10th International URBAN DESIGN CONFERENCE

PowerPoint Presentation Guidelines

A Wholistic Planning Approach for Wind

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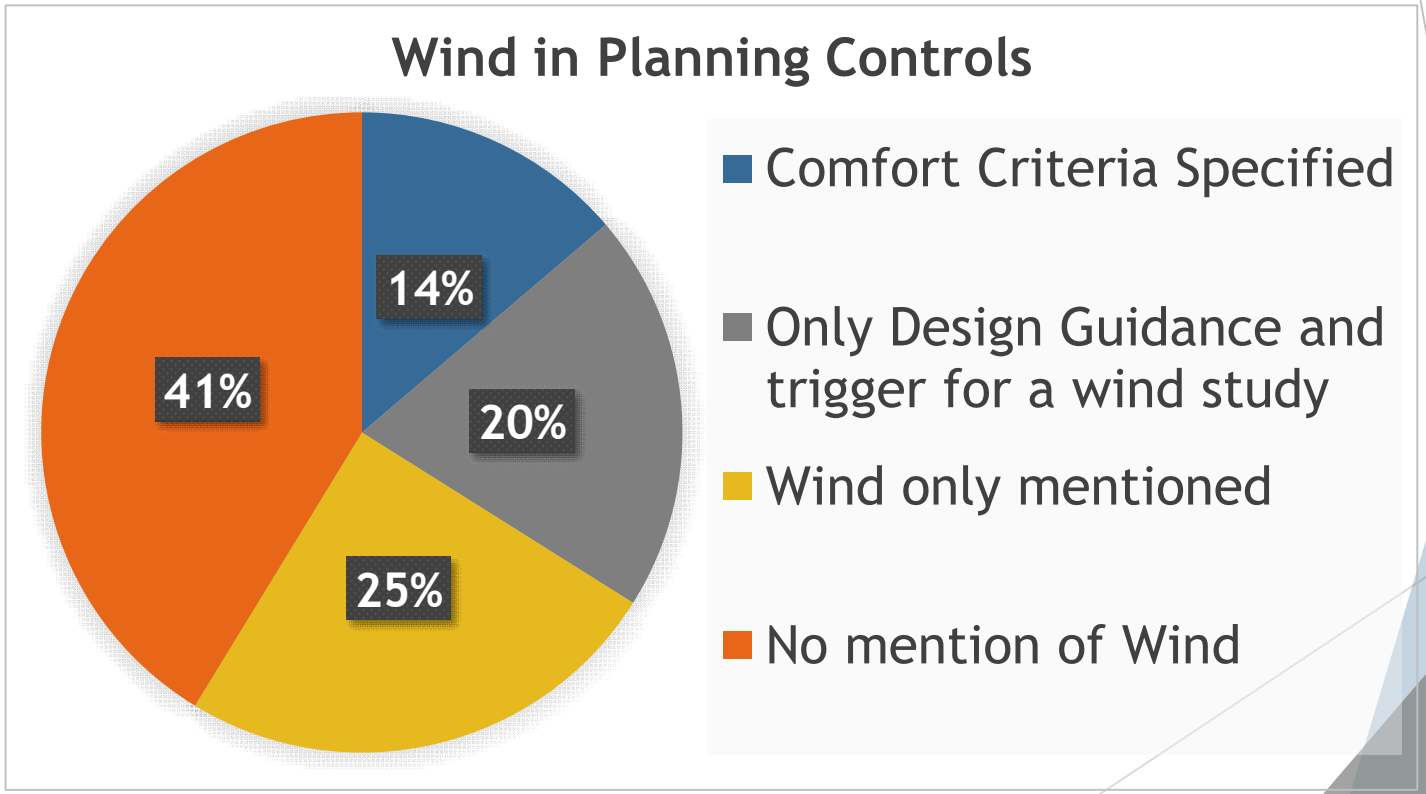
WINDTECH

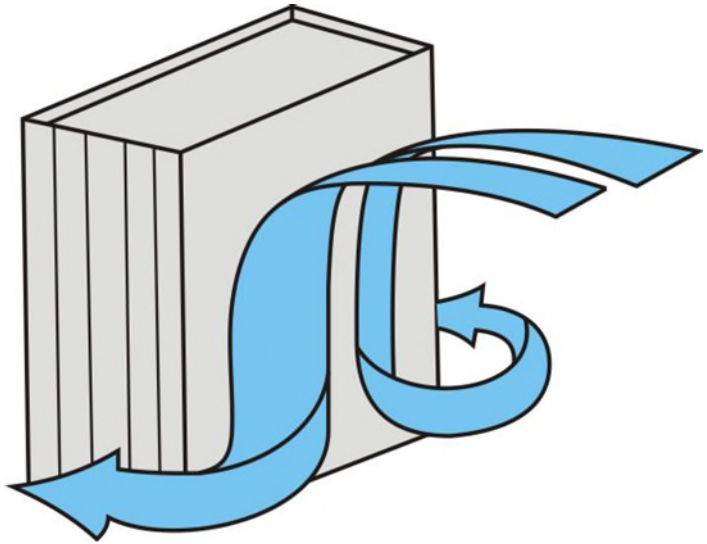
Why Plan for Wind Comfort?

- Minimise impact on pedestrian environments by new developments.
- To treat existing wind environment problems in areas where there is a change of use/ rezoning.
- To ensure continued enjoyment of outdoor facilities (eg. malls, outdoor theatres & restaurants)
- To ensure public safety and avoid litigation by the public and tenants (tenant owners)

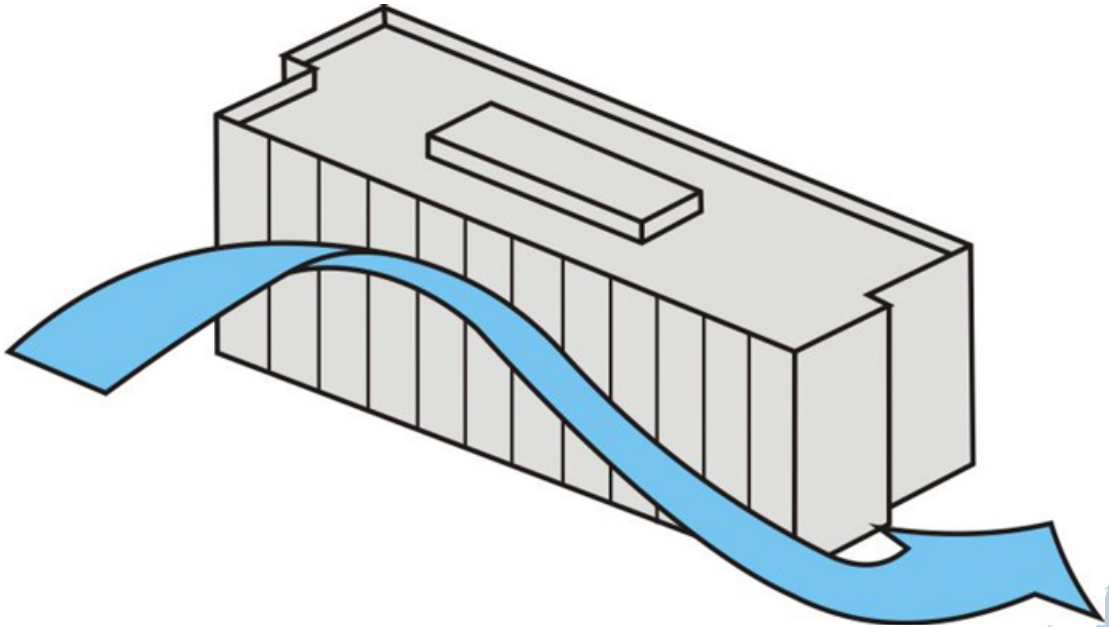
Why Plan for Wind Comfort?



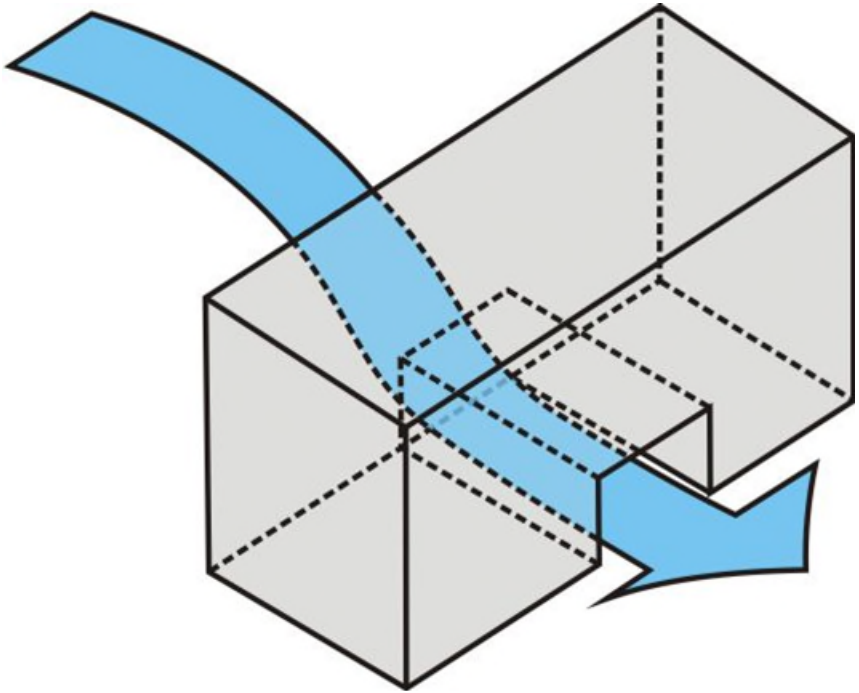
Wind Flow Mechanisms around buildings:
Downwash Effect



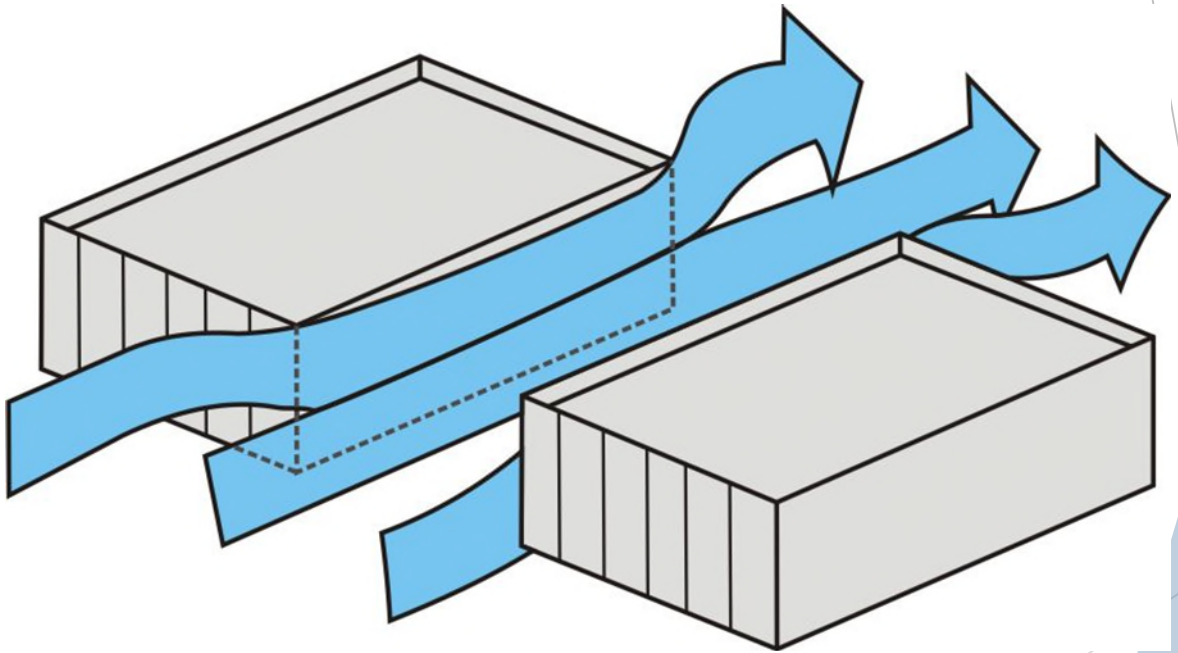
Wind Flow Mechanisms around buildings:
Side Stream Effect



Wind Flow Mechanisms around buildings:
The “Gap” Effect



Wind Flow Mechanisms around buildings:
Venturi or Funneling Effect



Effect of Lack of Planning Controls

Example: Bridgewater Place, Leeds, UK (opened 2007 – video in 2016)

Effect of Lack of Planning Controls

How to Ensure No Negative Outcomes

+

Design Considerations

Examples of treatments:

- Design of the Built Form for the site
- Awning / canopy design
- Inclusion of screens or baffles
- Design of efficient airlocks
- Landscape strategy (not suitable for Safety Limit)

Treatments need to be appropriate to the site and the cause of the wind effect.
One solution doesn't fit all.

Design Considerations

Note:

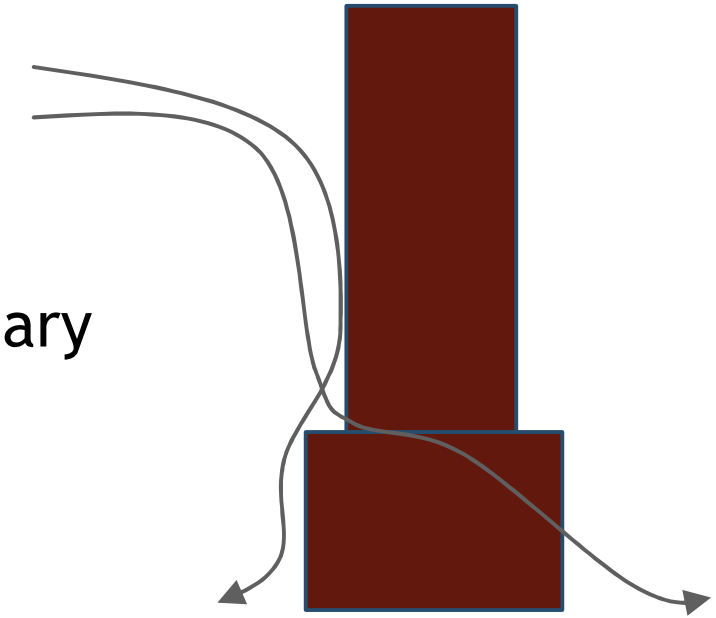
- Encourage rather than enforce design parameters
- As long as strict comfort criteria are adhered to
- Over-regulation can stifle design innovation
- Over-regulation can make a project unviable

Wind mitigation and overall design approach needs to be responsive to the site constraints.

Design Considerations

Example: New Planning Controls for Melbourne CBD

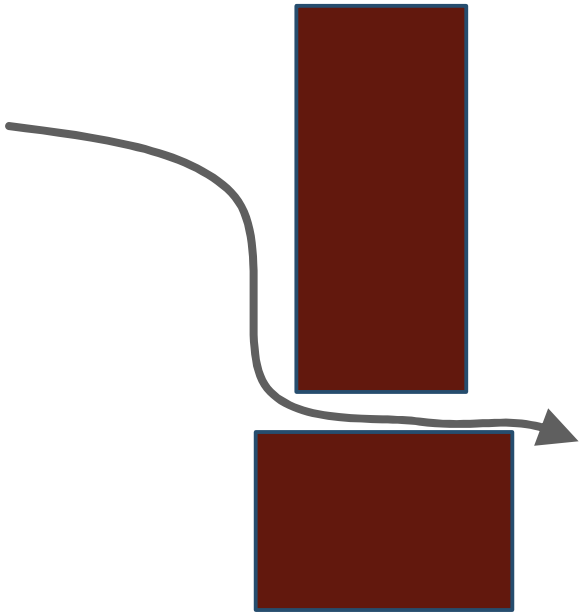
Preliminary design concept



Design Considerations

Example: New Planning Controls for Melbourne CBD

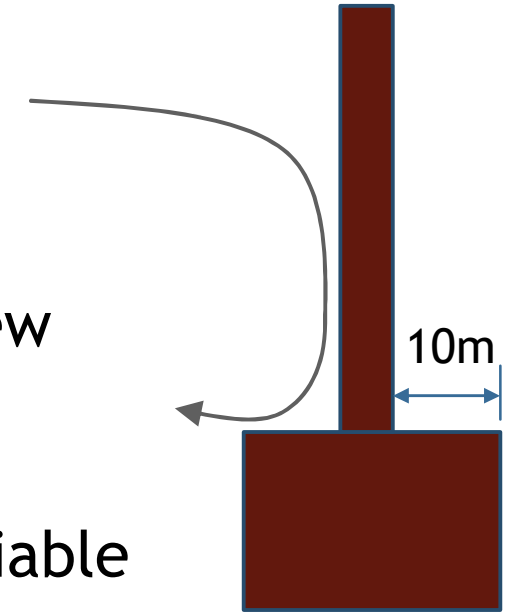
Possible wind mitigation strategy



Design Considerations

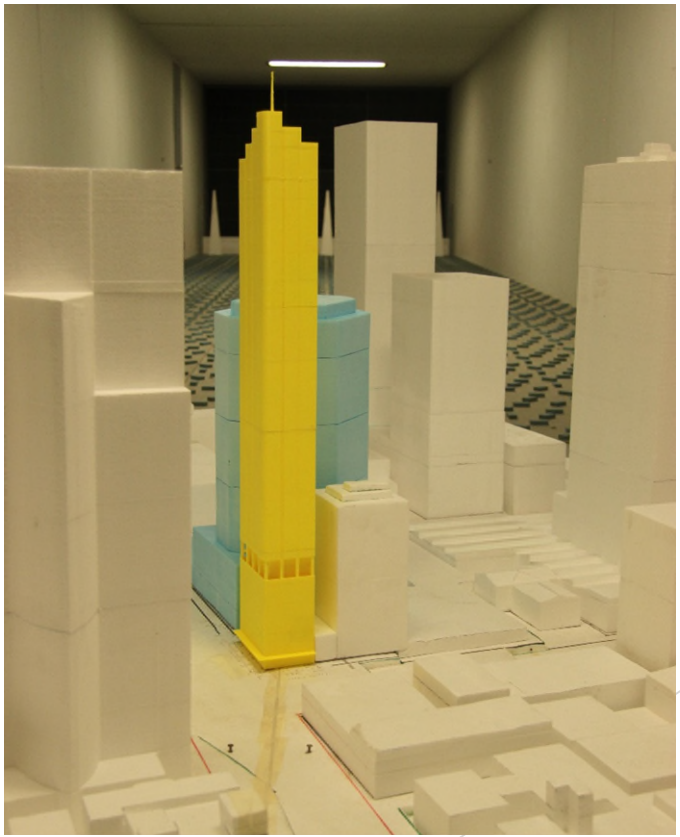
Example: New Planning Controls for Melbourne CBD

Effect of New Planning Controls: project unviable



Design Considerations

Example: 338 Queens St, Melbourne (Sept, 2013)



Wind Mitigation Using a double height recess near the base

Design Considerations

Example: 619 Lonsdale St, Melbourne (Dec, 2009)

Wind Mitigation by making the podium porous (car park levels)

Main wind direction

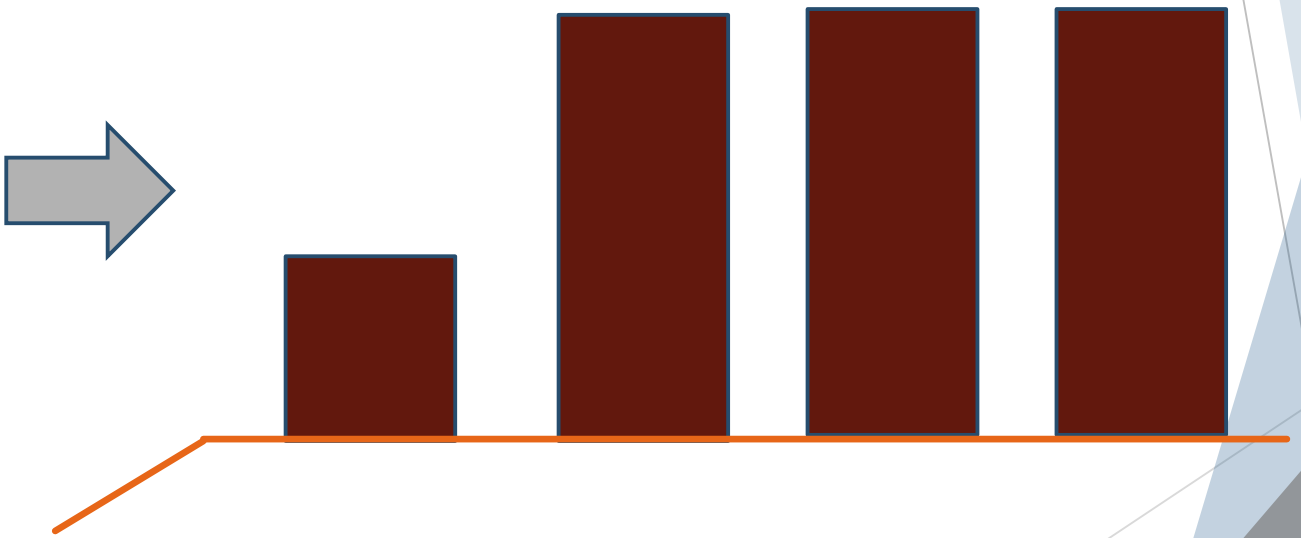
(N)

Trigger for Modelling of Wind Effects

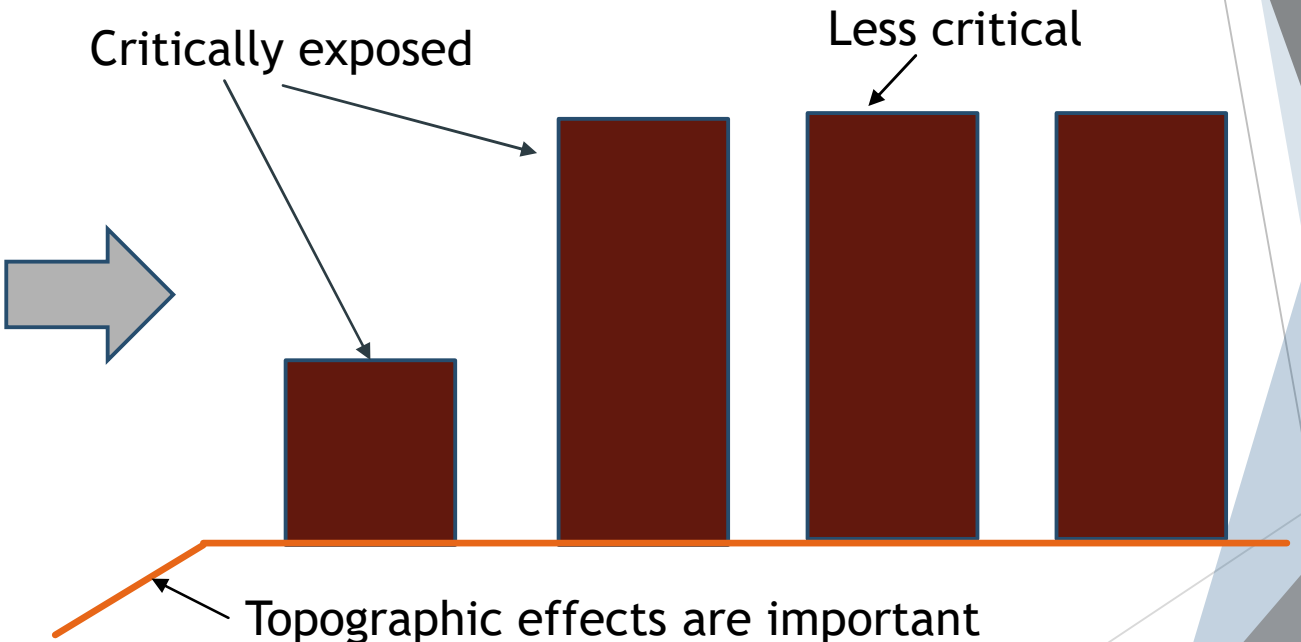
Generally based on building height, not exposure:

- Sydney City DCP 2012: 45m
- Melbourne Central City: 40m
- Parramatta: 32m
- San Francisco: 24m (80ft)
- Mississauga: 20m and >2xht of surrounds or >40m
- Toronto: 20m
- Edmonton: 20m
- Wellington: 18.6m

Trigger for Modelling of Wind Effects

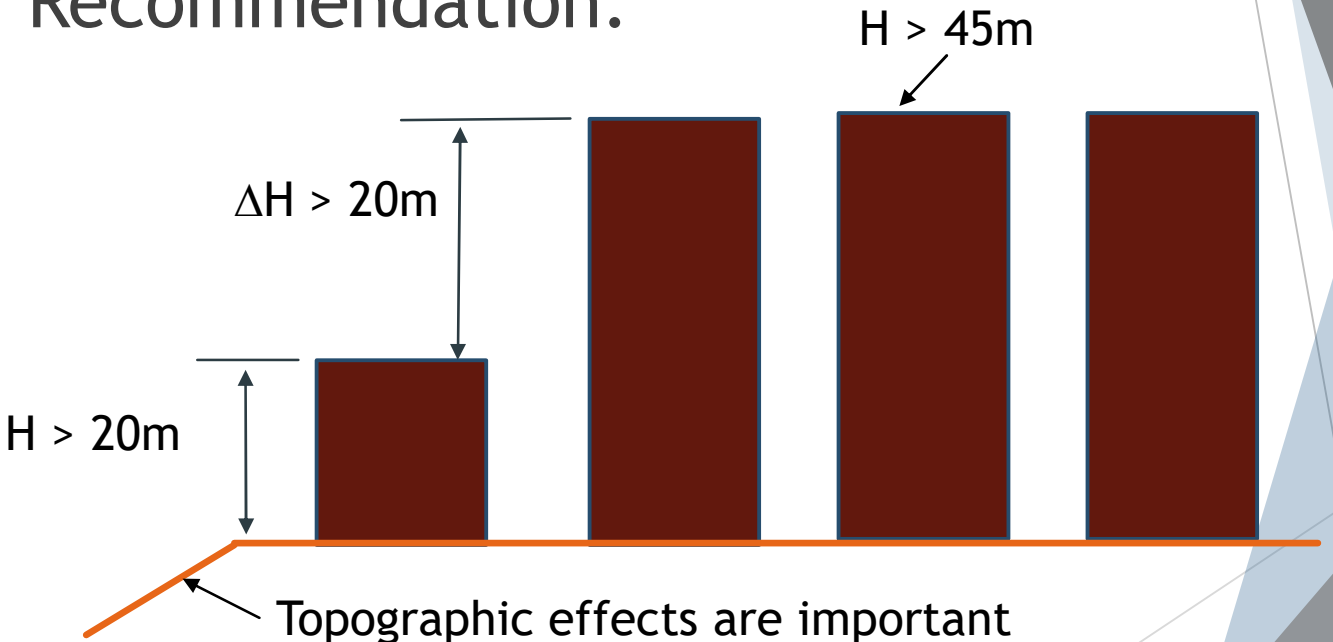


Trigger for Modelling of Wind Effects



Trigger for Modelling of Wind Effects

Recommendation:



Recommended Wind Comfort Criteria

		Comfort category	Gust Equivalent Mean Speed m/s (kmh)	Description
		Sitting	< 2.6m/s GEM p=20%	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without it blowing away
		Standing	< 3.9m/s GEM p=20%	Gentle breezes suitable for main building entrances and bus stops
		Walking	< 5.4m/s GEM p=20%	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
		Uncomfortable	> 5.4m/s GEM p=20%	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended
		Exceeded	< 25m/s gust p=0.1%	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

Sample Criteria Suggested by the ASCE (2004)

Recommended Wind Comfort Criteria

		Comfort category	Gust Equivalent Mean Speed m/s (kmh)	Description
		Sitting	< 4m/s GEM p=5%	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without it blowing away
		Standing	< 6m/s GEM p=5%	Gentle breezes suitable for main building entrances and bus stops
		Walking	< 8m/s GEM p=5%	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
		Uncomfortable	> 8m/s GEM p=5%	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended
		Exceeded	< 25m/s gust p=0.1%	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

Alternative Criteria Suggested by the ASCE (2004)

Note: ASCE and others also suggest a criterion of 10m/s GEM with p=5% for business walking – **NOT RECOMMENDED**

Recommended Wind Comfort Criteria

		Comfort category	Gust Equivalent Mean Speed m/s (kmh)	Description
		Sitting	< 3.5m/s GEM p=5%	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without it blowing away
		Standing	< 5.5m/s GEM p=5%	Gentle breezes suitable for main building entrances and bus stops
		Walking	< 7.5m/s GEM p=5%	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
		Uncomfortable	> 7.5m/s GEM p=5%	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended
		Exceeded	< 23m/s gust p=0.1%	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

Recommended by Rofail (2007) based on field observations and remedial studies – adapted from Davenport (1972)
Safety limit based on work by Melbourne (1978)

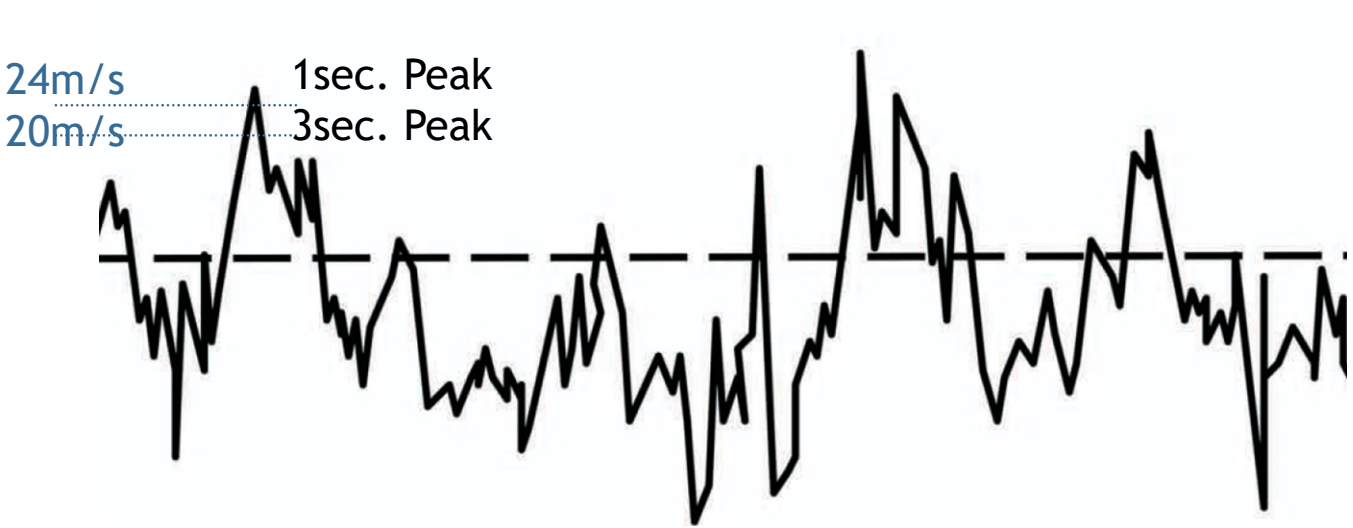
Safety Limit Wind Speeds

- **Sydney City DCP 2012:** 23m/s (not defined but assumed to be a 3sec duration annual maximum gust)
- **Sydney City Draft DCP:** 24m/s 1sec duration annual maximum gust
- **Melbourne Central City:** 20m/s 3sec duration annual maximum gust
- **San Fransisco Bay Area:** CEQA wind speed (0.7*mean+1.4*stddev) of 36mph (16m/s). This is equivalent to the GEM based on a turbulence intensity assumption of 22%.

Safety Limit Wind Speeds

- **Australasian Wind Engineering Society (2016):** 23m/s 3sec duration annual maximum gust
- **American Society of Civil Engineers (2004) :** 25m/s 3sec duration annual maximum gust

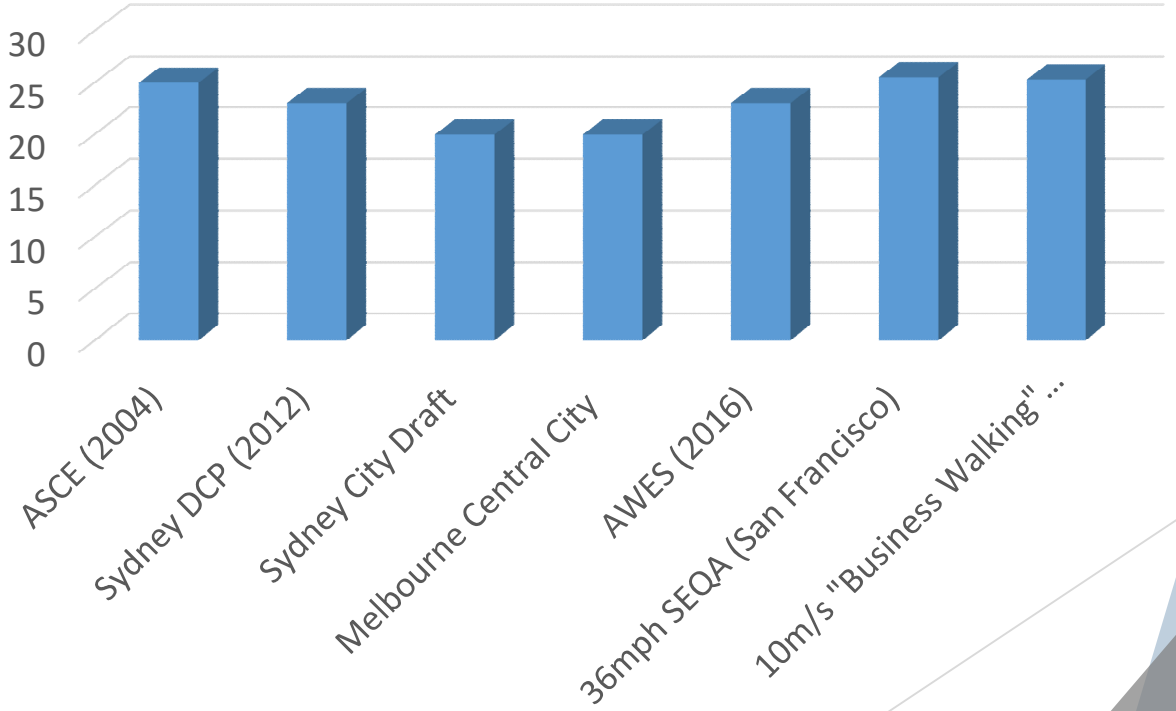
Safety Limit Wind Speeds



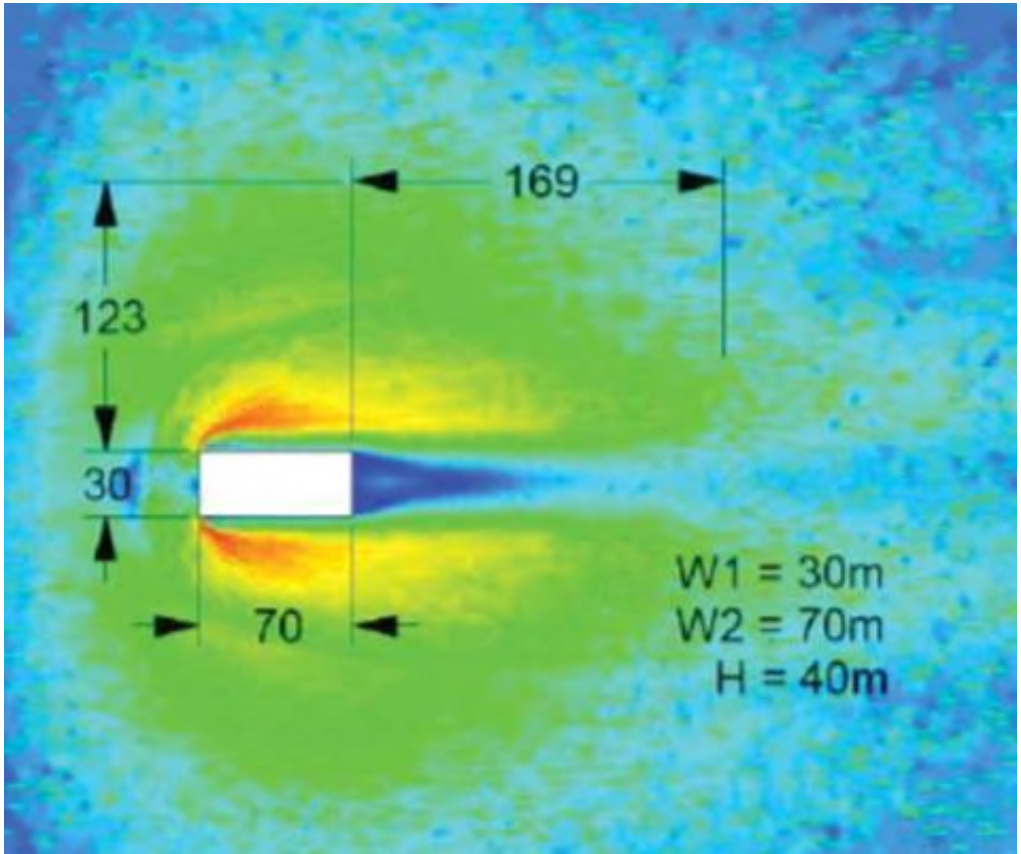
Safety Limit Wind Speeds

Comparison of Various Safety Limits (m/s):

(after converting to Annual 3s. gust in 20% to 25% turbulence intensity)



Recommended Assessment Area



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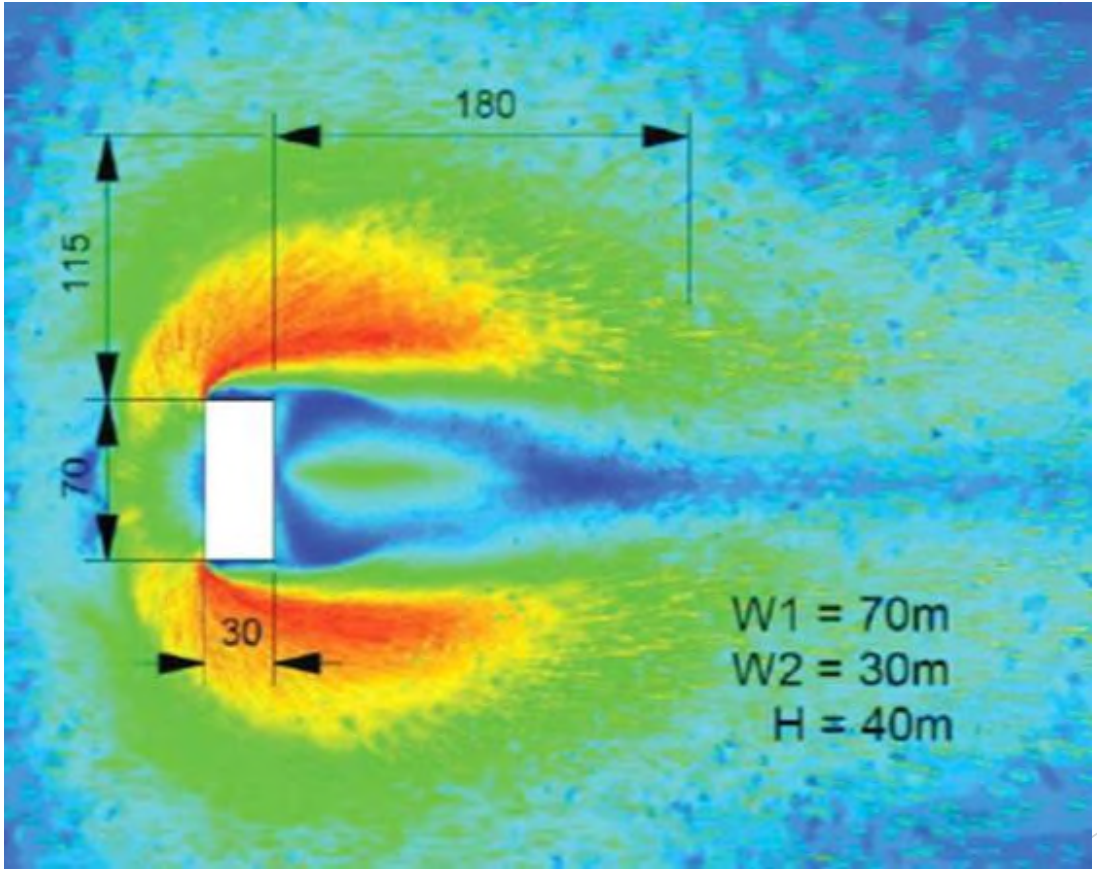
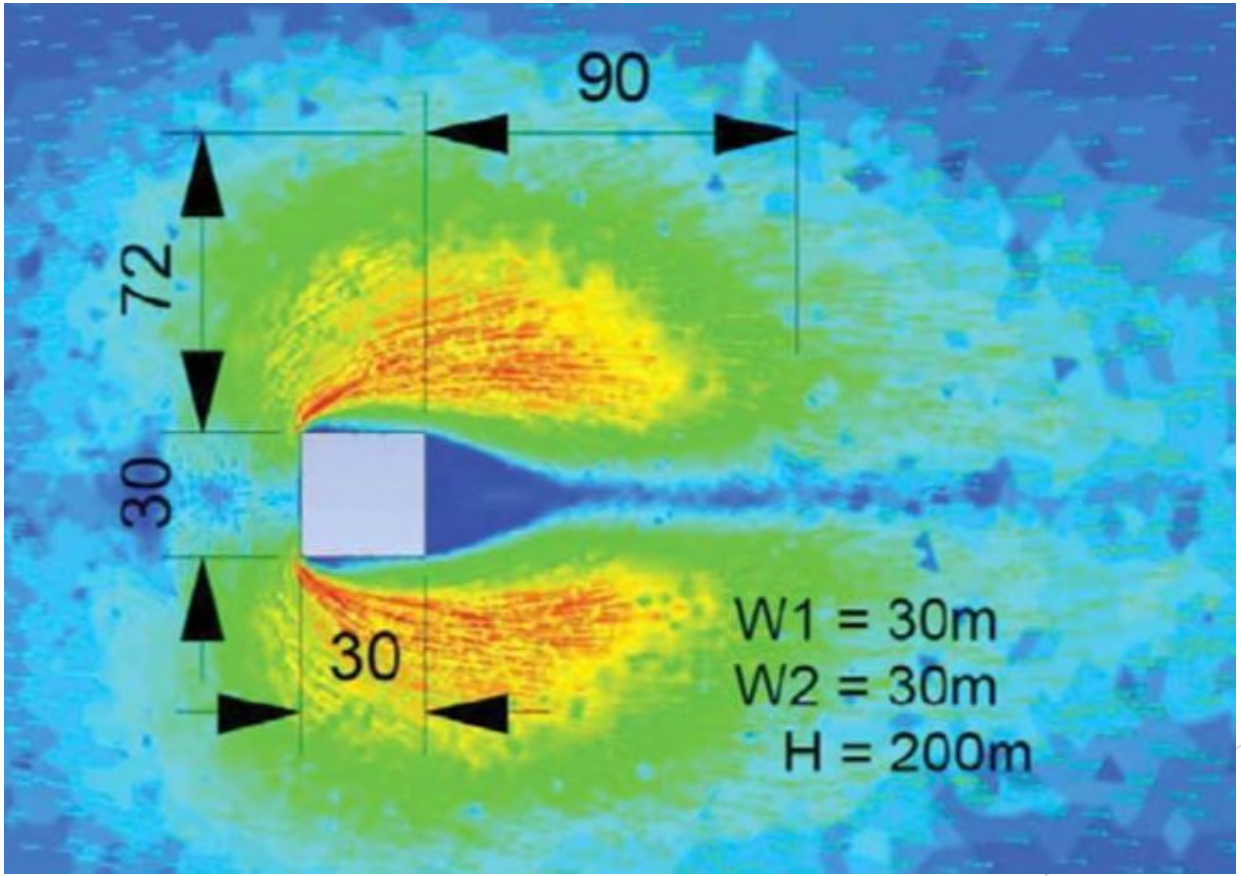


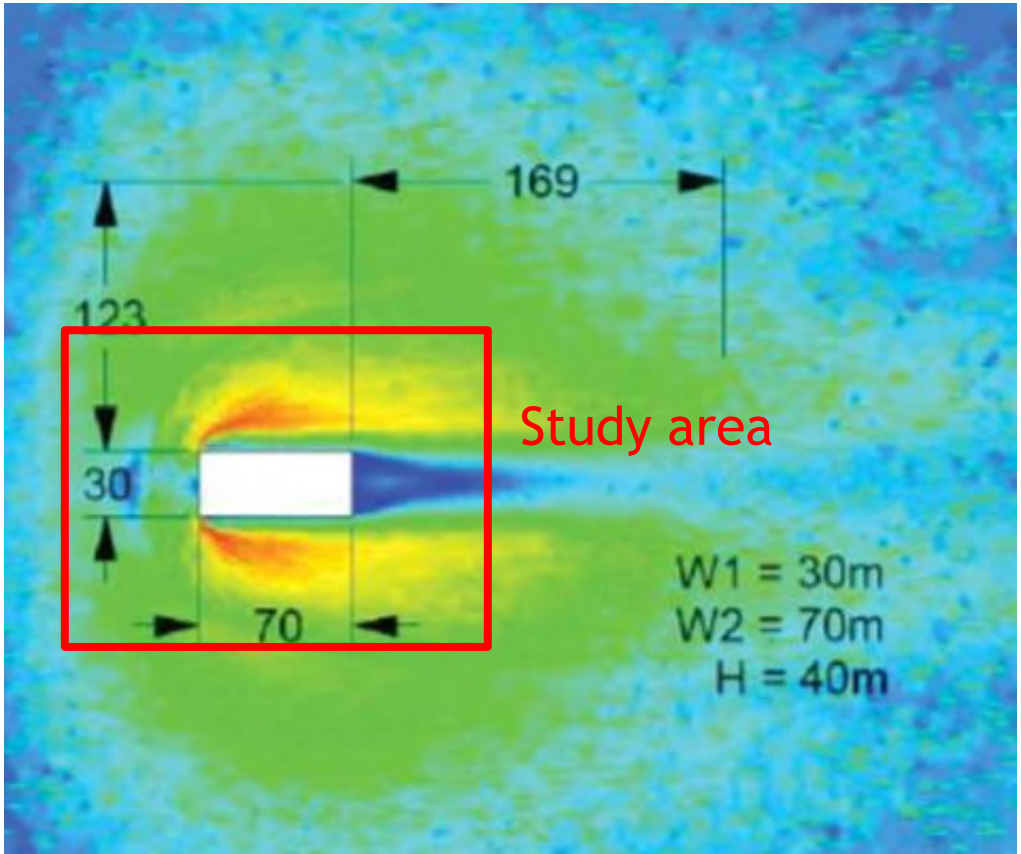
Recommended Assessment Area



Recommended Assessment Area

Building Proportions	Assessment Distance Away from Site
H < minimum of Width or Depth	Distance = Building Height
H > maximum of Width or Depth	Distance = maximum Building Width or Depth
H between Building Width or Depth	Distance = maximum Building Height, Width or Depth

Recommended Assessment Area



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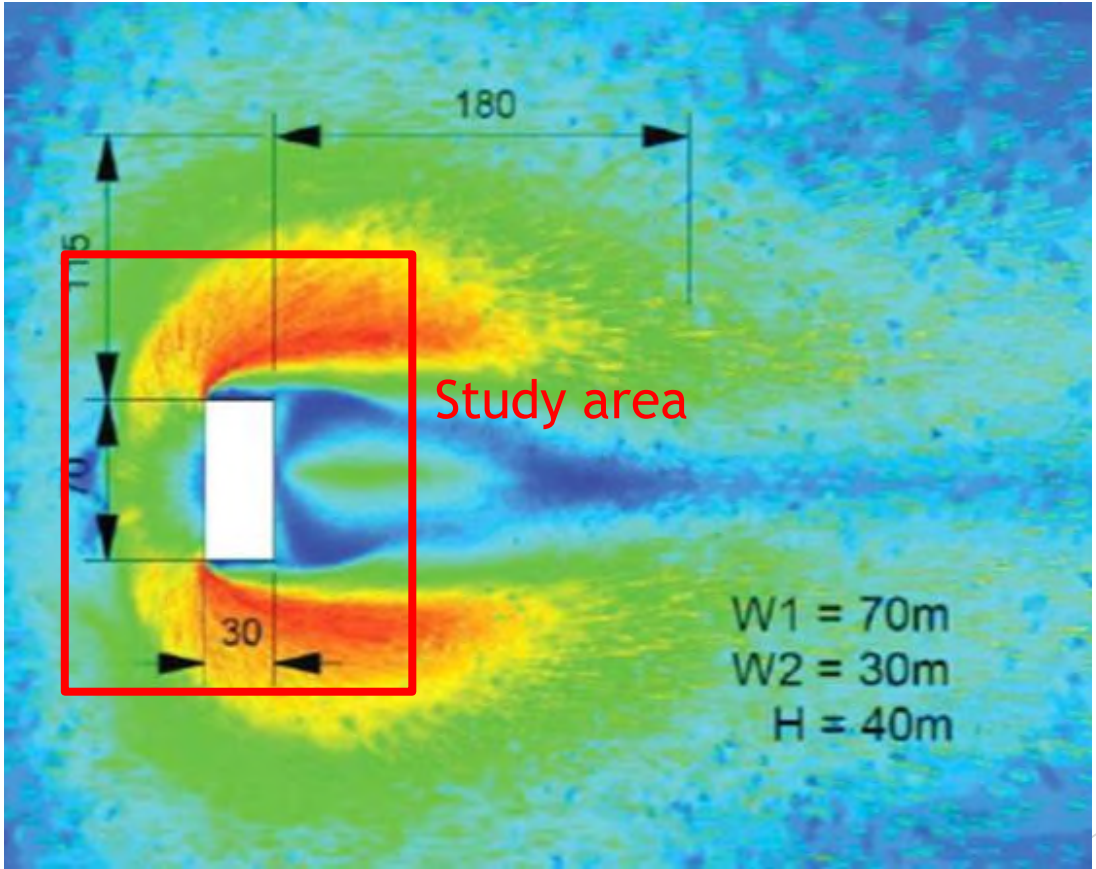

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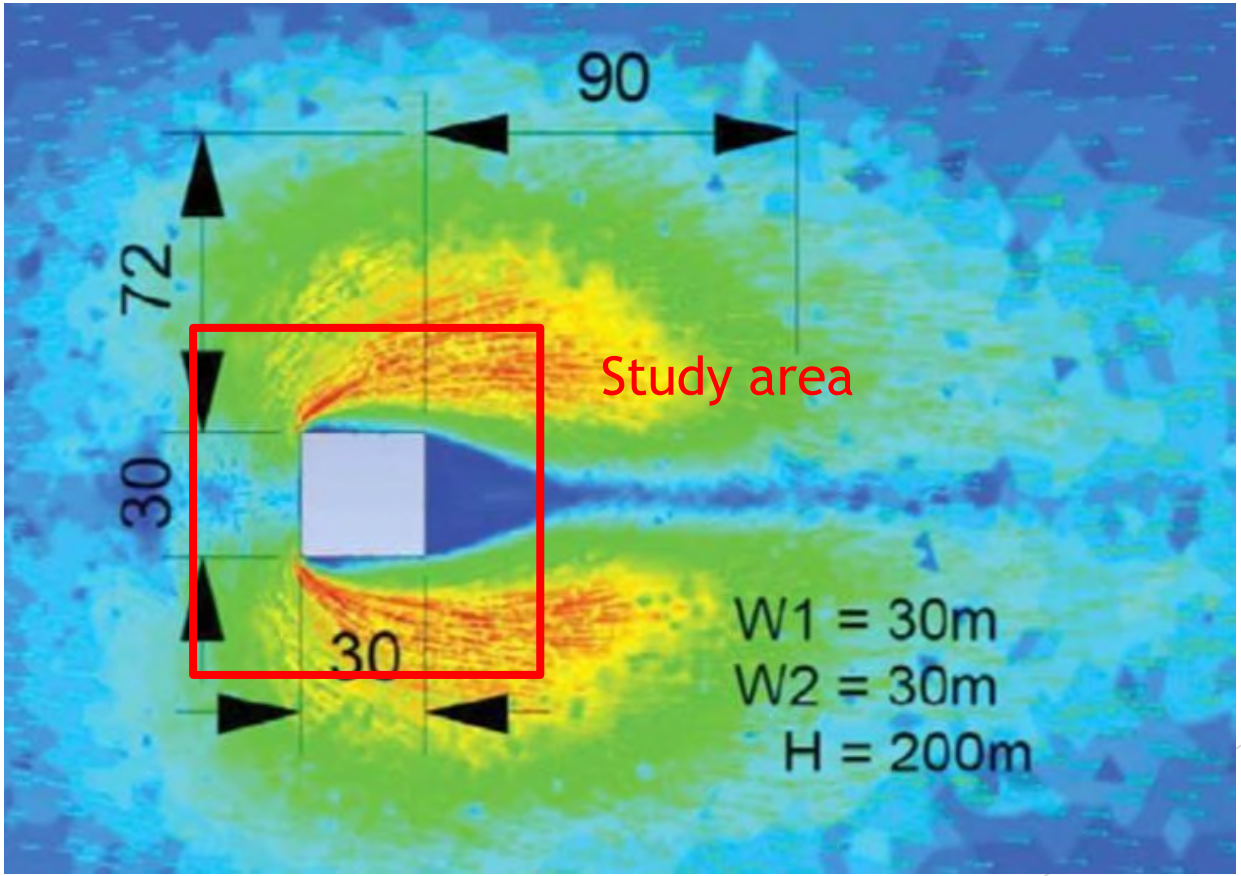
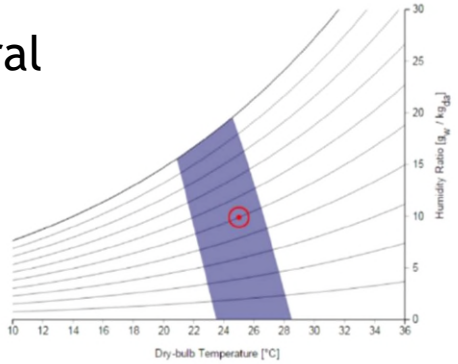
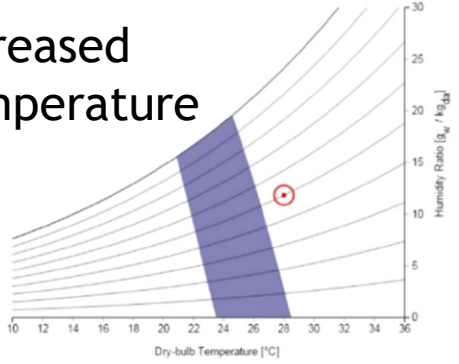


Wind as part of a set of comfort parameters

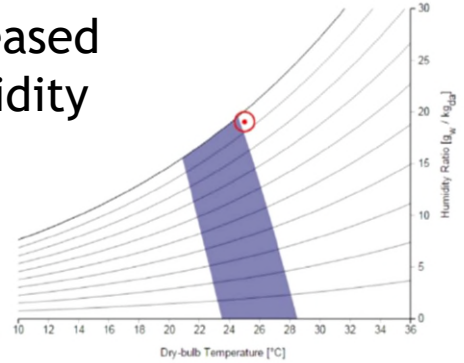
Neutral



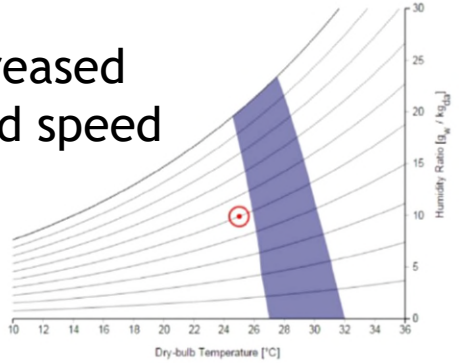
Increased Temperature



Increased Humidity

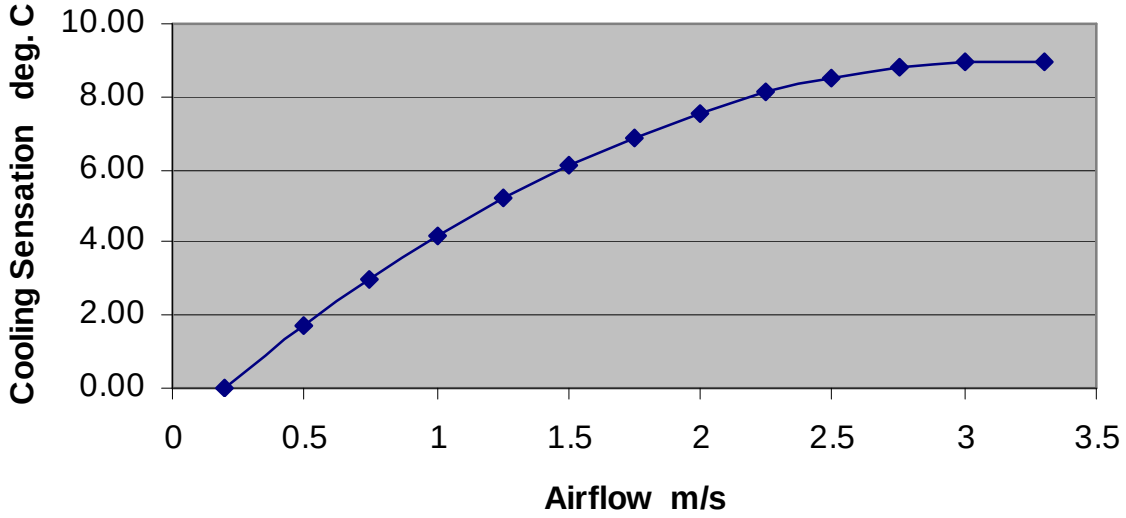


Increased wind speed



Effect of Air Movement over the Body

- The human body's perceived temperature drops with increased air-flow



(Aynsley and Su, 2005)

Wind as part of a set of comfort parameters

"Some allowance for **degradation of wind comfort levels during winter months may be deemed to be acceptable** *[not safety limits]* due to reduced pedestrian usage of outdoor spaces."

Mississauga City Council

Wind as part of a set of comfort parameters

"Pedestrian comfort is to be evaluated based on wind force, thermal comfort and **wind chill** to evaluate the comfortable use of sidewalks and open spaces for appropriate uses including sitting, standing and walking."

Toronto City Council

Wind as part of a set of comfort parameters

"Special regard to … buildings … **restricting air flow**… which may bring about potential impact on air ventilation in the macro wind environment"

Technical Circular 1/06

Hong Kong Planning Department

Why Plan for Natural Ventilation?

Reduce Reliance on Mechanical Systems

- Can significantly reduce mechanical cooling during summer in the colder climates, during winter in the warmer climates and throughout the year in the equatorial regions.

Reduce the Carbon Footprint

- Less reliance on mechanical cooling leads to lower carbon emissions.

Why Plan for Natural Ventilation?

Air Quality AS1668.4 / ASHRAE 62 / CIBSE Guide A

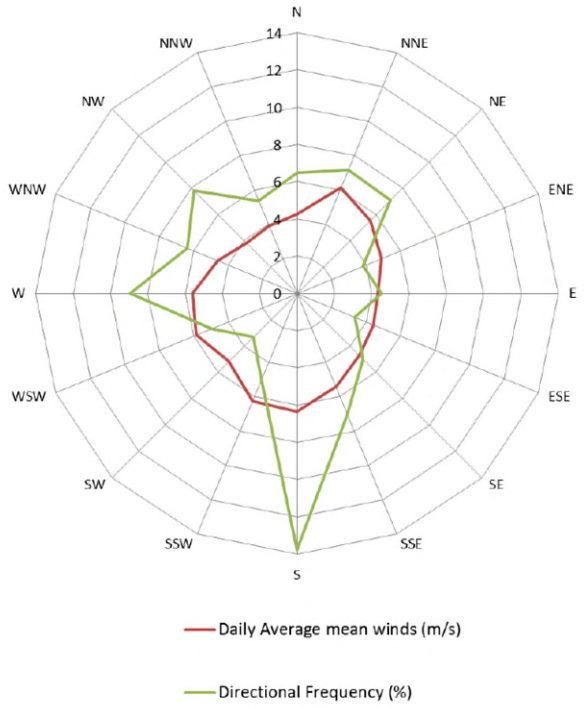
- Sufficient air-changes for expected occupant and material related contaminants.

Thermal Comfort ASHRAE 55

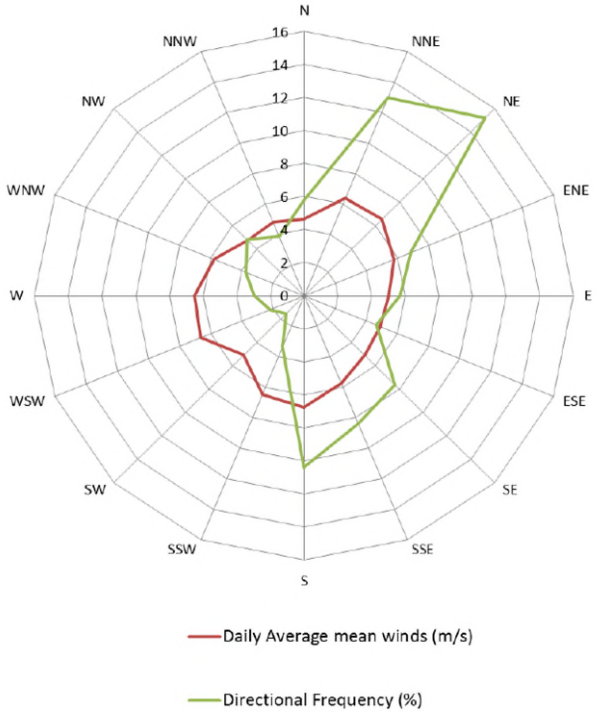
- Reduce the reliance on mechanical cooling.
- Much more demanding in terms of air flow.

Wind Climate – e.g. Sydney

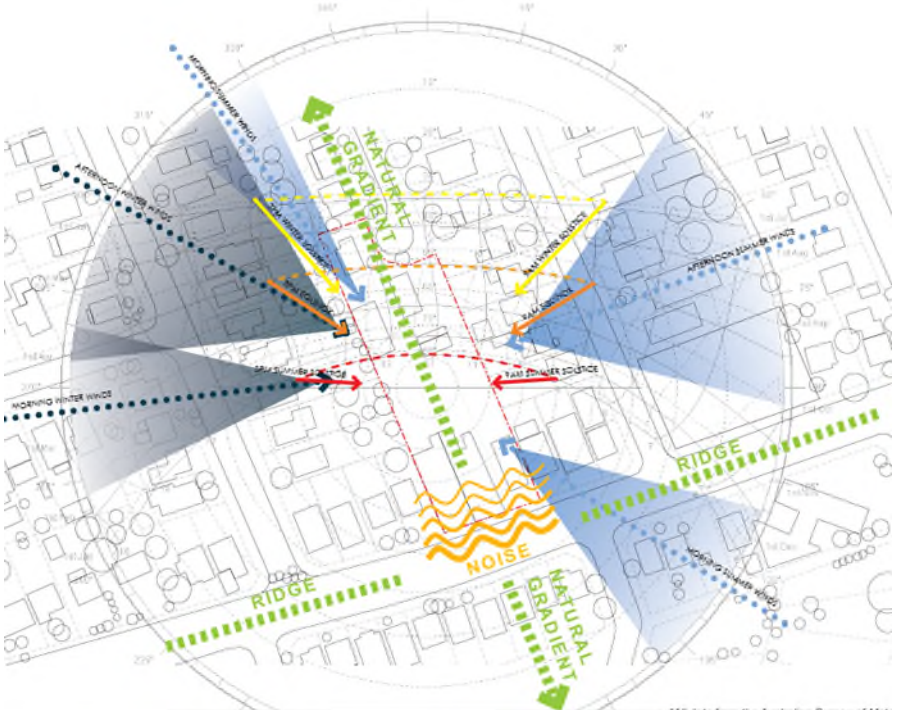
for Indoor Air Quality



for Thermal Comfort



Natural Ventilation Design



- Should originate at the concept design stage.
- Consideration for prevailing winds, temperature and surroundings.
- An opportunity rather than a burden.

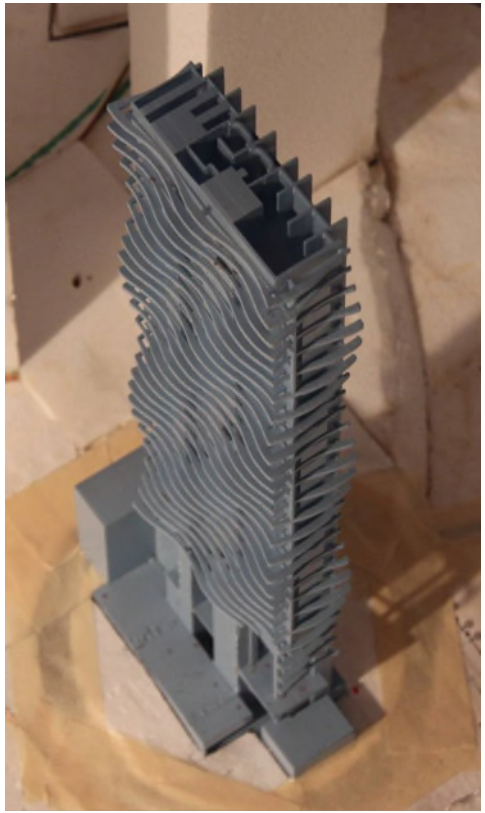
“Typical” Design Approach??

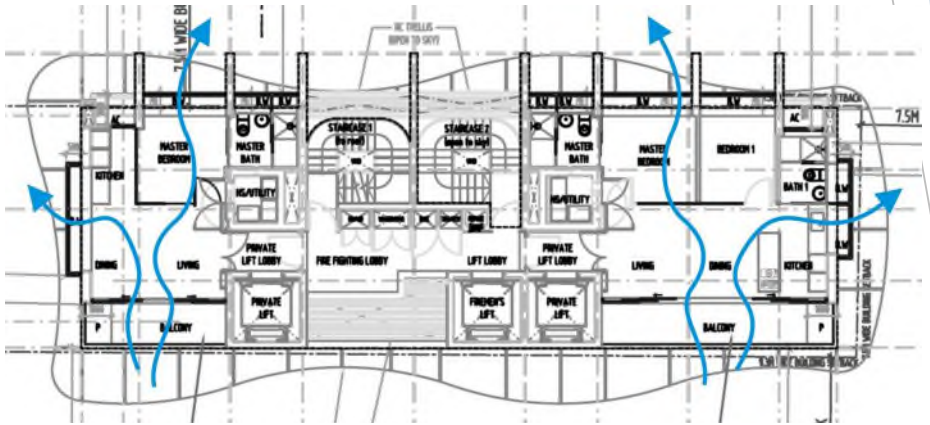
- There is no such thing as a “typical” design.
- A project is not “naturally ventilated” because of a few colorful lines.
- Quantitative assessment of a buildings performance is required to be able to determine a projects performance.

Indoor Comfort

- Occupants are more sensitive to wind movement within a building (“controlled space”).
- Excessive internal air movement can cause thermal discomfort, movement of loose materials, paper etc.
- Recommended comfort criterion limits for internal air movement:
  - 1.2m/s Daily Average Mean or Gust Equivalent Mean Wind Speed
  - 3.5m/s Weekly Max Mean or Gust Equivalent Mean Wind Speed

Design Principles





Orchard Suites, Singapore

- Openings across the dwelling have opposite sign pressures

Design Principles

CleanTech One
Singapore

- Shading element in a warm climate allows air to penetrate.
- Plants cool the air as it enters.

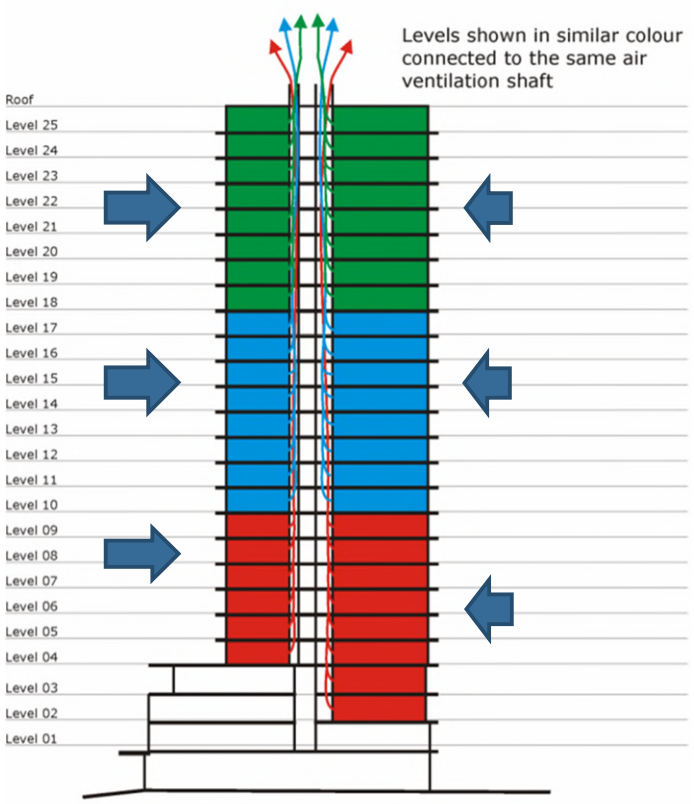
Design Principles

Lodha Bellissimo, Mumbai

- The use of multiple lift cores to allow apartments with opposite aspects

Wing A and B

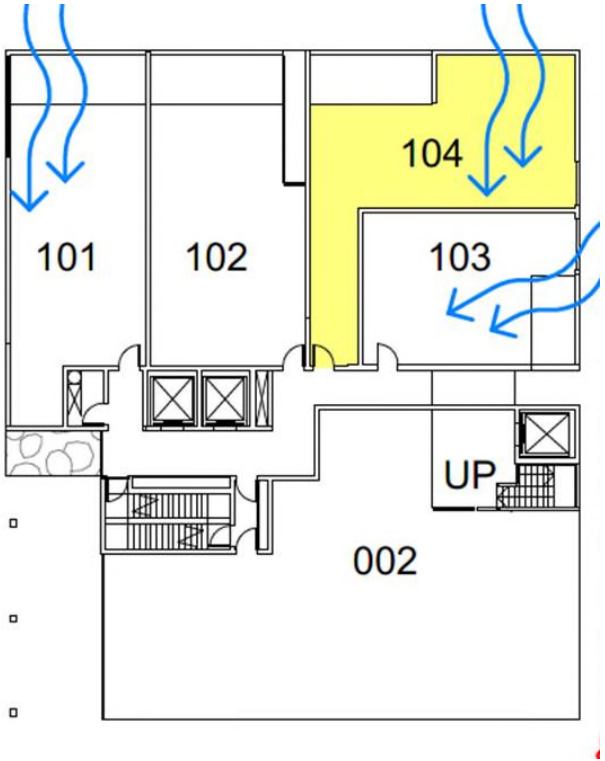
Design Principles



V by Crown, Macquarie Place, Parramatta

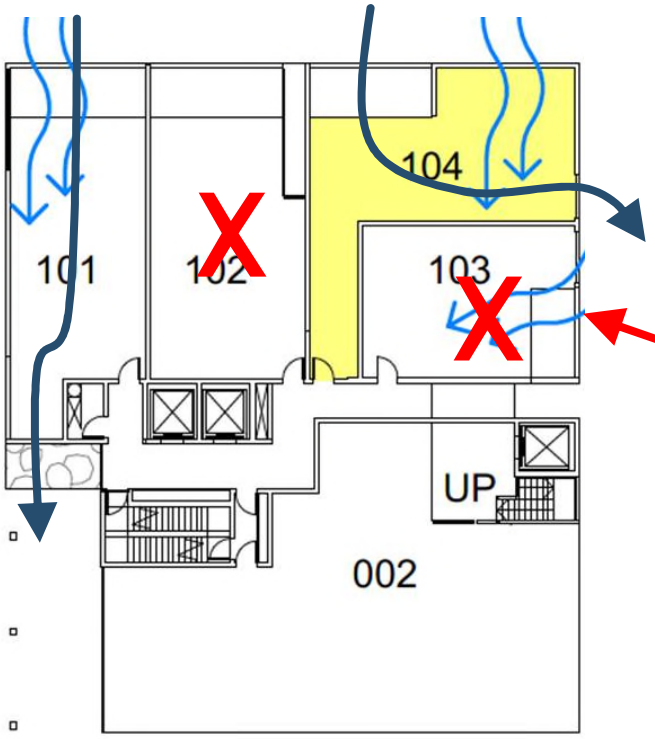
- Use of full height stepped in façade to provide pressure differential between windows of unit
- Stepped in façade also doubled as solar light access for internal corridor
- Ventilation shafts designed to minimise noise and odour

Design Principles



Mark-ups on architectural floor plans do not qualify as a natural ventilation assessment

Design Principles



Mark-ups on architectural floor plans do not qualify as a natural ventilation assessment

This apartment has poor natural ventilation regardless of the height of the floor. According to the NSW Planning Dept's ADG this would automatically pass if located above Level 9.

Other environmental planning considerations…

Wind-Induced Noise

Example: Beetham Tower, UK

Designing for Wind Noise

- In most cases we start with a desktop assessment by reviewing shop drawings prior to tender/ fabrication.

- Full Scale Testing of Louvers and Sunshades
  - Sample subjected to winds from various angles of attack
  - Sound pressure levels measured

Designing for Wind Noise

Designing for Wind Noise

Other environmental planning considerations…

Paver and Furniture Lift-off

Pedestal Paver Systems

Pedestal Paver Systems

Conclusions

- Importance of incorporating controls for wind conditions in planning instruments.
- Need to address both safety and comfort.
- Equally important to define the wind speed.
- Need to reference existing conditions except where there is a substantial change of use or change in rezoning.
- A proposal is presented for the trigger condition.
- A proposal is presented for the extent of study area.
- Difficult to regulate for thermal comfort other than for minimum wind speeds for warm temperate climates.

Conclusions

- Natural Ventilation can be harnessed in most urbanized areas around the world.
- Need to base controls on the physics and not the designer's perception.
- Basic principles and design concepts have been presented.
- Another issue is wind noise – needs to be addressed for all proposed buildings with unusual or articulated façade features.
- Attention also needs to be given to the issue of potential debris from roofs, terraces and balconies.