Assessing amenity issues

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What's in a DA?

Assessing amenity issues

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1. Introduction

Councils do a lot of things, and much of what they to is the subject of the planning process. But when we couple the two terms 'planning' and 'development' we usually converge to a fairly narrow understanding — that the development approval process is about protecting the continuing amenity of our physical environment. If we look at the introductory paragraphs of almost any Council's website entry, under its planning and development link, we find something like:

> We aim to protect and enhance the quality of the built environment.
> To meet this aim we will ensure:
>
> - Areas of special character and of heritage significance are protected and enhanced.
> - New development complements existing development and respects neighbouring amenity.
> - New development meets the needs of existing and likely future residents.
>
> This Division ensures environmental protection and the enhancement of the local area through the control of development, design and planning, whilst adhering to Local & State Government regulations and our own Policies and Codes.

So what is amenity?

> a·men·i·ty (ə-mĕn'ĭ-tē, ə-mē'nĭ-)
> *n. pl.* a·men·i·ties
>
> The quality of being pleasant or attractive; agreeableness.
>
> Something that contributes to physical or material comfort.
>
> A feature that increases attractiveness or value, especially of a piece of real estate or a geographic location.
>
> *Synonyms: amenity, comfort, convenience, facility*
> These nouns denote something that increases physical ease or facilitates work……..

From this we can derive one of two different perspectives. In the first, amenity is a fairly precise notion from which springs a checklist of attributes, against which any proposed development may be measured to gauge whether it enhances — or at least protects — the environment. In the second possible view, amenity is that soft and cuddly 'comfort' or 'pleasantness' concept, determined by subjective reaction to the actual, measurable variables of the physical environment, which are more properly assessed by detailed performance projections.

Aspects of residential amenity have acquired great importance due to the influence of State Environmental Planning Policy 65 - Design of Residential Flat Buildings. SEPP65 highlights problems of assessing appropriate projected building performance to achieve compliance, both for the designer and for the approving authority.

This paper draws attention to the considerable expertise now required for such assessment. In particular, it raises the problem that failure to achieve prescribed quantitative measures often does not mean that proposed designs will fail to comply with the Policy's more complex performance criteria. The issues relate to all aspects of amenity. But they are notably heightened in the control of solar access and natural ventilation, on which this paper focuses.

We should, by rights, distinguish between the desired amenity of the public domain and the private. As will become increasingly clear, the instruments to regulate the impact of private development on the public domain are not well developed. In contrast, typical development control plans have some quite rigorous controls to protect the right to enjoyment of private property, when neighbours seek to develop. But ultimately our most stringent and complex controls are reserved for multi-dwelling development.

2. Mandating amenity

2.1 Residential Development Control Plans

Where local government authorities mandate minimum standards of amenity, they have traditionally done so by provisions in their Development Control Plans (DCP's), sometimes with reference to other documents such as a more general code for energy efficiency.

DCP provisions are usually aligned with one of two model codes, being the NSW Department of Planning *Residential Development Controls* of 1990, and the *Australian Model Code for Residential Development* (AMCORD 95). These two models provide different levels of stringency, especially with respect to sun access and overshadowing, and it is not uncommon for applicants to refer to this discrepancy when seeking exemption from full compliance with Council's requirements.

2.2 SEPP65 and the Residential Flat Design Code

As of two years ago, when SEPP65 was announced, the Residential Flat Design Code which gives it substance has dominated the compliance process for all proposals with medium and high rise multi-dwelling components. The role assumed by the RFDC is made clear on page 1 of the .*Introduction*:

> *The Design Code is a set of guidelines that provide benchmarks for better practice in the planning and design of residential flat buildings. The application of this code will help achieve:*

- *environmental sustainability benefits through design including improved energy efficiency (p.93) and narrow building depths for natural ventilation (p.86) and daylight (p.84)*
- *improved residential amenity such as greater ceiling heights (p. 73), better apartment layouts(p.67) and quality outdoor living spaces (pp. 46, 48)*
- *higher design quality to improve the presentation of the building to the street, for example by removing garage entries from main streets (p.65) and screening car parking behind other uses (p.62).*

But if one relied only on the structure of the RFDC, as evidenced by the table of contents, one could be seriously misled as to the scope of what is considered amenity.

2.2.1 The public domain

The realm of the *public domain* is covered by Parts 1 and 2 of the RFDC. In these parts of the Code we find only:

Part 02 .Site Design

Site Amenity

- *Safety*
- *Visual Privacy*

Herein lies the first and major problem with both the RFDC and many of the Development Control Plans, that the true scope of the amenity issues they regulate is considerably greater than first appears. Thus, in the body text of *.Site Configuration .Open Space*, we find rather more detailed clues as to the range of amenity variables:

The primary function of open space is to provide amenity in the form of:

- *landscape design*
- *daylight and ventilation access to apartments*
- *visual privacy*
- *opportunities for recreation and social activities*
- *water cycle management. (see Stormwater Management)*

A second problem becomes apparent in that the *objectives* and the *design practices* derived from this checklist spell out no particulars of performance, either suggested or required. We are instead referred to the section of the RFDC which deals with building design — but not surprisingly, that section elaborates the required amenity almost exclusively for the individual apartment occupier.

2.2.3 The private domain

When it comes to thoughtful and holistic guidance as to the amenity of individual apartments, Part 3 *.Building Design* of the RFDC could be said to take a significantly more comprehensive approach. Amenity considerations inform almost every subsection of this part of the Code, beginning with the very first, *.Building Configuration .Apartment Layout.* It is worth quoting the opening paragraph:

The internal layout of an apartment establishes the spatial arrangement of rooms, the circulation

- *between rooms, and the degrees of privacy for each room. In addition, the layout directly impacts*
- *the quality of residential amenity, such as access to daylight and natural ventilation, and the*
- *assurance of acoustic and visual privacy. The apartment layout also includes private open space.*

Equally telling is that even this most general of introductory sections concludes with *rules of thumb* that specify very particular quantitative standards. Thus:

Rules of Thumb

- Single-aspect apartments should be limited in depth to 8 metres from a window.
- The back of a kitchen should be no more than 8 metres from a window.
- The width of cross-over or cross-through apartments over 15 metres deep should be 4 metres or greater to avoid deep narrow apartment layouts.
- Buildings not meeting the minimum standards listed above, must demonstrate how satisfactory daylighting and natural ventilation can be achieved, particularly in relation to habitable rooms (see Daylight Access and Natural Ventilation).
- If council chooses to standardise apartment sizes, a range of sizes that do not exclude affordable housing should be used. As a guide, the Affordable Housing Service suggest the following minimum apartment sizes, which can contribute to housing affordability: (apartment size is only one factor influencing affordability)
  - 1 bedroom apartment 50m²
  - 2 bedroom apartment 70m²
  - 3 bedroom apartment 95m²

.Residential Flat Design Code .Part 03 .Building Design Page .69

Subsequent sections, such as *.Balconies, and .Ceiling Heights* expand on these particulars with further recommended standards, usually of minimum dimensions and expected inclusions.

One of the most influential sections of the RFDC is *.Internal Circulation*. This section has strong prescriptions tending towards multiple 'vertical cores' and short internal corridors. The drivers for this, apart from more general considerations of identity and scale, are the provision of appropriate natural light and ventilation to the common spaces of apartment buildings.

In this part of the RFDC dealing with the individual building, the section headed *.Building Amenity* more closely conforms with expectations, in that it addresses:

- acoustic privacy,
- daylight access and
- natural ventilation.

However, there is significant variability of how satisfaction of the requirements of these parameters may be measured or demonstrated.

2.2.3 Acoustic privacy

The section on *.Acoustic Privacy* is brief. It gives practical guidance on apartment layout to design out noise control issues. But unlike many of the sections of Code, it resolves down to no qualitative standards at all.

This is understandable if one realises that noise control performance is the subject of a great multiplicity of compliance instruments generated by an equally great number of relevant agencies, and including Australian Standards. Acoustic performance is properly the subject of another paper.

2.2.4 Daylight/Sunlight and Natural ventilation

.Daylight Access is a potentially confusing section of the Code, including as it does the regulation of *sun access* and *overshadowing*. Together with *natural ventilation* these two parameters of amenity are possibly the most contentious of the technical matters which are the subject of planning control.

In practice both the RFDC and the usual local controls in DCPs resolve to relatively simplistic rules of thumb, the more especially in the area of natural ventilation. But a proper consideration of both of these parameters of residential design should really be in terms of criteria that describe overall performance, with the clear objectives of achieving both comfort and energy efficiency. Separate Attachments A and B expand on these two topics at much greater length.

3. BASIX

3.1 What is BASIX?

The Building Sustainability Index, or BASIX, is a web-based planning tool designed to assess the potential performance of residential developments against a range of sustainability indices. The first stage of BASIX focuses on Water and Energy, for which targets are set. Landscape, Stormwater and Thermal Comfort indices are also activated because information relating to these indices impacts on water consumption and greenhouse emissions.

BASIX asks for information about a proposed development, such as site location, dwelling size, floor area, landscaped area and services. BASIX compares the proposal to the average of existing housing stock. The proposal is scored according to its potential to consume less potable water or energy than the average existing dwelling.

Building applicants will be responsible for undertaking a BASIX assessment for each residential development proposal as part of the development approval process in NSW. The BASIX tool is accessed via the BASIX website, www.basix.nsw.gov.au.

3.2 How and when will BASIX be implemented?

BASIX has been introduced as a mandatory component of the development approval process in NSW under the Environmental Planning and Assessment Act 1979, through the Environmental Planning and Assessment Amendment (Building Sustainability Index (BASIX)) Regulation 2004 and State Environmental Planning Policy 75 - Building Sustainability Index (BASIX).

Applications for certain residential development proposals which require development consent must be accompanied by a BASIX Certificate before they can be assessed and development consent granted.

From 1 July 2004, development applications and complying development certificates for new single dwellings lodged in Sydney must be accompanied by a BASIX Certificate confirming compliance with the government's sustainability targets. From 1 October 2004, a BASIX Certificate must also be lodged with applications lodged in Sydney for new multi-dwelling development. The remainder of NSW will be subject to BASIX for all new housing from 1 July 2005. Additionally, from 1 October 2005, BASIX will also apply to alterations to existing residential development throughout NSW.

3.2 The significance of BASIX

The text above has been quoted directly from the DIPNR website of the recently released public exhibition of this newest SEPP.

As with all SEPPs, the application of BASIX will prohibit local government from applying any other regulatory instruments to matters covered by the SEPP. It is therefore not entirely clear just whether some aspects of amenity, most especially in solar access and overshadowing presently regulated by the combination of DCPs and the RFDC, will continue to be the subject of those controls.

Attachment A:

Issues of solar access and energy efficiency

Steve King

1.0 Introduction

1.1 The need for sunshine

Human beings' 'need' for sunlight seems rooted in evolution in natural conditions, and the extremely short distance in biological terms by which we have moved beyond this. It has proved extremely difficult to quantify. Generally, surveys show that people 'need' what they have, and are therefore inconclusive.

Little recent research has been done on social dimensions of preference for sun in dwellings. Dutch researchers in 1967 found that housewives expressed a preference for sunlight rather than a fine view from their living rooms, but no similar studies have been conducted in warmer climates. Brierley, in the U.K., concerned with low-rise, high density housing, concluded that the 'reasonable' spacing for privacy will usually 'automatically' allow for sufficient sunshine.

Studies have been conducted to try and determine why occupiers value sunlight, but have come up only with keywords suggesting romantic rather than pragmatic views: that it contributes to the 'feeling of warmth', 'pleasantness', 'sparkle' of interiors. It has been suggested that a view of sunlit surroundings may be enough to fulfil these. A *disinfectant* function of sunlight has long been recognized, and has entered the folk adages of many cultures, contributing to the reluctance to dispense with some sunshine in the home.

These various factors have led to the relatively recent attempts to incorporate provisions for minimum sunshine in a number of building codes. The inexactitude of knowledge in this area is reflected by the variety of the provisions. The basic principles still applied today, were laid down after World War 2.

In N.S.W. the Bunning Report of 1944 stated that a proposed building should not reduce to less than one hour the sun falling on the living room and main bedroom windows of an adjoining building between 9am and 3pm. This form of specification remains the one favoured by most local authorities, but the required period has been increased to either two, three and even four hours.

Various Municipal Councils in N.S.W. have in the past tried alternative approaches to specify varied periods of sunshine, on quite different percentages of variously elevated horizontal planes of adjacent blocks, with or without specifying times of the day, or periods of the year. This form of specification is/was favoured by those councils more preoccupied with 'solar opportunity' on the majority of undeveloped blocks in their area.

It is important to note that all such codes only seek to ensure sunshine reaching the building. It is up to the designer what to do with it.

1.2 Solar access: energy and amenity

Since the 1970's oil crisis, there has been some emphasis in state and local government policies on energy efficient design of dwellings. This has intensified more recently in response to the heightened awareness of the contribution of domestic household energy use to the generation of greenhouse gases.

As part of the strategy to reduce household energy use for heating and cooling, passive solar design has been encouraged by most jurisdictions. Conventional passive solar design is applicable in much of temperate Australia. All design guidelines for dwellings since the early 1970's have reflected this emphasis. The chief consequence has been a concern with protecting solar access for northerly facing windows of existing dwellings, and potential north glazing of future dwellings on vacant land.

More recent research following the introduction of widespread mandated house energy ratings has suggested that much of the individual home market is dominated by project home designs that are relatively insensitive to orientation. The thermal performance of these project homes is likely to be rather less influenced by solar gain than had been assumed. To this finding might be added the difficulty of predicting by calculation the likely impact on the energy use of any typical dwelling of marginal variations in solar gain. It quickly becomes apparent that in enforcing minimum solar access requirements, approving authorities would have problems relying on objective comparative measures where these conflicted with other considerations in a development application.

On the other hand, amenity resulting from guaranteed winter access to sunshine in much of Australia is relatively easy to demonstrate, both in terms of thermal comfort opportunities, and in terms of various other factors contributing to the usability of private outdoor space.

1.3 Mandating solar access

Where local government authorities mandate minimum solar access, they usually do so by provisions in their Residential Development Control Plans, sometimes with reference to other documents such as a more general code for energy efficiency. These DCP provisions are usually aligned with one of two model codes, being the *NSW Department of Planning* Residential Development Controls of 1990, and the Australian Model Code for Residential Development (AMCORD 95). These two models provide different levels of stringency, and it is not uncommon for applicants to refer to this discrepancy when seeking exemption from full compliance with Council's requirements.

When solar access standards are disputed by applicants, Councils should be wary of relying on their requirements being based on the NSW *Department of Planning* Residential Development Controls. In my opinion, the provisions of that document are unsafe. Specifically, they are:

- *Ambiguous*, in that, the recommendations fail to make clear whether it applies to adjacent properties, or to within a proposed development. It may be inferred that the former is more likely.
- *Anomalous*, in that the Explanatory Notes, Solar Access specifies, *inter alia* "The predominant feature is that access decreases as density increases…….", but Clause 2.7.2 Sunlight Standards specifies only one access standard independent of density.
- *Insufficiently specified*, in that they make no reference as to what *portion* (eg. living space glazing) of the dwelling, or what *proportion* of open space they are applicable.

AMCORD recommends slightly less stringent solar access criteria, but makes some nominal distinctions between amenity and energy objectives.

2.0 Demonstrating compliance in applications

2.1 The Shadow Diagram

For demonstrating compliance of proposed designs with minimum projected solar access, the ubiquitous requirement is submission of Shadow Diagrams.

Such diagrams are always specified as plan projections for mid-winter, with some Councils also requiring Equinox and possibly Summer projections. Most commonly, the diagrams required are for 9am, 12 noon and 3pm. This bracket of time is itself based on notional usefulness of the received solar radiation as an energy source.

Some Councils explicitly require documentation of projected shadows at the same times on potentially affected building elevations. In my experience this requirement is rarely if ever enforced.

2.2 Why are shadow diagrams always wrong?

This rhetorical question deserves serious attention. In fact, shadow projections on an hourly or less frequent basis, almost always only in plan, are a very poor basis for establishing compliance with minimum guaranteed solar access. There are a variety of reasons for this:

- Shadow diagrams are onerous and time consuming to construct.
- Plan projections rarely contain much of the relevant information, such as accurate response to slope, etc. because the 3D geometry is difficult to visualise.
- Detailed answers to questions of solar access, to points of interest (such as windows) in vertical planes of different orientations and heights, are difficult or impossible to infer from plan projections.

In addition, shadow diagrams are prone to error and abuse through several mechanisms:

- *Wrong orientation.* The prime source of this error is the use of Magnetic North from survey plans. All solar projection relates to True North. In critical situations, typically involving narrow separation of buildings, this error can easily make the difference between apparently complying design, and severe and unacceptable overshadowing.
- *Misreading of sun position information.* The standard graphic source of apparent sun position data is unfamiliar in construction, and often misread by infrequent users.
- *Operational failure* of the projection. In other words, someone didn't know how to cast shadows.
- *Approximate or distorted shadow lengths.* This may be deliberate, or the result of incompetence. Even competent shadow casts may result in such distortion (usually in the applicant's favour), because the reference plane onto which the shadows are cast is arbitrary and elevated above natural ground level.
- *Misunderstanding of the 3D geometry* necessary to translate from sun angles relating to North, to those seen in the conventional architectural drawings — which are usually orthographic to the main walls of the building. Usually confusion of Altitude and Vertical Shadow Angles.
- *Missing detail.* Most commonly shadows of vegetation and other obstructions. Though the reasons for such omissions may be various, they invariably affect the judgement of comparative degrees of overshadowing.

So why are such Shadow Diagrams required by Councils, and obligingly provided by applicants? Because they are intuitive to look at — they look vaguely like the shadows that may eventuate. Yet, put simply, a shadow diagram cannot answer the key question: how much sun does a particular point in space receive?

All alternative means of analysing and presenting the solar access data are less intuitive abstractions.

2.3 Preferred analysis tools

There are a number of representations of solar access and overshadowing, which emphasize the representation of sunlit periods, rather than shaded conditions, and do so with much greater precision than shadow diagrams.

2.3.1 Computer based

Computers may be used to produce normal shadow diagrams, if the 3D model of the building and potentially affected surfaces have been entered. These may be animated, etc. and even accurately rendered. However, that is not the preferred use of the computational power, as the legibility of cast shadows is still deficient.

The preferred output from a comprehensive computer model is views of the building and its environs from the direction of the sun. Such views clearly and unambiguously distinguish sunlit from shaded surfaces — only sunlit surfaces can be seen.

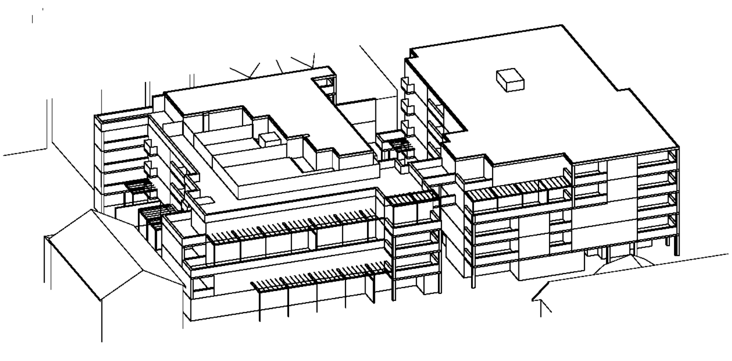

Figure 1 View from the direction of the sun

2.3.2 *Computer or manually based*

The most powerful of all technique for answering precisely how much sun a point receives over a whole year can be carried out readily by both manual and computing methods. It consists of projecting onto the stereographic sun position diagram the horizontal and vertical 'shadow angles' subtended from the point of interest by potential obstructions. Computers speed up the computation and representation.

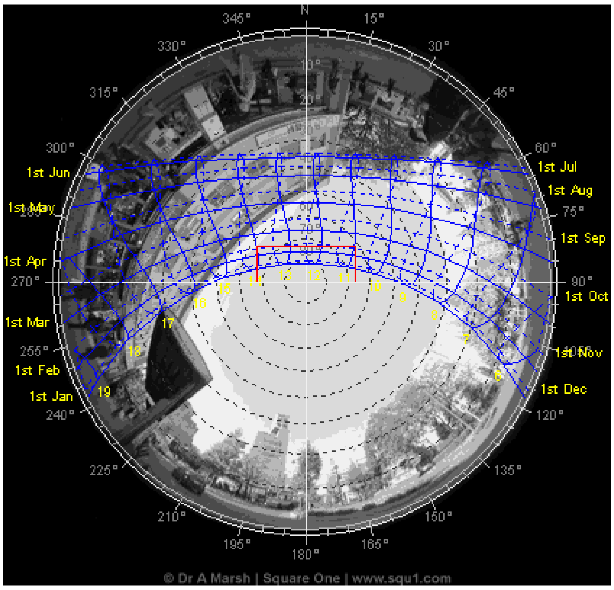

Figure 2 Potential obstructions superimposed on stereographic diagram of sun positions

2.3.3 *Manual analysis*

SUNLIGHT INDICATORS

Effectively a derivation of the previous technique, but most suitable where only key dates of the year are of primary interest, pre-printed Sunlight Indicator templates may be used as transparencies superimposed on the hard copies of conventional architectural drawings. Relying only on simple computation of relative levels, they yield impressively accurate schedules of shaded and sunlit times for individual points in space.

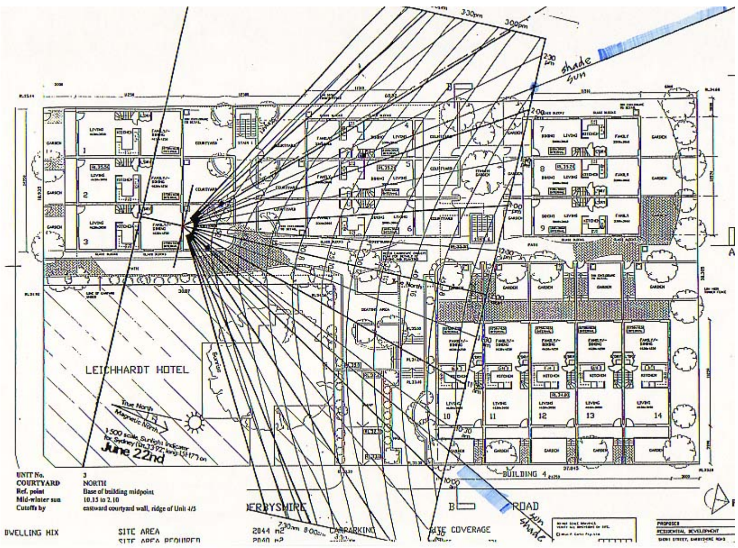

Figure 3 Sunlight Indicator for Sydney, June 22 superimposed on plan.

Sunlight indicators are by far the quickest and most effective way for Council staff to carry out compliance checking.

MODEL STUDIES

Where physical models are produced for other purposes, they may be examined for solar access and overshadowing by use of a simple polar sundial. The accuracy of the shadows is dependent on the distance of the light source, and the alignment between model and sundial.

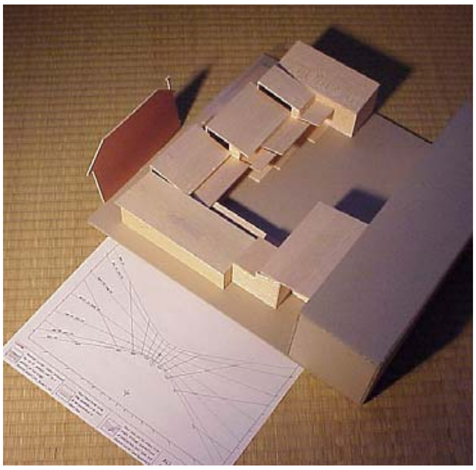

Figure 4 Model with polar sundial

Model studies may be recorded by photography, and minuted. They are particularly well suited to pre-application conferencing.

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Attachment B:

Assessing natural ventilation

Steve King

Introduction

Considerable confusion exists with regard to the ventilation of apartments. Whilst SEPP 65, Principle 7 - Amenity - refers to "natural ventilation", supporting documents specify or describe "cross ventilation". The paper explores concepts of ventilation, describes the necessary conditions for natural ventilation to be effective, and considers the need for, and advantage of, cross ventilation.

Basic concepts of ventilation

Air change

At its most basic, ventilation is required to exhaust air from an interior, and replace it with 'fresh' air. Historically such air change served to remove pollutants such as combustion products and water vapour, generated by cooking and heating. Since the 19th-century, minimum ventilation rates have been invoked in various building codes and standards, usually by way of prescriptions for required openings. However, the most important role of ventilation in warmer climates is to remove accumulated heat gains during overheated periods. In all of these cases, ventilation is intended to achieve *predicted rates of volumetric air change.*

Impact on people - thermal comfort

Also important in warmer climates is the role of ventilation in directly improving the perception of thermal comfort by occupants of a space. This is achieved when, by passing over the skin, moving air aids the evaporation of perspiration. As long as there is a bit of air movement, most people will tolerate somewhat higher temperatures before they complain of discomfort. In this context, ventilation is intended to achieve *useful air velocities directed over the occupant*.

There is a practical limit on the air velocity useful for comfort ventilation. At 1m/s air speed, hair and papers begin to move. By 1.4m/s (or 5km/h) conditions are noticeably draughty, and considered a nuisance by most. Worse, planning and detailing for enhanced summer ventilation — especially the over-use of louvred windows — can have undesirable consequences in winter: increasing heat loss by cold drafts.

How is ventilation achieved?

Momentum effects

Although air has relatively little mass for a given volume, individual molecules of moving air do have appreciable momentum. Thus, any wind affecting an opening will assure that the air will move a certain minimum distance into the interior, even where no separate outlet opening is available. This is the most fundamental basis of so-called single-sided natural ventilation. By itself, it is of limited effectiveness, but hardly negligible when appreciable breezes are available.

Pressure differences

The dominant motive force that drives air movement is *relative difference in atmospheric pressure*. Air will move from a place with a relatively elevated pressure to one of lower pressure. This is true at all scales. A good way of grasping this fundamental concept is to envisage that wind does not blow, rather it 'sucks'.

Natural ventilation is therefore most reliable when any space has at least two openings, one on a facade of the building that is experiencing a zone of relatively elevated pressure and another on one experiencing a relatively depressed pressure. Figure 5 shows simplified airflows around a building, and Figure 6 shows simplified pressure distributions on a typical tall building in plan. They make clear that under most circumstances, the required pressure differences for locating effective inlet and outlet openings may be found on either adjacent or opposite faces of the building. This is the basis on which so-called ‘cross ventilation' is usually premised.

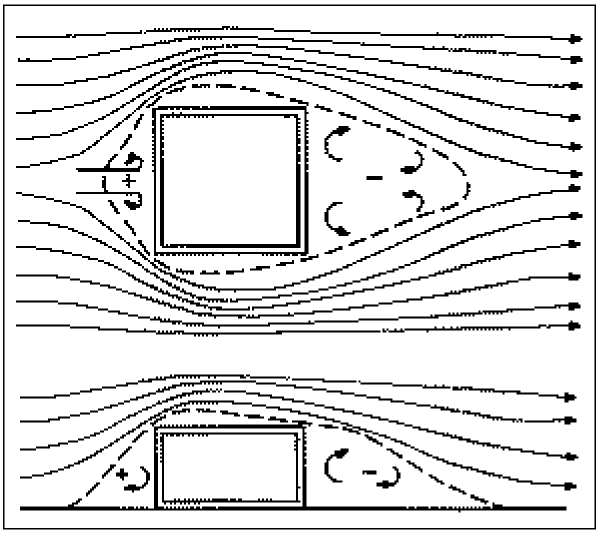


Figure 5: Airflow around buildings

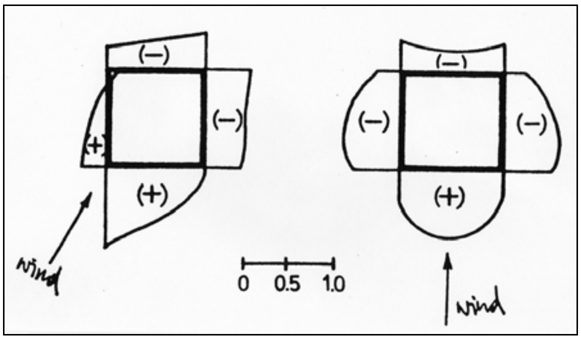


Figure 6: Simplified pressure distributions

What such simplified diagrams do not make equally clear is that there are many more detailed features of most building configurations, which also set up smaller, and more complex conditions of local pressure differences. These smaller pressure differences may nevertheless be useful in achieving some air movement through interiors.

Convection - stack effect

Another way that relatively smaller pressure gradients may be achieved is by exploiting the difference in density between cooler and warmer air. This situation occurs typically in taller interiors, where warm air rises towards the top of the containing space and is allowed to escape, while another opening near the bottom of the space allows cooler air to enter. The effectiveness of such stack effect ventilation is directly proportional to the height between the inlet and outlet openings, and the difference between the exhaust and inlet air temperatures.

Stack effect ventilation is driven by relatively small pressure differences. Therefore stack effect ventilation of normal residential interiors is likely to be completely swamped by even gentle breezes. This is especially true in coastal climates such as Sydney, where absolute calm is almost unknown.

Windows / openings

Natural ventilation is obtained and enhanced by suitable location, sizing and detailed design of openings, typically windows. The first and most important consideration is the location of inlet and outlet openings in relation to predicted pressure differences resulting from suitable prevailing breezes.

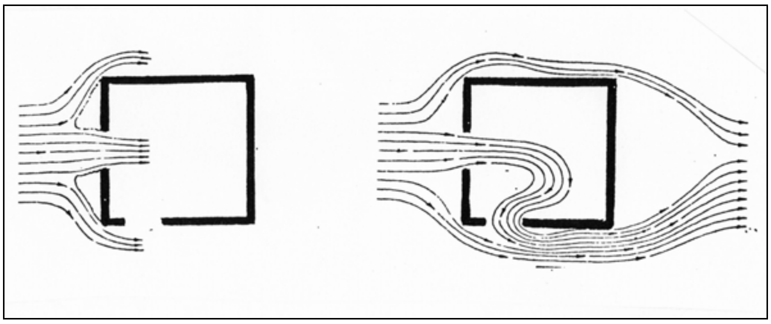


Figure 7: The role of inlet and outlet

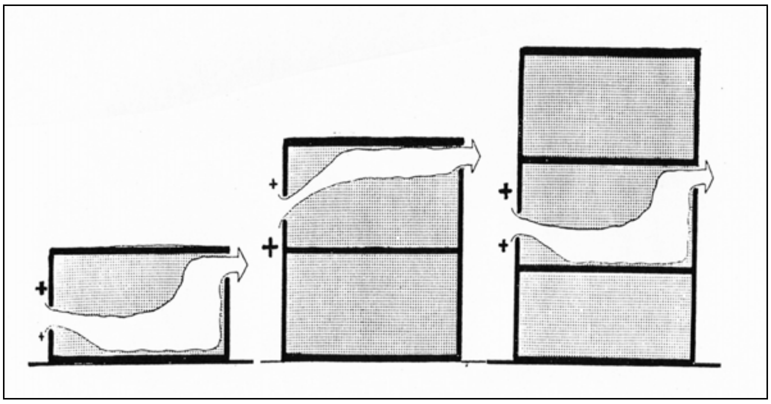


Figure 8: Effect of inlet position on ventilation pattern in the room

But little understood by most designers is that the location of the inlet opening in relation to the overall pressure distribution on the windward *facade* of a building, makes the most significant difference to air movement patterns within the interior. In comparison, the location of the outlet opening can be relatively inconsequential. Figure 7 and Figure 8 illustrate the simplest of these effects. Note how the identical window placement in relationship to the *interior* of the room can produce dramatically different ventilation patterns on different floors.

Also poorly understood is that if air movement for *comfort ventilation* is the primary issue, enhanced air velocities are obtained with *smaller*, well placed inlet openings and much *larger outlet* openings. Of course, the ventilation inlet opening may itself be a small part of a much larger view panel.

Figure 9 compares typical internal air velocities (expressed as a percentage of the prevailing wind speed) as the outlet opening increases in relation to the inlet opening.

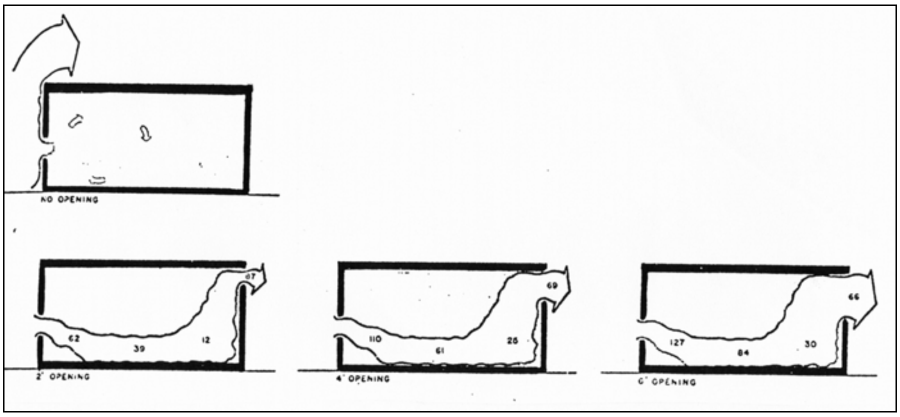


Figure 9: Relative air velocities due to inlet/outlet proportions

Capturing wind/breezes

Various factors, especially landscape design, can make significant differences to the availability of breezes for summer cooling. The most important, of course, is an appreciation of the distribution of regional prevailing winds, keeping in mind which of them are reliable sources of cooling, and at what time of day they typically occur. In Sydney we are fortunate to enjoy a fairly clear differentiation between the dominant afternoon on-shore sea breezes, and the westerly winds that are more typically a nuisance in both summer and in winter. The primary design response to the use of natural ventilation for summer cooling is therefore sensitive orientation of buildings.

However, regional wind patterns can be dramatically modified by local conditions. Channelling, downwash, wind shadow and other effects can change both the direction and velocities of available breezes within more complex developments. Some of the resulting conditions, including unfavourable orientation, may sometimes be modified by suitable landscape and building detail. The underlying principle of all such possible modifications of natural ventilation potential is systematic design to achieve suitable relative pressure differences between inlet and outlet openings.

Mechanical assistance

Mechanical assistance has a definite role to play in ensuring adequate ventilation. Under many circumstances in multi-dwelling design reliable exhaust ventilation is more effectively provided by mechanical means, than by difficult distortions of the overall building form. The energy requirements of exhaust fans, to meet mandated air exchange for domestic occupation, are relatively humble and may be easily justified.

More interesting is the issue of control over air movement for enhanced thermal comfort. It should now be clearly understood that air movement and volumetric air exchange can be treated as independent variables in design. In a climate like Sydney, in many apartments for much of a summer day, the temperature inside is likely to be a lot cooler than the air outside. *To open windows at those times actually serves to heat up the interior more quickly.* In such circumstances, ceiling fans are a much more effective option for reducing the requirement for air conditioning, than any attempt to achieve similar air movement effects by completely passive means. It is not an accident that ceiling fans are so common in warm humid climates.

Cross ventilation

What is meant by cross-ventilation?

'Cross-ventilation' can now be understood to describe the condition where a dwelling has operable openings to two or more distinctly different orientations, thus making likely that in any conditions of breeze, relative pressure differentials will assure some air movement through connected spaces in the dwelling.

Strictly speaking, true cross ventilation implies not only the placement of inlet and outlet openings on the opposite facades of the building. It also requires attention to the paths that air movement can take through the building interior. In order to be fully effective, and especially to maintain useful velocities for thermal comfort, the air path has to be relatively unobstructed. Design in the tropics, where such comfort ventilation is critical, is characterised by buildings with single loaded planning arrangements. The placement of interior partitions, and even furniture, is critical in maintaining relatively straight air paths in order to minimise the loss of momentum in the air stream.

Clearly, tortuous air paths through deep apartment plans, and negotiating several doors or other openings, are unlikely to deliver the desired cross ventilation outcomes.

Corners

In some respects, providing openings in adjacent facades is a special condition of cross ventilation. As we saw in Figure 6, adjacent facades may or may not generate the same reliable pressure differentials between openings, as two opposing facades with favourable wind directions. In addition, such corner conditions can actually be the cause of unfavourable internal ventilation patterns. Nevertheless, in most practical circumstances corner locations may be assumed to provide for significantly enhanced air exchange and air movement, in comparison to single sided dwellings. Sometimes, they may actually be preferable to plans that fully penetrate the building, if only because the inlet and outlet openings are more often within a single open space.

What SEPP65 says

SEPP 65

This policy aims to improve the general design quality of residential flat buildings. Within SEPP65 itself there are few quantitative or qualitative standards to regulate technical performance. Indeed, reference to ventilation as a major determinant of thermal comfort and likely energy use for heating and cooling, may only be found under Principle 7 – Amenity, which refers only to a generalized requirement for natural ventilation.

However, amongst its objectives, SEPP65 lists:

- to maximise amenity, safety and security for the benefit of its occupants and the wider community, and
- to minimise the consumption of energy from non-renewable resources, to conserve the environment and to reduce greenhouse gas emissions.

It would therefore be reasonable to assume that specific performance measures for buildings designed in compliance with SEPP65 would be scrutinized in light of these objectives.

Residential Flat Design Code

The introduction to this document clearly states:

> "The Residential Flat Design Code sets broad parameters within which good design of residential flat buildings can occur by illustrating the use of development controls and consistent guidelines. It will be an important resource for council planners responsible for creating new plans relating to residential flats and for assessing residential flat development under SEPP 65. With the SEPP, it provides the 'how to' of designing better built outcomes."

In support of this objective, the Code states explicit qualitative and quantitative standards applying to most of the technical performance factors addressed by SEPP65. The Code devotes a discrete section to natural ventilation, summed up in the following *Rules of Thumb*:

- Building depths, which support natural ventilation typically range from 10 to 18 metres.
- Sixty percent (60%) of residential units should be naturally cross ventilated.
- Twenty five percent (25%) of kitchens within a development should have access to natural ventilation.
- Developments, which seek to vary from the minimum standards, must demonstrate how natural ventilation can be satisfactorily achieved, particularly in relation to habitable rooms.
  (Building Amenity .Natural Ventilation p.87)

But any assessment will rely only on these rules alone at its peril. The explanatory text includes objectives which clearly delineate the context of fresh air ventilation, thermal comfort and minimising energy use. Comprehensive *Better Design Practice* guidelines rehearse all of the variables of building design that may contribute to achieving good natural ventilation, from landscape strategy to opening detail, albeit with a strong bias towards planning for cross ventilation.

Pattern book

The Residential Design Pattern Book is a collection of Case Studies supported by a set of principles. It predates the more prescriptive Flat Design Code, and sets out to illustrate the application of the principles of SEPP65 by example. Under the *Building Principles: Environmental Performance*, it loosely references natural ventilation, and strongly favours cross ventilation as the preferred condition.

As a consequence, the majority of the case studies, and all of the Building Types illustrated in the Pattern Book feature apartments which fully penetrate shallow blocks, and enjoy full dual aspect. There is no comparable discussion of the consequences of site constraints and other considerations, which may not allow this general approach to be followed.

Discussion

Amongst other objectives, the general intent of SEPP65 and its supporting documents is to encourage the design of apartments to avoid air conditioning, and to assure the best possible amenity by exploiting climate responsive design. Planning layouts that allow for cross ventilation definitely contribute to this objective.

However, the problem quickly becoming manifest is that both designers and planning officers are applying a rote interpretation of what constitutes a cross ventilated apartment — simply looking for the openings in two different facades. Little if any attention is being paid to whether good natural ventilation will actually be realized, such as in severely elongated ‘cross-over units’, where air paths are tortuous, and likely to be defeated by closed doors to bedrooms. Worse, the often acceptable ventilation performance of single sided units is being completely ignored.

Cross ventilation is certainly desirable in climates with little technical calm, like coastal Sydney. However, this does not mean that a more general assessment of the likely adequacy of natural ventilation cannot be made in other situations, such as where there is a predominance of single aspect dwellings.

Prior to the common availability of refrigerative air conditioning and mechanical exhaust ventilation, accepted design rules for adequate natural light and ventilation were commonly expressed in terms limiting the ‘depth’ of single sided open plan space to approximately 8m from the glazing line. This was premised on long experience of a balance between achievable air change rates, and the overall benefit of enhanced air velocities in temperate climates. Such former guidelines are echoed in the Residential Flat Design Code *Rules of Thumb* for Apartment Layout.

Contemporary trends in apartments are also increasing the likelihood of attributes that further enhance such ventilation performance. Chief amongst these is the prevalence of generously dimensioned verandahs, conceived as outdoor rooms, a trend encouraged by the Residential Flat Design Code itself. By creating significant recesses and protrusions in the façade, and often by creating local corner conditions, such terraces give rise to appreciable local pressure gradients and improvements in the ventilation of adjacent rooms.

The provision of even modest façade reveals, such as privacy screens, can have reliable effects in assuring usable ventilation patterns for some single sided apartments.

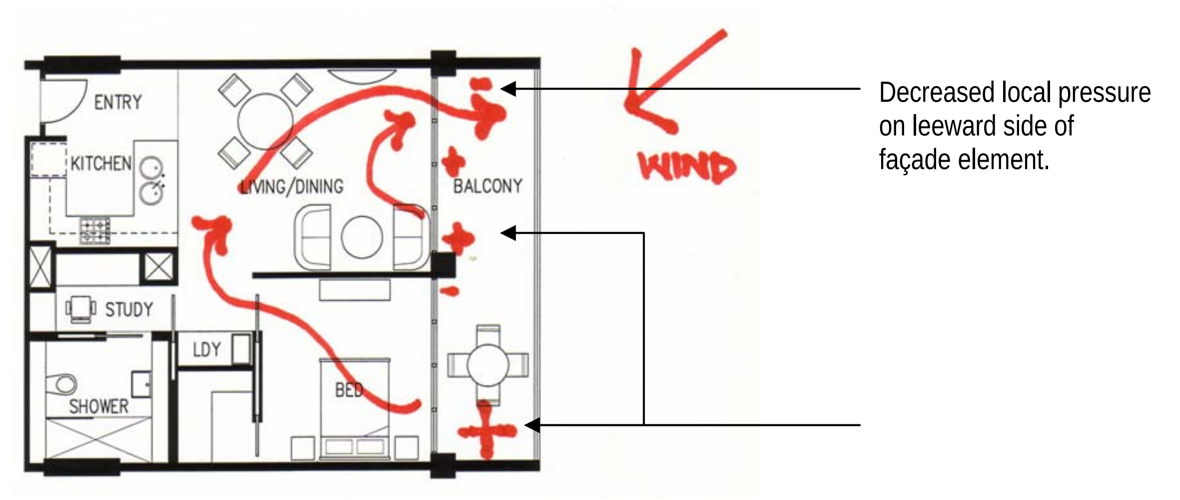


Figure 10: Variations in façade pressure distribution and resulting ventilation patterns
The illustration is of a south facing one bedroom unit on an upper floor, subject to southerly summer winds relatively common in Sydney.

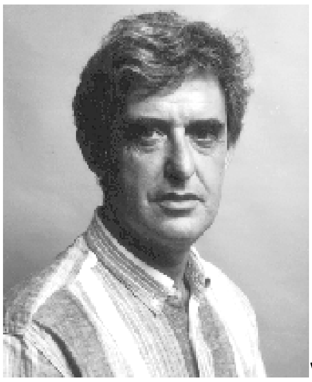
For apartments on the upper floors of medium and high rise developments in Sydney, enhanced air velocities are hardly an issue. More pressing by far is to achieve construction that is sufficiently air-tight to make life tolerable in the often unacceptably windy conditions experienced at these higher levels.

Conclusions

The intent of SEPP65 with respect to natural ventilation is to be commended. However, the manner in which cross-ventilation is mandated can create significant difficulties for designers. A mechanistic interpretation of the quantitative standards implicit in rules of thumb in the Residential Flat Design Code distracts from a proper evaluation of the likely ventilation performance of many apartments.

The natural ventilation issue has already been tested in the Land and Environment Court. In that setting, of course, the full complexity of predicted ventilation performance can be interrogated, and the Court is not backward in its preference for the more expert assessment. But it's a pity to add this to the Court's already excessive workload. It would be preferable if both designers and planning officers developed a more reasoned approach to design for natural ventilation of apartments.

In a more general sense, the difficulty of properly assessing natural ventilation in building proposals serves to illustrate a growing problem of assessing compliance for technical performance generally.



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