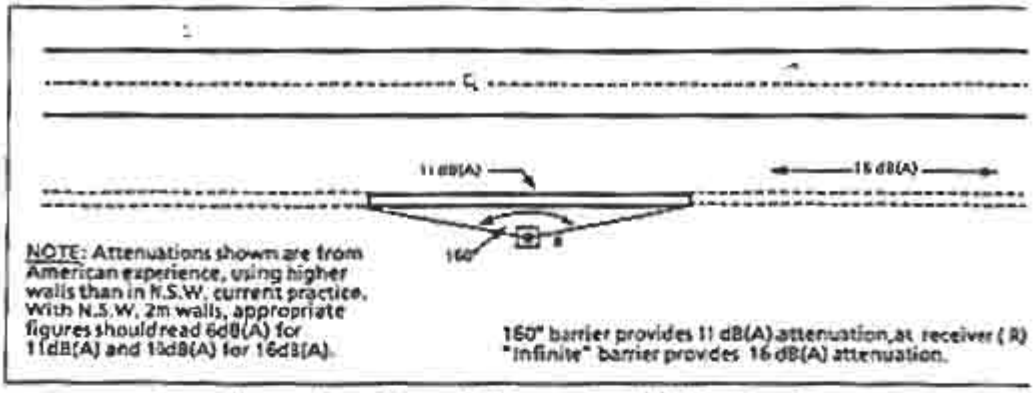
APPENDIX D

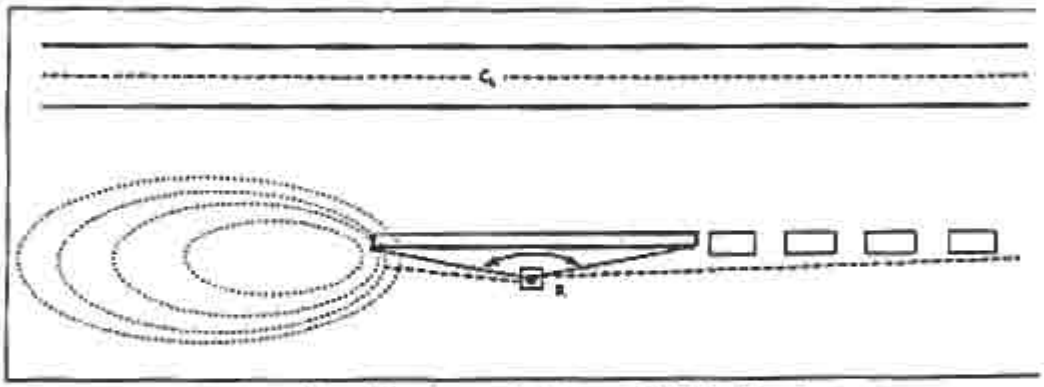
EXTRACT FROM

ROAD TRAFFIC NOISE

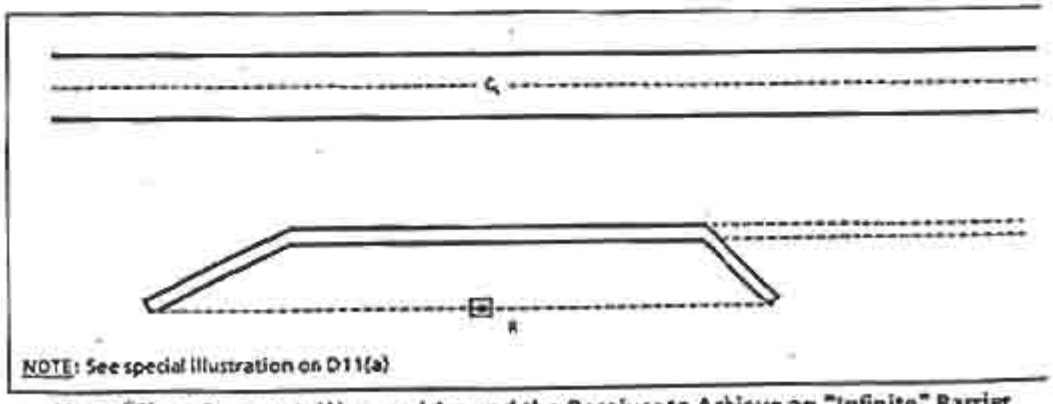
PUBLICATION



Illusttration of Loss of Attenuation with Short Barriers

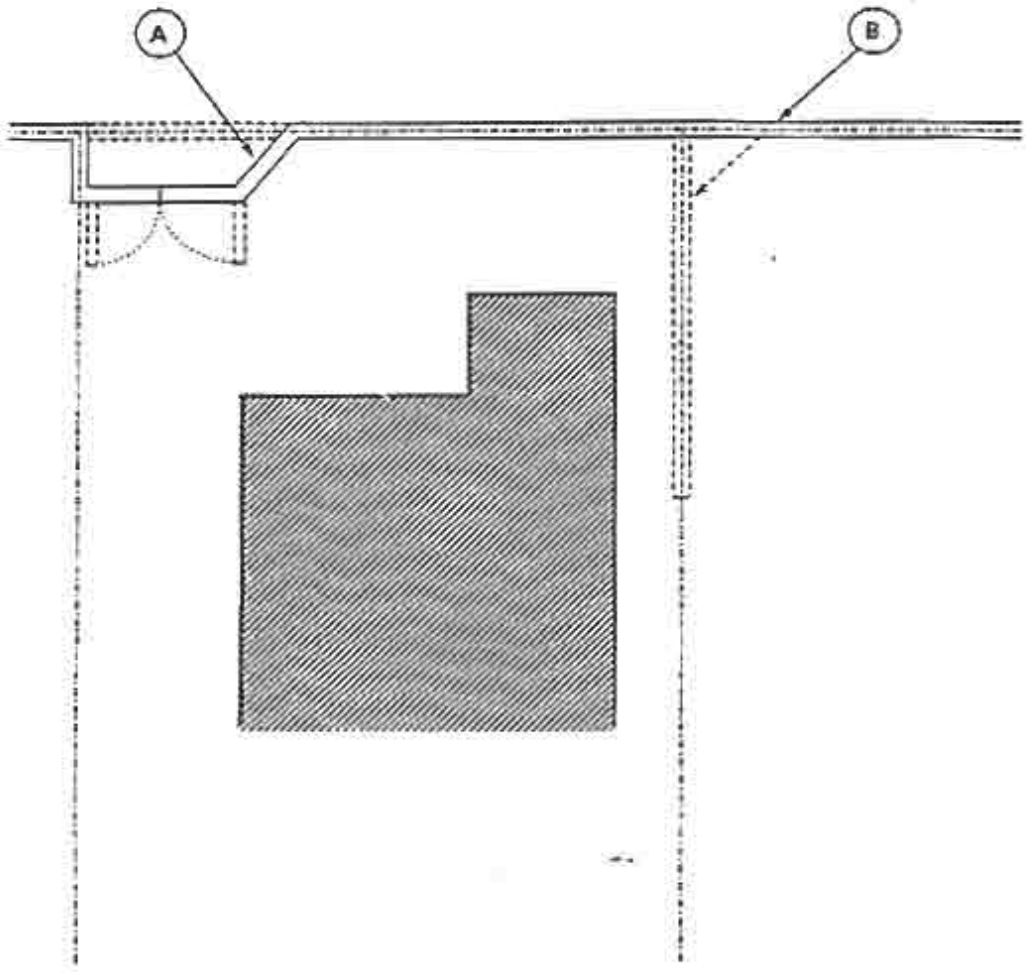


Use of Local Features to Achieve an "Infinite" Barrier



Use of Short Segments Wrapped Around the Receiver to Achieve an "Infinite" Barrier

FIGURE D11

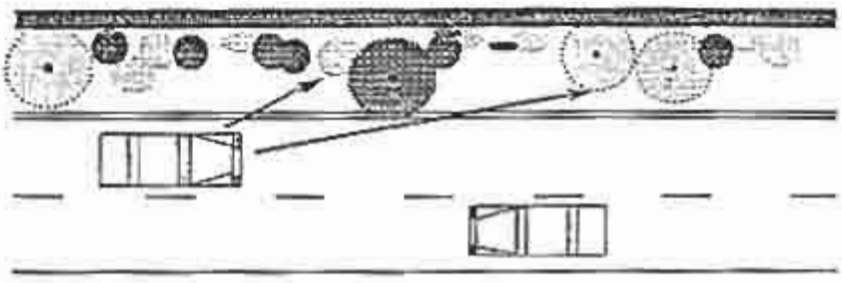


A- A cut-off can give a 'wrap around' effect and improve the effectiveness of a front boundary fence as a noise barrier. Gate should be solid, and similar height as front fence.

B- Where possible, a front fence should be continuous. Alternatively, front wall should return along side fenceline. Consideration should be given to the choices available to adjoining property owners for greatest effectiveness in noise reduction.

UPGRADING OF EXISTING URBAN ROADS

FIGURE D11(a)

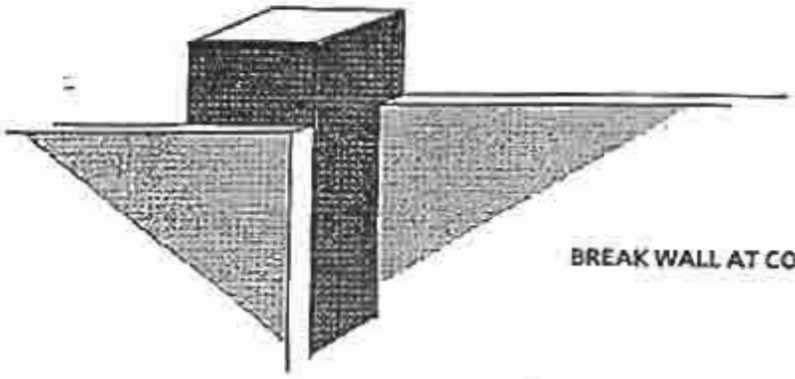


CREATING A VARIETY OF SPACES

LINKING DIFFERENT SIZE WALLS

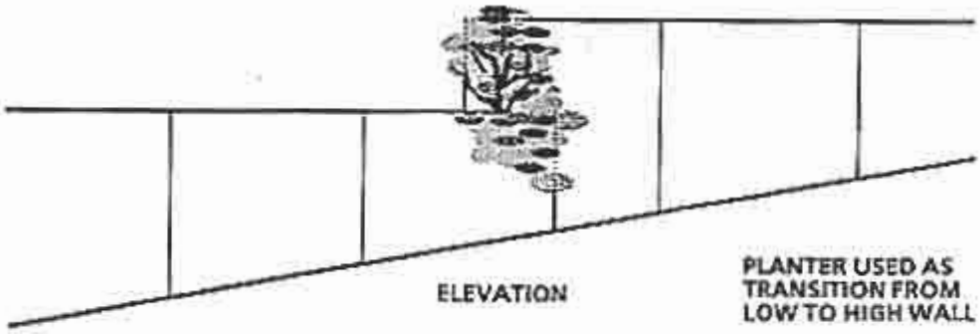
VARYING THE VISUAL FORM

FIGURE D12



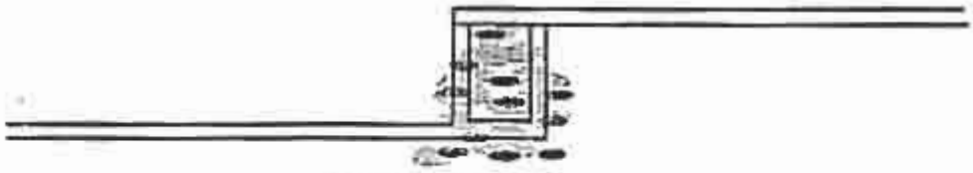
BREAK WALL AT COLUMNS

Direction of Traffic ⟶



ELEVATION

PLANTER USED AS TRANSITION FROM LOW TO HIGH WALL

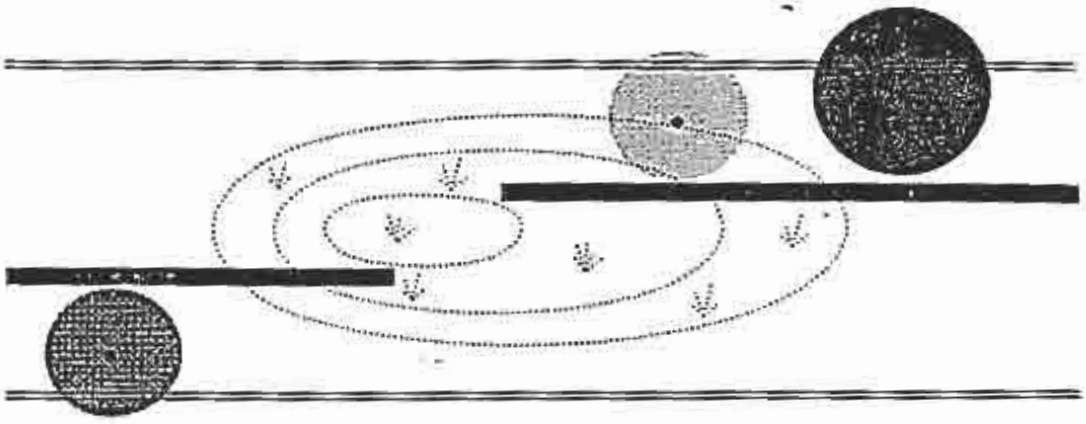


Direction of Traffic ⟶

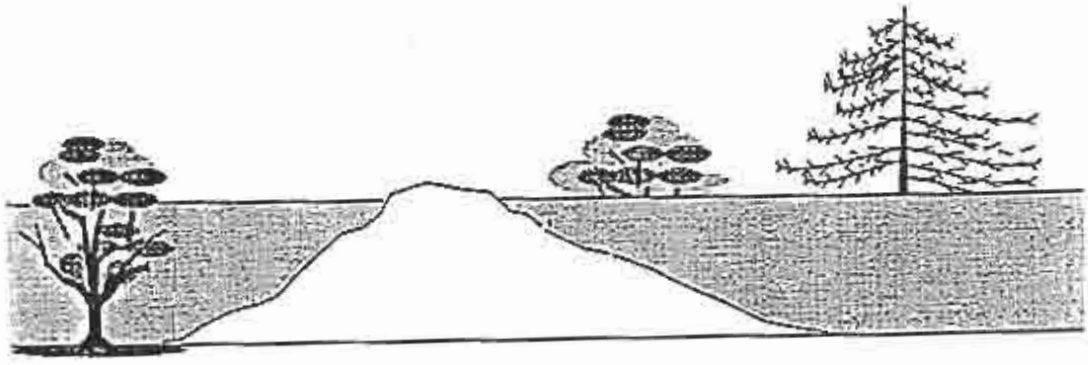
PLAN

CONNECTING DIFFERENT HEIGHT WALLS TO VARY VISUAL FORM

FIGURE D13



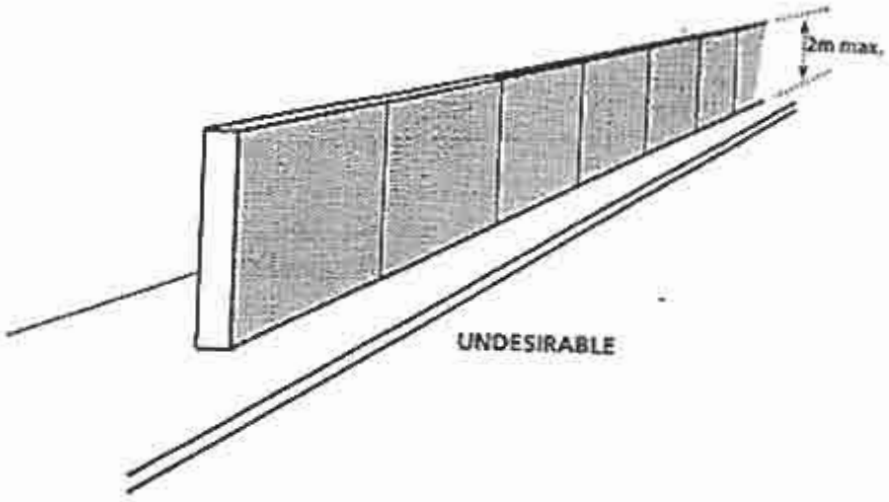
PLAN

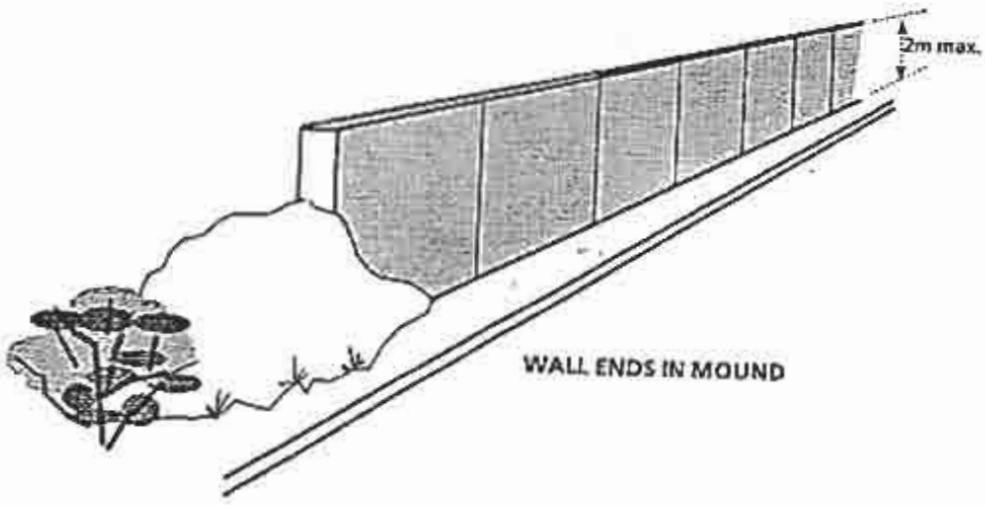


SECTION

USE OF MOUND TO CONNECT WALLS AND ADD VARIETY

FIGURE D14

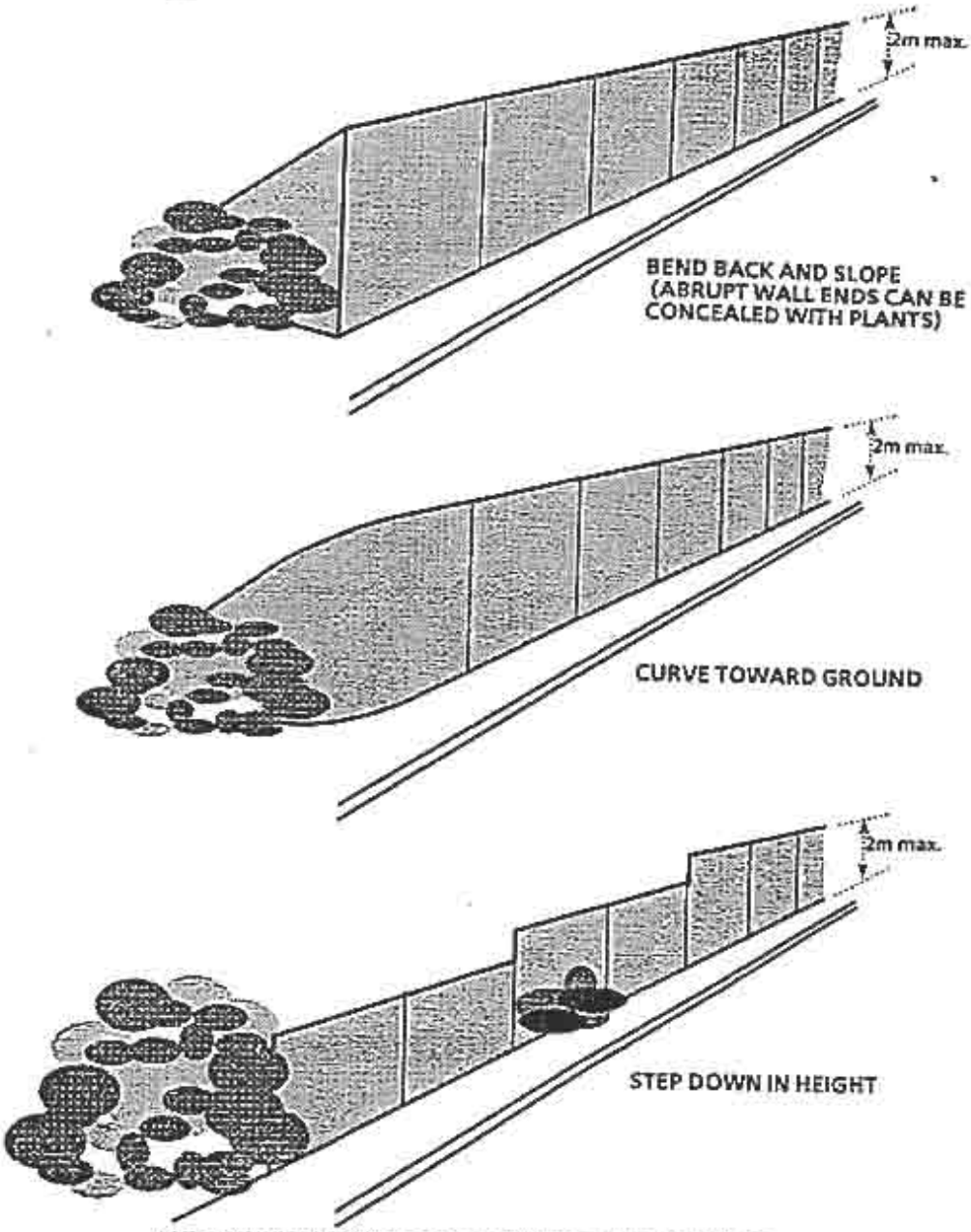




USE OF EARTH MOUND TO TERMINATE WALL

NOTE: Diagrams shown are from American experience, where walls in excess of 2m height (current general max. in N.S.W.) are used.

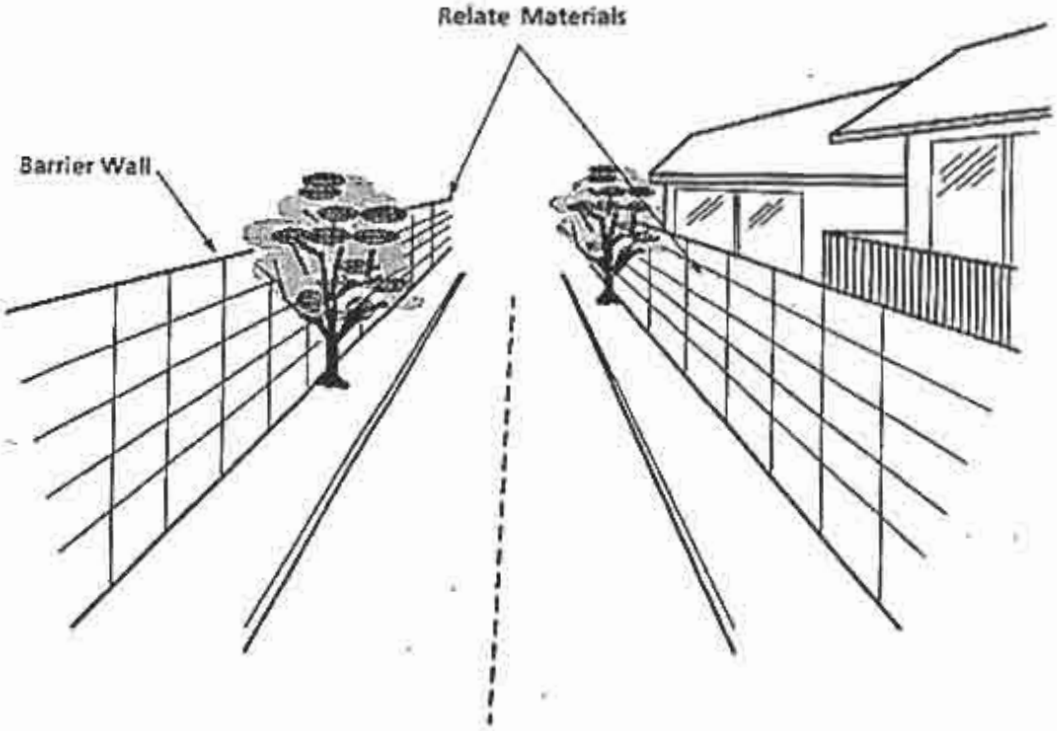
FIGURE D15



ALTERNATIVE MEANS OF TERMINATING BARRIER WALLS

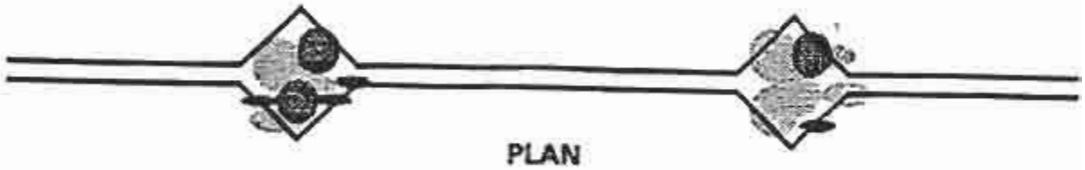
NOTE: Diagrams shown are from American experience, where walls in excess of 2m height (current general max. in N.S.W.) are used.

FIGURE D16

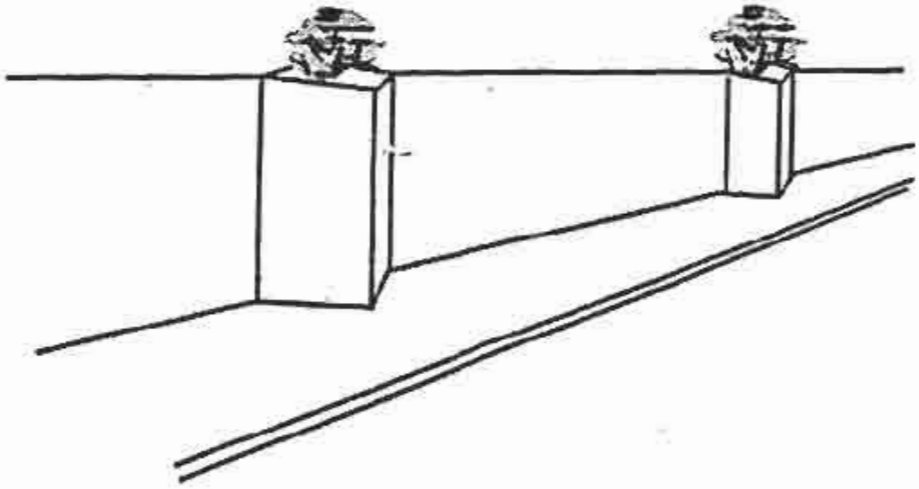


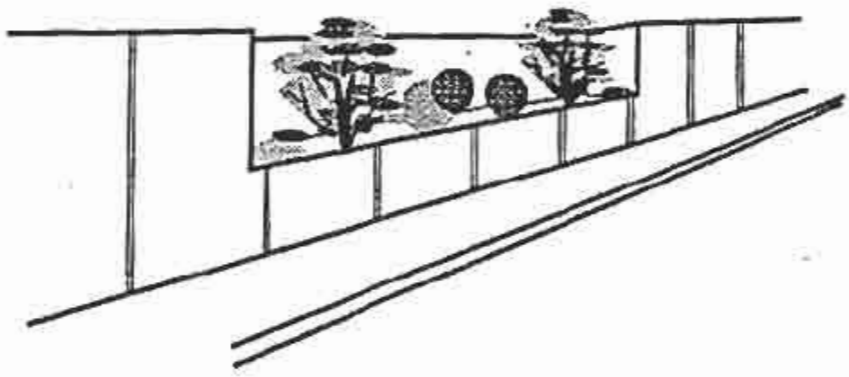
RELATING BARRIER DESIGN TO ARCHITECTURAL ELEMENTS IN THE COMMUNITY

FIGURE D17



PLAN

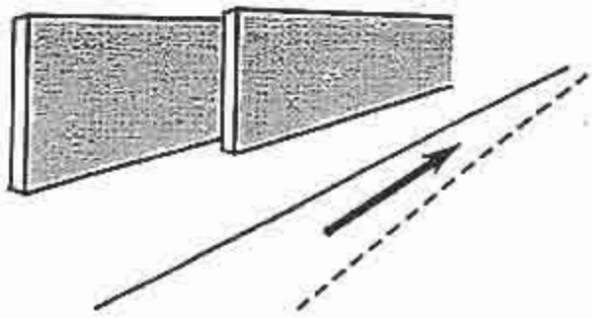




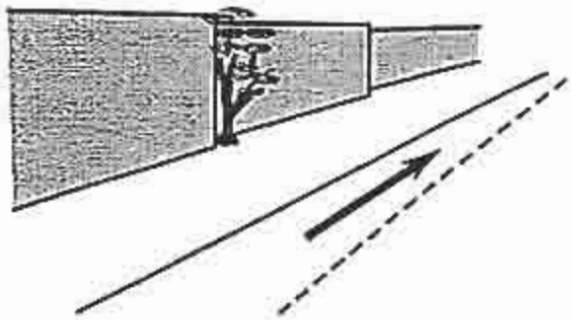
USE OF LANDSCAPING TO IMPROVE BARRIER APPEARANCE

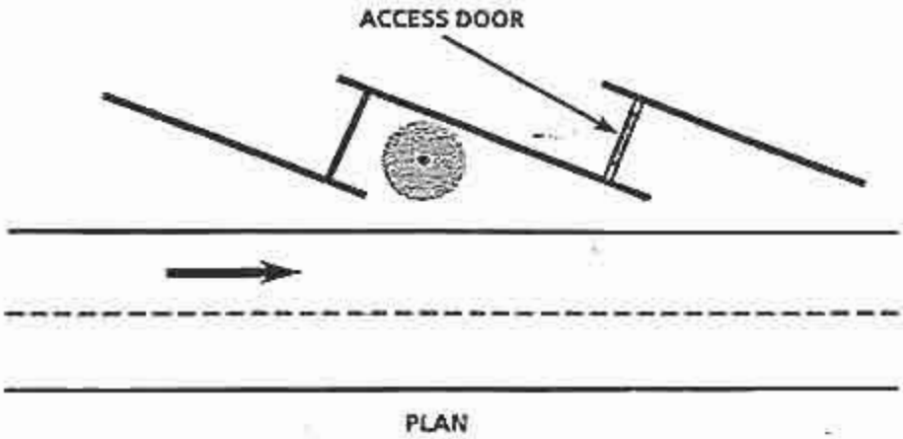
FIGURE D18

AVOID END WALLS EXPOSED TO FLOW OF TRAFFIC



DESIRABLE WALL SETBACK





PLAN

PROVIDING ACCESS FOR BARRIER MAINTENANCE

FIGURE D19

APPENDIX E

EXTRACT FROM

THE AUSTRALIAN MODEL CODE

FOR RESIDENTIAL DEVELOPMENT (1990)

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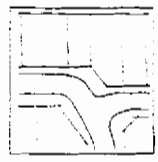
AUSTRALIAN
MODEL CODE

FOR RESIDENTIAL DEVELOPMENT

PREPARED BY THE MODEL CODE TASK FORCE
OF THE
GREEN STREET JOINT VENTURE

EDITION 2 - NOVEMBER, 1990

B1 LOT SIZE AND ORIENTATION



CONTEXT

AN ELEMENT CONCERNING THE SIZE OF LOTS FOR LAND SUBDIVISION AND THE ORIENTATION OF LOTS FOR MICROCLIMATE MANAGEMENT, VIEWS AND SLOPE.

BACKGROUND AND DISCUSSION

Throughout Australia there is considerable variation in controls which determine the size and orientation of lots.

Related to the size of allotments is the broad issue of density. Generally, Australian practice is that density control is achieved through formal statutory planning instruments, and therefore, at this stage in the development of the Model Code, density is not incorporated as an element of residential development control.

Approaches to lot size in the past have been conservative as reflected in adopted "standard lot" minima ranging from around 500 square metres to 800 square metres. More recently States such as New South Wales and South Australia have established guidelines setting 450 square metres as the minimum lot size for detached houses. Victoria has established a guideline extending this down to 300 square metres.

There is now an increasing number of municipalities encouraging a diversity of lot sizes by allowing lots of 400 to 450 square metres for detached houses. The work of the Joint Venture has involved, as part of its Demonstration Estate Program, the documentation of a range of examples in the States and Territories where less traditional approaches to lot size have produced some innovative results.

These include projects at Mt Colah in Sydney, Broadwater in Perth, Golden Grove in Adelaide, and Vermont in Melbourne.

Regulations governing the orientation of lots are not widely applied, although an increasing awareness of the importance of energy conservation has meant at least a general acknowledgement of the need to consider lot orientation as a residential design element.

In hot, humid climates, microclimate management is mainly concerned with gaining access to cooling breezes and protection against the heat of the sun.

The size of lots

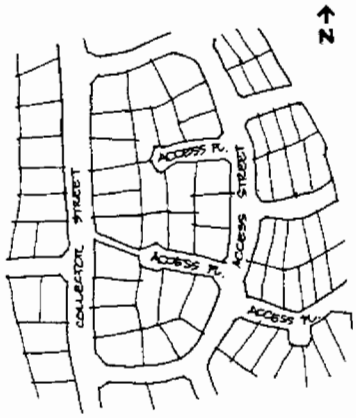
The question of whether there should be controls over the size of lots, or what those controls should be, has been debated at considerable length over the years. Local councils, in particular, have resisted changes to lot size controls due to, among other things, perceptions that the size of lots is directly related to the quality of a residential environment, or due to fear that allowing smaller lots would somehow downgrade the status of a locality because "less desirable" people would buy such properties.

In the Background Material Report prepared as a prelude to Edition 1 of the Model Code, it is noted that a lot size control element is largely redundant to other controls and that it circumscribes a variety of design opportunities and more affordable types of dwelling (Scott & Furphy et.al., 1987). The Task Force supported this finding but decided that lot size should be included in the Model Code to satisfy the widespread preference for such a control, and to create the opportunity for a range in lot sizes.

This is not to say the element has no practical value. The element usefully provides emphasis to the Joint Venture's encouragement, (stated at Chapter 6 of the Guidelines for Cost-Effective Residential Development), for the integration of the processes of land development and house construction, where smaller lots are of a size that requires a more thoughtful approach to house siting and design. (JVMAH, 1986). In this Code this is defined as *Integrated Development.*

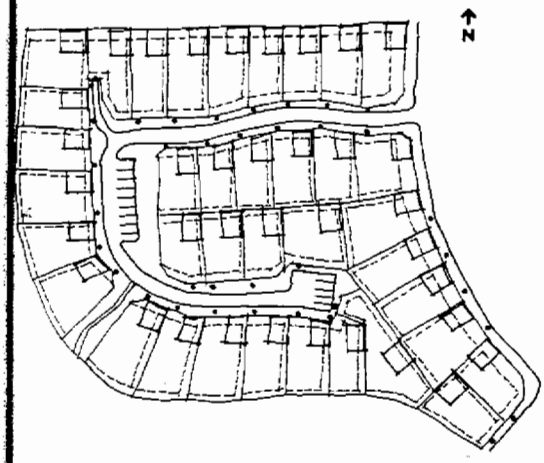
It is considered that the greatest opportunities for cost-effectiveness and innovation arise where land subdivision and housing layout are conceived and executed together. Integrated development involves some additional design at the subdivision stage, and as outlined in the Research Study into Design & Siting Requirements for Small Allotments (Loder & Bayly, 1990) such design is important because it contributes to predictability, acceptability and greater confidence in the building product.

DIVERSITY OF ALLOTMENTS



A.C.T. example of 'standard' allotments (650 square metres min.) and 'courtyard house' allotments (360 square metres to 465 square metres)

ENVELOPE CONTROLS



Building envelope *Mandatory open space*

- *Location of driveways*

Maximum height of 2 storeys

Queensland example of integrated development by envelope controls at subdivision - Moreton Shire

LOT SIZE AND ORIENTATION | **ELEMENT B1**

ELEMENT OBJECTIVE

O1. Lots to have area and dimensions to meet user requirements and to be orientated to enable, where practicable, microclimate management, including the application of energy conservation principles.

PERFORMANCE CRITERIA

P1. Lot sizes to meet the projected requirements of people with different housing needs.

P2. Lots to have the appropriate area and dimensions to enable the siting and construction of a dwelling and ancillary outbuildings, the provision of private outdoor space, convenient vehicle access and parking, and to permit solar access, access to cooling breezes and any other relevant siting and design requirements of the Model Code to be met.

DEEMED-TO-COMPLY CRITERIA

The following are deemed to meet the control element objectives and performance criteria:

Lot Size

D1. Lots with an area greater than 450 square metres capable of containing a rectangle suitable for building purposes measuring 10 metres by 15 metres.

D2. Lots with an area of between 300 square metres and 450 square metres, capable of containing a rectangle measuring 10 metres by 15 metres*, and where a plan has been approved showing a building envelope which conforms to the performance criteria of element B2 – Building siting, and the deemed-to-comply requirements of control elements B3 – Private open space, and B4 – Vehicle parking.

D3. Lots with an area of between 300 square metres and 450 square metres where a plan has been approved designating the long axis of the lot in an approximately north-south direction and describing building envelopes to ensure that dwellings will be semi-detached.

D4. Lots less than 300 square metres in area forming part of an approved *Integrated Development.*

** Where a boundary wall position is nominated the rectangle shall be 9 metres by 15 metres*

Additional design at the subdivision stage means that appropriate attention will be given to architectural design, parking, driveway locations, fencing and landscaping.

There is also a technical side to having a control element related to lot size. In the absence of information as to how the site will be used, it can be applied to ensure space is provided for the normal requirements of the future allotment user. These are thought to be much the same as those set out in the NSW Technical Bulletin No.15 (Department of Environment and Planning, 1982) and include space for a dwelling and outbuildings, private outdoor recreational space, garden areas, utility areas for clothes drying and storage, and on-site car parking.

The importance of a control element for lot size may also be related to important goals of cost-effectiveness and ensuring wider housing choices. The requirements applied in the A.C.T. over the past 30 years express this well.

"The subdivision of land for residential dwellings is to provide a range of block sizes to satisfy the different demands for land and to ensure that the particular characteristics of the topography are used to advantage" (NCDC, 1988).

There is a range of demands for space, bearing in mind the varying requirements of households of differing socio-economic characteristics, age, culture and stage of family life cycles.

As predicted by the work of the Joint Venture, in the 1990s the "traditional two child nuclear family" will represent less than 30 percent of Australian households. Households are getting smaller and more varied, and lifestyles are changing with more and more time spent in leisure outside the home. Not everyone wants a big garden or to pay for a large lot, and it is realistic and appropriate for residential development regulations to help improve the opportunity for people to have wider choices in housing, as can be achieved by the provision of smaller lots. Such changes are not restricted to metropolitan areas. The smaller lot provides a valid alternative housing choice in country township areas.

In the Research Study, Siting Related Issues of Residential Development (GH&D et. al., 1989), undertaken as an important input to the Model Code, it is revealed that the innovation of reducing the lot area has generally been well received by residents of houses on smaller lots. The study found the size of a lot appeared to have "little bearing on residents level of overall satisfaction".

Reference was made, however, especially for the smallest lots, to inadequate space for storage. This when examined more closely related not so much to the size of the lot, but rather to the need to give careful attention to the layout of buildings and creation of outdoor spaces.

The State Governments of New South Wales, Tasmania and Victoria have accepted a minimum as of right lot size for detached housing of 450 square metres as generally applicable to residential areas. This minimum size is seen as being adequate in the majority of circumstances.

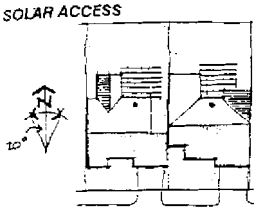
Designing for smaller lot sizes should, where relevant, take into account factors including:

- The slope and orientation of land, and the existence of any potential foundation difficulties such as rock outcrops, or highly reactive clays;
- Costs of providing services and the capacity of existing services;
- The desirability of retaining special qualities or features such as trees and views;
- The advantages of building to a boundary and using attached and semi-detached forms of housing;
- The expectation that over-development of the site will be avoided;
- The need to avoid undue repetition of, say, small narrow lots except as part of a designed urban streetscape;
- Design considerations relating to architectural style and interest of proposed buildings, provision of undercover parking, fencing and landscaping; and
- The possible need for the retention of existing subdivision character.

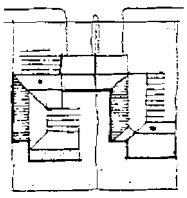
Broader issues, relating to factors such as landslip, the possibility of flooding, location in a bush fire prone zone, and so on, would more appropriately be addressed as part of town planning scheme requirements, where authorities could vary planning provisions in a more comprehensive way, and according to the demonstrated special needs of a locality.

Battle-axe blocks which provide for detached houses at the end of a private or shared driveway have been used to advantage in Canberra and Sydney as a cost-effective subdivision feature which generally takes particular advantage of an open space, topographic or street design feature, or a combination of these.

SOLAR ACCESS



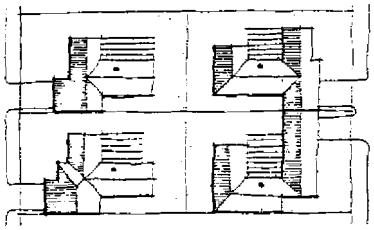
To make best use of solar access reduce frontage set-back for north side lots on E— W streets



On the south side of the street, buildings could be set well back to allow N-facing rooms to look on to larger front yards

• N — facing living rooms gardens or courts on sunny side

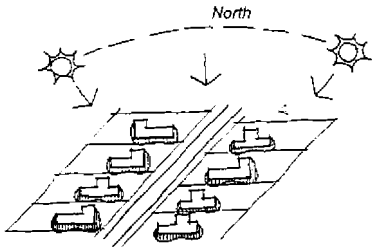
(b) East - west streets



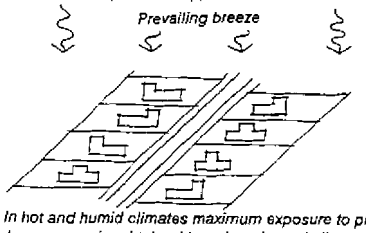
(b) North - south streets

On N — S streets lot frontages need to allow for private open space on the N — side and houses could be built on the S — boundary provided shadowing of adjoining living room windows does not occur

SKEWED ALLOTMENTS



(a) Skewed lots improve the opportunities for solar access



(b) In hot and humid climates maximum exposure to prevailing breezes can be obtained by using skewed allotments. Privacy is also enhanced

Deemed-to-comply criteria cont'd

Orientation for Temperate Climates

D5. The majority of lots in new residential areas having a size and orientation so that dwellings can be built on them in which the living room will receive not less than 4 hours of sunshine between 9 am and 3 pm during midwinter.

D6. Any new lot in an established residential area having during midwinter not more than one third of its area covered by shadow of existing development and where any development on such new allotment in turn will not cast a shadow covering more than one third of the area of an existing allotment at midwinter.

Orientation for Hot Humid Climates

D7. The majority of lots in new residential areas with orientation so that dwellings can be built on them to take advantage of cooling breezes.

Whilst consideration of the area of a lot is warranted, the setting of minimum lot frontage dimensions may also be required, if only to ensure that sufficient width is available at the front boundary for access and services. Allotment dimensions are also controlled by the specification of a minimum rectangle to be contained within the lot, and indirectly through compliance with other elements such as building siting, the provision of private open space and vehicle parking.

Orientation and Micro-climate Management

The ability to utilise the sun, shade and cooling breezes to ensure a level of comfort in the dwelling which will be built on a site is relevant in all climates or both lot creation and building siting and design. In temperate climates there are two further objectives:

- to facilitate energy conservation; and
- to enable energy generation through solar collectors wherever this is required.

Room comfort can be achieved through the ability for householders to manage solar access and breezes within their dwelling. In temperate climates this means that the sun should be able to penetrate the dwelling in winter, while in hot climates it should be able to be excluded and the dwelling should be able to catch the prevailing breezes.

The objective of energy conservation can be expressed as the ability to heat/cool the dwelling with minimum use of energy. The important criteria which apply to achieving comfort also apply here, but there are some additional requirements. Energy conservation is discussed under Element B2.

The objective of energy generation can be expressed as the ability to utilise the sun for generating heat (or electricity) at the dwelling e.g. using solar collectors. Solar energy collectors for generating heat (or generating electricity which may then be used for cooling) are of benefit in all climates. However, as these collectors are usually on the roof the sunlight exposure for energy conservation is readily satisfied.

In developing guidelines for the control of residential development through a Model Code with Australia-wide application, attention must be given to three criteria: universality, essentiality and simplicity. Clearly, the different climatic and topographic conditions require different guidelines, but the principle of comfort applies universally. The issue is to determine under what conditions regulation is essential and how it can be expressed in a form which can be easily understood and administered.

It is not essential for comfort that the dwelling be exposed to the sun at all times of the day (in contrast to the objective of energy conservation where a long exposure is important). It must also be recognised that there are locations where it is difficult to obtain solar access, but where people are prepared to forego this need because of exceptional location or views. There will also be situations where development economics make it difficult to satisfy a universally applied requirement for solar access. Finally, a distinction must be made between new residential areas and lot creation in infill areas.

Solar access for comfort in the dwelling is important in all climates, but the way it is controlled varies with the type of climate. Solar access is not the only factor in micro-climate control; in hot, humid climates, for instance, comfort also can correlate to local wind patterns. In all climates, however, the ability to manage solar access and breezes is strongly correlated with the orientation of the dwelling and the location of the living areas, which, in turn, are influenced by the lot size and orientation.

The main emphasis in this element of the Model Code is upon achieving passive response to solar access by ensuring that an allotment will be of sufficient size and will be orientated so that a house can be built with the main living room being able to receive sunlight. This is generally achieved where windows to living areas of dwellings have an orientation within an angle of 20 degrees east and west from the north.

Lots with an area in excess of 450 square metres and capable of containing a 10 metre by 15 metre rectangle suitable for building purposes, are normally large enough for such an orientation to be achieved without special requirements in respect of lot dimensions and orientation.

This is not necessarily the case on smaller allotments, especially those with narrow frontages. Narrow frontages are more cost-effective than wider frontages, but an east-west orientation may, depending on the latitude and slope of the land, cause the northern facade of the dwelling to be in shadow, while lots with attached housing would only receive the morning and afternoon sun. These are reasons for a preference for lots with an area of less than 450 square metres to have a north-south orientation so that the living space can face north. Lots with an area of less than 450 square metres which have a frontage to streets running in an east-west direction (defined as a segment within an angle of 20 degrees north and an angle of 20 degrees south from the eastern or western direction) are considered capable

of accommodating dwellings with the required north orientation.

However, lots with an area of less than 450 square metres and/or a frontage to streets running in other directions cannot automatically be assumed to provide reasonable exposure unless dwellings are suitably designed and sited for a northerly aspect. As the slope of the land across the allotment increases away from the northern aspect, an increased width of allotment may be required at the points where solar access is required.

Solar access is governed not only by orientation and slope, but also by latitude and the shadow cast from buildings and walls along the northern boundary. In Hobart, for instance, which has a latitude of 45 degrees, a 3 metre high building casts a shadow of 12.3 metres on a slope of 16 per cent or 9 degrees facing south. Steep sites facing south may never get the sun, except in summer. On lots with less than 450 square metres, facing south, it would be very difficult to ensure solar access in midwinter.

The identification of areas where subdivision may need to be restricted, because of problems with solar access, is a matter which must be part of a local planning scheme. Similarly, there may be areas where subdivision could occur, but two-storey developments should not be permitted. While these matters are not addressed in the Model Code, studies undertaken show the need for care in the development of south facing residential land for small lots and two-storey development, even at latitudes of 35 degrees.

With integrated development, where the streets, lot sizes and their orientation, and the siting of buildings can be planned with care, it may be possible to develop difficult sites and ensure that adequate sunlight can penetrate the windows facing north.

Lot size and orientation also influence the ability to site and design a dwelling which takes account of solar access management for comfort in hot and humid climates. Important considerations are the protection of northern, eastern and western sides of the dwelling by eaves, an appropriate orientation, and appropriate windows to catch breezes. Protection from eastern and western sun can be achieved on narrower lots with frontages to streets running east-west, where buildings are built to the boundary. Lots with a frontage of 15 metres may contain a detached dwelling with its axis along the length of the lot.

To minimise the exposure to eastern and western sun, the shortest sides of the dwelling should face east and west, and streets should be in a north-south direction. Lots with a wider frontage, however, permit the dwelling to be sited with its axis in an east-west direction, irrespective of the street direction.

In all areas, the lot shape, size and orientation can be varied to attain particular objectives. Skewed or oblique lots can offer some advantages in special situations. For instance, skewed lots can combine desired orientation with exposure to breezes from the prevailing direction, such as in Darwin. Skewed lots can also reduce the amount of overshadowing by buildings on adjoining allotments and permit the retention of views on sloping land.

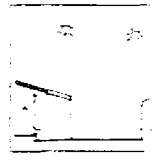
In view of the fact that there may be special situations where a rigid, prescriptive control is inhibiting, the deemed-to-comply criterion for solar access for comfort specifies that, in new residential areas, the majority of allotments should have a size and orientation so that dwellings can be built on them in which the living room will receive not less than 4 hours of sunshine between 9 am and 3 pm during midwinter.

It should be noted that the requirement for energy conservation is set out in Element B2 and that, in areas where such a requirement applies, the majority of dwellings should be capable of receiving not less than 4 hours of sunshine during midwinter. In these areas, the requirements for solar access will be satisfied if the requirements for energy conservation have been met.

While these conditions are appropriate for subdivision control in new residential areas, they are not suitable for infill and dual occupancy situations. A simple and effective technique in such situations is to require that any new allotment will have not less than one third of its area covered by the midwinter sun from the shadow of existing development and that any development on the new allotment will not cast a shadow of more than one third of the area of an existing allotment at midwinter. This technique is a variant of that used successfully in the Development Control Plan for the Manly Residential Zone (Amendment No. 2, 1990).

Other factors which need to be considered in the orientation and layout of lots, relate to privacy, the cost-effectiveness of smaller frontages and the economics of street design and construction.

B2 BUILDING SITING & DESIGN



CONTEXT

AN ELEMENT CONCERNING THE SITING OF BUILDINGS IN RELATION TO SIDE AND REAR LOT BOUNDARIES, THE UTILISATION OF DAYLIGHT AND SUNLIGHT, AND THE ACHIEVEMENT OF DESIGN OBJECTIVES OF PRIVACY AND AMENITY.

BACKGROUND & DISCUSSION

Overview

The research undertaken as a prelude to Edition 1 of the Model Code confirmed privacy and daylighting as important considerations of residential design which were often dealt with in considerable detail in local codes (Scott & Furphy et.al., 1987). From comments received after the preparation of Edition 1 it appears that solar access is also of importance in many areas of Australia, both to habitable rooms and to the roof for solar collectors.

A variety of techniques exist to satisfy these requirements. The simple application of minimum setbacks from property boundaries for the control of building siting is the most common technique used. It is a technique that works well in the case of dwellings on "conventional" allotments.

One of the objectives of the Model Code is to increase choice in housing and, as indicated in Element B1, the opportunity of creating smaller allotments is one of the means available. Dual occupancy (two dwellings on one lot) now widely used in Victoria and New South Wales, is another means of achieving this objective. It is open to question whether simple numerical setbacks are sufficient in these cases. This was examined in a study undertaken for Edition 2 of the Model Code (Loder & Bayly, 1990).

With smaller allotments and dual occupancy, buildings are closer together and, in order to satisfy needs for solar access, daylight, privacy and amenity, the siting and orientation of dwellings in relation to each other, and in relation to the topography and climate, become more important. In hot and humid climates exposure to predominant breezes is a further consideration, unless there is reliance on air-conditioning as the means of creating acceptable living conditions.

While the relationship between buildings is important, effective utilisation of each building site is of equal importance. In addition to providing space for the dwelling, the site should provide adequate private open space (see Element B3), space for on-site parking (see Element B4), on-site and inter-allotment drainage (see Element B12).

Prescriptive standards, based on separation of dwellings and on the prevention of overshadowing, overlooking or overhearing, are often used to satisfy the objectives of sunlight utilisation, privacy and amenity. A number of variables are usually considered including, setback from side boundaries, building height, location of boundary walls and fences, and setback from the front boundary (which is discussed in Element B5). These variables do not apply equally to all parts of the building and the site. For instance, exposure to sunlight is important for the windows in the living room and for some part of the private open space, while noise protection theoretically could be applied to all windows in the dwelling.

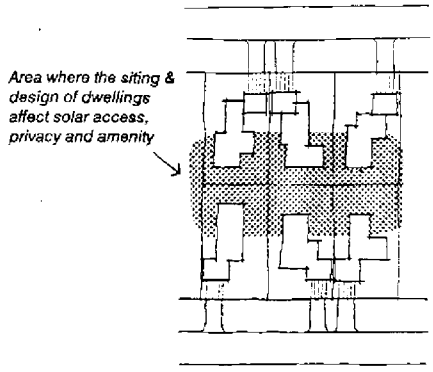
Buildings and walls of buildings abutting, or near to, side and rear boundaries can be sensitive issues for neighbours. High walls which are close to neighbouring properties, as well as long walls, tend to draw a response that there will be loss of amenity through overshadowing, overhearing and overlooking. With correct design this may not be the case.

Building to the boundary (referred to in American literature as "zero lot line") is a technique which is particularly useful for smaller lots and is regularly used to improve the efficient usage of a lot, especially in Canberra and Adelaide. It enables a higher density to be achieved, and can contribute to the privacy and amenity of a property.

Building to the boundary can take a number of forms, such as "courtyard housing", "villa housing" and "attached housing" (where dwellings share a common boundary).

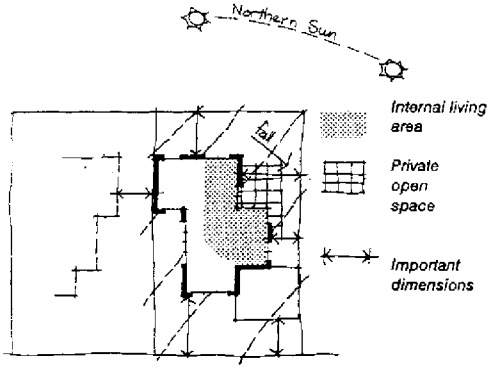
Practical examples of building to the boundary and the issues associated with the use of this important siting technique are presented in Action Sheet No.6 of the Joint Venture's Action Kit (JVMAH,1986a).

RELATIONSHIP BETWEEN DWELLINGS

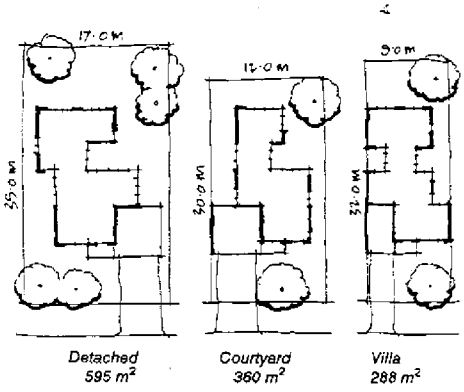


With smaller lots these relationships become more important

IMPORTANT DIMENSIONS IN BUILDING SITING



DWELLING TYPES AND SITING



Example of house & lot types and terminology from Golden Grove South Australia

ELEMENT OBJECTIVE

O1. Siting buildings to meet projected user requirements for privacy and daylighting.

O2. The scale, *height* and length of a building and walls relative to side and rear boundaries to be of appropriate residential character.

PERFORMANCE CRITERIA

Daylight & sunlight

P1. *Habitable rooms* to be capable of receiving adequate daylight.

P2. In localities where the *Heating Degree Day* calculation exceeds 500, the majority of dwellings to be sited so that the northern facade of the dwelling will receive the maximum amount of sunshine in winter.

Privacy

P3. The privacy of dwellings and outdoor spaces to be protected taking into account local community expectations.

Building height and wall length

P4. Dwelling and outbuilding walls to be sited and be of length and *height* to ensure no significant loss of amenity to adjacent dwellings and land.

DEEMED-TO-COMPLY CRITERIA

The following are deemed to meet the control element objectives and performance criteria:

Daylight

D1. Dwellings sited in compliance with the Building Code of Australia by the location of *windows*:

- to face a court or other outdoor space to the sky or an open verandah, open carport or the like; or
- not less than a horizontal distance of 1 metre from any building of an adjoining lot that they face.

Energy conservation

D2. Dwellings in climates with *Heating Degree Days* exceeding 500 units where the northern facade of the dwelling in a new residential area is exposed to the sun from 9 am to 3 pm during midwinter.

The Research Study into the Design and Siting Requirements for Small Allotments (Loder & Bayly, 1990) indicates that on land exceeding 5 per cent slope, and progressively thereafter, the following issues become increasingly sensitive:

- boundary retaining walls, particularly in association with building to the boundary;
- overlooking;
- solar penetration where slopes face south; and
- excessive bulk to streets from blocks above street level.

For instance, lots of less than about 450 square metres should, generally, have a crossfall of not more than 5 per cent in order to avoid costly retaining walls on the boundary.

Economic factors, however, are not the only reason for great care. The siting and design of a dwelling, the relationship of the dwelling living areas to the private open space, vehicular access to the site, overshadowing, overlooking, exposure to breezes, retention of views and amenity are all influenced by the land form and the design of the allotments.

It is not possible to develop prescriptive criteria for all situations as so many factors must be considered. This is one of the reasons why a performance based approach, combined with integrated development, offers considerable advantages, especially in the case of dwellings on smaller allotments.

There are a number of conditions which can, and should be applied to residential development generally, in order to satisfy basic requirements. These are related to daylight and sunlight, visual privacy (overlooking), acoustic privacy visual intrusion (building bulk) and - in tropical areas - exposure to breezes. They are discussed further in the following sections.

Daylight

The requirement for access to daylight generally relates to a perceived health need, although there is little research or proven evidence to show what daylight levels should be achieved.

Many of the sought-after inner suburban terrace houses would probably not meet daylight requirements of many of today's codes. The reality is that few windows in any development achieve the minimum levels of daylighting, since privacy and open space provisions tend to dominate in many aspects of site layout.

Both intuition and observed practice suggest that different values are placed on daylight to, and outlook from, rooms used for different purposes. To some degree, people may trade off a high level of daylight in one area for a low level in others. (Loder & Bayly, 1990)

A consistent and Australia-wide approach to daylighting provisions is contained in the Building Code of Australia (1990) and this approach has been incorporated into this Model Code. (It is acknowledged that there are wide differences in actual daylight standards that occur in existing dwellings to those which are provided for in the Building Code of Australia.)

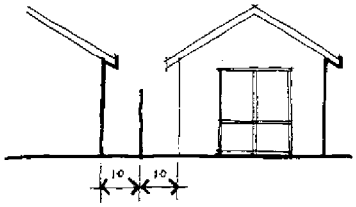
Energy Conservation

As mentioned in the discussion under Element B1, the objective of energy conservation can be expressed as the ability to heat, or cool, the dwelling with minimum use of other forms of energy. An increasing amount of energy is being used for heating and cooling in dwellings. This energy demand can be reduced substantially by sensitive siting and design. This is what the New South Wales Energy-Efficient Site Planning Handbook (Australian Housing Research Council, 1982) describes as "North Wall Access". That is, the protection from shadows of the north facade, including the north roof and north wall, for the solar access period of between 9am and 3pm in midwinter.

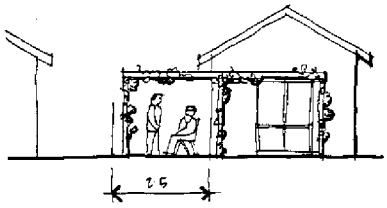
Access to sunlight and energy conservation were seen in the Background Material Report to Edition 1 of the Model Code as relatively complex issues (Scott & Furphy et.al., 1987). It was noted that the inclusion of energy conservation in Codes reflected a conflict between two forces – an increasing concern on the part of some groups to encourage energy saving practices, contrasting to a lack of market response to, or broad public concern about, the same issue. Comments received since Edition 1 was published and more recent events suggest that these issues are becoming more important.

The ability to conserve energy is becoming a matter of public policy and is, therefore, addressed in some detail in the Model Code. In all localities, orientation, siting and design of a dwelling are now seen to be of fundamental importance. Energy conservation requires that the northern facade of the dwelling in localities with a heating degree day rating of more than 500, is not cast in shadow by adjoining buildings between 9 am and 3 pm in midwinter. In hot climates the northern facade should be cast in shadow between 9 am and 3 pm midsummer.

SIDE SETBACKS

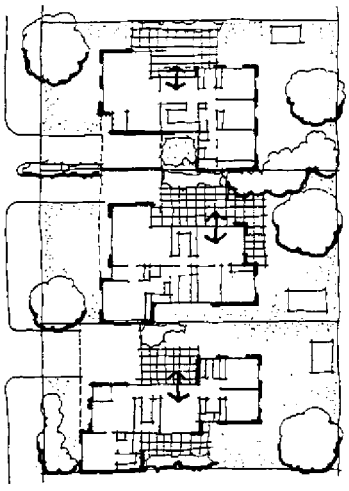


(a) Daylighting achieved by 1 metre setback to the lot boundary but of minimal use.



(b) Increased to 2.5 metres the side setback serves as usable private open space. Building to the boundary would also increase usable private open space.Trellis and landscaping can be provided by neighbours to enhance privacy.

IMPROVED SITING



Innovative use of narrow lots with plan designs that link the outside to the inside of the house, can make good use of building to a boundary techniques.

Deemed-to-comply criteria cont'd

D3. Dwellings in climates with *Heating Degree Days* exceeding 500 units where the northern facade of a new dwelling in an established area is exposed to the sun for not less than two hours of sunlight per day between 9 am and 3 pm, midwinter, and which do not cast a shadow on existing dwellings which reduces the sunlight available to the northern facade of such dwellings to less than 2 hours per day between 9 am and 3 pm, midwinter.

Privacy

D4. Dwellings sited in accordance with the approved plan for an *Integrated Development* or with the *Deemed-To-Comply* provisions of elements B3, B4 & B5 of this Model Code.

D5. Two-*storey* dwellings sited in accordance with the *Deemed-To-Comply* provisions of all relevant elements of this Model Code, without a *balcony* overlooking adjoining residential property.

D6. Two-*storey* dwellings sited in accordance with the *Deemed-To-Comply* provisions of other relevant elements of this Model Code, where upper storey *windows* that overlook adjoining residential property are glazed in obscure glass or have window sills a minimum of 1.5 metres above the upper storey floor level.

Height and building siting

D7. Buildings with a maximum height of 2 *storeys*, and complying with the following setbacks and wall lengths:

- 1 metre minimum setback for walls up to an average of 3 metres in *height* unless the wall is built to the boundary;# and
- For that part of the wall over 3 metres average *height* the minimum setback to be 1 metre plus 0.3 metres for every 1 metre of height over 3 metres; and
- 15 metre maximum wall length on boundaries.

 # Built to the Boundary (zero lot line) conditions are outlined on page 24.

In areas with a continental climate, such as Alice Springs, evaporative cooling systems can be very cost-effective during the hot summer, while a northern orientation is essential for effective use of the winter sun.

The regulation of building siting and design in order to create a potential for energy conservation is not essential in all areas of Australia. The test of essentiality is the extent to which there are great differences between the outside temperature and room temperature. In areas where this occurs, energy for heating is required and substantial savings can be achieved by managing solar exposure during the day. In those areas it is necessary to go beyond the guidelines for solar access set out under element B1. Effective energy conservation can best be achieved by maximum use of the sun. (There are other aspects which affect energy-efficiency, such as internal design, building materials and construction details, but these cannot be considered as part of this Model Code.)

To develop a simple Australia wide measure for determining where energy conservation should be a matter of regulation, the concept of *Heating Degree Days* has been utilised.

The term "Heating Degree Day" refers to the measure of the severity of a particular climate, and is related to maintaining thermal comfort within a building to the level of 21 degrees celsius. It is assumed that the average effect of solar radiation in heating months on the typical house is to elevate the mean internal temperature by about 3 degrees celsius. Heating on the day is, therefore, required when the temperature falls below 18 degrees celsius.

For Australia at present, Heating Degree Days are taken to the base level of 18.3 degrees celsius, and Degree Day values are determined from basic weather data available from the Bureau of Meteorology.

Overall calculations are made by adding, for the heating months, the values obtained by multiplying the difference between the base 18.3 degrees celsius temperature, and the mean daily temperature for the month, by the number of days in the month.

For example, in Sydney for the month of July the mean daily temperature is 11.7 degrees celsius. Consequently the number of Degree Days equals 31 x (18.3 - 11.7) = 205 Degree days. Adding the values for other heating months gives a measure for Sydney of 732 days.

Calculations for the Heating Degree Day measures for various cities provide the following values:

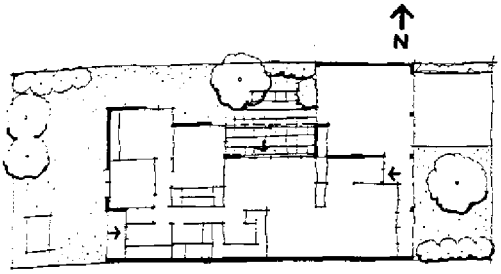
City/town	Heating Degree Days
Darwin	0
Brisbane	310
Alice Springs	660
Sydney	732
Perth	775
Campelltown	1011
Adelaide	1280
Melbourne	1500
Albury-Wodonga	1607
Armidale	1800
Canberra	2270
Hobart	2300

There is evidence of a clear link between energy use and heating degree days, but the selection of the cut-off levels above which any regulation for energy conservation should apply requires further study. On the basis of empirical data and experience, it is proposed that solar access requirements apply as deemed-to-comply criteria to localities with a "Heating Degree Day" measure exceeding 500.

Similar calculations could be made for determining Cooling Degree Days, where the values are obtained by multiplying the difference between a base 24 degrees celsius temperature, and the mean daily temperature for the month above that value, by the number of days in the month. However, there is no research evidence of a clear link between energy consumption and cooling degree days in dwellings. The cooling load does not correlate with comfort, particularly if dwellings are not air-conditioned. Until such evidence becomes available, it would be inappropriate to propose any guidelines for energy conservation based on "Cooling Degree Days".

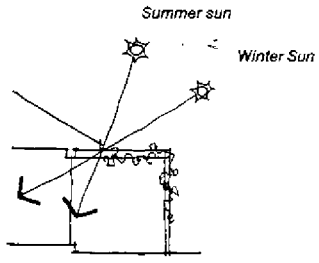
In localities where the heating degree day exceeds 500 units, the length of time the northern facade is exposed to the winter sun is important. Clearly, the longer the exposure the greater the energy conservation potential. In new residential areas, exposure of the facade from 9 am to 3 pm during midwinter should be capable of being achieved for the majority of dwellings. Such a period may be more difficult to attain in dual occupancy and infill situations. The precise conditions will vary from locality to locality and can be determined only through detailed study. In the inner urban area of Leichhardt in Sydney, for instance, the minimum requirement is for 2 hours exposure during the 9 am to 3 pm midwinter period.

BUILT TO BOUNDARY



Prototype plan from A.C.T. courtyard house on 360 — 465 m^2 allotment

Private outdoor space abuts wall built to a boundary giving privacy and enhanced opportunities for enclosed comfortable private open space



Northerly aspect with simple and economical sun control in summer but with full penetration in winter

Allowable encroachments

D8. The distance from an *allotment* boundary must be the shortest distance measured from the outermost point of the building or buildings concerned, except that:

- fascia, gutters, downpipes, non-combustible lining of eaves and the like; and
- masonry chimney backs, flues, pipes, domestic fuel tanks, cooling or heating appliances or other services may encroach into that distance if the distance to the boundary is not reduced to less than 0.5 metres or the distance between the buildings is not reduced to less than 1 metre, unless protected by a wall complying with Clause 3 of the Building Code of Australia 1990. Light fittings, electricity or gas meters, aerials or antennae, pergolas or sun blinds, and unroofed terraces, landings, steps or ramps, not more than 1 metre in *height* are not restricted.

Built to the boundary

D9. Built to the boundary (zero lot line) conditions restrict openings on boundaries. Walls within 1 metre from the boundary must not contain any openings unless they comply with the fire resistance levels of the Building Code of Australia 1990 and are infilled with translucent or opaque materials/windows. Roof lighting and ventilation are exempt from this requirement.

D10. The building envelope plan required under Element B1 should designate any boundary where a wall may be constructed to the boundary.

Frontage setbacks

See Element B5 for setbacks to streets.

Whatever exposure value is chosen, the measurement of the area of the facade should be taken from the ground floor level, as solar exposure in temperate climates can heat the walls as well as penetrate through the windows.

The solar penetration to a dwelling can best be demonstrated by means of solar access planes. In midwinter, the sun is at its lowest position, with its height being determined by the latitude, and the plane determined by the height of any building, wall or any other physical obstruction to the north of the dwelling. The length of the plane is also determined by the slope of the land. New buildings should not intrude into the midwinter solar access plane, nor affect the northern facade of other buildings to the south. In midsummer the sun is at its highest position and an overhang or pergola can screen exposure of the facade.

A simple method in new residential areas in temperate climates is to start with the position of the midwinter sun at noon (determined by the latitude of the area), to measure the shadow length of any buildings or walls to the north and to construct a plane within the limits of 45 degrees from each side of the facade.

Table 2-1 shows how this length varies depending on the slope of the site. The Table assumes that the building (or wall) casting the shadow is 3 metres in height. The figures can be adjusted proportionally as the height increases. In hot climates, the only requirement is to ensure that any overhang is sufficient to screen the facade during midwinter.

TABLE 2.1 Shadow Length for 3 Metre High Buildings or Walls at Noon, Midwinter.

Slope	Degrees Latitude			
%	45	40	35	30
Towards North				
20	5.1	4.3	3.8	3.3
15	5.7	4.5	4.0	3.4
10	6.0	4.9	4.3	3.6
5	6.6	5.4	4.6	3.8
(flat)	7.5	6.0	5.0	4.0
5	8.7	6.6	5.5	4.2
10	10.2	7.5	6.0	4.7
15	12.3	8.7	6.6	5.2
20	15.6	10.2	7.5	5.7
Towards South				

NOTE: The above figures are for a north-south orientation. For other orientations see Energy-Efficient Site Planning Handbook (1982).

In view of the fact that there may be special situations where a rigid, prescriptive control is inhibiting, the deemed-to-comply criterion for energy conservation specifies that, in new residential areas, the northern facade of the majority of dwellings should receive the maximum amount of sunshine between 9am and 3pm during midwinter. However, the aim should be to maximise the potential for energy conservation, and careful design and siting of dwellings can make a considerable contribution to this objective.

For infill and dual occupancy situations, the objective may be more difficult to achieve. A suggested minimum requirement is for the northern facade of dwellings to receive not less than 2 hours of sunshine between 9 am and 3 pm during midwinter. For infill areas and dual occupancy sites, shadow diagrams may need to be prepared to demonstrate that the northern facade of the new dwelling receives the specified minimum exposure and does not screen the northern facade of any existing dwellings to the south beyond that specified.

Visual Privacy

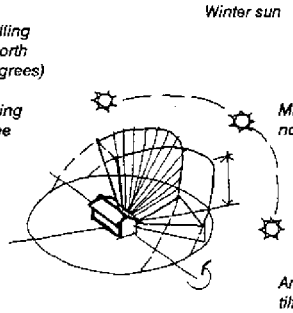
The background research for Edition 1 of the Code did not reveal any specific controls to protect visual privacy. The Victorian Residential Development Provisions (RDPs) do not provide for detailed control over matters of privacy. Presumably this is in recognition of the fact that traditionally the erection of dwellings, including two storey dwellings, has occurred as-of-right, subject to meeting nominal building setbacks.

Privacy requirements vary in different localities and appear to be related to the historic character of an area and local expectations, rather than to any objective standard for privacy. Overlooking of dwellings on land with steep gradients is almost impossible to avoid and in some areas this may be accepted as a fact of life (e.g. Hobart). However, visual privacy has long been one of the strong concerns expressed by residents of most forms of housing, and where dwellings are sited close to one another (e. g. North Sydney) it is regarded as an essential component of residential amenity control.

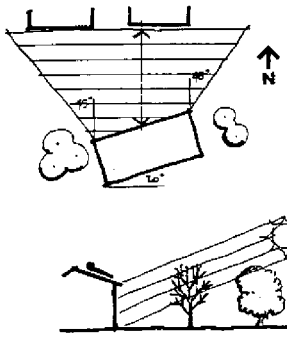
As people's perception of an acceptable level of privacy is highly subjective, it is difficult to define prescriptive standards. The Victorian Diversity of Allotments Study (Ministry for Planning and Environment, 1987) concluded, in respect of the siting controls of the Victorian Building Regulations, that often they seemed to provide more of a psychological measure of privacy rather than some pre-determined objective standard of privacy.

SOLAR ACCESS CONE IN NEW AREAS

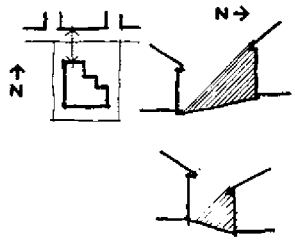
When a dwelling is tilted off north (up to 20 degrees) the plane is drawn by using the 45 degree angles from the north



(a) Access planes to be used in new developments

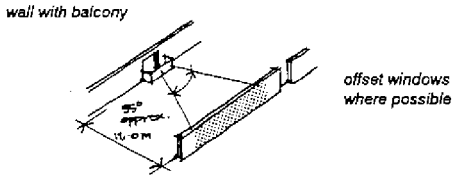


(b) For critical distances from walls to allow for sunlight penetration refer to Table 2.1

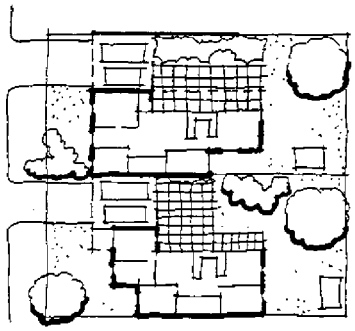


(c) Solar access for infill development may be constrained by existing buildings. The critical distance is the shadow created by any building or wall north of the northern facade of the new dwelling

PROVISION FOR VISUAL PRIVACY



(a) NSW Department of Planning suggestion to use screen windows or avoid locating them in this zone if less than 12 metres separation between dwellings



(b) On small lots use of courtyards abutting a wall built to a boundary offers opportunities for a high level of privacy and amenity

As for the objective of achieving adequate daylight, building setbacks are generally proposed in order to ensure adequate privacy levels are achieved. Such setbacks tend to be arbitrary and may not take into account factors such as sloping ground, window location, or the effect of landscaping in assisting privacy.

Current practice for conventional allotments is to consider visual privacy control to be adequate if a dwelling design and layout is such that overlooking can be avoided by voluntary erection of screens and landscape planting.

The Research Study into Siting Related Issues of Residential Development (GH&D et.al., 1989) found that, in the main, residents of housing on small allotments were satisfied with the level of privacy. It was also observed that a significant number of residents had erected some form of screening to enhance privacy.

On small lot residential development and other closer forms of group housing it is acknowledged that the potential for loss of privacy increases. At the same time, a wide variety of techniques for resolving such potential problems are available, even where it is proposed to build two-storey dwellings.

The Research Study into the Design & Siting Requirements for Small Allotments (Loder & Bayly, 1990) examined a number of ways in which privacy can be obtained, including specifying minimum horizontal separation between windows. The Model Code does not set deemed-to-comply provisions for privacy protection on allotments of less than 450 square metres, but it should be recognised that there may be situations where such controls will be considered necessary. In these situations, the controls recommended in the above report may provide a suitable basis for incorporation in a local code.

Acoustic Privacy

With acoustic privacy, the major noise generating sources are the abutting road and the adjoining lot. Protection against traffic noise is discussed under Element B5.

Noise control has three dimensions: control at the source, the level of acceptable noise exposure at the point of reception, and measures of attenuation between emission and reception.

The Background Material Report to Edition 1 of the Code noted that acoustic privacy was not addressed in any of the regulatory sections of the codes reviewed, although in some States and Territories noise pollution control legislation applied (Scott & Furphy et.al., 1987). Under this legislation, conditions may apply which govern the time, nature and intensity of noise in residential areas. In other words, the statutes set limits to the emission of noise.

What constitutes an acceptable noise level at the point of reception can vary with the time of day, the condition of the recipient and the opportunity available to mitigate the noise (e.g. location of bedrooms, closing of windows). Standards exist which reflect the maximum desirable exposure inside the dwelling (e.g. 35 dB(A)) and at the facade (50 - 58 dB(A)).

Measures of attenuation between emission and reception can take two forms: (i) separation by distance and (ii) by intervening structures which reflect, absorb or disperse the noise. Separation by distance is not practical in closer forms of housing, but solid walls can provide an effective means of attenuation, provided they are of sufficient height. However, this technique is not appropriate for two-storey development, and careful design is necessary instead (for instance, by avoiding locating windows in adjoining dwellings opposite each other).

Whilst the Model Code contains provisions for building to the boundary, with an implicit intention of providing a measure of visual and acoustic protection, it does not set specific conditions for noise attenuation, as they are, essentially, matters of good design which cannot be achieved by regulation. It must be stressed, however, that acoustic privacy is even more important than visual privacy, as visual privacy can be achieved by voluntary means, whereas acoustic privacy is far less amenable to personal control.

Visual Intrusion

The research for Edition 1 of the Code also found that the issue of visual intrusiveness of buildings is one of the most confusing of all control items with respect to its intended purpose (Scott & Furphy et.al., 1987). Primarily, the control is a siting concern expressed in terms of provisions for building height and length of walls. It is used to ensure satisfactory levels of privacy and to prevent over-development of a site, and sometimes to assist maintenance of the character of an area.

Perceptions of the quality of a residential environment are often influenced quite strongly by the bulk or "visual intrusion" of buildings. The Model Code deals only with buildings up to two storeys, where visual intrusion is largely limited to the impact of the side or rear portion of a dwelling or out-building closest to a neighbouring residential property. Where sufficient space between buildings is provided, landscaping can reduce these impacts as many trees grow to the height of two storey buildings. Good examples of practices are given in NSW Technical Bulletin No. 15 (Department of Environment and Planning, 1982).

The need to apply controls relating to the height and length of a building wall is also related to the desire to encourage the practice of building to the boundary. In these circumstances, there is a perceived need to control the siting, length and height of walls to ensure community acceptance of such practices and avoid circumstances where an appearance of excessive building bulk and visual intrusion is created.

For reasons of cost-effectiveness and amenity, much benefit can be gained by introducing the freedom to construct walls to boundaries. This will allow greater variety of lot size, more choice in layout and better use of private open space.

The Model Code Task Force considers that issues of privacy, building bulk and visual intrusion for medium density forms of housing of more than two storeys are important areas for further research.

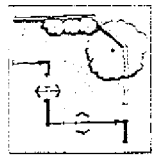
Exposure to Breezes

Exposure to breezes is a specific need in tropical situations, such as in Darwin. During the wet season in the summer, a dominant design factor is to take advantage of the north-west breezes which provide relief from oppressive conditions. This can be readily achieved with allotments of 800 square metres or more, but becomes more difficult with smaller allotments. One way to satisfy this need is to provide skewed allotments and staggered siting of dwellings. This form of subdivision layout and siting has the additional advantage of ameliorating any potential problems with acoustic and visual privacy.

Adaptation and Change

During the life of a dwelling there is often a need to extend or modify it arising from changes in household size and composition. As a general practice there is merit, particularly in the case of small allotments, to identify areas where any future extension can and cannot be considered.

B3 PRIVATE OPEN SPACE



CONTEXT

AN ELEMENT CONCERNING THE PROVISION OF USABLE OUTDOOR SPACE FOR THE EXCLUSIVE USE OF THE OCCUPANTS OF THE DWELLING.

BACKGROUND & DISCUSSION

Throughout Australia there seems to be general acceptance of the importance of providing adequate private open space in residential development. In the Background Material Report prepared as a prelude to Edition 1 of the Model Code it was noted that on-site open space requirements aim to satisfy a range of perceived user needs, and are generally expressed as a requirement to provide a specific minimum ratio of private open space to total site area (Scott & Furphy et.al., 1987).

Concerns have long been expressed that private open space has been determined on a site by site basis without regard to use. The size of private open space must be adequate, but it also needs to be functionally located; for unless the space is located so that it can serve its proper function, the required benefits to residents will not be achieved.

The issue of ensuring that sufficient land area for private purposes is available on any allotment is largely pre-determined by the shape and size of the allotment. The primary purpose of this element of control, therefore, is focussed on the function and usability of private open space (Scott & Furphy et. al. 1987).

Whilst the quantity of private open space should take second place to its usability, it is arguable that control of both is most readily expressed in terms of an area having dimensions sufficient to enable it to usefully serve domestic outdoor functions.

In the Design Manual Streets for Living, this need is expressed as a requirement for 90 square metres of private open space for houses of up to 3 bedrooms, and 150 square metres for houses with 4 or more bedrooms. (Colman, 1978)

The New South Wales Technical Bulletin No. 15 indicates that as part of the space required for the average household's activities, an estimated 100 square metres is needed for the purpose of an outdoor living area (Department of Environment & Planning, 1982).

Definitions of the purpose of private open space have included:

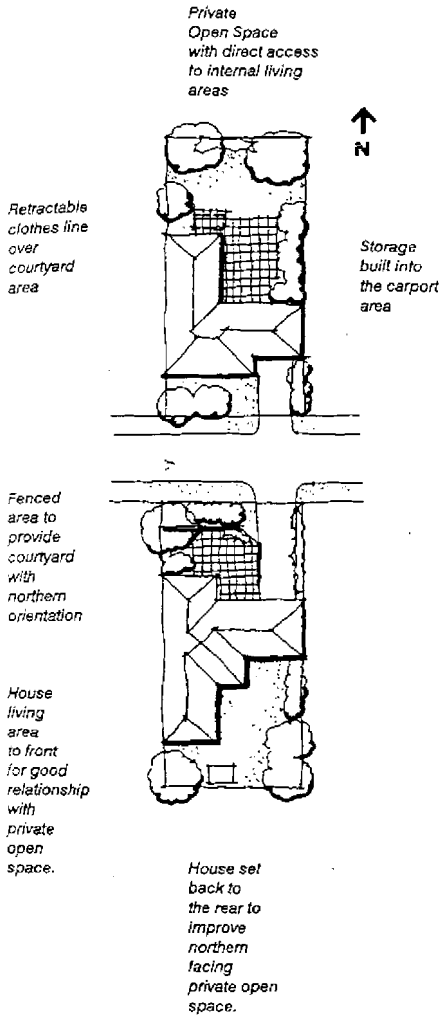
- outdoor living space provided as an extension of the function of a house for activities such as relaxation, dining, entertaining, recreation and children's play;
- a space allowing for a small table and chairs, outdoor lounge or children's play equipment;
- a space which is wholly private and capable of being used exactly as occupants wish "short of downright unneighbourly behaviour" (Keeble, 1976).

An American review, Affordable Single – Family Housing: A Review of Development Standards, based on a 1981 nationwide survey of 1,086 communities, concluded that integrating indoor and outdoor areas to allow for better use of limited space became important as lots and dwellings are reduced in size (Sanders et. al., 1986). This view appears equally applicable to Australian housing.

The structure of this control element reflects the widespread traditional approach of not requiring town planning permits for detached dwellings. This approach assumes that the initial choice of an adequate allotment size and compliance with siting provisions will make it possible to satisfy the requirement for private open space.

In these circumstances, the objectives and performance criteria are appropriately framed to identify a range of activities or functions. They are also included because of the special importance they have to medium density forms of housing and small lots.

PRIVATE OPEN SPACE — DESIGN FACTORS



ELEMENT OBJECTIVE

O1. To provide *private open space* to each dwelling to meet user requirements for outdoor activities and use.

PERFORMANCE CRITERIA

P1. *Private open space* areas to be of dimensions to suit the projected requirements of the dwelling occupants and to accommodate both outdoor recreation needs as well as providing space for service functions such as clothes drying and domestic storage.

P2. Part of the *private open space* to be capable of enabling an extension of the function of the dwelling for relaxation, dining, entertainment, recreation and childrens play, and be directly accessible from the dwelling.

P3. Location of *private open space* to take account of outlook, natural features of the site and neighbouring buildings or open space.

P4. Orientation of *private open space* to provide for maximum year round use.

DEEMED-TO-COMPLY

The following are deemed to meet the control element objectives and performance criteria:

D1. *Private open space* of the dwelling having a minimum area of 80 square metres, and where:

- the minimum dimension of *private open space* is 2.5 metres;
- one part of the *private open space* comprises an area of 25 square metres with a minimum dimension of 4 metres, is not steeper than 1 in 8 (12.5 per cent) and is directly accessible from the dwelling.

Christopher Alexander, in A Pattern Language, noted as early as 1977 that outdoor spaces which are merely "left over" between buildings will, in general, not be used. He sees an outdoor space as being positive when it has a distinct and definite shape, such as in a room (Alexander et. al., 1977).

The slope of the outdoor space is also important. Steeply sloping spaces are difficult to use. Generally, it is desirable to ensure that there is at least a relatively flat outdoor space of 25 square metres located immediately adjacent to a dwelling's living room. This space may be provided in the form of a deck or terrace, provided care is taken to minimise overlooking of adjoining property.

The extent of provision of private open space may also be influenced in some localities by the proximity of major areas of public open space such as district parks or seaside coastal reserves. For example, there may be a tradeoff made in the amount of private open space for each dwelling, to provide for increased density enabling more people to enjoy a view and coastal setting.

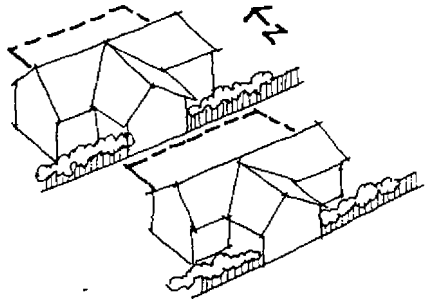
In the Background Material Report, the City of Knox Cluster Code was identified as providing a clear example of the performance requirements for private open space as follows:

- "Each dwelling shall have attached thereto an area for the private outdoor leisure of its occupants.
- The private outdoor living area shall be of a dimension which will suit the likely requirements of the dwelling and its occupants.
- The private outdoor living area shall act as an extension of the function of the dwelling (i.e. relaxation, dining, entertaining, recreation, children's play area), as well as providing space for service facilities (eg. clothes drying, garbage and storage of bulky items)" (Scott & Furphy et. al., 1987).

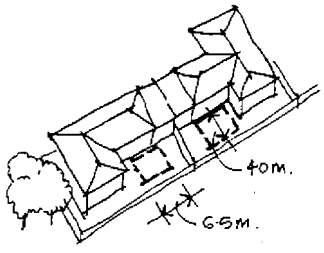
The Research Study into Siting Related Issues of Residential Development, indicated that for single dwellings, irrespective of allotment size, the overall satisfaction with private open space was quite high. Where there was dissatisfaction with private open space reasons given were lack of space for items such as tools, lawnmowers, etc. and for outdoor tasks. The level of satisfaction was not directly proportional to the size of private open space.

In fact, 96 per cent of respondents with 75 square metres of open space were satisfied, or very satisfied as compared to 85 per cent of respondents with 100 to 150 square metres (GH & D et. al., 1989).

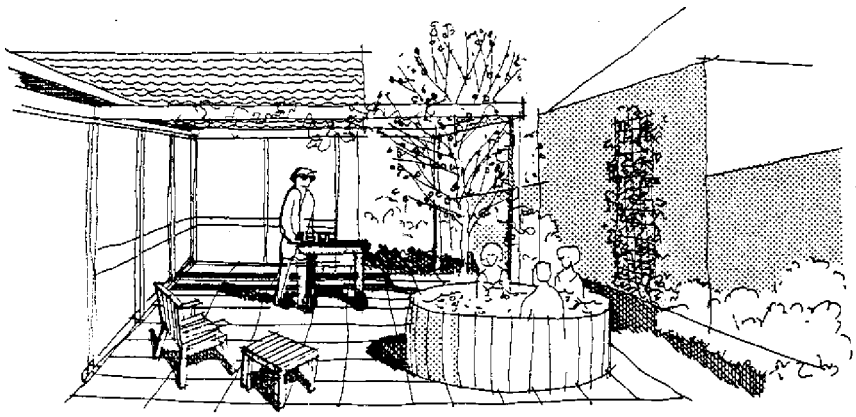
The Model Code's deemed-to-comply provision of 80 square metres is considered adequate for a wide range of allotment sizes.



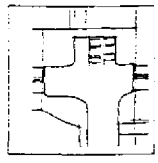
Private open space enclosure is assisted by building to the boundary



Minimum private open space dimensions



Private open space in the form of a courtyard with direct connection to internal living areas



B4 VEHICLE PARKING

CONTEXT

AN ELEMENT CONCERNING THE PROVISION OF VEHICLE PARKING.

BACKGROUND & DISCUSSION

Development of this control element is based on the Research Study Into Road Characteristics for Residential Development (Pak Poy & Kneebone, 1989), as well as a number of key references examined as part of the Background Material Report produced as a prelude to Edition 1 of the Model Code (Scott & Furphy et. al., 1987.)

A general proposition for car parking is for there to be sufficient on-site space for resident and visitor cars, and for residential streets to be kept free of parked cars. This is one approach suggested in the Subdivision Guide, The Streets Where We Live, where subdivision designers are reminded of the correlation between parking on streets and pedestrian accidents (NSW Department of Environment and Planning, 1984).

Western Australia's Review of Residential Road Policy (Town Planning Board, 1985) found that parked vehicles affect residential roads in a number of ways, including:

- taking up space on the carriageway - which is an inefficient use of a relatively expensive facility;
- creating visual intrusion in a residential area; and
- impeding visibility of children by other motorists and between moving vehicles.

As noted in the Research Study Into Road Characteristics For Residential Development, ensuring adequate on-site parking is provided in the more traditionally designed subdivisions is generally not a concern, at least on traffic grounds, because the wider carriageways can usually accommodate any excess parking, albeit in an undesirable and costly way. It is the adoption of narrower carriageways which requires specific provision of adequate parking off the through carriageway.

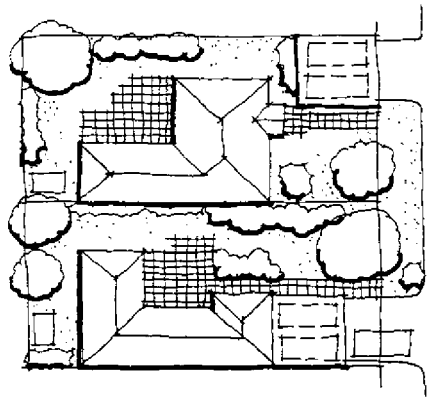
Whether drivers park on-street or off-street is a somewhat complex issue and depends on a variety of factors. These are set out in the Subdivision Guide The Streets Where We Live, and include:

- the number of cars in a household;
- the slope of driveways away from or towards the street;
- the width of the carriageway and convenience of parking bays when a narrower carriageway is involved;
- whether the distance from on-site parking space to the house door is longer or shorter, less or more convenient than walking to the house door from the street;
- whether cars must be parked on a last-in first -out basis;
- the security of the neighbourhood; and
- the general lifestyle and workstyle of the residents.

Where smaller allotments are proposed it may be important to try and accommodate visitor carparking requirements off-site in order not to constrain layout design opportunities. The Guidelines for Cost-Effective Residential Development objective of "maximising usable private open space in allotments by minimising the space set aside for driveway and carparking area" illustrate this. (JVMAH, 1986)

Provision for parking within a residential street with a narrower carriageway may be made by indenting the pavement for parking parallel to the carriageway, or by constructing separate right angled parking bays. In this way a widening of the street pavement for its whole length is avoided and a higher level of safety is achieved.

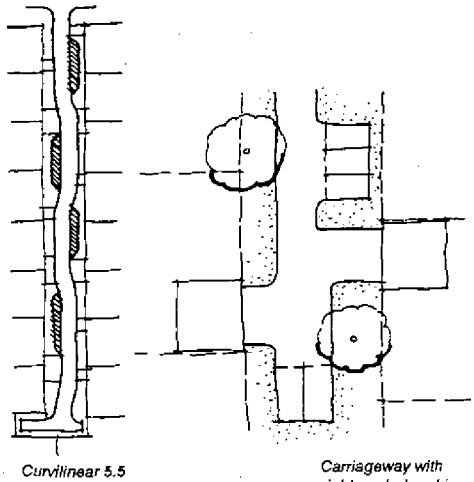
ON-SITE PARKING



Vehicle parking designed for zero frontage setback

Tandem vehicle parking possible for visitors in lieu of on-street parking

ON-STREET PARKING



Curvilinear 5.5 metre carriageway with indented parallel parking

Carriageway with right-angled parking in an urban streetscape

ELEMENT OBJECTIVE

O1. To provide sufficient and convenient parking for residents, visitors and service vehicles.

O2. To ensure that parked vehicles do not obstruct the passage of vehicles on the *carriageway* or create traffic hazards.

PERFORMANCE CRITERIA

P1. Resident and visitor carparking to be provided according to projected needs which are determined by taking into account:

- availability of public transport;
- the provision of public carparking easily accessible to visitors;
- possible locations of higher density forms of housing; non-residential uses such as schools and local shops located, or to be located in the area;
- the effect of sloping land in reducing parking opportunities;
- any adopted hierarchy for the street network and related objectives of the hierarchy;
- the possible intrusion of vehicles from adjoining localities seeking parking opportunities;
- the occasional need for overflow parking;
- the safety of vehicles and pedestrians;
- the projected requirements of people of differing socio-economic status, age, cultural background and stage of family life cycle; and
- efficient use of carspaces and accessways including adequate manoeuvrability for vehicles between the street and the lot.

DEEMED-TO-COMPLY CRITERIA

The following are deemed to meet the control element objectives and performance criteria:

PARKING ON SITE

D1. The dimensions of carparking spaces and accessways to comply with Australian Standard 2890.1 (1986), or requirements of a local planning scheme.

D2. Provision of two carparking spaces per dwelling, which may be in tandem and one of which is capable of being covered.

D3. Provision of three carparking spaces for each two dwellings forming part of an *integrated development*, with one car space being equally accessible to either dwelling.

Factors such as location, proximity to public transport and availability of on-street or other nearby off-street carparking need to be considered in order to take the cost-effective approach where less carparking can be provided to meet the needs of each locality.

Adequate access to and ease of use of parking areas are also matters for consideration when deciding on how much carparking is required to be provided.

The Research Study Into Siting Related Issues of Residential Development indicated that satisfaction with visitor carparking was often related to street width. On streets of less than 7 metres width, residents often assumed that there was a need to design more formally for the "spill-over" parking traditionally provided in wider streets (GH & D et. al., 1989).

The minimum deemed-to-comply provision for resident parking given in the Model Code is 2 spaces for each allotment, which caters for the usual parking requirements of 85 per cent of dwellings. Where the carriageway is less than 5 metres in width it is recommended that one additional space for each dwelling be constructed off the street pavement but within the street reserve.

Even with this level of provision, it is acknowledged that on occasions parties or other activities will generate a higher level of parking than can be accommodated within easy walking distance. However, it is not considered reasonable for taxpayers and ratepayers to cater for such infrequent occasions at public expense. Experience indicates that visitors will walk longer than usual distances on the odd occasion that this is required.

Driveway Locations and On-street Parking

As pavement widths are reduced, and/or as lot frontages decrease, on-street parking supply warrants additional assessment, particularly to minimise problems of exit and entry into the driveways.

Typical on-street parking demands are generally low in residential streets which do not have spill-over parking from commercial uses, and where most residential parking is off-street, i.e. in driveways or garages/carports.

It is desirable to allow on-street parking to occur as close to the source of demand as possible. It is practicable to provide one on-street space per two dwellings on streets with a 5 metre wide carriageway, layback kerbs, and where lot frontage widths may be down to 9 metres wide. However, with poor spacing of driveways it may be difficult to provide half this level of parking with even 15 metre frontages.

Research done for the Victorian Urban Land Authority (O'Brien, 1990) indicates that two factors are important in maximising on-street parking opportunities:

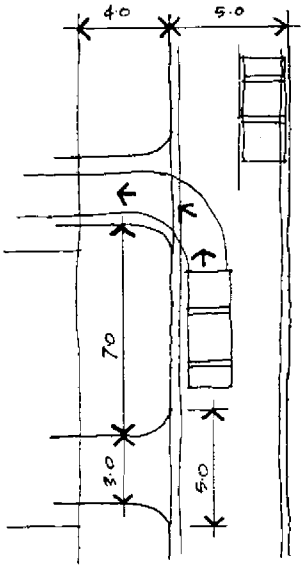
Firstly, on a 5 metre wide pavement, a driveway with a "throat" width of 3 metres and a width at the kerb of 5 metres allows the "SAA design car" to enter the driveway even if there are cars parked either opposite or immediately beside the driveway.

Secondly, an absolute minimum of 6 metres is required between such driveways to allow a car to park between driveways. A more comfortable minimum is 7 metres. To provide two spaces between driveways, the minimum separation is 11 metres.

For lots having narrow frontages and individual access, a separate parking area may be needed nearby. Alternatively, the verge width can be increased so that there is opportunity for right angled parking.

On streets with narrow pavements, special care is needed to ensure that a vehicle reversing from a driveway onto the carriageway has adequate opportunity for turning if another vehicle is parked on the opposite side. Paired access drives (adjoining or on opposite sides) overcomes this problem, and also provides greater opportunity for parking. As the abiltity to consider such detailed design is normally only possible in the case of integrated development, a wider verge and/or a wider throat width near the kerb line should be considered in deemed-to-comply situations.

Further information on parking in streets is provided in elements B6- Transport Networks and B7- Street Design.



Driveway access for streets where lots have reduced frontages

Deemed-to-comply criteria cont'd

PARKING OFF SITE

D4. The dimensions of carparking spaces and accessways to comply with Australian Standard 2890.1 (1986), or requirements of a local planning scheme.

D5. On *Access Place* single lane carriageways — one space for each two dwellings to be located in the verge within an average distance of 25 metres of each allotment.

D6. On *Access Place* single lane carriageways a number of verge spaces to be combined to provide for short term service vehicle parking within 40 metres of any allotment on carriageways.

D7. On two-lane carriageways parking as per Table B7-1 on page 61.

B5 STREETSCAPE

CONTEXT

AN ELEMENT CONCERNING CHARACTER, APPEARANCE AND LANDSCAPING OF THE STREETS IN RESIDENTIAL AREAS AND THE SITING AND DESIGN OF BUILDINGS IN RELATION TO THEM.

BACKGROUND & DISCUSSION

The character and appearance of the streetscape in residential areas is important in determining the value and image of properties, and contributes significantly to the identity and amenity of an area.

People care about the quality of their street. The Research Study of Siting Related Issues of Residential Development, found that the appearance of a dwelling in its streetscape context is a major factor of resident satisfaction and saleability. (GH&D et. al., 1989).

Factors contributing to a streetscape include:

- level of traffic and parking;
- a sense of place and identifiable character (the spatial relationship of the elements creating the street);
- formal and informal landscaping;
- natural vegetation especially mature trees;
- street pavement type and alignment;
- natural features and topography;
- housing forms and styles; and
- absence of poles and signs.

These are usefully grouped into the main components of:

- paving;
- verge;
- landscaping and fencing;
- street furniture; and
- building form and siting.

Street pavement and verge are discussed in a technical sense in elements B7 - Street Design, and B8 - Street Construction.

Their relevance as part of the Streetscape element is a matter of appearance and scale. This also is the case for the remaining components of streetscape, including landscaping, fencing, street furniture, and building design and siting.

Paving & Verge

Each street within a subdivision will provide access for motor vehicles, cyclists and pedestrians, parking for vehicles and recreation space for children.

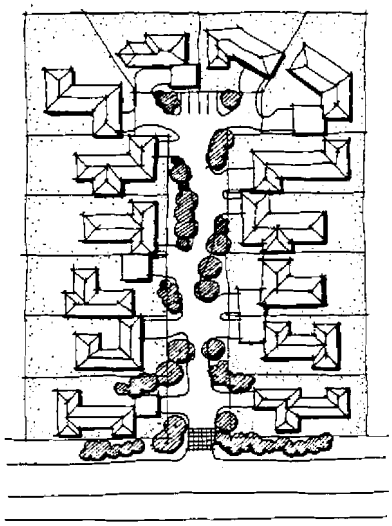
The width of pavement may vary from 3.5 to 7.5 metres depending on the function of a street (See Element B6). For example, the use by motor vehicles increases substantially on the higher order Collector and Trunk Collector streets, and a wider pavement is needed.

The width of the pavement has a major influence on the response of an observer in a street. Wide pavements in a residential locality with low traffic intensity, can produce a bleak and barren space for residents and pedestrians while encouraging higher traffic speeds. If the pavement width is out of scale with the street elements, there is also no sense of friendly enclosure, and the pavement is visually dominant. In access places (usually cul-de-sacs) the pavement width is reduced to provide a safer residential environment with a higher level of amenity, where people can use the road as part of their recreation space.

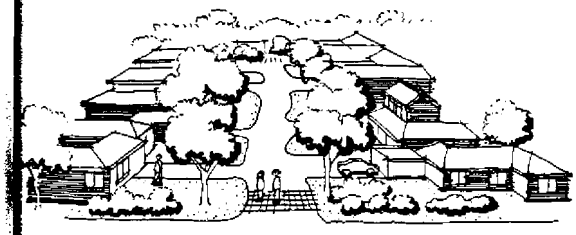
Choice of materials for the hard surfaces - especially carriageway and footpath - will have a significant effect on the streetscape. Choices made can reinforce or detract from the desired character, whether it be urban, intimate, expansive, open or otherwise. In some cases the street carriageway may be constructed of brick or concrete pavers to achieve a more intimate effect, or to reinforce the urban appearance of the building form.

Changes in paving material can be used to signal changes in the street use and character. The streetscape will be different if driveways are constructed in the same material as the carriageway or footpath. Attention should be given to the sensory messages given by such choices, and whether they are consistent with the character being sought and the function of the street.

STREETSCAPE OF AN ACCESS PLACE



PLAN



PERSPECTIVE

SECTION

ELEMENT OBJECTIVE

O1. To provide attractive streetscapes which reinforce the function of a street and enhance the amenity of dwellings.

PERFORMANCE CRITERIA

P1. Residential development to provide an attractive streetscape setting with opportunities for landscaping and varying setbacks of residential buildings.

P2. The streetscape to reflect the function and characteristics of the street type in the network and incorporate a landscape approach which satisfies safety and maintenance requirements, and the requirements for the placement of utility services.

P3. Development in built-up areas to complement existing attractive streetscapes of which it will be a part.

P4. The streetscape to be considered as an entity, embodying the *performance criteria* for the element of Transport Networks (B6), Street Design (B7), Vehicle Parking (B4), and Allotment Size and Orientation (B1).

P5. To ensure landscaping which:
- complements the function of the street;
- incorporates existing significant vegetation wherever possible;
- is of an appropriate scale;
- is sensitive to site attributes such as streetscape character, land capability, micro-climate, views and vistas.

P6. Any *building line setback* from the street boundary, and any walls between the building line and the street boundary, where such walls are proposed to be used, to have minimal impact on existing or other future dwellings.

DEEMED-TO-COMPLY CRITERIA

The following are deemed to meet the control element objectives and performance criteria:

D1. The *building line setback* from the street boundary for allotments of not less than 450 m^2 is in accordance with requirements set out in Table B5-1.

Attention should also be given to the choice of materials that "go together" and create a sense of harmony with the streetscape.

The street verges, or nature strips are another important aspect of a streetscape, especially in their capacity to accommodate street furniture and landscaping. Verges provide the space for services such as electricity, telephone, gas, water, sewerage and drainage, most of which are underground. Space is also required for pedestrians, cyclists, landscaping, street furniture including lighting, access ways and carparking.

Street furniture components such as lighting poles, plant guards, barriers, bus shelters and signs, should be designed as an integral part of the streetscape.

Table B7-1 of Element B7 - Street Design, provides a guide to the required verge width according to the classification of the street. The choice of verge width should ensure acceptable noise levels measured at the front facade of a dwelling. The width should also vary according to the gradient of land with increased verge widths on steeply sloping land.

Landscaping and Fencing

Landscaping between the street pavement edge and the front of a dwelling contributes significantly to the streetscape appearance.

The research for the Background Material Report prepared as a prelude to this Model Code (Scott & Furphy et.al., 1987), revealed that for the majority of detached housing on large lots, landscaping is a feature that is not the subject of control by regulations. Most of the reviewed codes did not include reference to landscaping for detached housing, or where it was mentioned there were broad statements about landscaping being used to generally enhance area amenity.

For more intensive forms of housing, including detached housing on small allotments, landscaping was seen as important, particularly as a means to soften and break up building form.

Research has confirmed that landscaping is very important to the residents. It is observed that many developers of integrated residential developments, consciously set out to create an enhanced street image through the provision of a landscaping in order to increase marketability. This concern with streetscape reflects its importance as "the most publicly visible element of a dwelling, and provides the readiest means of categorising or identifying a neighbourhood". (Scott & Furphy et. al. , 1987)

Landscaping within the privately owned space of a streetscape is generally accepted by the community as being an area where individuals are free to express their own ideas and likings.

In multiple dwelling developments involving common property such as units and townhouses, there has been a much greater tendency for an integrated landscape design to be implemented. The streetscape for such forms of residential development also includes shared access driveways and the abutting landscaped area.

Landscaping helps to maintain and enhance streetscape character, reduce overlooking, assist in energy conservation, and create an image for a street that reflects characteristics of safety, identity, and marketability.

Street tree planting is the strongest component of landscaping within the streetscape. It is generally achieved by planting, within the verge, a single tree for each allotment, or two trees for a corner allotment. Such tree planting should be to responsible authority requirements, should satisfy the intersection sight distances of this Code, and should not obscure street lighting or overhang the carriageway so as to interfere with service vehicles or buses. In addition, it should not compromise the structural integrity of nearby buildings, services or street pavement.

The Research Study into Siting Related Issues of Residential Development, found that resident satisfaction with their housing estate was quite high for moderate levels of landscaping. Extensive landscaping did not result in any major increase in the level of resident satisfaction. The emphasis on landscaping, therefore, may be more on the quality and design rather than quantity. (GH&D et. al.,1989.)

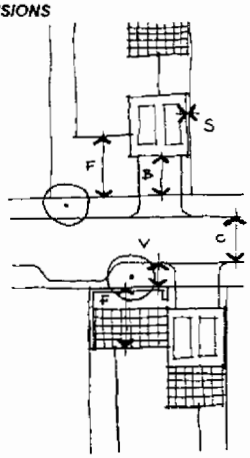
The Model Code does not prescribe landscaping, although it is acknowledged to be an important matter and should form part of local authority guidelines.

Where a detailed landscape plan is required as part of a residential development approval, it is important that it addresses a variety of matters including:

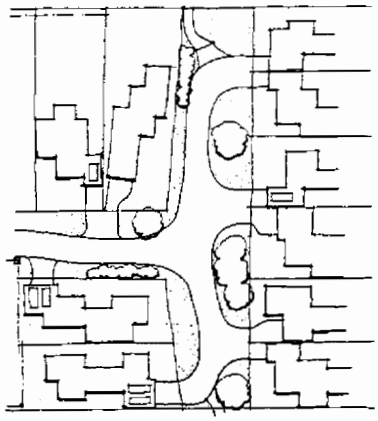
- The local climate, level of fire risk, and soil types; (For example, in localities with highly reactive clays very careful choice of the type of trees will be required - see AS2870 for a full discussion.)
- The position of underground services and the potential need for digging to repair or maintain those services;

STREETSCAPE DIMENSIONS

C - Carriageway Width
B - Building Line
F - Frontage Setback
S- Side Spaces
V - Verge Width



(a) Important horizontal dimensions in the design of streetscape



(b) Integrated streetscape with the access place linked to the main pedestrian route and designed for shared use by pedestriens and cars. Example in the Shire of Cranbourne, Victoria

Deemed-to-comply criteria cont'd

Table B5-1 RELATIONSHIP BETWEEN STREET TYPE AND BUILDING LINE SETBACK

Street Type	Minimum Frontage Setback* (metres)	Minimum Side Street# (metres)
Access Place	4	2
Access Street	5	3
Collector Street	6	4
Trunk Collector	**	**

 # For corner allotments
** The setback is not less than any adjoining building or the distance prescribed in Table - B5, whichever is the lesser, provided that the frontage set back may be varied to a minimum of 3 metres subject to the minimum specified in the table being retained as the average setback.*

*** Where the street carries more than 3000 veh/d an acoustic study is required to demonstrate that traffic noise will not exceed 58dB(A)L10, measured at the facade of the dwelling closest to the street.*

D2. Allotments less than 450m^2 on *access streets* and *local streets*, with *building line setbacks* described by an approved *building envelope* plan for two or more adjoining *allotments*. In the case of a single *allotment*, the *building line setback* should not be more forward than the closest adjacent *allotment*.

D3. Front fences and walls less than 1.2 metres in height.

D4. Carports between the building line and the street boundary which are compatible with the design of the dwelling.

D5. Garages on the frontage building line of the side street or rear lane.

D6. For *allotments* less than 450 m^2 or an *integrated development* the submission of a *streetscape plan* to the requirements of the responsible authority.

- The position of above ground services and the need not to obstruct them;
- The width of the verge and the location of underground utilities that might affect the longer term health of trees;
- The future level of maintenance;
- The extent that carparking will be located on the verge and the location and width of driveways;
- The need to ensure trees will not obscure lighting or design sight distances from vehicles; and
- Design objectives for providing scale and identity and enhancement of the harder elements of the urban environment such as buildings.

Streetscape is also influenced by fences that are forward of the building line. Fences of all types are to be found throughout Australia. When placed on the front property line they have often become more a symbol defining territory, rather than providing an actual protective barrier. Fences may be used to enhance the appearance of a dwelling and to extend the use of its private open space.

Practice throughout most of Australia is not to control fencing. The most notable exceptions to this is the Australian Capital Territory (A.C.T.), where front fences are generally not permitted forward of the building line. Many other exceptions have occurred throughout Australia, where local authorities consider areas to have heritage significance, or where an open landscaped appearance is established as a broad objective for an estate.

In residential developments involving common property, control over fencing is usually inevitable.

Also in streets or estates where a more unified, identifiable or higher quality streetscape is required, there may be a need to more carefully consider the effect of fences. This can be done as part of the streetscape/landscape plan, as is the practice of a number of leading residential estate developers.

Building Form and Building Line Setback

In addition to landscape planting between buildings and pavements, a major factor in the character and appearance of residential areas is the distance of buildings from streets - comprising the verge and the building setback from the front property line.

The study of codes in Australia (Scott & Furphy et. al., 1987) showed that setback requirements, while often quite extensive in the level of detail, are generally arbitrary.

There is some recognition of the type of street which a site abuts, particularly in New South Wales and Canberra. Setbacks are also, in some instances, related to site gradient relative to the boundary, with sites sloping downwards from the street requiring a lesser setback distance than those sloping up from the street.

Setbacks have also been related to site area. In Western Australia, for example, sites with areas less than 666 square metres require a setback of 6 metres, while sites of 0.5 hectares require a setback of 20 metres.

The setback requirement in almost all codes is a simple, and perhaps crude, regulatory device to protect perceived neighbour amenity, and create a suitable street appearance. However, when such setbacks are arbitrarily applied they contribute to ineffective land utilisation in residential areas. There is also a tendency to consistently build to the minimum frontage setback in order to save on utility reticulation costs (pipes and wires), such that opportunities to create greater interest in the streetscape, by siting buildings at varying setbacks, are not taken up.

The Guidelines for Cost-Effective Residential Development (JVMAH, 1986) advocates greater flexibility in building line setbacks in conjunction with the determination of allotment size, width, orientation for solar access, and intended use/performance.

Such an approach would permit, for example, a reduced frontage setback on south fronting dwellings to maximise northerly aspect of rear allotment space. It would also enable a carport and/or hardstanding car spaces between the front of the dwelling and the street, permitting the more efficient use of private open space on the allotment.

Some codes have based setbacks on a minimum distance between dwellings across a public street for reasons of privacy, but there is no evidence of complaints in this respect even in older, inner urban areas developed before any setback requirements were introduced.

Houses can be constructed with minimal frontage setback, provided traffic noise exposure is not an issue and visibility can be provided for the reverse movements of vehicles from the site to avoid unacceptable pedestrian and vehicle conflict.

Land utilisation is an important condition, as any setback requirement will limit the areas available for building on the allotment. The space in front, unless contained by a wall on the boundary, may be of limited use. With small allotments, the minimum required setback becomes a more critical issue, but provided they abut lower order streets, or are part of an integrated development, there is no reason why setbacks of less than 5 metres and down to 2 metres should not be permitted.

Building Appearance

Streetscape is also influenced by the visible design features of dwellings such as its elevation, fenestration details, gable ends and entrances. However, the control of the design of detached housing, is both difficult and unpopular. A widely held perception is that property owners should be permitted to exercise freedom of choice in design. There is also practical difficulty in formulating and then administering objective controls to prevent "inharmonious" design.

In most situations the landscaping, when it matures, will greatly reduce the visual impact of discordant elements in suburban areas, especially with dwellings not more than two storeys high.

The Research Study into Design and Siting Requirements For Small Allotments (Loder & Bayly, 1990) found no need to introduce specific controls over the architectural design of buildings on allotments in the size range of 300 to 450 square metres.

For streetscapes with more urban appearance (where building form and materials are dominant) compared to a suburban appearance, greater attention to building design is warranted. This certainly is the case for more intensive forms of housing such as villa units and town house developments, where the internal streetscape tends to take on more of an urban appearance.

The Streetscape as a Whole

The various components identified so far, should not be considered in isolation. It is the way they are combined that produces a streetscape that is not only functional but exciting.

However, there may be other considerations which determine what the street could, or should look like.

For instance, there is merit in ensuring that streets with a similar function have the same "legibility", so that drivers entering such streets learn to adjust their driver behaviour. This must be measured against the desired degree of intimacy or openess of the street. It is essentially a question of scale, and is generally related to the function of the street. For example, busy streets suggest a more expansive scale - wider verge and carriageway and larger frontage setbacks of buildings.

In some cases it will be important to require a streetscape plan to be submitted, which shows how the components are related to each other. This may be necessary for streets with groups of dwellings on lots of less than 450 square metres, streets where garages or carports are permitted up to the property line, and streets where fullheight walls (1.80 metres) are proposed.

Whether or not a plan is required, it is suggested that careful attention be given to the design of streetscapes. One way of approaching this design is to consider the degree to which the street is, or desirably should be, "urban", as contrasted to "suburban" in character. In an "urban" street, space is well defined and related to a high degree of enclosure, with built form and hard surfaces of pavement, fences, walls and faces of buildings tending to predominate over soft or green surfaces. This does not preclude the presence of trees - even large ones (particularly deciduous trees) - but it does suggest that verges might be paved footpaths rather than grass, and that the verge width would be reduced.

In contrast, the "suburban" streetscape has space that is less well defined and tends to give a softer and greener impression. The verge would be wider than for the "urban" streetscape and grassed from the carriageway edge to the building line. In many cases there will be no fence or other line of demarcation at the boundary.

The design of the streetscape will also be influenced by whether the residential development is to occur in an infill situation, or in a greenfields situation.

In greenfields situations, the designer has choice and control over the ultimate streetscape and should take the opportunity to introduce visual interest and reinforce legibility in residential areas. Residential areas will be both more interesting and user friendly if they respect and capitalise on natural attributes.

Some examples are:

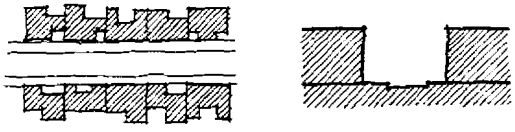
- aligning streets so as to offer vistas to worthwhile views or landmarks (including buildings);
- aligning streets along contours whenever possible to minimise cut and fill and create gentle transitions from one area to another;
- using curvature of streets to create a degree of visual openness as well as to create changing views of the streetscape;
- adjusting the setbacks of buildings from the street to emphasise or frame key aspects of the streetscape such as the street entrance and street vistas.

For more urban situations, the streetscape becomes an important issue at the time of introducing more intensive forms of residential development into an existing street. It would normally be undesirable to introduce a significantly different streetscape section into an existing street. Unless an "infill" development is of a large enough scale or is located so as to read separately from its surroundings, or the existing streetscape is an undesirable one, the infill design should take its cue from its surroundings.

The exceptions may include cases such as the small access place located off an existing street. Here, provided the entrance treatment is compatible with the existing streetscape, there is no reason why even an urban streetscape could not be considered for what might otherwise be considered as a suburban locality.

Use of the above ideas and careful consideration of the components of streetscape will provide the variety and visual interest which are the characteristics of successful residential areas. Good design can create value without added cost.

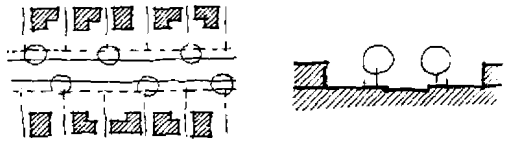
URBAN STREETSCAPE



PLAN *SECTION*

Elements are in close proximity in both plan and section, and the spaces formed are well defined

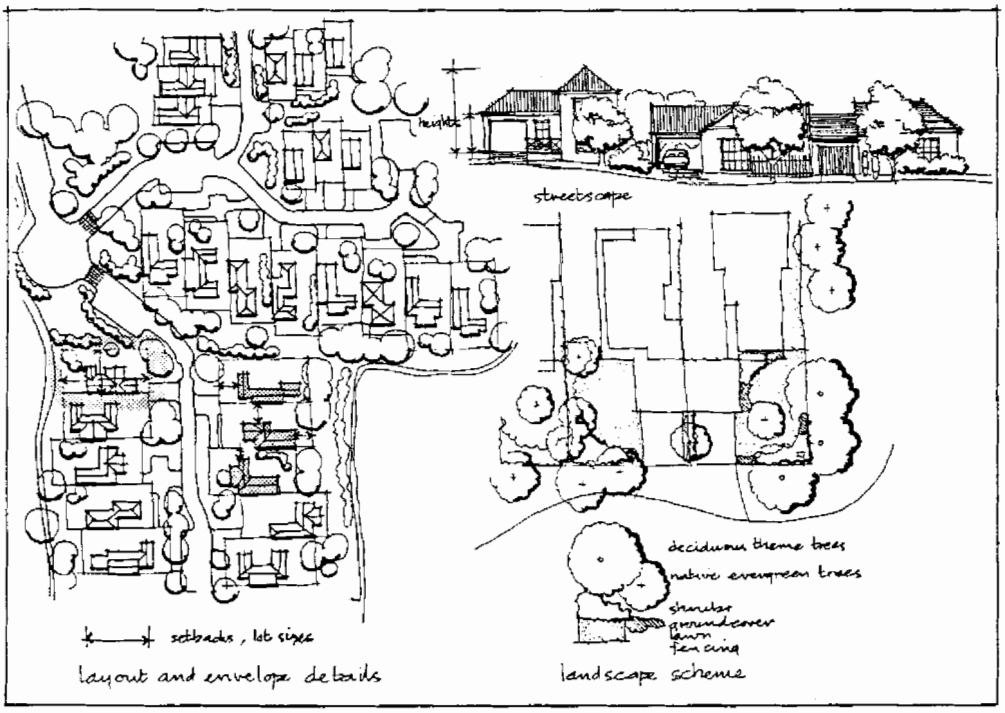
SUBURBAN STREETSCAPE



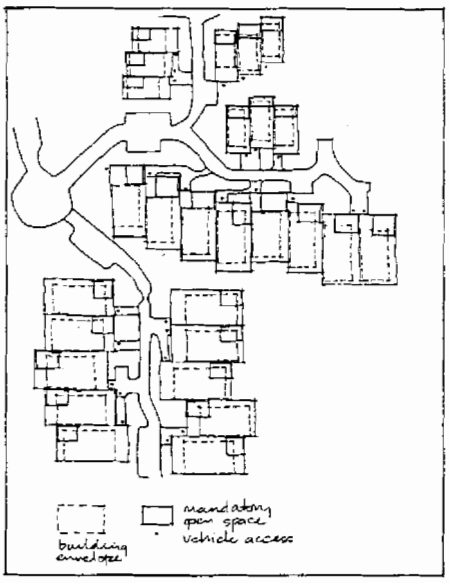
PLAN *SECTION*

Elements are more dispersed in both plan and section. The spaces are not as well defined

TYPICAL INTEGRATED DEVELOPMENT PLANS

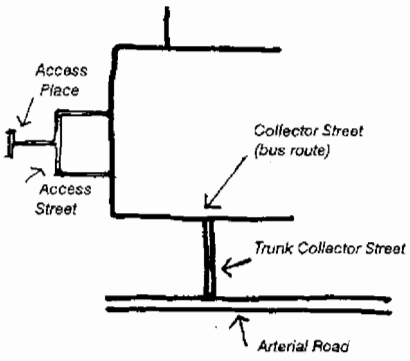


(a) Illustrative layout of development

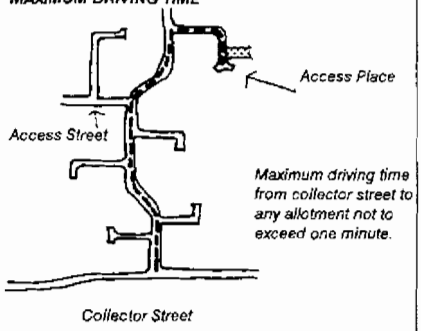


(b) Building envelope plan to accompany illustrative layout

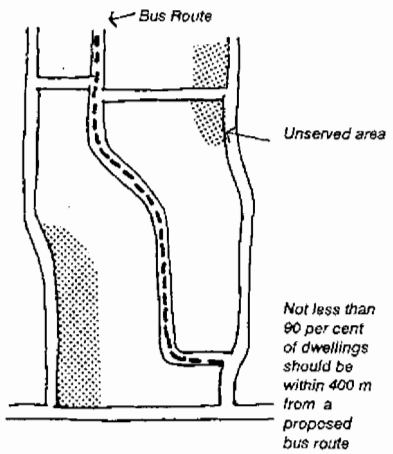
STREET/ROAD TYPES



MAXIMUM DRIVING TIME



BUS ROUTES



Performance criteria cont'd

P3. The internal street layout to conform to the requirements of the external arterial road network and satisfy the transport provisions of an outline or concept development plan which conforms to the principles of this Model Code.

P4. The design features of each type of residential street to convey its primary functions and encourage appropriate driver behaviour.

P5. Streets to link with other streets that are no more than two levels higher or lower in the hierarchy. In some circumstances, a street may link with streets more than two levels apart.

P6. Connections between residential streets to be T-junctions or controlled by roundabouts.

P7. Where *access streets or places* form part of a pedestrian or cycle network, access links should provide suitable connections to adjoining access streets or open space systems so that the pedestrian and cycle networks are functional, cost-effective and have visual supervision.

P8. The street and road network to provide for bus routes within acceptable walking distance from all dwellings.

P9. The proposed bus routes to efficiently connect with existing or likely future bus routes, to provide for ease of movement of buses between developments, and link major activity centres within and external to the development. Buses to be able to safely gain access to the development and cross arterial roads when travelling between developments and without complicated turning manoeuvres.

P10. Bus routes to be as direct as possible. The alignment and geometry of the streets that form the bus route to allow for the efficient and unimpeded movement of buses without facilitating high traffic speeds.

DEEMED-TO-COMPLY CRITERIA

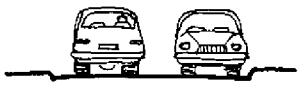
The following are deemed to meet the control element objectives and performance criteria:

D1. Street and road network conforming to a concept development plan for the area showing an existing and proposed major road network above the level of trunk collector street which satisfies projected district and regional travel.

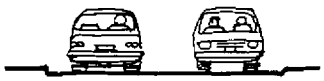
D2. At least 90 per cent of dwellings are within 400 metres straight line distance from an existing or potential bus route and not more than 500 metres from the nearest stop or potential stop.

VEHICLE SPEED & CARRIAGEWAY WIDTH

A 3.5 m carriageway allows a car to pass a cyclist (or pedestrian) at up to 30 km/h



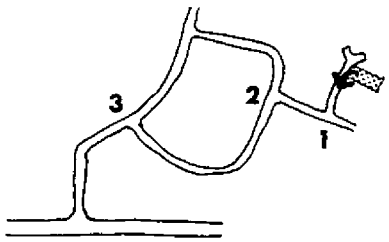
A 5.0 m carriageway allows a car to pass a parked car at up to 30 km/h or a moving car or truck at up to 20 km/h



A 6.0 m carriageway allows a car to pass a moving car or parked truck at up to 40 km/h or a moving truck at up to 30 km/h

A 6.5 m carriageway allows a car to pass a moving car at up to 50 km/h or a moving truck at up to 40 km/h

MAXIMUM TURNING MOVEMENTS



No more than three turning movements should be required between any address and the nearest collector street, or arterial road. Street design and other features should enhance legibility.

In steep terrain more turning movements may be required

Deemed-to-comply criteria cont'd

D3. The streets suitable for bus routes through the development are no more than 30 per cent longer than those available on the arterial network.

D4. The street network has the characteristics specified in **Tables B6-1 and B7-1.**

TABLE B6-1 CLASSIFICATION OF STREETS AND ROADS

Type	Maximum[1] traffic volume (veh/d)	Maximum speed (km/h)
Residential Streets		
Access Place	300	15
Access Street	1000	30
	2000	40
Collector Street	3000	50
Trunk Collector	6000	60
Traffic Routes[2]		
Sub-arterial Road	20000	
Arterial	30000	
Regional Arterial	50000	

(1)Maximum 24 hour volumes
(2)Approximate limits

D5. Trunk Collectors are less than 150 metres in length, except where the topography or the location of arterial and sub-arterial roads make a longer distance unavoidable.

D6. No access street connects directly to a Trunk Collector or higher order road.

D7. No more than three turning movements at intersections or junctions are required in order to travel from any address to the most convenient collector street or higher order road.

D8. Internal intersections are either T-junctions or roundabouts.

D9. For safety reasons, internal road junctions are spaced as set out in **Table B6-2.**

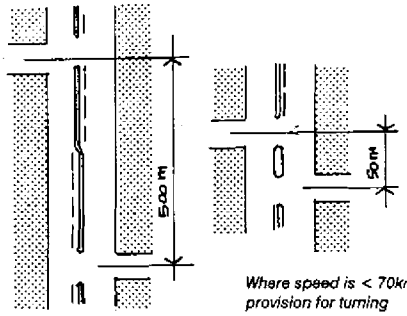
Deemed-to-comply criteria cont'd.

D10. The desired maximum street speeds, specified in **Table B6-1**, are achieved according to the following design principles.

Table B6-2 MINIMUM JUNCTION SPACING

	Typical Average Junction Spacing (Metres)	Speed (km/h)	Minimum spacing of Staggered Junctions Left/Right Stagger	Right/Left Stagger
Access Place	n.a.		n.a.	n.a.
Access Street	40		20	20
Collector Street	40		20	20
Trunk Collector	n.a.		20	n.a.
2-lane Sub-arterial	100		60	30
3-lane Sub-arterial	150		100	30
Div. Sub-arterial	300		150	50
Div. Arterial	500	<71	150	50
Div. Arterial	500	>70	200	50
Div Major Arterial	1000	>80	250	50

ARTERIAL ROAD INTERSECTION SPACING



Where speed is < 70km/h provision for turning movements may be determined by gaps in the traffic stream and vehicles turning from side streets

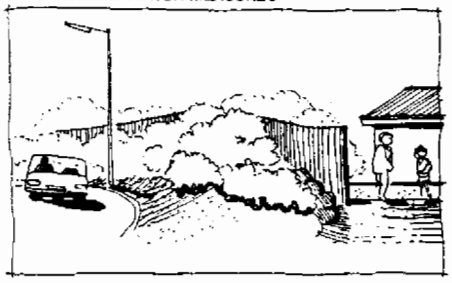
Where speed is > 70 km/h allowance should be made for acceleration and weaving distance

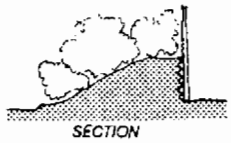
Limiting Street Length

D11. Street length defined as the distance between intersections or junctions, or points and locations where vehicles must slow to a maximum of 20 km/h.

D12. Design speed defined as a speed fixed for the design and correlation of those geometric features of a carriageway that influence vehicle operation. Design speed not less than the highest 85 per cent of the maximum operating speed (i.e. the speed which is not exceeded by 85 per cent of vehicles).

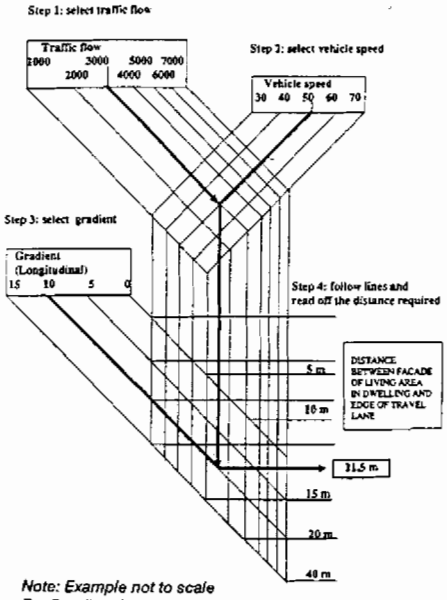
NOISE REDUCTION MEASURES





Treatment of the street verge to reduce the impact of noise on residential properties

NOISE LEVEL CHART



Note: Example not to scale
For Details refer
PakPoy & Kneebone, 1989

Chart showing the calculation of the desired setback from the carriageway to ensure appropriate noise levels are not exceeded at the facade of the dwelling

Deemed-to-comply criteria cont'd

D13. Where the street length is limited in order to control vehicle speed, the lengths specified in **Table B6-3** shall be used

Table B6-3 STREET LEG LENGTH AND DESIGN SPEED

Street Leg length (metres)	Design Speed (Km/h)
40	25
75	30
100	35
120	40
140	45
155	50

D14. For down grades between 5 and 10 per cent the maximum speed is increased by 5 km/h; for grades of 10 per cent and more, the maximum speed is increased by 10 km/h.

Introducing bends

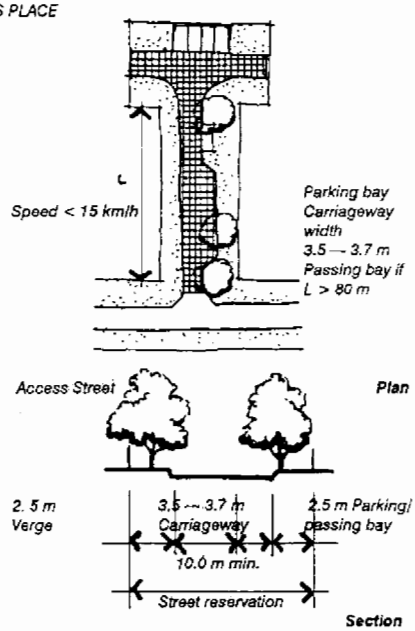
D15. Where bends are introduced, the radius of the bend in relation to the maximum speed shall be as set out in **Table B6-4.**

Table B6-4 RADIUS OF BEND AND MAXIMUM SPEED

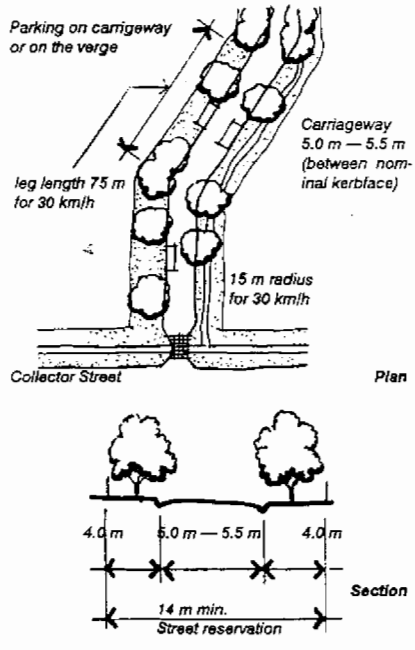
Desired Max'm Vehicle Speed (km/h)	Appropriate Curve Radius Continuous Series of Bends(1) (metres)	Isolated Bends or in a Chicane(2) (metres)
20	15	10
25	20	15
30	30	20
35	50	30
40	90	40
45	105	50
50	120	60
55	140	70
60	160	80

(1) Based on field surveys (Stapleton, 1988)
(2) E + F = 0.35

ACCESS PLACE



ACCESS STREET



Deemed-to-comply criteria cont'd.

Introducing slow points

D16. *Slow points* are lengths of a road or street which have geometric features which limit the travel speed of vehicles. These include bends, constrictions to carriageway width, humps, etc. some of which are illustrated on Page 48.

D17. Where *slow points* are used with or without bends in order to achieve a prescribed speed, the length of street between slow point or bend complies with the distances specified in **Table B6-5**, subject to the conditions set out below.

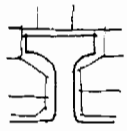
Table B6-5 SPEED AT SLOW POINT OR BEND AND LENGTH OF STREET BETWEEN SLOW POINTS OR BENDS

Speed at SlowPoint/ Bend, etc (km/h)	Length of Street (m) Between Slow Points/Bends to limit Maximum Street Speed to (km/h)					
	25	30	35	40	45	50
20 or less	40	75	100	120	140	155
25	-	45	60	80	100	135
30	-	-	45	65	80	115
35	-	-	-	50	65	100
40	-	-	-	-	55	80
45	-	-	-	-	-	60

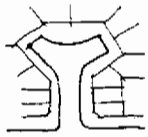
There are conditions where slow points are not appropriate. These are set out in Element B7.

ALTERNATIVE CUL-DE-SAC HEADS
for cost-effective provision of turning movements.

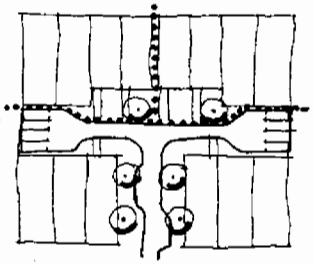
Square Offset



T Heads



Y Heads



Carriageway 3.5 - 3.7 metres

Example of an access place with small lots

Deemed-to-comply criteria cont'd

D6. The geometry of streets identified as bus routes which are suitable for the turning, stopping sight distance, grade and parking requirements of buses as determined from appropriate design documents.

D7. Bus stops which prevent vehicles from overtaking a stationary bus or where vehicle speeds are reduced to ensure safe pedestrian crossing.

D8. Street design which ensures the appropriate driver behaviour required along particular street sections or at particular points, and which avoids sudden and unexpected changes in driver behaviour.

D9. Cross-fall on street pavement which are between 0.025 and 0.040 metres (fall) per metre (width).

D10. Longitudinal gradient which does not exceed 15 per cent except on access streets which may have grades up to 20 per cent.

D11. All vehicle turning movements which are accommodated by utilising NAASRA Design Vehicles and turning Templates, as follows:

- for turning movements involving trunk collector or collector streets, the "design semi-trailer" with turning path radius 12.5 metres;
- for turning movements involving access streets or collector streets but not trunk collectors, the "design single unit" truck with turning path radius 12.0 metres;
- for turning movements on access streets but not involving trunk collectors, collector streets or access streets, the "design car" with turning path radius 7.5 metres;
- for turning movements at the head of access places, sufficient area for the "design single unit" truck to make a three-point turn. Where the length of the access place is less than 60 metres for the "design car" to make a three-point turn. Where driveway entrances are to be used for turning movements, the required area is to withstand the relevant loads.

D12. Turning radii at intersections or driveways on collector streets which accommodate the intended movements without allowing desired speeds to be exceeded.

D13. Separate entry and exit driveways 3.0 metres wide on Trunk collector streets.

D14. Roundabouts designed according to NAASRA guidelines, including the provision of adequate sight distances.

APPENDIX F

CONCURRENCE LETTER AND MAP

FROM THE DEPARTMENT OF ENVIRONMENT AND CONSERVATION

Department of
Environment and Conservation (NSW)

Our reference : DOC04/16243; 04/01
Contact : Robert Humphries, 9585 6952

Mr Kerry Yates
General Manager
Wyong Shire Council
PO Box 20
WYONG NSW 2259

Attention: Scott Duncan, A/Landuse Planning Manager

Dear Mr Yates

Various proposed residential developments at Wadalba and deemed concurrence of the Department of Environment and Conservation

Council's Landuse Planning Section has been liasing with the Department of Environment and Conservation (DEC) with respect to a number of development applications at Wadalba over the past 12 months. Council determined that five of these proposals were likely to have a significant impact on threatened species and subsequently advised the proponents to prepare separate species impact statements in accordance with Part 5A of the *Environment Planning and Assessment Act*. Council would have been required to request the concurrence of the DEC for each of these developments. However, in order to streamline the process and provide greater certainty for both development and conservation outcomes, the DEC suggested a more strategic approach for the proposed developments in Wadalba.

In February 2004 the DEC indicated that it was prepared to provide a 'deemed' concurrence for all developments in the area, pursuant to Section 64 of the *Environment Planning and Assessment Regulation* 2000, provided that conservation issues were addressed in a strategic manner.

Council subsequently engaged an independent consultant to undertake an assessment of the habitat and corridor values of the naturally vegetated areas of the subject lands. The study identified a footprint of a preferred conservation area (wildlife corridor) whilst the remaining areas were identified as being available for development without impacting on conservation values. The DEC subsequently participated in several meetings between Council and Peter Johnson, of Johnson Partners, representing the various landowner/ proponents including AV Jennings, Bellvale Homes, Westminster Homes and a number of individual landowners, to 'fine tune' the footprint and develop some accompanying fundamental conditions with which the Department's concurrence could be assumed.

The DEC understands that Council has now obtained agreement from all of the relevant land holders regarding these conditions and that the area identified in the attached map as wildlife corridor (shown in green crosshatched), is to be transferred to Council ownership, rezoned to an appropriate conservation zoning and managad as community land. Appropriate arrangements must be put in place to ensure that this occurs so that concurrence of the DEC can be assumed.

PO Box A290 Sydney South NSW 1232
59-61 Goulburn St Sydney NSW 2000
Telephone (02) 9995 5000
Facsimile (02) 9995 5999
ABN 30 841 387 271
www.environment.nsw.gov.au

Accordingly, I advise that Council can assume my concurrence for all developments in the blue stippled areas of the subject land (depicted within the black line of map - F2004/06924 attached) in accordance with Section 64 of the *Environment Planning and Assessment Regulation* 2000 subject to the following conditions:-

1. A management plan (MP) is to be prepared and implemented for the identified wildlife corridor (green crosshatched areas on Map F2004/06924) to the satisfaction of the Director General of DEC prior to release of construction certificates for any developments in accordance with this assumed concurrence.

    - The MP will need to address a range of issues including signage; weed control; bushfire management; rubbish dumping; prohibited uses; cultural values; community education; stormwater structure management; storm water quality; community vigilance and reporting; habitat enhancement initiatives including artificial hollows; habitat tree relocations/maintenance; frog habitat features; and a monitoring and reporting regime that requires a biannual report being forwarded to DEC.

2. All necessary fire protection measures (asset protection zones, fuel free and fuel reduced zones) are to be contained within the blue stippled areas as depicted on the attached map and are not to impact on the wildlife corridor area.

3. Placement and construction of any detention/water treatment structures required within the wildlife corridor are located sensitively and designed and landscaped to enhance habitat values for threatened amphibians and mitigate identified Key Threatening Processes (eg. *Gambusia* and frog chytrid).

4. Services such as water, sewer, power and telecommunications that are unavoidably required to be within the wildlife corridor are to be sensitively placed so as to avoid, protect or retain known habitat features (eg hollow bearing trees, dams, drainage lines etc)

5. The four proposed road crossings that traverse the conservation corridor area identified on the attached map are to be designed with features to assist with fauna movement and to reduce mortality. (eg underpasses, landscaping, lighting issues, speed suppression, glide poles – as appropriate).

6. Properties adjoining, abutting or adjacent to the wildlife corridor (including those separated by only a roadway) are to be provided with a restriction as to user covenant with respect to cat ownership; and

7. A community education strategy (as described in the management plan in point 1 above) is to be developed prior to release of construction certificates for any approved developments in the blue stippled areas of the subject land and implemented by the proponents that raises resident/landowner awareness of the purpose of the corridor, its biodiversity/ecological and cultural values, the need for long term management and the desired community role in assisting with meeting these objectives.

    - This will likely take the form of a brochure/pamphlet that identifies key issues of the corridor area. Provides a map depicting the development/subdivision lot layout, the corridor and the corridor/vegetated areas, identifies affectations/restrictions/ covenants on lots, sensitive areas within the corridor etc. It should explain the actions residents can take to ensure corridor values are maintained or enhanced. The specific values the corridor habitat area is known to contain and where additional or more detailed information can be obtained (this might be a web link to copies of the various digital reports).

Should you require any additional information regarding the above, please contact Robert Humphries, Manager, Metro Threatened Species Unit on 02 9585 6952 or at robert.humphries@environment.nsw.gov.au.

Yours sincerely

TONY FLEMING
Acting Director General
24/12/01

ENVIRONMENTAL CORRIDOR
WADALBA

PLAN OF CORRIDOR EXTENTS
F2004/06924 DWG 1