CRC Construction Innovation

BUILDING OUR FUTURE

Report
The Role of Natural Ventilation in Building Sustainable Subdivisions in South East Queensland

Research Project No: 2002-077-B-01

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PREFACE

A recent research project conducted by the Cooperative Research Centre for Construction Innovation examined the link between subdivision design in the subtropics and how characteristics of resultant lots affect energy efficiencies obtainable for dwellings built on these lots (Miller and Ambrose, 2005). The project assessed an existing lot rating methodology and found that the methodology would need to be modified to allow for natural ventilation, to be applied appropriately in South East Queensland.

The researchers found that increased density and dwelling orientation were critical factors impacting on the energy efficiency rating of dwellings in sub-tropical climates, where the combination of urban setting and poor orientation may increase a dwelling's heating and cooling needs by 30% above the optimum which could be obtained with good design for thermal comfort. It was identified that access to natural ventilation is impacted by these factors as well, and that lack of breezes is likely to be a contributing factor to the increasing demand for air conditioning in Queensland dwellings as well.

EXECUTIVE SUMMARY

The objective of the consultative phase is to examine the role that natural ventilation has and can play in the subdivision planning process in SEQ. The Centre for Subtropical Design at QUT coordinated the consultative phase and has conducted a workshop, and interviews, with stakeholders including developers, land development consultants, land surveyors, urban designers and regulators, to identify current understanding of the impact of urban subdivision on natural ventilation, and the role of natural ventilation in achieving energy efficiency for dwellings. This report details the findings thereof.

The workshop and the interviews sought to:

- identify whether stakeholders are actually concerned with maximising natural ventilation to future residences to be built on the subdivision;
- establish, if any, their approach to preserving breezes when planning subdivisions;
- establish the kind of evidence or indicators stakeholders currently have to measure performance, and investigate what they do with them;
- if current indicators are inadequate, what kind of evidence or indicators would give them more meaningful information; and to
- gauge the degree of acceptance within the land development industry of the proposed lot rating methodology.

Analysis of this data assists in identifying the kinds of evidence or indicators that would give stakeholders more meaningful information to use in planning and design of subdivisions for energy efficiency. Subsequently this information could be put to use by house and land package providers and consumers in better selection of residential design for subdivision sites.

1. INTRODUCTION

This report is a component of the Cooperative Research Centre for Construction Innovation project 2002-077-B 'Sustainable Subdivisions: Ventilation'. This project is the second of a multi-stage sustainable subdivisions project theme and focuses on the energy performance of subdivisions by examining the correlation between lot orientations and dwelling efficiencies in terms of the energy required to heat and cool premises in sub tropical South East Queensland (SEQ).

The project consists of three discrete phases:

Phase One has been conducted and resourced through QUT and the CSD. It involved a workshop and interviews with industry stakeholders, carried out to determine the importance practitioners apply to designing for ventilation to create climatically appropriate subdivisional settings in subtropical South East Queensland (SEQ). This has been an essential part of the research, invaluable to understanding the current knowledge base and practices of professionals actively engaged in subdivision design. This is the report on Phase One.

Phase Two is being conducted by CSIRO in Queensland and Victoria. It involves the collection, analysis and interpretation of ventilation data acquired through monitoring a range of typical subdivisional settings in SEQ. The aim of this Phase is to quantify the degradation in wind speed and direction between Bureau of Meterology (BoM) sites and a variety of dwelling sites and types through monitoring of wind conditions in SEQ. It will quantify, and verify or challenge, the role natural ventilation has in passively cooling residences in sub tropical climates. The outcome of Phase Two will be the development of a lot rating methodology for use in SEQ. It is also expected to recommend that the existing lot rating methodology in use in other parts of Australia, be modified to allow for the impact of ventilation.

Phase Three will be conducted through QUT and the CSD. It will involve a workshop to consider a proposed lot rating methodology to industry professionals engaged in subdivision design in SEQ.

Objectives

The objectives of the study are to:

- Verify and quantify the role natural ventilation has in cooling residences in sub tropical climates through
- Monitoring wind speed and direction in a range of subdivisional settings throughout SEQ
- To establish the degree of degradation in natural ventilation imposed by increasingly densely constructed suburban environments
- Compare this data with BoM monitoring stations in SEQ
- Apply a ventilation factor to the existing methodology; and
- Thereby develop a lot rating methodology for use in SEQ.

The project may also make a recommendation that; the existing lot rating methodology in use in other parts of Australia be modified to allow for the impact of ventilation as all areas have the potential for passive cooling in the warmer months. It is also expected to

- Highlight the importance of good design at both subdivisional and dwelling level
- Inform the ongoing development of thermal programs.

Project Partners

The partners involved in this research project were:

CSIRO Manufacturing and Infrastructure Technology

Queensland University of Technology

Centre for Subtropical Design

Queensland Department of Public Works

Bovis Lend Lease

Brisbane City Council

Key Assumption

The key assumption behind this research is that increasing energy efficiency standards will require a better understanding of natural ventilation opportunities, especially in sub tropical and tropical climates. While urban developers and designers needs tools that aid in promoting natural ventilation dwellings in all climate zones, in Queensland, there is ongoing criticism of southern based methodologies or tools that ignore this 'traditionally' important component. Regulatory authorities and industry have both indicated a strong need for better understanding of natural ventilation in suburban environments.

Structure of the report

The next section of this report summarises the industry workshop, providing an overview of participants, outlining the workshop methodology, summarising the keynote presentations, and summarising the findings in terms of fourteen key challenges identified by the participants.

Section 3 presents the findings of seven key informant interviews that were undertaken to supplement the workshop and to follow up issues arising from the industry workshop.

The final section of the report presents the overall conclusions from this initial consultative stage of the research project.

2. THE WORKSHOP FINDINGS **By Dr Daniel O'Hare**

In April 2006 a workshop, entitled “Planning for Air-movement,” was held to investigate the importance practitioners apply to ventilation to sustainable subdivision design in subtropical South East Queensland.

2.1 Investigating Ventilation: A Workshop

The twenty participants in the workshop are leaders in national and regional development firms, consultancy, local and State government, and peak industry bodies including the Urban Development Institute of Australia, Housing Industry Association, and the Royal Australian Institute of Architects Environment Committee. Building Codes Queensland was also represented. House and land package providers were invited but were unable to attend. This deficiency was mitigated by the presence of a representative of a national land developer that has a house and land package division, and by the industry organisation representatives.

The workshop opened with presentations by Associate Professor Glenn Thomas and Dr Nur Demirbilek. Using the example of a typical outer Brisbane subdivision, Thomas demonstrated the influence of the slope and orientation of lots on climate comfort and energy demand in summer and winter. He illustrated how permeable shelterbelt planting maximises ventilation benefits, and noted that research is needed into the ventilation effects of increasingly popular barriers such as high walls along property boundaries. For his presentation, Shelter Belts, refer to Appendix One.

In her presentation, (Appendix Two) Dr Demirbilek defined 21 degrees Celsius as the most comfortable indoor temperature (assuming 40 per cent humidity), and 21-26 degrees as the outdoor comfort range (in the shade). She outlined six elements of thermal comfort:

- dry bulb air temperature;
- relative wind speed;
- relative humidity;
- mean radiant temperature;
- activity level; and
- clothing level.

Workshop participants debated whether the ventilation aspect of sustainable subdivision is principally a technical and biophysical issue relating to energy usage, or whether it is primarily a social and cultural issue. There was considerable agreement that currently inexpensive-to-install and relatively cheap to run air conditioning has become the standard expectation in SEQ, with one producer of house and land packages claiming that air conditioning is a necessity for three months of the year in this subtropical region. Rosie Kennedy, Coordinator of the Centre for Subtropical Design, cited studies (Lincolne Scott, 2005) supporting the argument that SEQ’s heat and humidity is uncomfortable only one per cent of the year, while it is too cold in the shade for 20 per cent of the time. This 1 per cent occurs when the external temperature exceeds 29 degrees (Hyde 2000,22). While this is 3 degrees above Nur’s assessment it should be noted that the discomfort is not a product of temperature but rather the combination of high temperature and high humidity.

The house and land packager argued that they can no longer find buyers for non-air conditioned houses, particularly as there are no price signals to deter the installation and use of air conditioning.

The principles of good design for sustainable subtropical developments are referred to frequently throughout this report. Readers from other climate zones may like to refer to the report *"Subtropical Neighbourhood Design"* (Deicke Richards 2004, 41) Chapter 6 Principles.

2.2 Critical challenges

Fourteen critical challenges were identified by the workshop participants. Key challenges were raised by individual participants, and debated and elaborated via group discussion. At the end of the workshop, participants were asked to indicate, individually, their highest priority for attention, by posting a single orange adhesive dot on the most important issue. In the list below, the first nine points were identified as of high priority, and points 10-14 were not specifically ranked. Points 1-5 (in that order) were identified as being most critical.

2.2.1 Fashion

Fashion is a key driver, influenced by television imagery and personal lifestyle aspirations. Can energy efficiency codes become fashionable? Participants proposed that climatically responsive design and development should be made more fashionable by setting the trend amongst those who can afford it, as others seek to emulate the housing preferences of the wealthiest. It was agreed that housing fashions may also be able to be shaped by advertising, education, economic incentives, and legislation.

2.2.2 Covenants and Legislation

Best practice should be seen as the starting point not the finishing point in any legislative approaches. Covenants are not enforceable, and people will challenge them if they are too restrictive. Legislation is only capable of preventing the worst practice, rather than encouraging best practice – effective incentives are more important. Legislative approaches need to be accompanied by education. One participant claimed that it would be an important achievement if the one per cent of the population who want a naturally ventilated home are not prevented from achieving this.[1]

2.2.3 Consumer Attitudes and Consumer Education

Consumer education is urgently needed, as the size of house and the number of visible luxury inclusions is more important to consumers than energy efficiency. Consumers are becoming more energy and water conscious, but energy efficiency and household running costs do not rate highly in the decision making process. The increasing cost of energy will force energy issues to the forefront of consumer thinking. It was noted that housing energy cost and usage is low compared to transport, but that this does not yet seem to be having a major influence. One participant pointed out that buyers of west facing houses report them to be hotter and less comfortable. Consumers have become accustomed to air conditioned workplaces and cars, and are now less tolerant of non-air conditioned dwellings. In rapidly growing SEQ, people have apparently not acclimatised to the

[1] Separate research by the Centre for Subtropical Design raises a similar concern: *"If we introduce regulations like the proposed 5 star building regulations, we could be eliminating those houses that are designed to not need air-conditioning at all. This could in fact result in houses that are designed to be air-conditioned throughout the year to maintain comfort and thus deliver an adverse effect in policy terms."* (Kennedy, 2006)

subtropical zone. The health impacts of living in artificial air have not yet been determined. Incentives are needed, to encourage consumers to exercise more sustainable preferences.

2.2.4 Benchmarking

Benchmarking is required to provide proper information for comparison, for example regarding ambient temperatures, climatic extremes, average home size, average household size, tracking, benchmarking and comparing results. Performance criteria need to be developed.

2.2.5 Project Home Building Practices

Project builders from the temperate southern states are importing designs that are not suitable for the subtropical Brisbane climate. The influence of the project home market is significant. Incentives can be put in place to encourage best practice. One size does not fit all when it comes to housing; strong arguments were put forward that people buy what is available – if houses are available that do not consider climatic influences, people will buy them because there is no alternative.

2.2.6 Knowledge of Climate Appropriate Design in Housing Production

Some participants argued strongly that this knowledge appears to be diminishing at all levels – designers, builders, customers. Those designers and builders with the required knowledge are currently too expensive for the majority of consumers.

2.2.7 Affordability of More Sustainable Approaches

Improvements in this area will require education and legislative intervention targeting the industry, the professions and the consumers of housing. Demonstration projects and workshops could play an important role in educating these sectors.

2.2.8 Point of Sale Energy Rating

The idea of using energy rating schemes at the point of sale was discussed. There is ongoing concern that national standards developed in Australia's temperate states are not currently adapted to the subtropical zone.

2.2.9 Density Issues

Residential density can be achieved without compromising the amount of landscape planting and space, despite the increasing scale of residential development. For example, Site Cover may be 50%, but when impervious surfaces, sheds and pools are taken into account, site cover is more like 80-90%; leaving no space for large trees. Maintaining significant vegetation on site will reduce urban heat island impacts. Technical knowledge is not yet matched by the design process or consumer preferences.

2.2.10 Housing Expectations

It was agreed that the size and form of houses, supplied and demanded, represents a poor match with the demographic profile of the occupants. 60 per cent of households are 1-2 people households, whereas the large houses supplied could accommodate large families. Increasing residential densities (which support more sustainable transport) increase the difficulty of designing for the air movement that is essential to thermal comfort in hot humid climates.

2.2.11 Household Turnover and the Payback Period for Innovation[2]

Average ownership turnover rates were reported to be every 7 years for owner occupied housing and every 5 years for investment properties. Rental tenancy turnover rates are higher again. The high turnover rate conflicts with the long payback periods for some energy efficient features – for example it takes 19 years to recoup the cost of a rainwater tank in savings on the cost of water. Rebates are required to support the installation of sustainability features as the payback period is not viable at the moment. The public needs to be made more aware of life cycle costs.

2.2.12 Leadership

There is more to subdivision design than carving up land – it involves roads, lot size, housing density issues and consideration of amenity and views. The design can be informed by the subtropical place - the character and identity of the subtropical identity of SEQ (the "subtropical vibe"). There is a role for leadership in sustainable subtropical subdivision and design. Although architect designed houses are only a small percentage of the market, they are potentially significant due to their leadership role in design. One participant argued that the professional elite represented in the workshop cannot generate the change that is needed because they are not involved in the majority of SEQ development and house building.[3]

2.2.13 Inertia of the Building Industry

Effecting change has the potential to create logistical difficulties and high costs for developers. The initial cost of housing purchase is extremely price sensitive. The inertia or flexibility of the land development industry (as distinct from house building) was not addressed by the main proponent of this point or by other participants.

2.2.14 Rating Methodologies/Tools

There is considerable disagreement between professionals as to the success and desirability of rating tools. Some are wary of introducing lot rating tools for subdivisions as at present, it would be difficult to achieve 3-star ratings on some lots, particularly those under 450 square metres. Smaller lots represent an increasing proportion of the market. Lot rating methodologies need further investigation before introduction of any rating system.

[2] This noted issue demonstrates the tendency of many workshop participants to focus on the house rather than the subdivision and lot.

[3] This comment perhaps relates to the absence of specific house and land packagers from the workshop, however at least two participants were directly connected with this industry – ie the Housing Industry Association representative, and a major national developer that contains a house and land package division.

2.3 Conclusions from the workshop

There was clear agreement in the workshop that the subtropical climate in SEQ raises important issues that are not addressed by national ratings approaches focused solely on maximising winter solar access, while ignoring the need for ventilation to mitigate the impacts of the hot humid summers of Australia's fastest growing urban region. This concern was matched by the observation a large proportion of the house designs desired by buyers and offered by house builders, have been developed in temperate markets. The participants' acknowledgment of these problems adds to the justification of the Sustainable Subdivisions: Ventilation research project.

While there was agreement, in the workshop, that it is necessary to focus attention where the greatest gains can be made, further research is required to identify precisely what that focus should be. Natural ventilation is a complex challenge that requires the combination of subdivision design and planning and house design to get it right. However this combination is not evident in current subdivisional practices. One possible reason, and a key challenge, evident in the workshop but not consistently acknowledged by the participants, is that land development in subtropical SEQ is commonly a separate process that precedes house design and siting by builders. Most consumers select a house design and building lot via separate processes. In contrast, the workshop participants, as key built environment professionals, find it difficult to address the ventilation issue in other than an integrated fashion that integrates subdivision layout, siting and building design.

A sustainable approach to climate-responsive residential subdivision and development will require design for climate comfort in the absence of air conditioning, even if in the short to medium term the majority of households can afford to run air conditioning. Sustainable design requires flexibility, so that dwellings are comfortable in the event that future energy constraints make air conditioning less viable. It is not sustainable to entrench a system of housing production that makes it hard to 'turn the air conditioning off'.

In the key informant interviews that follow the workshop, an effort is made to focus attention on the subdivision stage (that is, prior to house building), and to elicit more information on industry methodologies aimed at delivering a greater proportion of lots having 'sustainable' levels of ventilation access to maximise natural summer cooling.

The interviews are discussed in the next section of the report.

3. THE INTERVIEW FINDINGS **By Glenda Strong**

The interview participants were land developers, land surveyors, urban planners and regulators with a significant amount of experience in South East Queensland. The seven key informants that were selected had not all attended the workshop and the interviews took place in an informal semi-structured format so that participants where encouraged to expand on their own views on the topic.

The following represents the informants' response to the interview questions. They contain opinions based on their own experience and anecdotal evidence.

3.1 Reducing Energy Demand

Informants where asked if the achievement of natural ventilation for dwellings is important for reducing the demand for energy. Informants agreed, but stated that most of the time, when natural ventilation can play a large role, detached dwellings are spaced at low density, so there is much higher energy demand on the transport network and service infrastructure. For high density detached housing, the energy for transport and services is more efficient but ventilation suffers.

One informant stated that, *"…the best housing model for effective delivery of sewer, water or transport is the "six-pack" (six units in a two storey block). "Six-packs" can be correctly orientated and have enough height for ventilation. However, once one of these is built, the wind pattern for other allotments is disturbed."*

Poor design of this model has led to its discrediting in the Brisbane context. Access issues also reduce the wide spread acceptance of this style of design.

3.2 Consumer Consciousness

Informants were asked if, in their opinion, house buying consumers are conscious of ventilation.

One developer argued that, *"if you make consumers conscious of ventilation then land affordability is lost. Flat land presents very minimal opportunity for breeze and consumers want flat land most of all so they can build a slab-on-ground house for $600 per sqm (or $900 per sqm with new sustainability guideline requirements). On sloping land two adjacent small lots can both get ventilation because of their elevation difference but the house price goes up by thirty to forty percent. The cheapest construction cost for a suspended floor house is $1400 per sqm. The consumer wants the cheapest product and air-conditioning is similarly cheap so they will choose to install it regardless."*

One land surveyor explained that consumers who have spent time in well ventilated homes are aware that, through the use of ventilation, pleasant living environments are created but many consumers have not had this opportunity. One developer added that, "*The most price conscious of all, the first home buyers, only want what they can afford and creative ventilation is seen to be too expensive."*

One informant cited this example in order to demonstrates how little consumers think about ventilation:

"Now all houses have sliding windows. Sliding windows don't capture breeze; instead they have to be hit by breeze. Houses built prior to 1965 seldom used sliding windows; they used hoppers and casements that actually captured the breeze. The home owner could open specific windows to catch the morning or afternoon breeze and casement windows directed either way made this possible. Casements are no longer used in the majority of project homes."

While it is perceived that consumers only want sliding windows, in reality, are they given the choice?

3.3 Site Analysis Plans

When informants were asked if consumers are provided with any site analysis plans they all responded by saying that site analysis is taken into account early, at subdivision design stage but not later demonstrated to consumers. Given the size and speed of the process demonstrating site analysis to consumers is not seen as practical; two or three hundred lots on a small estate, six or seven hundred lots on a large estate. One developer said that project home buyers are given a general "how to design your house" guide which points out ventilation, local climate, orientation, and breezes but this is not site specific.

One informant stated that, "*80% of the land buyers who come in, have already decided or nearly decided on their house design and are just looking for a piece of land on which to put it. They are approaching the process exactly the wrong way around. No matter what initiatives are put in place, the land component is seen as secondary."*

Surveyors thought that land owners who are interested would do their own analysis and that buyers are making their decision based on location, view, size, and price and then after that they look at other design criteria. One Surveyor stated that, *"Consumers are interested in trees for their aesthetic value but will even cut these down to build the house they want.*"

Project home builders are thought to be completely disinterested in site analysis according to five of the seven interviewees. It is this market that the lot rating methodology aims to influence.

Regulators stated that on large subdivisions or small infill subdivisions (e.g. one block divided into two) a site analysis plan must be submitted as part of a complete development application and that site analysis plans are also required at pre-lodgement stage. The amount of information required is dependant on the scale of the development. In general terms, this site analysis includes solar access, prevailing summer breeze, prevailing winter winds as well as other positive and negative natural and man made attributes of the site.

3.4 Natural Ventilation in Subdivision design

Informants were asked if natural ventilation is a consideration in subdivision design and whether or not orientation and slope are considered an influence on the potential for natural ventilation.

Developers agreed that natural ventilation is a very important consideration in subdivision design but that it must be viewed in a balance with other factors. This informant noted that, *"In SEQ the easiest way to achieve the best natural ventilation is to have the long axis of a dwelling running from north-east to south-west; however, this orientation has the worst solar aspect and then a balance with topography must be considered."*

Surveyors agreed that ventilation is now becoming a consideration and that houses built on appropriately orientated lots have better living spaces. There is, however, some confusion within the building industry regarding orientation terminology. Developers, builders and home buyers consider the "facing" side of the house or allotment to be the side facing the street (which could be the short or long axis); while architects and designers think of the "facing" side the long axis only.

In a recent report, (Deicke Richards 2004, 52) appropriate orientation is defined as: *"The appropriate orientation of streets and lots creates lots and sites for better energy efficiency and good subtropical design for housing of the various types and densities in the neighbourhood. To achieve this streets are generally run north-south or east-west with variations between 20 degrees west of north and north of east and 30 degrees east of north and south of east."*

The same report goes on to say, "North/south streets allow the long sides of lots and dwellings to face north. Long verandas can face north and narrow built forms are possible which are good for cross ventilation. East/west streets allow for north facing rear or front gardens. Building forms can be more compact and shading of western facades needs design consideration."

Surveyors also stated that slope determines whether slab-on-ground or a pole-style house construction prevails. Surveyors and regulators agreed that in Brisbane there are very few flat sites available for development so alternative house types are required.

Regulators stated that they look at natural ventilation along with private open space. Ventilation principles can be applied on a larger scale development where there are fewer existing constraints and here, regulators can have greater influence on the design outcome.
Here again, topography is the major consideration, and regulators said that there are very few flat sites available for development on the Gold Coast, and that it is even more difficult here because the Gold Coast building industry is not accustomed to dealing with the issues of sloping land. The result is an over reliance on cut and fill techniques that are not considered suitable because they cause breeze to travel directly over a house as explained in detail in section 3.6.6

3.5 Variables in Subdivision Design

3.5.1 Weighting the Main Variables in Subdivision Design.

Informants were asked to list the main variables they deal with in subdivision design and then to position natural ventilation within this list. Earlier research (Mead and Wales, 2002) discusses the main variables in detail. The variables are included here only to position ventilation in terms of its relative importance to the other variables (in the informant's opinion).

The main variables in subdivision design are considered to be:

- Topography
- Yield
- Roads and drainage
- Solar orientation
- Ventilation

Informants all noted that the order of importance of design variables is only a guide and that they are weighed up and vary in importance depending on the site. Earlier research (Mead and Wales, 2002) also found this; however, this report adds to these findings in that most informants said that the other variables take priority and ventilation is usually considered last.

3.5.2 Some Project Examples:

The following examples were suggested by interviewees to illustrate how the consideration of natural ventilation varies according to site and how informants understand and are well aware of breeze but are not always able to incorporate it. The examples are not referenced in order to retain the anonymity of the informants.

- On the Sunshine Coast there is a very strong sea breeze and ventilation is very achievable. There is slope and elevation to allow maximum ventilation; and solar orientation is slightly less important

- A major new suburb, south of Beenleigh, is on the west of a major ridge, so the good breezes go over top, leaving only the undesirable westerlies. Therefore, consideration of ventilation on these sites is minimal.

- One Sunshine Coast subdivision has a flat site enabling ventilation and solar orientation issues to be paramount; all the blocks are orientated to maximise ventilation. Diamond shaped allotments allow all houses to be off set from each other so that they can capture breeze and so that breeze funnels between the houses. For these 400 houses a large effort is being made to maximize breeze capture.

- In Townsville planning is primarily topography driven. For sites west of the Stuart Range the morning breeze is blocked and micro-ventilation is very poor. Here, ventilation as a variable is not considered at all.

- The Springfield project is a green field site so there is no constraint on lot size and shape. Green field sites present unique opportunities that smaller subdivisions do not have, however some blocks here are small (300sqm) and the smallest sites have maximum sized homes on them. There are some innovative designs with breeze ways and outdoor fans so that ventilation is considered at house design stage.

3.5.3 A Regulator's Approach

Regulators do a constraints analysis first to define developable area; looking at issues such as bushfire, flooding, geotechnical, slope, stormwater and effluent disposal.

Once the developable area has been identified they look at related issues of access, circulation and town planning (e.g. built form code). Ventilation is reviewed as part of this stage. All variables are weighed up. At subdivision stage regulators can only influence lot layout and road design. Breezes are identified at the beginning of the subdivision design process, but are given a low priority compared with other factors. It tends to be considered an architectural issue to be solved later at the house design stage.

3.6 Impediments to Ventilation in Subdivision Design

Informants were asked if natural ventilation is enhanced or impeded by existing sub-division design. As the basis for his answer, one informant elaborated on the historical context of subdivision design in Brisbane in order to highlight what happens today in subdivision design.

3.6.1 Changes in subdivision design

According to one informant, *"the old way of sub-dividing in QLD was to make all blocks two chains (40metres) long and 10 metres wide with a similar allotment backing onto it. Land owners only wanted to build 120sqm houses and they positioned them at the front of their blocks.* (Refer Figure 1) *The same pattern was repeated on the blocks behind and adjacent which effectively gave a separation of fourty to fifty metres between the backs of houses and twenty five metres between the fronts of houses. A row of these houses would have breeze channelling back into them. Houses were built on stumps and breezes could travel underneath as well so the whole subdivision was much more permeable."*

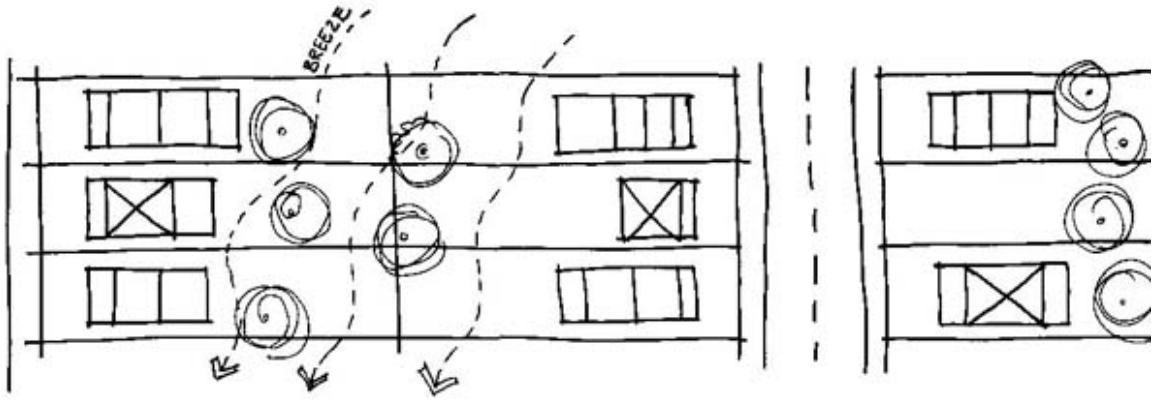

Figure 1: Small houses on large lots

3.6.2 Building Footprint and Plot Ratio

Today, the process of subdivision and dwelling design as it is practised in SEQ, means that opportunities for natural ventilation are rarely enhanced and often impeded. Most buyers seek frontage as they want a house with a street presence. Three depths of blocks are offered to buyers: 32m deep, 25m deep and 18m deep. On a 32m deep block most home buyers have changed from building a 120sqm house to building a 250sqm house. No matter how wide a block is, the house is built from boundary to boundary (taking into account prescribed set backs), so that the backyard gap between houses no longer exists and neighbours block each others breezes. The yard is not important to consumers as they would rather use their money to make their house bigger. (Refer Figure 2)

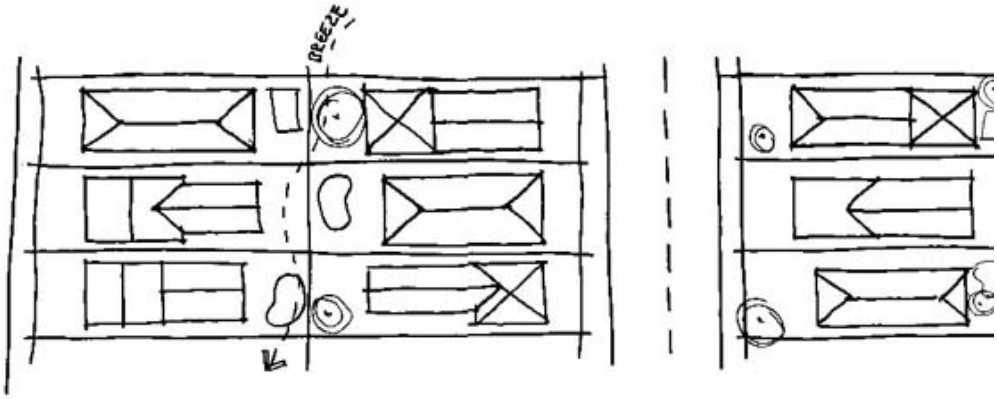

Figure 2: Large houses on small lots

This informant asked, *"How do you convince the 40% to 60% of people who live in Queensland that they should live in an apartment? That apartment living is more sustainable, can catch better breezes, can be orientated well and can use infrastructure efficiently?"*

3.6.3 Small Lots

The problem of large dwelling foot prints is made worse on smaller lots. Affordability drives the market so that every lot sold in this segment is either 18m or 25m deep. Cross flow ventilation is restricted and small lots result in a limited range of dwelling type and less breeze capture. Residents of these dwellings may be the least able to afford air-conditioning but they are likely to need it.

In the planning process lot density is seen as an even greater restraint than topography, and increased lot density is said to eliminate the achievement of natural ventilation of allotments. One informant stated that *"small lot development is a disaster for natural ventilation."*

3.6.4 Project Homes

Project home builders were not represented at the interviews. Informants said that project home builders tend not to be interested in ventilation and that these builders may have at least 80% of the housing market. Project home builders are seen to want a formula, a familiar product, quick turn over time and minimal changes to standard plans. They have a set product that does not respond to unique sites that require a responsive approach. Instead, houses are imposed on lots. Informants had not seen a house in the project home market that delivers good ventilation.

3.6.5 Masonry Garden Walls

One regulator stated that, *"In the past, most houses had no front fence or, if they did, it was low and made of chain wire or timber palings so breeze could penetrate. Nowadays there is a predominance of impenetrable 1800mm high solid masonry walls"* (Refer Figure. 3).

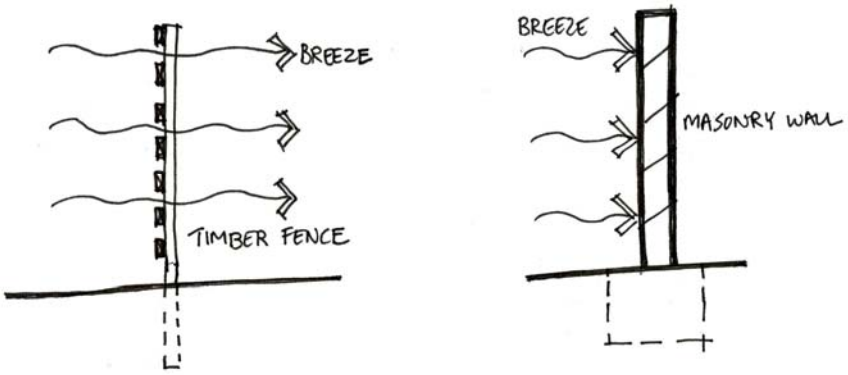

Figure 3: Breeze permeability of garden walls

3.6.6 Cut and Fill

This regulator went on to say that, *"A predominance of cut and fill, and the resulting three metre high rock battered retaining walls, mean that breeze goes directly over a house completely by-passing it. When masonry boundary walls are added on top of a cut and fill situation, the breeze blocking problem compounds and regulators have little control over the combined results. Whatever efforts are made for correct orientation at the subdivision design stage, they are negated by the combined effect of masonry boundary walls, and cut and fill on sloping sites."* (Refer Fig 4 & 5)

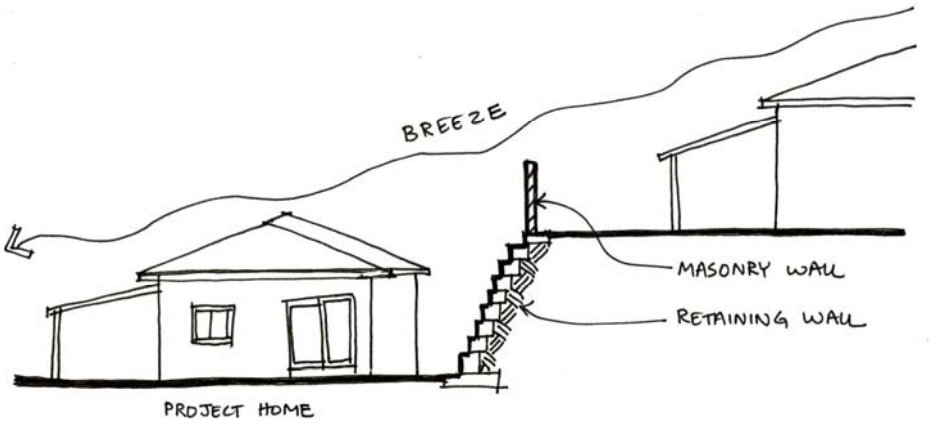

Figure 4: Breeze by-passing house due the effect of cut and fill combined with garden walls.

Figure 5: Typical retaining wall at a typical subdivision: blocking window level breeze.

3.6.7 Security and Quiet

In one urban planner's opinion, residents require the ability to "lock down" their home as a house sealed for air-conditioning is quiet; the inhabitants can concentrate as well as feel secure. Another informant said that while noise is blocked from external sources, the fans on condenser units are seldom quiet and can actually become a noise source for neighbours.

Also, the use of dense wire mesh security screens, advertised as breeze penetrable, in reality may let very little moving air through.

3.6.8 Driveways

One urban planner said that a land owner will completely change a proposed house orientation if it means they can save $30 000 on the cost of building their driveway. Cars are a reality that cannot be ignored in the planning process.

3.7 Conserving Existing Breezes

Informants were asked if they have any approach towards conserving existing breeze during the subdivision planning process and in the global scheme of the subdivision design informants said that they do consider existing breeze but again they said they have no control over the micro breezes that ventilate a house. They tend not to look at the micro breezes of a specific site and one informant stated that, "*This would require a year with a weather station on site and the land sale delivery process is simply too fast for this.*"

One surveyor and one planner said that where the topography of the site allows for it, they will align roads with existing breeze patterns planning roads that run in the same direction as the prevailing breeze. Generally, however, only on the coast, where prevailing winds can be problematic (for example in a storm area) does wind pattern get more attention.

Regulators said that vegetation is looked at from an environmental conservation and bush fire point of view but not from a breeze point of view. Similarly, adjacent structures are viewed more from the point of view of privacy or blocking views than from a ventilation point of view. But a property with good views is likely to have good ventilation.

3.8 Existing Lot Rating Methods

Informants were asked if they knew of any existing lot rating methodologies. Before the workshop, the majority did not know of any, however one informant is using a combination of SEDA Solar Access for Lots (drawn up for NSW under BASIX) and the VIC urban guidelines (SEAV) and they stated that neither system is adequate at this point in time. Both rating systems have a ventilation component but only based on the spacing of an allotment. There is no component in these systems that includes breeze.

One major developer has joined the Global Reporting Initiative for sustainable companies. A lot rating methodology may assist their reporting by providing a method to rate every lot.

"GRI's vision is that reporting on economic, environmental, and social performance by all organizations is as routine and comparable as financial reporting. GRI accomplishes this vision by developing, continuously improving and building capacity around the use of the GRI's Sustainability Reporting Framework, the core of which being the Sustainability Reporting Guidelines." (www.globalreporting.org, 2006)

3.9 Possible Incentives

Incentives were noted by workshop participants as possible tools for addressing four of the top five key challenges (see section 2.2), interviewees were asked what incentives there could be for achieving good ventilation in subdivision design.

A developer working on inner-city multi-unit dwellings said that*, "at higher densities there is reduced infrastructure and that if it could be demonstrated, through good solar and ventilation design, that the load on another energy resource has been decreased, there could be an opportunity for a reduced electricity tariff."*

Informants noted that rebates or rate reductions available to property owners are possibly the only type of incentive that would really work. Home buyers are seen to drive the market and the success of the Brisbane City Council rainwater tank initiative is a classic example. In turn, consumer demand would be an incentive to the developer.

One urban planner stated that *"home buyers dismiss ventilation and even ceiling fans. In the public mind ventilation does not exist. There is a complete lack of consumer awareness about the importance of good orientation let alone ventilation; the effects of which are only measurable in long term by their energy bill. Ventilation is too intangible and it is difficult to get incentives for things that are not easily measurable."* This planner suggested giving potential buyers a compass at the land sales office in order to create awareness.

3.10 Measuring Performance of Lot Design

Informants were asked if they knew of any indicators or evidence with which to measure the performance of lot design. The Urban Planner, mentioned above, re-iterated that ventilation is intangible and essentially unmeasurable. Generally, however, informants came up with the following indicators:

- A house that doesn't automatically require a/c;
- Going out on site to get visual feedback;

- Interviewing people in new estates (Council only responds to complaints.);
- Lot rating.

3.11 Envisioning a Lot Rating Methodology

Informants were asked to what extent they thought a lot rating methodology could enhance access to natural ventilation and the interviewer tried to gauge their level of acceptance of such a methodology.

Informants agree that good design should be a given and anything that can be done, in design terms, to arrive at a lot that presents the opportunity for maximum ventilation, energy efficiently, and minimum impact on infrastructure, is a good thing.

However, one informant stated that current lot rating systems do not include breezes or balance this variable with other important issues. The net result of lot rating needs to produce allotments that are still affordable. If resulting allotments are unaffordable, the net result is out of balance with required project outcomes. Ventilation is one of many variables and a system that attempts to include all the variables could easily make a lot rating methodology unwieldy.

Some informants believe that to achieve a five star rating an 800sqm lot is required to facilitate natural ventilation and this is unaffordable and has other undesirable impacts on sustainability and energy use. One informant stated that, "*Under the current methodology, most small lots would not even get a two star rating."* There is much scepticism about whether a lot rating system could be practical and actually work, even though it sounds like a good idea to some.

One surveyor cited the example of a high rise building where the developer was very keen on achieving a 4 or 5 star rating under the Green Star system. As soon as achieving the star rating was seen to cost several hundred thousands dollars more, it was rapidly abandoned. This surveyor stated that, "*a rating system needs to be neutral in its financial impact. Too many regulations hinder innovation and that the more Council's prescribe outcomes, the less quality outcomes are achieved. A lot rating scheme would be a hindrance and just another box to tick. One issue being that a non-standard architectural solution would not get the tick but would solve a particular ventilation problem."* Most informants saw ventilation as primarily an architectural issue.

One urban planner, experienced in the New South Wales lot rating system, found it hard to implement and, in his opinion, not really relevant to the development or building industry in SEQ as, in his opinion, from Lismore northwards, houses can be designed on any orientation and have a good design outcome for both solar access and ventilation.

He stated that, "*In theory you would not design western allotments in Brisbane if you followed the existing rating scheme, but practically speaking, shading devices and planting on the western side will turn a bad site into a good site. Ventilation is an on site issue easily dealt with. In Brisbane people like to orientate to Mount Cootha where the sun goes down. Residents will use external shading devices for the three hours before sunset and then enjoy the view thereafter, and probably, they bought the lot because of the view. A lot rating system standardises something that cannot be standardised as every part of site has a different micro breeze. With an increase of lots zoned for mixed use standardisation is even less practical."*

"If the lot rating is the design driver we could end up losing trees and having too much cut and fill. We then have to ask the question "what is the sustainable bench mark being set?" Is it not better to let topography and existing trees drive the layout?" This urban planner believes that lot rating

could result in less environmentally sustainable subdivisions and that it can only work for flat tree-less sites, saying that *"….it (lot rating) is meaningless on sloping land. The building industry could not accept it."*

Another surveyor stated that a lot rating system would be beneficial and that any method used to arrive at a better design would be welcome but he could not imagine a developer accept this. He states, *"With developers the issue of yield is the greater dictate. A lot rating system could be a valuable tool to demonstrate the requirement to for a different yield. Smarter developers will look at all aspects rather than just yield."*

Regulators stated that such an assessment tool would have to be statutory so that it has weight and can be defended in a court.

Lastly, given the nature and speed of the land development process, any lot rating system that is to be adopted must be computer driven, and freely available on the internet to the house buying public as most of lot rating's value lies in educating the consumers as well as the designers of sub-divisions.

3.12 Other Energy Assessment Systems

A minority of informants were familiar with other rating systems such as AccuRate, BASIX, BERS, NatHERS, and Green Star. Their perception of AccuRate is that it accommodates internal ventilation but has nothing about site ventilation; and that it is still based on the reverse of our climatic cycle.

The other systems have too many trade offs so that a design can be manipulated to get a desired result (i.e. the required tick in the box). They include nothing on ventilation and they penalise a house on stumps so that unless the floor is completely sealed underneath, negative results are obtained.

3.13 Alternatives to Lot Rating

3.13.1 Covenants

When Informants were asked to suggest alternatives to lot rating one informant stated that, *"the problem with lot rating systems is that they look at individual house lots rather than a community of house lots.*[4] *A house on stumps gives back to the whole community as it lets breeze through. Covenants and building controls have potential to clearly articulate to the person buying the land that they have to use a design that not only achieves certain things for themselves, but contributes certain outcomes to the community. Most covenants are very superficial (e.g. how the front of the house should look) and they are all about "me.""*

This developer aptly said, *"Breeze is a community issue."*

A regulator explained that generally covenants attach to land, not the building; however, covenants could potentially provide a link between the land and the built form to follow.
The problem with covenants is that they have to be legally written on the title plan and every time there is an impediment on the landowner's right to enjoy their land, the land value is decreased.

[4] A counter argument is that the broader community context is addressed by the requirement that 80% of lots achieve a 5 star rating.

A surveyor explained that covenants are not enforceable, for example, residents cut down trees despite existing vegetation covenants. He asked, *"Would you then create a Breeze Police and a whole new layer of bureaucracy?"*

3.13.2 Better Neighbourhood Design

One Surveyor said, *"Consumers will put up with small houses and lots if they can have "lifestyle," streets that offer more, such as large trees and plenty of small local park*s." If density is high the neighbourhood as a whole needs to provide the design for ventilation.

We could also say*, "Breeze is a neighbourhood issue."*

One informant reflected that, *"it takes heart and commitment to achieve sustainable outcomes. When there are too many requirements sustainability is seen as too hard."* He suggested designing subdivisions that focus on one particular outcome, for example, one that focuses on hot water and another that focuses on waste management; perhaps making the goals more achievable so that energy efficiency is not seen as "over the top."

3.14 Statutory Controls

There are no specific controls that address natural ventilation in subdivision design. Regulators have regard for them through the site analysis process in the ROL (Reconfigure a Lot Code) and in the energy conservation planning policies. For example the Gold Coast City Council's Planning Policy 5, Chapter 3, states, *"Sub-division design should include measures such as variable set backs and zero lot lines as a means of maximizing solar access and opportunities to capture breezes, especially with small or narrow lots."* (Gold Coast City Council, 2006)

Breeze is viewed as part of a cumulative effect in the planning approval process. It is integral and does not stand out on its own, that is, an application cannot be refused on the grounds of ventilation alone, however if a plan does not meet ventilation requirements, generally, it also doesn't meet other requirements either.

Regulators try to stipulate where private open space will be located on the site and again, in a cumulative way, ventilation and energy efficiency are positively influenced. The energy conservation code is mainly concerned with solar access but it does mention maximising access to prevailing summer breezes and minimising exposure to winter winds however, it gives no specific planning solutions.

Regulators have influence if the developer is applying for both the built form certification and the land development approval at the same time, but when only the land development approval is applied for and private certifiers approve the built form, they have very little influence. For the latter situation they must rely on the BCA and the Town Planning scheme.

3.15 Conclusions from the Interviews

Developers, surveyors, regulators and urban planners understand and are well aware of ventilation in the subdivision design process, but find they have to balance this variable with many others. Topography, land affordability and yield are the strongest drivers and ventilation is seen as the weakest driver, but still integral to the process.

Factors such as large houses on small lots (poor plot ratios), houses selected by the consumer before land is selected, and the combined effects of masonry garden walls and cut-and-fill negate the best efforts made in subdivision design.

Four out of seven informants agreed that a lot rating system was a good idea as long as it is part of an overall sustainability outcome and that it includes all the cumulative effects of climate, water consumption, energy use and affordability. Informants insisted that such a system should be web based and freely accessible to the house buying public, as much of its merit lies in educating the consumer. Informants believe that the consumer is the driver that will best motivate the developer towards climate appropriate design.

It should be noted however, that those in favour of a lot rating system placed so many conditions or qualifications on their agreement that agreement could possibly be interpreted as disagreement.

Three out of seven of informants regarded a lot rating system as unwieldy and impractical and even standing in the way of good design outcomes in order to obtain the required “tick in the box.”

Informants had no indicators or evidence with which to measure the performance of allotments except via a lot rating system, or visual or user feedback and the - speed of the housing delivery process - means that performance is seldom measured. Informants were equally divided as to whether covenants could be a more meaningful solution than lot rating. Covenants are regarded as difficult (some say impossible) to enforce but more practical than lot rating.

OVERALL CONCLUSIONS **By Dr Daniel O'Hare and Glenda Strong**

The importance of sustainability is slowly gaining recognition within all industries and the land development and building industry is no exception. Presently, although tools and methodologies exist for assessing dwellings, there are no tools or well-established methodologies for land development in SEQ and, in particular, there is nothing that adequately considers ventilation, the latter being critical for energy efficient design in SEQ.

The Sustainable Subdivisions: Energy project found that there is a correlation between energy efficiency of a dwelling and the lot it is built on and that lot related issues play an important role in the overall efficiency that a dwelling is able to achieve. The workshop participants and the key informants interviewed were very aware of this correlation and regarded good climatic design as common sense.

Within the context of Energy Efficiency, this report has focussed on Ventilation, and found that while stakeholders are well aware of ventilation at subdivision design stage, the other design drivers, such as topography, yield, roads and drainage, make ventilation a low priority. The result is a significant 'gap' between the principles and practice of 'good design'. This 'gap' and the perception that knowledge is diminishing at all levels, combined with the importation of practices from other climate zones, is of concern to those engaged in promoting climatically appropriate design.

While the majority of informants were in favour, in principle, of a lot rating methodology, they were concerned that all the important variables be included otherwise the system would ultimately fail. Variables such the cumulative effects of climate, water consumption, and energy use (with ventilation as a component of this). Most importantly, the resulting lots must remain affordable for a rating system to be accepted by the building industry.

This stager of the Sustainable Subdivisions: Ventilation research project provides the feedback towards the proposed development of a lot rating methodology for use in SEQ. The industry workshop and key informant interviews, highlighted that natural ventilation is a complex challenge that requires the integration of subdivision design, planning and house design. This challenge is a difficult one, given the common separation of these processes.

Subdivisions that are designed to encourage climatically appropriate sustainable dwellings will provide residents with a home that is more comfortable to live in, has lower running costs and so has less impact on the environment. These are critical factors as subtropical SEQ continues to expand to accommodate more residents while striving to maintain its subtropical lifestyle and amenity.

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GLOSSARY

AccuRate	Thermal modelling tool developed by CSIRO for the Australian Greenhouse Office www.greenhouse.gov.au
BASIX	Building Sustainability Index www.basix.nsw.gov.au
BERS	Building Energy Rating System www.greenhouse.gov.au
NatHERS	National Housing Energy Rating System www.nathers.com.au
Green Star	Green Building Council of Australia's environmental rating tool www.gbcaus.org
SEDA	Sustainable Energy Development Authority www.energy.unsw.edu.au
SEAV	Sustainable Energy Authority Victoria www.sustainability.vic.gov.au
GRI	Global Reporting Initiative www.globalreporting.org

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APPENDIX ONE

APPENDIX TWO

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