

# Achieving sustainability – issues of sunshine, shadows and ventilation

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## DEALING WITH DAs 2008-STYLE

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### Achieving sustainability – issues of sunshine, shadows and ventilation

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#### 1.0 INTRODUCTION

This update is intended to briefly review some of the principles of sustainability which require the attention of applicants and approval authorities, especially relevant in the consideration of development applications for multi-residential construction. In New South Wales, this issue is dealt with almost exclusively under the BASIX regulations. I comment briefly on some trends under BASIX, but also indulge in just a little prognosis for the future.

Within the broader framework of sustainability concerns, the two amenity requirements of solar access and natural ventilation have become increasingly influential determinants of the architectural design of apartments. Because they are often poorly understood, both have tended to be interpreted rather mechanically both by designers and Council officers. I therefore return to them in this paper to highlight some of my experiences when one approaches these amenity issues with greater technical sophistication – hopefully without repeating too much of the material which has become familiar to attendees at previous seminars.

#### 2.0 SUSTAINABILITY – BASIX

Anyone at a NEERG Seminar would be familiar with the fact that in the New South Wales planning regulations, SEPP BASIX requires an online certificate to be issued for any residential development approval. Most participants would also be familiar with the general scope of compliance required under BASIX. But it is worth emphasising both its application and its limitations.

BASIX exclusively regulates minimum requirements for savings in the use of potable water, overall energy performance, and likely thermal comfort in as far as it is affected by building design and building fabric choices:

- On the one hand, in these three areas *BASIX explicitly precludes the application of any other controls*, including other SEPPs, LEPs or a DCPs. This is a fairly important aspect of the SEPP, which still seems to escape the notice of many parties, and has both advantages and disadvantages for both applicants and approval authorities.
- On the other hand, the scope of BASIX does *not* extend into the important areas of sustainability such as the management of construction waste, pollution, or disaster management, all of which remain the province of a variety of other controls. Embodied energy, indoor air quality, and the choice of materials (on various criteria of sustainable extraction, manufacture and management) at present do not fall under mandatory regulation for residential construction.

BASIX assessments have been required for all dwelling types, since alterations and additions were included a year and a half ago. In July 2007, the construction cost threshold for alterations and additions was revised to \$50,000, which effectively means that very little new residential construction escapes its provisions. At this time, there are not too many news related to BASIX, but they are fairly important.

#### 2.1 2nd Generation Thermal Simulation Software Implementation

The one with the greatest potential current impact is the upgrade to the **Thermal Comfort Index**. The NSW Department of Planning Sustainability Unit is currently working on an upgrade of the BASIX Thermal Comfort Index to incorporate '2nd generation' thermal simulation tools such as AccuRate and BERS Pro. The AccuRate software has been in use by some assessors as part of a year-long trial. When the upgrade is more generally rolled out, it will result in the removal of NatHERS, the current version of BERS and First Rate from the Simulation method. As the Department states on the BASIX website:

*It is expected that dwellings that may pass the current NatHERS stringency may not pass the final AccuRate stringency and vice versa as the superior thermal modelling in 2nd generation tools may place different weightings on the design elements of individual dwellings.*

Of particular interest is that AccuRate makes considerably more allowance for the effect of natural ventilation in extending thermal comfort conditions during warm weather. As a matter of practical procedure, the adoption of AccuRate means that the somewhat complicated definitions for characterising cross ventilation currently spelt out in the BASIX protocols will soon disappear. This is a good thing, in as much as they have also been used by some Council officers as prescriptive definitions applied to SEPP65 cross ventilation compliance. But perhaps it is a bad thing, in as much as it removes one of the sources of reference encouraging sensible design for cross ventilation by some practitioners, who would otherwise have been tempted to be overly optimistic in what constitutes effective apartment layouts for that purpose. But most importantly, designers should remember that because the allowances for simulated natural ventilation are based on generic climate data, they are neither entirely predictable nor necessarily accurate for a particular site and building combination.

Some practitioners will also be familiar with the so-called **DIY method** of thermal comfort evaluation typically used for smaller single dwellings, or of may have used the optional **Rapid** method. Rapid was made available prior to the introduction of DIY and is now considered to be superseded by DIY, as DIY has improved orientation sensitivity and more flexibility, yet is relatively quick to complete. As part of the upgrade to the thermal comfort index, DIY will have some improvements to the shading options, more windows will be available and, to the extent possible, the scoring will be aligned with the Simulation method subject to further analysis of the outcomes of the current AccuRate Pilot.

In brief, it may be safely assumed that the Department remains committed to the availability of the DIY method. This seems not only a matter of cost and convenience for some applicants, but also to preserve the opportunity to treat favourably some kinds of dwelling designs that might be unreasonably excluded, were BASIX to rely exclusively on the simulation method. While the DIY method is really only of any use to the designer of a relatively simple individual dwelling, its application may come into much sharper focus in the context of the imminent general changes in the New South Wales planning regime.

## 2.2 What of other trends in achieving compliance under BASIX?

Given that **thermal comfort** has to achieve a pass before one is allowed to proceed to the generation of an overall energy point score, it has been interesting to observe the outcomes of the *simulated heating and cooling energy loads*. It is now well-known that few large individual dwellings will have difficulty passing under either NatHERS or AccuRate. This is a function of the way that heating and cooling energy loads are normalised for dwelling area, and is considered by many to be defeating policy aims relating to energy conservation. Designers should be aware that under BASIX one does not escape so lightly, because ultimately the dwelling area is taken into account when calculating the complying total energy performance. However, the Department is also now being advised to introduce an **absolute heating and cooling energy consumption threshold**, which should afford a more favourable treatment to small dwelling designs.

Relating to apartments, the observable trend has been the vital role of **internal thermal mass**. This impacts markedly on the choice of materials for ceilings and internal partitions. Where designs incorporate false ceilings throughout living areas, the effect is to 'decouple' what would otherwise be a thermally massive concrete ceiling slab. If in addition internal partitions substitute framed and sheeted construction for the more traditional rendered blockwork, some apartments may be struggling to achieve thermal comfort compliance.

Because of the relatively high glazing areas of Sydney apartments, adding wall insulation often has little effect on the ratings, and assessors are rather quick to advise expensive **glazing substitutions**. Again, this may be a good thing, in as much as it encourages the local glass industry to make available specialised glazing systems at more affordable prices. Much more generally, it reflects the continuing poor understanding of the adverse effect of overglazing on the likely thermal performance of dwellings.

## 2.3 On-site generation of power.

To achieve *overall energy compliance for a multiunit development*, it is now apparent that a fairly standard set of provisions must be considered. These include efficiencies in common area lighting, parking ventilation, and the choice of mechanical equipment generally. More radical initiatives include potential substitution of **photovoltaics**

or **cogeneration** for part of the projected electrical load. Because of the expense, the former is still fairly rare. Experience to date has been that cogeneration is helpful when nothing else seems to work to reduce the energy score, but is limited by the ability to make sensible use of the heat component. As esoteric solutions — such as absorption chillers for central air-conditioning — are unlikely in most situations, the practical determinant appears to be whether there is a heated swimming pool in the development. It has also come to my attention that the consideration of cogeneration has been limited by the available gas supply. In brief, while cogeneration equipment is becoming more readily available in a greater range of capacities, it remains an option mainly for large developments.



Figure 1: Capstone 30KW microturbine co-generation units

#### 2.4 Grey water and black water.

A similar conclusion may be drawn about grey water and black water. Theoretically, on-site treatment of one or both would contribute significantly to any potential water score in BASIX. The cost of duplicate reticulation is relatively small. However, risk factors remain with the future operation of any small treatment systems owned by the body corporate. At the moment, it would appear that reliability of operation and minimising public health risk are both best achieved at the district scale, rather than the scale of individual apartment buildings.

Taken overall, BASIX is rapidly becoming accepted as a notable achievement in planning regulations, both in Australia and internationally. It is clear that in its nature as a broad approach to sustainability assessment, it will most likely be adopted eventually as the preferred framework in most Australian jurisdictions. In the local context of a poor response by the New South Wales government to climate change, BASIX is touted as its most effective and enduring initiative. If only for those reasons, everyone involved in residential development in New South Wales can safely assume that BASIX will certainly not be weakened, and that when eventually proper resources are dedicated to the Department of Planning Sustainability Unit, the scope of the SEPP will inevitably be extended.

#### 2.5 Beyond BASIX

The Green Building Council has expanded its range of voluntary rating tools to include GreenStar Residential. So far, this multi-factor scoring system has found little application in the face of the rigorous, if narrower mandatory compliance requirements — except typically as a reference by individuals trying to argue exemplary commitment for sustainability initiatives.

Similarly, the Federal Government sponsored, NSW developed 'snapshot' tool NABERS is not yet part of either designers' or Councils' repertory. Nevertheless, we get a clue to what the variables of sustainability, able to be regulated by planning, will include in the not too distant future. NABERS sets out to measure:

- Energy use and greenhouse emissions

- Water use
- Stormwater runoff
- Stormwater pollution
- Sewage outfall volume
- Transport
- Landscape diversity
- Toxic materials
- Waste
- Indoor air quality
- Occupant satisfaction

NABERS is not intended to be a replacement to other ratings systems that focus on the design stage of projects, and the intention is that NABERS can be used in a mutually supportive way with other rating systems currently in the market. But an increasingly likely use of NABERS by local government is the monitoring of how well policy is being achieved on a broader front, and therefore how local planning objectives are to be adjusted, perhaps on shorter time frames than we are used to.

### 3.0 SEPP65 SOLAR ACCESS

Solar access and overshadowing assessment has been the subject of a number of my previous presentations at NEERG Seminars. For anyone who needs to be taken back to some of the fundamentals, I commend a copy of my paper *Daylight & Solar Access*, NEERG Seminar of 31 August 2006. In that paper, I especially concentrate on preferred techniques for reporting the achieved solar access for individual apartments under the Residential Flat Design Code, and on the impact of the Land and Environment Court *Principles* that relate to such assessment.

As I never tire of pointing out, solar geometry and shadow casting are purely geometric exercises, which should be well within the competence of any practicing architect or building designer. Overshadowing and solar access compliance is also assumed to be one of the matters that is well within the competence of Commissioners on the Land and Environment Court to determine — if reliable projection of those impacts is put before them. Yet, perhaps because most Council officers are not trained in physical planning, and because most applicants do not produce convincing evidence of solar access compliance, it remains one of the most contentious areas of assessment.

At the same time, perhaps because it is so clearly geometric and dimensional in nature, solar access remains one of the strongest design determinants. In my experience, the sophistication of Council officers is growing, in that many are becoming aware of tools available to applicants to check solar access during the design process. Therefore they are more likely to expect to see evidence that applicants have used such tools. Council officers are also strengthened in their position because of the increasing use of the Land and Environment Court *Principles* as *de facto* 'deemed to satisfy' standards. In my view, again, this latter trend has both a positive and negative consequences.

#### 3.1 The Parsonage Principle

The Principle embodied in *Parsonage v Ku-ring-gai* [2004] NSWLEC 347 has become increasingly influential in constraining sun that may be considered as complying. In brief, the Principle requires that the sunpatch on glazing should be a minimum proportion of its area, and any sun falling at an acute angle to the glazing is to be ignored. For outdoor space, the sunpatch should be at ground level.

Many Council officers still appear to take the attitude that unless a sunpatch represents minimum 50% of the area of the glazing to which it's applied, it cannot be counted towards compliance. The Court has long ago accepted that that particular provision is regressive, and in practice more likely to result in reduction of a particular window size, than in an attempt to increase the size of the sunpatch. It is a mistake in the framing of the Principle, and sooner or later will be better put in a future judgment. In the meantime, both applicants and Council officers need to take from its intent the notion that unless a usable area of glazing is sunlit, reporting it as complying may just invite cynicism about the design effort.

The situation is more interesting with respect to the acceptable 'angles of incidence' of sun to the glazing. I do not repeat here my concern that any acceptable angle should properly be applied in three dimensions rather than merely in plan; it is simply too difficult in practice. The underlying intent of this part of the Principle is to prevent



the counting of slivers of sunlight, and to acknowledge that the optical properties of glass prevent the transmission of any sun which strikes the glass at too acute an angle. In this role, it has been generally well accepted.

### 3.2 Effective sunlight

Perhaps less well understood is the fact that by corollary, the Principle therefore defines 'effective sunlight', as any sun that genuinely does strike and penetrate the glazing. It has long been my view that it is legitimate to review midwinter sun access outside the limits of 9am to 3pm, as long as it can be demonstrated that the orientation of the glazing is favourable to the penetration of such early morning or late afternoon winter sun, and that such sun is unlikely to be obstructed by surrounding developments or topography.

While unstated in Parsonage, the proper application of the Principle reinforces my view. For both applicants and Council officers the significance is that there is greater latitude in usable orientations for complying solar access, but that to demonstrate effective sun may require the use of techniques much more sophisticated than crude plan shadow diagrams. With the ubiquitous use of three-dimensional digital models, this should not be beyond most applicants. My own favourite technique remains the so-called 'Views from the Sun', with which all the Commissioners of the Court are now certainly familiar.

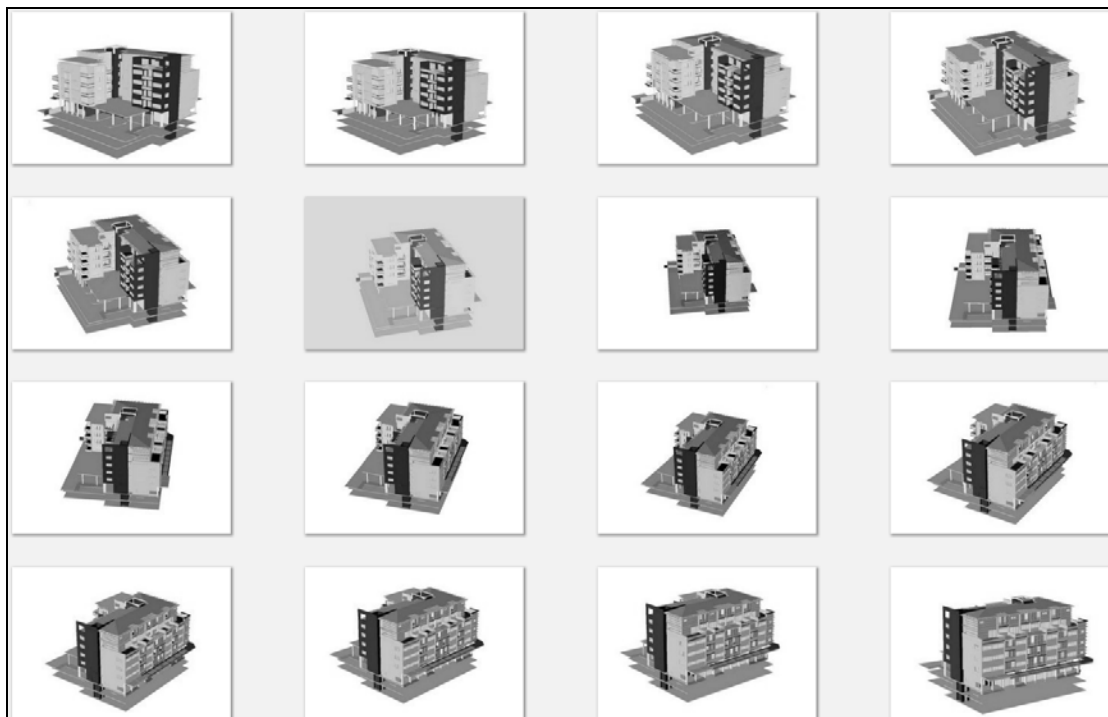


Figure 2: Half-hourly views from the sun, June 21. Only sunlit surfaces visible in these views.

Even the problem of solar access to a private outdoor space remains somewhat negotiable. I have previously demonstrated that the absolute injunction that only ground level all floor level sunpatches may be counted cannot be properly applied for certain kinds of courtyards and terraces, which are of otherwise acceptable minimum dimensions. Simply put, if such small spaces receive sun at all, it is actually difficult to *avoid* being in the sun – and therefore of it may well be legitimate to demonstrate the sun access by means other than delineating the sunpatch at floor level. In my own consultancy, for a minimum size courtyard I continue to investigate sunpatches at table height, and have found favour with both Councils and the Court with that approach. However, I stress that for other circumstances (such as larger courtyards and conventional outdoor areas of individual dwellings), I support the Senior Commissioner's conservative definition, and would find any other approach unconvincing.

### 4.0 NATURAL VENTILATION

Perhaps the slowest but most interesting developments have occurred in how natural ventilation compliance is taken to affect residential design. Because no controls generally address themselves explicitly to cross ventilation with respect to individual dwellings, this issue is only really taken seriously by Council officers when applied to multi-unit designs which fall under SEPP65 and the Residential Flat Design Code. This masks the fact that

effective ventilation design of individual dwellings is very generously recognized by AccuRate, the second-generation simulation software for thermal comfort — for that reason alone, designers may find it is worth taking design for ventilation in individual dwellings very seriously. In terms of apartment design on the other hand, the separate amenity provision under SEPP65 continues to bedevil many larger apartment developments.

#### 4.1 Cross ventilation

It remains desirable to design for effective cross ventilation for apartments in the coastal climate zones of New South Wales. On the other hand, employing liberal cross ventilation in inland climates has to be undertaken with greater attention to orientations for *night-time*, rather than daytime summer breezes.

Especially important, but completely ignored in the controls, is that injudicious design for cross ventilation can be dramatically counterproductive for energy efficiency of apartments that, for whatever reason, are to be air-conditioned. It is safe to say that most corner apartments and many other apartment layouts which are exaggeratedly adapted to achieve cross ventilation, will also have significantly increased external surface areas. It is easily demonstrated that such apartments will probably have significantly higher heating and cooling loads than single sided middle apartments in the same complex.

Also ignored in the controls is the very obvious fact that many single sided apartments are likely to achieve perfectly good summer ventilation. When correctly identified, certain multi-frontage single sided apartments with significant facade relief — and with appropriate orientations exposed to reliable summer cooling breezes — can be shown to have air movement patterns and even air velocities comparable to some cross ventilated apartments. Lately, I have been able to convince a number of clients to undertake some simulation-based investigations of the likely patterns, and effectiveness of single sided ventilation for certain designs of single sided apartments.

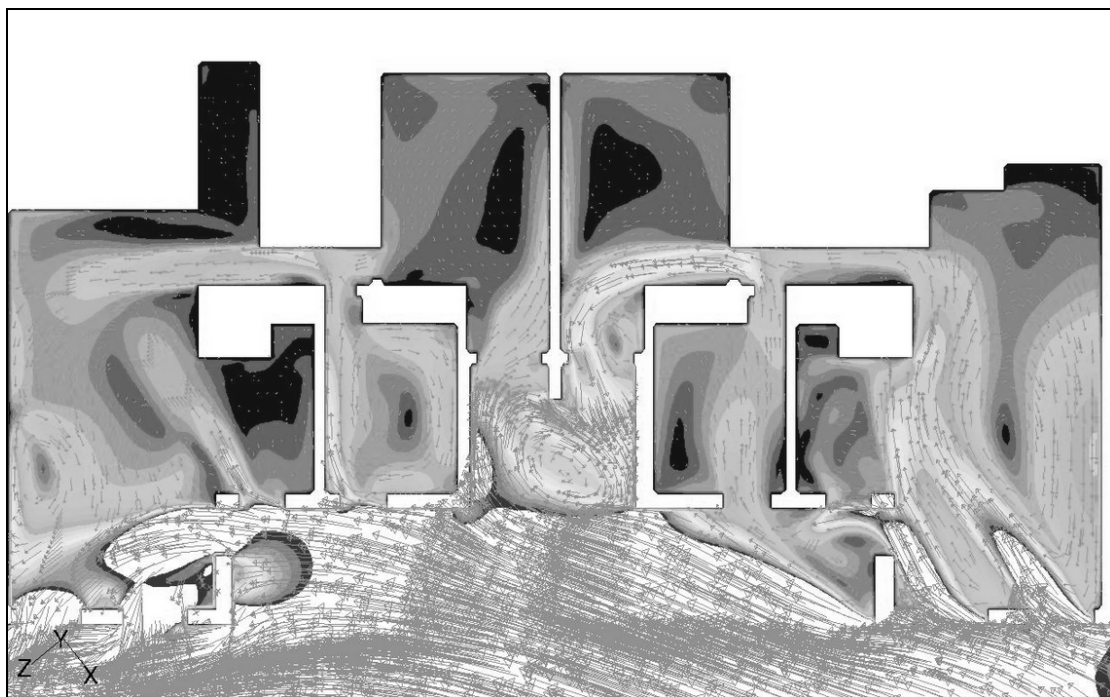


Figure 3: Contour velocity vectors for single sided ventilation. CFD study by CPP Pty Ltd.

These so-called CFD studies are not cheap, but they are extremely cost-effective. There is a growing capacity in Sydney to undertake such design support in the area of ventilation design. On many projects it should be considered early in the design cycle, and should definitely be considered as part of the compliance reporting.

#### 4.2 Natural ventilation and acoustic control

An emerging area of difficulty is the recognition that the requirement natural ventilation too often conflicts with required acoustic performance of glazing. On the face of it, the resolution is not difficult at all. Complying window and door systems with appropriate acoustic performance are not defined by the BCA as *sealed* glazing. They remain openable, and regardless of location it remains the prerogative of the occupant to utilise such openings for

natural ventilation. In other words, the design should both comply for mandated noise reduction in 'closed window mode', and with the Residential Flat Design Code for natural ventilation when opened.

#### 4.3 Wintergardens

However, developers and their designers are also recognizing that so-called 'wintergarden' style balconies represent a better solution for amenity in many of the locations where this conflict arises. Fortunately, most Councils appear to be disposed to be convinced of the merits of this argument, as long as the applicant take some care to properly distinguish floor surfaces between the nominally interior, and the nominally exterior space. The disadvantage, if any, is that the use of almost any glazed system to preserve the intention of a permanently ventilated outdoor space – typically glass louvers – will almost certainly diminish the effectiveness of single sided wind exposure. It might make it difficult to demonstrate 'enhanced single sided natural ventilation' compliance for apartments without cross ventilation. Notwithstanding this reservation, in my view the wintergarden approach to required private outdoor space in adversely exposed locations has far more benefits than disadvantages.

My last caution is against any mechanistic interpretation for preserving the nominal 'open' nature for such wintergardens. Lately I have seen exaggerated attempts by design architects – probably under pressure by overzealous consultant planners – to create permanent open 'slots' as part of the facade treatment. All that achieves is the loss of winter living amenity, without any real gain for summer ventilation. In other words it's not worth it.

#### 5.0 CONCLUSIONS

The general public and politicians are finally now aware of the likely seriousness of climate change, and of both the impact of construction choices on creating the problem, and the consequences of continuing to live lifestyles of exaggerated consumption. Buildings do account for a surprisingly high proportion of greenhouse gas generation, both during construction and operation. There is also a sense that every new building not conforming to a high standard of sustainability will continue to contribute to the problem for a very long time. We can therefore expect to see continuing concern with sustainability as a design driver in residential construction, and judging by trends in Europe a dramatically accelerating rise in expected standards.

More than anything, it puts applicants on notice that it is pointless complaining about the additional cost; the real problem is to find the economic solutions. And that in turn confronts designers with a shift in focus: from hoping that hired gun experts will help to convince approving authorities that everything is all right with preconceived, technically poor designs, to raising their own skill levels in giving due consideration to sustainability *during* design. The range and precision of such necessary knowledge and skills will rapidly become a challenge in architectural offices.

Applying appropriate scrutiny to applications will become an even greater challenge for approving authorities, many of whose officers do not even have the beginnings of training in the physical design of buildings. The only saving grace for them is that some of the compliance reporting processes are being captured by systems such as the online BASIX Certificate. However, as exemplified by my comments on consideration of natural ventilation, there is a very real danger in relying on any sort of automated process or collection of deemed to satisfy solutions. It tends to get in the way of truly understanding the desired performance, and can act to stultify innovation.

My continuing emphasis on *solar access* and *natural ventilation* is not because they are the most important factors in sustainable performance of dwellings. It is simply because both of them relate so strongly to the physical form and arrangement of buildings, that they become disproportionate determinants both in design and in the approval process. I expect that approving authorities will become increasingly insistent on proper analytical tools being applied to both these concerns during the design process, and that by the time of development applications it will be expected that the evidence of compliance should be appropriately demonstrated.

To anyone concerned that it all represents even more work in preparing development applications, I can only suggest that doing it properly and early, using the right tools, is much less work than the endless design variations necessary to get poorly thought out schemes through approvals.