parking. If perpendicular parking is sought, 6.0m is added for each row of car parking to allow reversing motorists to better sight on-coming cars.

On short blocks with buildings lining the rear and sides, the aisle is effectively governed by the manoeuvring apron. For small business parks, a 9.0m aisle/apron with perpendicular car parking and loading docks on each side, appears appropriate.

Truck traffic should circulate in a clockwise direction because turning to the right is easier for drivers and the truck is then placed in the most favourable, space efficient position for backing into the dockway.

Access driveways should be designed to accommodate the largest vehicle expected to use the service area and to allow for simultaneous two-way movement. Driveway dimensions and design principles are covered in full in Section 3 of AS2890.2. Minimum two-way driveway widths are given as 6m for SRV's, 8m for LRV's, and 10m for AV's with splays or kerb returns to be provided as appropriate to ease turning. However, there is scope to vary the driveway width depending upon the angle and nature of the approach and departure paths; eg, parking in the kerbside lane would necessitate a turn farther from the kerb and the width of lane would be narrower than if the vehicle turned from the kerbside lane. The adequacy of driveways should be checked using the circulation templates of AS2890.2.

All vehicles turning left into or out of a road or driveway should be able to complete their turning manoeuvres without crossing the centreline. It is desirable that for wider driveways, a small island be provided between entry and exit lane for the protection of pedestrians and physical separation of vehicles.

4.7.4 Grades and Height Clearances

Ramp grades for trucks should be kept to a minimum where manoeuvring occurs. The maximum value permitted is 1 in 12.5, which is governed by reversing constraints. If forward only manoeuvres on the ramp occur, the grade may be relaxed to 1 in 6. For change of grade details, refer to Section 2.7 of AS2890.2.

Clearances between ground and overhangs should be 3.6m for general loading docks, 4.5m for general servicing and deliveries, 5.0m for large rigid trucks and semi-trailers, 4.5m for delivery docks in hotels and taverns, and 3.6m for buses and Council garbage trucks. Consideration will be given to relaxing these requirements on demonstration of the nature and size of expected service vehicles at the proposal.

4.7.5 Other Considerations

All vehicles should be able to enter and leave in a forward direction at all times, if necessary with the assistance of a mechanical turntable. All servicing, its access and manoeuvring should be carried out wholly within the site and not encroach upon public roads. The area set aside for service vehicles should desirably be a physically defined location that is clear of parked vehicles and through traffic. It should not be used for other purposes such as storage of goods and equipment.

4.8 Bicycle Parking Facilities

AS2890.3 *Bicycle Parking Facilities* and Austroad's *Guide to Traffic Engineering Practice - Part 14: Bicycles* are good sources of bicycle parking information. Extracts from AS2890.3 follow this brief summary.

When designing bicycle parking facilities, consideration needs to be made of the type of bicycle user as there are varying levels of security needed. The location of parking area and directional signage are also important factors to encourage bicycle use and security. The table below summarises the levels of security of various parking facilities and their recommended application. A mix of storage types is acceptable - usually along the lines of visitors to a development not needing higher class facilities.

SECURITY ARRANGEMENTS AND APPLICATION OF THE VARIOUS CLASSES OF PARKING FACILITY

Facility class	Security arrangements	Surveillance	Application
1	Bicycles are stored in a completely enclosed individual locker, such that the bicycle is protected from weather and hidden from view A unique key is provided	Direct surveillance is not normally required, but lockers should be located in a reasonably well lit public place to deter vandalism	All-day parking where the owner continues on to a remote location, e.g. as a public transport commuter; the facility is exposed to the general public, and no close surveillance is available
2	Bicycles are stored in a secure communal compound, protected from the weather but not necessarily from view, and accessed via an attendant or by use of duplicate keys Compounds have rails or fixtures where the bicycle can be secured with the owner's lock Entrance gates are self closing and self locking	Where available to the general public, or in large workplaces or institutions, some level of direct surveillance (Note 1) may be necessary to ensure that there is no theft among users	All-day parking, where the owner may continue on to a remote location, e.g. as a public transport commuter; or to a nearby location, e.g. a workplace, school or college; and some surveillance can be provided so as to ensure satisfactory operation
3	Bicycles are locked to a support rail to which there is open access. The rail is designed so that it supports the whole bicycle, and the frame and <i>both</i> wheels can be locked to it using the owner's own chains and locks	If to be used as a long-term parking facility, direct surveillance will be required (Note 1) Short-term facilities in well lit and highly visible public places may achieve a reasonable level of security without direct surveillance (Note 2)	Short-term parking on-street or off-street at e.g. shopping centres, amusement parlours without direct surveillance, or for longer-term parking at e.g. schools, colleges, workplaces, where direct surveillance is provided

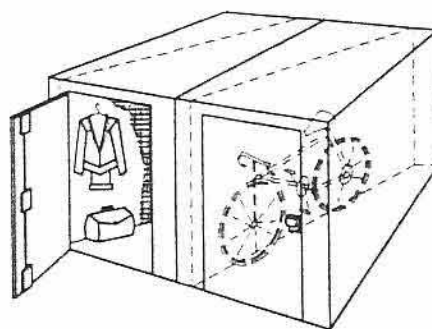
NOTES:

- 1 Direct surveillance means either constant surveillance, or at least consistent surveillance at critical times, by an interested person, e.g. a paid attendant as part of other regular duties, who has a view of the bicycle parking facility adequate for the purpose.
- 2 Wherever practicable, Class 3 facilities should be located where there is some passing pedestrian traffic. This will provide a form of supervision which may reduce the likelihood of theft and vandalism.

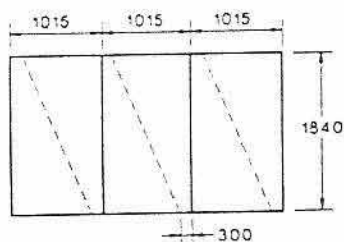
Facilities which typically comprise racks in open public places, and providing only the means to lock one wheel of a bicycle to a fixture, are not regarded as a secure arrangement and are not endorsed. Arrangements requiring a wheel to be removed are also not acceptable.

For longer term parking, secure storage lockers incorporating rails or side-by-side or vertical racks are required (refer extracts), depending on preference and site constraints. Preferred short term/visitor parking facilities are rails embedded in the floor or wall.

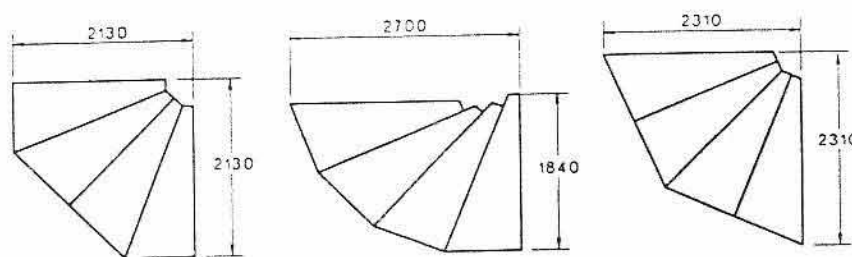
Access paths to bicycle parking should be a minimum of 1.5m wide to allow the passage of a pedestrian pushing a bicycle. Standardised information signs (see diagrams) giving directions to bicycle parking areas are necessary to advise the public of their presence.



(a) Bicycle lockers



(b) Typical double-sided layouts

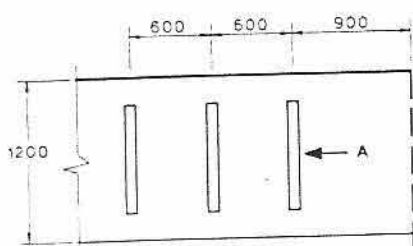


(c) Typical quadrant or fan layouts

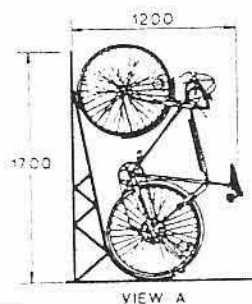
DIMENSIONS IN MILLIMETRES

FIGURE B1 TYPICAL CLASS 1 PARKING FACILITIES WITH BICYCLE LOCKERS

FIGURE 2.3 BICYCLE STORAGE—NOSE-TO-TAIL ON A FOOTPATH OR VERGE

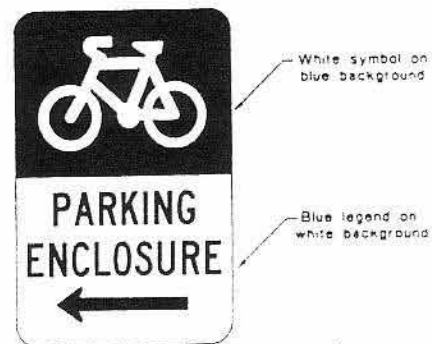


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VIEW A

FIGURE 2.4 BICYCLE STORAGE—VERTICAL RACKS



White symbol on blue background

Blue legend on white background

Size 300 x 450

(a) Direction sign

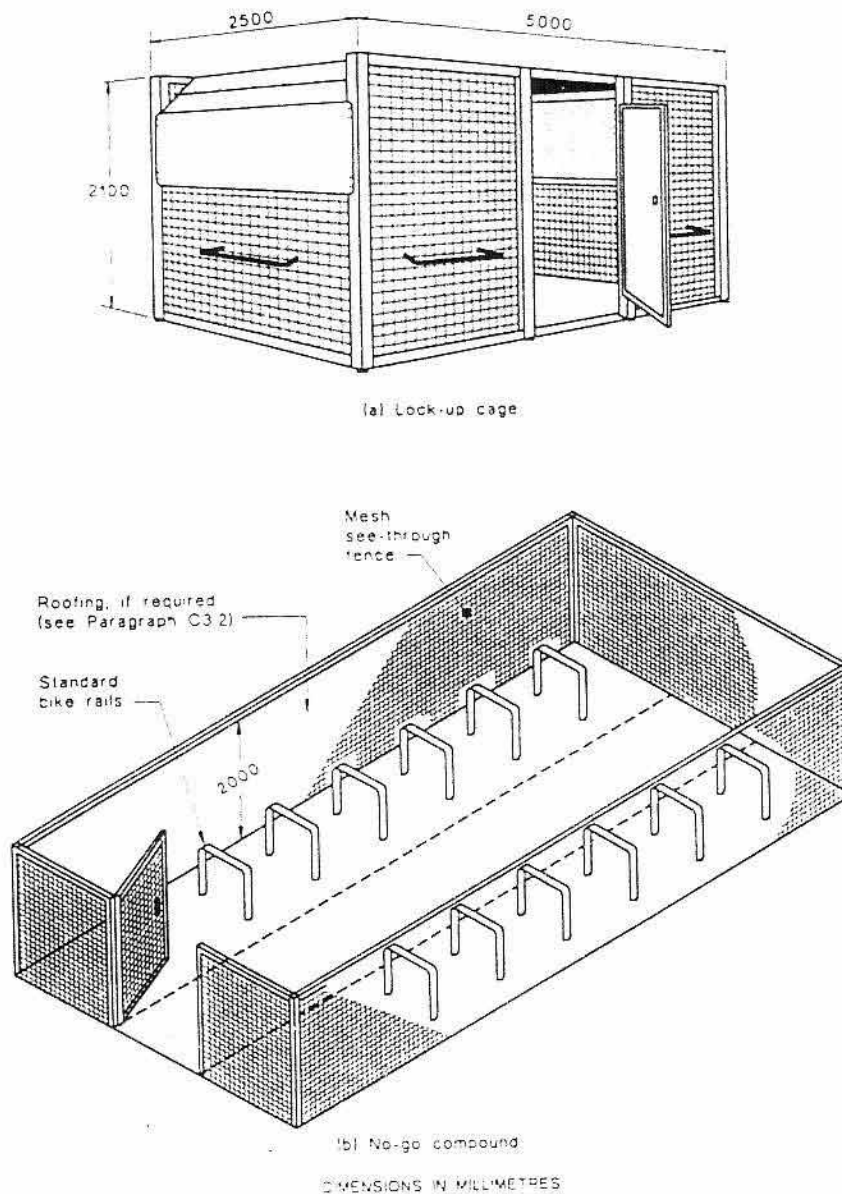
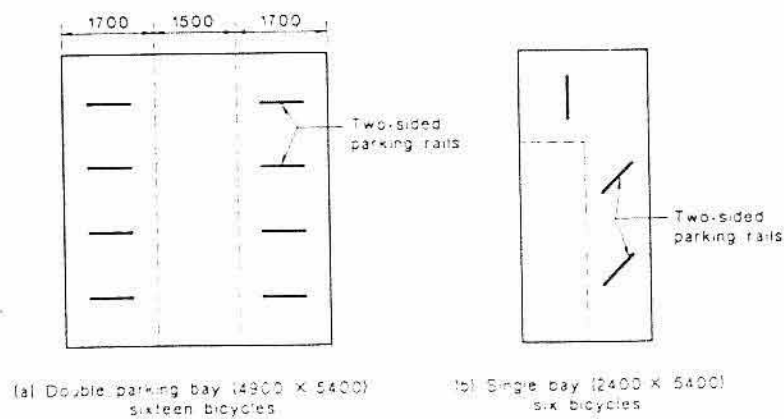
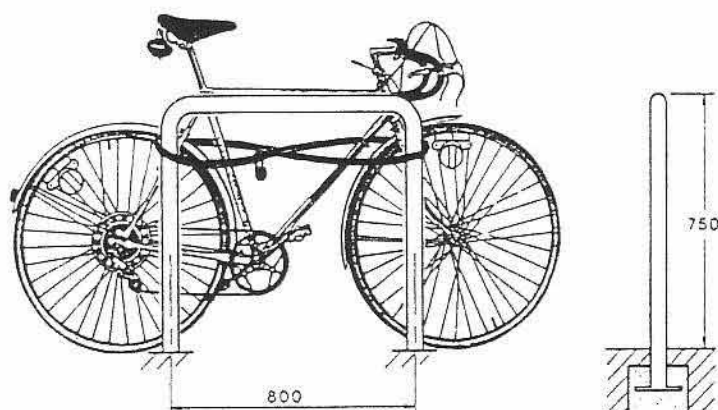


FIGURE B2 TYPICAL CLASS 2 PARKING FACILITIES

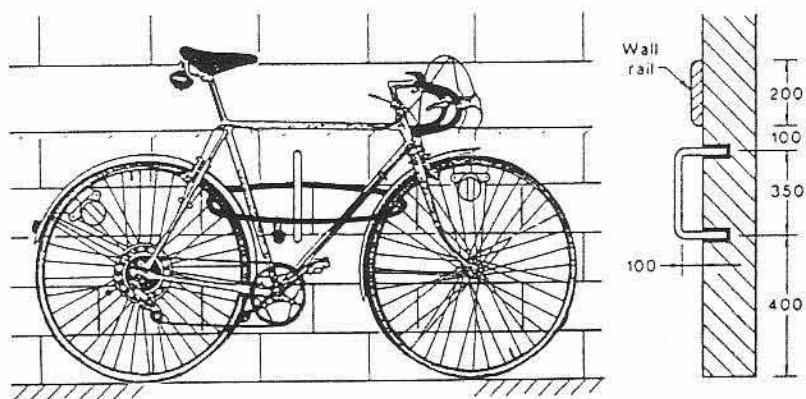


- NOTES
- 1 A perimeter barrier should be provided to protect bicycles from damage by moving cars.
 - 2 Signposting or physical devices may be required to discourage or prevent access to the area by motor cycles.

FIGURE B4 CAR SPACE CONVERSION FOR BICYCLE PARKING



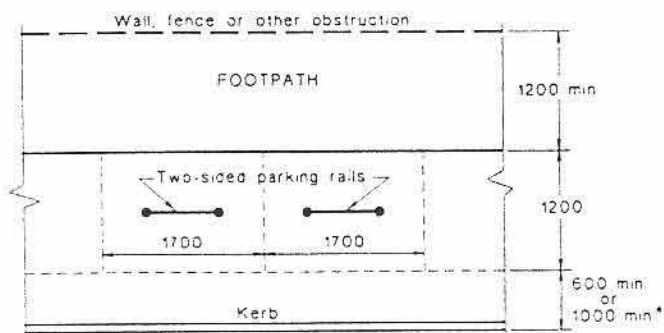
(a) Floor rail — frame and both wheels secured by single chain in figure-of-eight pattern



(b) Wall-mounted bracket and rail — frame and both wheels secured by single chain

DIMENSIONS IN MILLIMETRES

FIGURE B3 TYPICAL CLASS 3 PARKING FACILITIES



*See Clause 2.5.3

DIMENSIONS IN MILLIMETRES

4.9 Landscape Guidelines

Applicants are requested to provide a landscaping scheme with each proposal. The landscape principles outlined below will assist in reducing the visual impact of large hard paved areas and improve the visual quality and amenity of the surrounding precinct. A well landscaped carpark should improve shade potential, integrate the development into the surrounding area and enhance the visual environment through the added colour and texture of shrubs and trees.

- The planting layout and carpark design should be functional as well as aesthetic:
 - planting must not hinder visibility of both drivers and pedestrians;
 - clear sightlines must be maintained between the carpark, public roads and paths;
 - visibility across the site should allow surveillance of the carpark from street level;

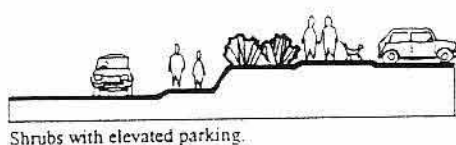
Recommended plant heights are 0.6m above ground and above 2.0m in areas where small children are anticipated (eg, residential and retail), and up to 1.0m from the ground and above 2.0m in areas where they are not (eg, industrial sites).

- Conflict between services and planting should be avoided by ensuring that:
 - trees greater than 7m tall are placed at least 8m away from high lighting posts to maintain security;
 - trees are not planted within 2.0m of services and 1.0m from footpaths and kerbs;
- The layout of a carpark should maximise shade cast by trees. Diagrams overpage demonstrate options of carpark aisle and planter bed orientation to achieve this.
- Planting should be carried out on the perimeter and internal to the parking area. Perimeter planting should be designed to minimise the visual impact of the parking area and co-ordinate with the streetscape planting. Internal planting should improve the pedestrian amenity of the parking area and provide shade for vehicles.
- When selecting plants:
 - reference should be made to the **South Sydney Street Tree Masterplan** when selecting trees suitable along the street frontage;
 - Council recommended trees for carpark areas are listed overpage;
 - **Tree Preservation Orders** apply within South Sydney. All existing and proposed trees are to be identified in the carpark design;
 - plants should be of vigorous growth, longevity and have minimum long term maintenance requirements;
 - plants should not be prone to drop fruit, branches, sap or bark. Plants having berries or thorns should be used selectively on the periphery of carparks only;
 - trees should preferably have a long stem and ample shade protection. They should be selected from mature nursery stock to ensure a higher chance of establishment.
- Drainage issues should be addressed as follows:
 - direct downpipe and surface water runoff into planter beds should be avoided;
 - sumps should be placed at soil level and kept clear of all foreign debris;
 - weep holes in concrete kerbs around planter beds are needed to allow drainage;
 - all irrigation equipment and their installation including pressure reducing devices must comply with Australian Standards and be approved by the Water Board and Council's Public Works and Services Department.

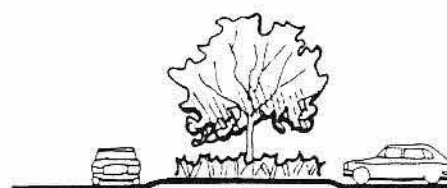
- Design and construction issues to be addressed are that:
 - all planter beds should be mulched except where slopes exceed 1:3;
 - small and awkward shaped grass areas which require mowing and long term maintenance should be avoided;
 - gravel surfaces on slopes adjacent to building entrances should be avoided also;
 - temporary fencing to protect young plants should be provided;
 - appropriate vehicle barriers, bollards, timber edging or kerbs are needed to define parking aisles and prevent cars overhanging planting areas if not wanted;
 - planter beds need to allow plants adequate aeration and water to their root zones.

Recommended Tree Species For Car Parks

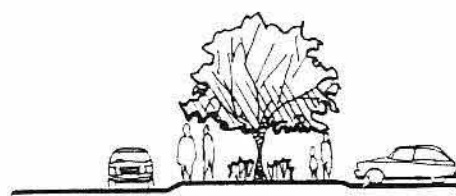
Botanical Name	Common Name	Botanical Name	Common Name
<i>Acer negundo</i>	Box Elder Maple	<i>Flindersia australis</i>	Crow's Ash
<i>Acmena smithii</i>	Lilly Pilly	<i>Fraxinus griffithii</i>	Evergreen Ash
<i>Allocasuarina torulosa</i>	Forest Oak	<i>Fraxinus oxycarpa</i> 'Raywoodii'	Claret Ash
<i>Casuarina glauca</i>	Swamp Oak	<i>Fraxinus pennsylvanica</i>	Green Ash
<i>Casuarina littoralis</i>	Black She Oak	<i>Gleditsia triacanthos inermis</i>	Honey Locust
<i>Casuarina stricta</i>	Dropping She Oak	<i>Jacaranda mimosifolia</i>	Jacaranda
<i>Celtis australis</i>	Chinese Hackberry	<i>Koelreutaria paniculata</i>	Golden Rain tree
<i>Cupaniopsis anacardioides</i>	Tuckeroo	<i>Lophostemon confertus</i>	Brushbox
<i>Eucalyptus botryoides</i>	Bangalay	<i>Magnolia grandiflora</i>	Southern magnolia
<i>Eucalyptus citriodora</i>	Lemon scented gum	<i>Melaleuca quinquenervia</i>	Broad leaf paperbark
<i>Eucalyptus ficifolia</i>	Scarlet Flowering gum	<i>Pistacia chinensis</i>	Pistacia
<i>Eucalyptus gummifera</i>	Red bloodwood	<i>Platanus x hybrida</i>	London Plane
<i>Eucalyptus haemastoma</i>	Scribbly gum	<i>Robinia pseudoacacia</i> 'Frisia'	Golden Robinia
<i>Eucalyptus leucoxylon</i> var. <i>macrocarpa</i> 'Pink'	Pink flowering yellow gum	<i>Sapium sebiferum</i>	Chinese Tallow tree
<i>Eucalyptus maculata</i>	Spotted gum	<i>Schinus areira</i>	Peppercorn
<i>Eucalyptus microcorys</i>	Tallow wood	<i>Syncarpia glomulifera</i>	Turpentine
<i>Eucalyptus scoparia</i>	Wallangarra Whitgum	<i>Ulmus parvifolia</i>	Chinese Elm
<i>Eucalyptus tereticornis</i>	Forest Red gum		



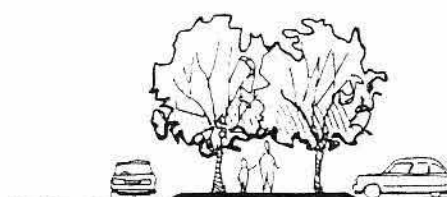
Shrubs with elevated parking.



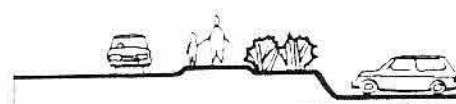
Tree and shrub screen planting with no pedestrian access.



Tree and shrub screen planting with sidewalks



Tree screen with centre walk

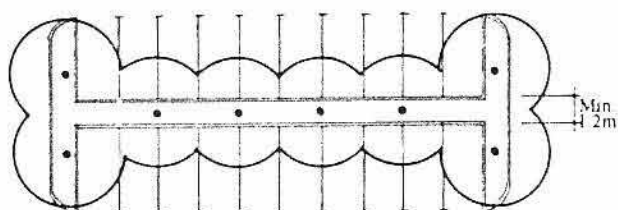


Shrubs with sunken parking

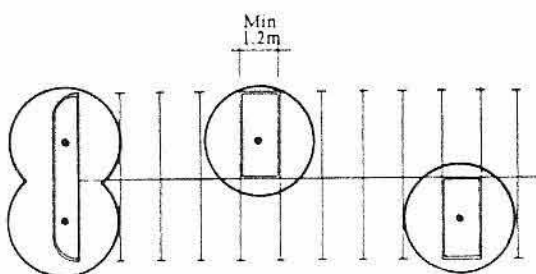


Berm screen and groundcover planting

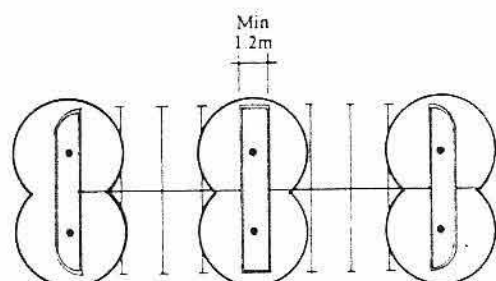
Screen Planting



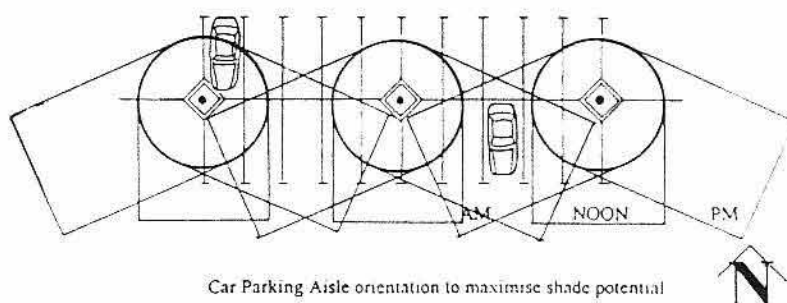
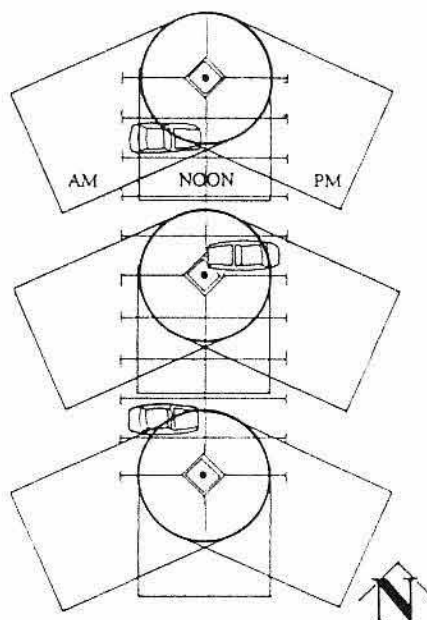
Centre Planting



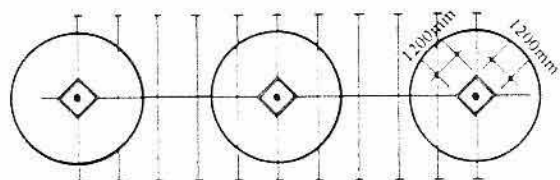
Single bay planter beds - Informal layout



Two bay planter beds - formal layout

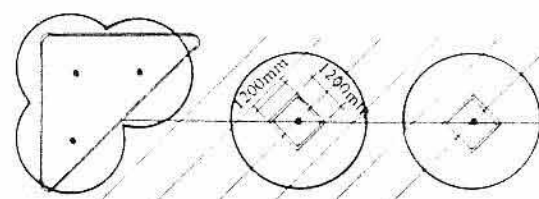
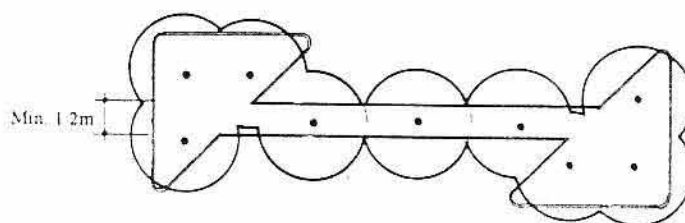


Car Parking Aisle orientation to maximise shade potential



Minimum loss of space with diagonal planter beds at regular spacing

90 Parking Bays



Angled Parking