



Thermal Comfort and Natural Ventilation

Overview

This factsheet focuses on indoor thermal comfort and natural ventilation inside a dwelling. Thermal comfort refers to the range and combination of environmental conditions including air temperature, humidity, air movement and radiation that most people find to be pleasant. Natural ventilation refers to indoor air-movement that derives from natural sources such as outdoor breezes. Under present climatic conditions in subtropical environments, most people will be reasonably comfortable through-out the year simply by adjusting their level of clothing.

The concept of thermal comfort was initially coined by Professor P. Ole Fanger in 1970 [1], who, with his colleagues, performed groundbreaking research on the importance of indoor air quality, temperature and humidity for human health and the role of poor indoor air quality in causing illnesses such as asthma as well as symptoms associated with Sick Building Syndrome.

Liveability of dwellings can be improved by optimising thermal comfort, especially through maximising natural air-flow. Dwellings can be oriented, designed and manipulated to improve thermal comfort. Maintaining a comfortable thermal environment can have environmental, economic and health benefits, including:

- Health benefits due to improved air quality
- Reduced reliance on mechanical heating and cooling and associated energy savings (for example, reduction in use of air-conditioning means that energy bills are lower, and greenhouse gas emissions are reduced at the same time)

Research on thermal comfort has shown that occupants of naturally ventilated buildings are comfortable in temperatures that closely reflect the outdoor climate. [2]

A study in Sydney showed a reduction of energy use by 25 – 33% in naturally ventilated mixed mode buildings and high occupant comfort satisfaction scores. [3]

Research has shown that occupant control over an operable window is related to perceived well-being. [4]

What our Findings Revealed...

Residents' Perceptions of Thermal Comfort

Preference for Natural Air-flow

Balconies Enhancing Thermal Comfort

Residents' perceptions of thermal comfort

Survey results from the QUT High-Density Liveability Study indicated two thirds of respondents rated the average temperature of their living space as comfortable (neither too warm nor too cold) while 12% reported it was too warm and 1% reported it was too cold. Residents highlighted a range of different design features that impacted on their climatic experience within their dwellings. Features that contributed to thermal comfort include natural air-flow and control over exposure to the sun's heat and light; dwellings with balconies and other outdoor living areas; internal and external modifications (e.g. shades and blinds); and orientation of the dwelling to maximise breezes during summer months and to maximise access to the sun's warmth, and daylight, in winter months.

Preference for natural air-flow

Residents generally expressed a preference for natural air-flow over air-conditioning. The majority of residents (80%) had space cooling equipment in their dwelling while 53% had space heating equipment. However, survey results indicated when thinking about 'climate control' in summer, residents were more likely to open the windows and doors (83%) rather than turn on the air-conditioning (63%). Qualitative interviews supported residents' preference for natural air-flow over air-conditioning, as long as other negative impacts such as noise or air pollution were not introduced as an unwanted consequence:

We try and use the air conditioner as little as possible... if you open the windows you get a good breeze, it's generally fine.

We're lucky we've got flow through. We're actually on both sides of the building. So you can open up one side and the other and get a breeze right through it, so in that respect it's good. One that I've got that my in laws are living in, doesn't have that facility and that can get a little bit stuffy. They rely more on the internal cooling rather than external breezes.

[I] open the back door and let the breeze go through. That's just the simplest form of conserving energy. Most people would go and turn the air conditioner on. Well, yeah, there are times in the year where I have to do that but, you do simple things with what you've got to reduce the amount of energy you take to live there and you find that you can live more cheaply and very, very comfortably.

Interviews with residents suggest that a lack of natural air-flow and cross-ventilation is associated with an undesirable reliance on air-conditioning.

Because we don't get a breeze right through the apartment, we do use [the air conditioner]. .

All the (dwellings) in the centre of the building have a corridor so you don't get the flow through of air, and therefore there is a reliance on air-conditioners. These apartments are built so there is an air-conditioner in the bedroom and in the living room in every apartment in the building.

Balconies enhancing thermal comfort

Balconies provide a good opportunity for natural air-flow and improved thermal comfort. Balconies were considered to be important by 87% of survey respondents. Many of our interviewees expressed preference for spending time on their balcony and identified their balcony as a favourite design feature:

(The climate is) really beautiful, because we get the afternoon sun and then there's a little balcony out the back that gets the morning sun so it's perfect.

It has been made significantly more liveable because they built that entire balcony in, glassed it in. It's glassed on three sides. The sun comes in, heats that area and the warmth flows through into the main lounge area. I can usually get by in the wintertime just by putting a jumper and a pair of socks on.

Recommended Guidelines

The following table presents practical suggestions for Residents, Building Managers, Designers and Developers with regards to maximising Thermal Comfort and Natural Ventilation. Building design that takes advantage of passive cooling and heating can reduce reliance upon artificial heating and cooling methods, improving the economic and ecological sustainability of dwellings while optimising thermal comfort for residents.

	Residents	Building Manager	Designer	Developer
The northern orientation is the easiest to control in terms of solar access, and is recommended for living areas or spaces used throughout the day.			✓	✓
Use external shading to prevent the sun's heat from entering interiors. Screens and awnings that are adjustable are most flexible to achieve ideal conditions throughout the year.	✓		✓	✓
Use narrow floor plans with the long side facing north. Combined with the correct location and sizing of openings, this strategy can successfully combine sun control, daylight entry and air flow through a building.			✓	✓
Cross ventilate every habitable space by deliberate configuration of layout, combined with size and location of operable openings. Cross-ventilation requires both inlet and outlet openings. Maximum air flow occurs where large openings of equal size are placed opposite each other. Other opening positions achieve other effects. Determine ideal size and location of window and door openings through detailed architectural layout. This requires strategies to cross-ventilate access			✓	✓

corridors and other common circulation spaces such as stairwells, and must work within the regulatory environment for fire safety, access and egress				
Ensure adequate space for substantial shade trees in overall site plan, particularly on the western and eastern sides of building Implement Building Management strategy to ensure these initiatives are maintained.		✓	✓	✓
Configure and orient blocks in accordance with characteristics of wind availability and topographic features			✓	✓
Use overhangs/other shading strategies to block direct sun in summer/allow the sun to shine in during winter.	✓		✓	✓
Use materials with high thermal mass to maintain cooler indoor temperatures, keep these fully shaded on warmer days			✓	✓
Provide each dwelling with private outdoor space such as a balcony or terrace, that is directly connected to life indoors. Maximise northerly aspect. Balconies must be deep enough for people to gather around a table, and should give residents a sense of privacy. Fully transparent balustrades are not recommended because they discourage people from making full use of both the balcony and the adjoining living spaces.			✓	✓
Use louvre or casement windows to capture and channel external breezes into dwelling. These types of windows offer the advantage of being able to be adjusted to regulate wind speed and direction.			✓	✓
Design 'privacy' screens to prevent overlooking and maximise effective natural ventilation. Instead of blocking air movement, privacy screens can act as wind 'scoops', improving ventilation and air flow rates for occupants, and improving privacy for neighbours. This may require screens to 'project' beyond the general external line of the building.			✓	✓
Use ceiling fans to assist air movement strategies. Ensure ceiling heights are appropriate. Ceiling fans can also assist thermal comfort on balconies.	✓		✓	✓
Insect screens must be integrated with openings but can reduce air flow by a substantial amount, so, where possible, make screens retractable for those times when they are not required.				
Educate occupants on climate control	✓	✓		

Further Information

Queensland Development Code (QDC)

Mandatory standards in the Queensland Development Code are in addition to the Building Code of Australia. They refer primarily to buildings rather than lots.

<http://www.dip.qld.gov.au/building/queensland-development-code.html>

South East Queensland Regional Plan 2009 – 2031

The SEQ Regional Plan provides broader design principles for the subtropical climate of South-east Queensland.

<http://www.dip.qld.gov.au/seqregionalplan>

Your Building

The Your Building web portal provides information for investors, owners, and occupiers as well as developers, builders, designers, and facility managers.

<http://www.yourbuilding.org/display/yb/The+Second+Plank+-+Building+a+Low+Carbon+Economy+with+Energy+Efficient+Buildings>

Your Home Technical Manual and Website

A Federal government initiative, for use by tenants, home owners, builders, designers and developers, applying a series of checklists for what one wants to achieve, followed by implementation through a series of Fact sheets that are tailored for different climate zones,

<http://www.yourhome.gov.au/>

Hawaii Commercial Building Guidelines for Energy Efficiency

A comprehensive State government of Hawaii document, that provides an overview on natural ventilation and thermal comfort, design recommendations, application and relevance to existing code. While designed specifically for Hawaii, the climatic context has relevance to the coastal SEQ environment.

http://www.archenergy.com/library/general//chapter2_nat_vent_030604.pdf

Centre for Subtropical Design

www.subtropicaldesign.org.au

Think Brick Australia

www.designingforclimate.com.au

Cleaner Greener Buildings – Qld Government Legislation

New legislation in 2009 will prevent body corporates and developers from restricting sustainability features in their buildings such as light roof colours and window tinting

http://www.climatechange.qld.gov.au/__data/assets/pdf_file/0003/25626/3_P-and-B_-_E1_web.pdf

References

1. Fanger, P.O., *Thermal Comfort*. 1970, New York: McGraw-Hill.
2. Artkins, C. *All in the Mind*. Essential Matters 2007 [cited 2009; Available from: http://www.essentialmatters.com.au/resources/PropAust_Issue10_p68_69.pdf.
3. Rowe, D., *Mixed Mode Climate Control*. AIRAH, 1996. 50(12).
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5. Queensland Department of Local Government and Planning. *Queensland Development Code*. 30 April 2003. Available from: <http://www.lgp.qld.gov.au/?id=247>.
6. Photography Page 1: Lorraine Bell, 2008.