WINDTECH

Windtech Consultants
Experts in the study of wind effects on buildings and structures

Wind Studies | Sustainability | Solar Studies

Contents

Introduction

Who are we?

Windtech Consultants are a leading global Wind engineering consultancy firm. Our wind engineering services cover all aspects of wind effects on buildings and other structures.

We support sustainable design by providing accurate modelling and sound advice for natural ventilation, daylight, solar access, glare and thermal comfort.

7 reasons why you should use Windtech Consultants:

1. Our two boundary layer wind tunnel facilities feature the most advanced data acquisition and processing systems to allow for superior accuracy of results, greater reliability and faster turnaround.
2. Windtech's policy of continual improvement is backed by ongoing research and development to ensure that we are constantly at the forefront of our field, internationally. This ensures we are able to offer the most advanced and robust analysis techniques possible.
3. Our staff are actively involved with various committees that regulate our industry.
4. We have developed a reliable quality assurance system with a competitive fee structure.
5. We have worked on over 2,500 projects around the world since the company's establishment in 1991, from single dwellings to large-scale regional masterplans.
6. Our depth of experience ensures the viability of the project and that you do not need to pay for unnecessary investigations and retests.
7. We provide the highest level of detail, depth of experience and quality of service at the best value for the client.

We look forward to demonstrating to you our commitment to excellent service and high quality on your next project.

Façade and Cladding Pressure Studies for cost-effective robust designs

Windtech Consultants have developed the most advanced data acquisition, signal conditioning and data processing system to ensure the highest possible accuracy in the prediction of wind pressures for the design of façade cladding and external fixtures. This has enabled our wind tunnel results to have demonstrated the closest match to full-scale measurements ever published.

The trend to have high-rise buildings with operable façades can result in large internal pressures, which directly affect the net façade pressures. Windtech's standard practice for all projects determine the net differential pressures by measuring them directly in the wind tunnel and applying a risk-based analysis, ensuring the most accurate results are provided.

This approach provides an accurate and reliable prediction enabling substantial savings for the client by eliminating over-design.

Windtech also have substantial experience in the study of design pressures for double skin facades, as well as the measurement of wind loads on appurtenances to building facades, such as sun-shading elements.

Sample Past Projects

- Q1 Tower (323m), Surfers Paradise
- Greenland Centre, 115 Bathurst St, Sydney
- Lodha Venezia, Mumbai
- Malad Residential Towers, Mumbai
- Bank of New Zealand Building, Auckland
- Fort Cambridge Development, Malta
- Z Towers, Riga, Latvia
- Dream Mall, Kaohsiung, Taiwan
- Sukoon Tower, Juffair, Bahrain
- Icon Tower, Bahrain
- Kahramaa Awareness Park, Doha
- Ocean Heights (310m), Dubai Marina
- Signature Towers (360m), Business Bay, Dubai
- Tamouh City of Lights, Abu Dhabi
- One Shenton Way, Singapore
- The Sail @ Marina Bay, Singapore
- Marina Business and Financial Centre, Singapore
- KL Sentral, Kuala Lumpur
- Shanghai Finance Commission Building, Shanghai
- Jiu Shi Headquarters, Shanghai
- Yanlord Plaza, Chengdu, China
- World Plaza, Bonifacio Global City, Manila
- Trump Tower, Manila

CASE STUDY

BAM South, Brooklyn, New York

A detailed climate study including directionality effects of the extreme wind climate for New York was initially conducted. This involved the analysis of historical data from 3 local meteorological stations as well as numerical hurricane simulation data.

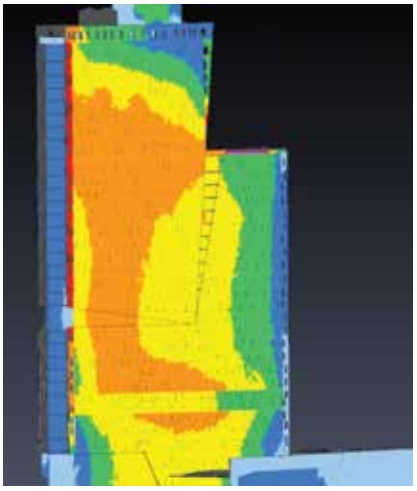
An instrumented model of the study building was prepared and set up in the wind tunnel within a local proximity model of Brooklyn.

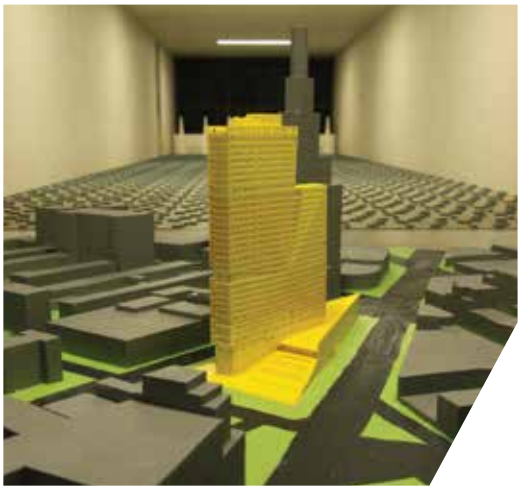
Design scenarios investigated included open and effectively sealed cases for the operable sections of the façade and the impact of existing and future surrounds cases on the design loads.

All façade pressures measured were more than 20% lower than that estimated by ASCE 7. The study included real time differential pressure measurements for the various vertical fins located along the edges of the tower.

Modelling of the effect of the isolated case showed that it would be better overall to exclude this case from the worst case scenario, especially since the New York Code follows ASCE 7.

In addition to the 2D contour diagrams of the maximum and minimum net pressures, 3D models overlaid with pressure contours for each of the 3 surrounds configurations investigated were presented.





Structural Loads/Motion Studies for Tall Buildings for cost-effective robust designs

Windtech provides accurate modelling of the base overturning moments, equivalent static point loads and shear force distributions over the height or span of the tower / structure.

Windtech Consultants' modal analysis technique used in the analysis of wind loads on tall buildings, represents current world best practice. This technique provides the most accurate approach to the analysis of wind tunnel data, particularly for complex structures or buildings having highly coupled modes of vibration between the two translational modes and torsional mode.

Our standard scope also includes the prediction of the correlation between different modes of vibration, which is particularly important when the natural frequencies of these modes are very close.

For super-tall or slender and dynamic buildings, Windtech Consultants also undertake wind tunnel studies on an aeroelastic model to accurately quantify the effect of aerodynamic damping where applicable. Windtech Consultants have also devised an advanced methodology to accurately determine the effect of load transfer between structurally linked tall buildings.

Windtech's standard scope goes above and beyond that of other wind engineering consultants. This includes:

- A free initial desktop assessment of the structural responses (excluding certain unusually structures).
- Commentary on the dynamic properties is issued to the structural consultant.
- A sensitivity study is performed on the outputs (base moments, displacements, accelerations, rotational velocities) for ± variation in the assumed natural frequency, providing design guidance.
- Optimisation of the development with the inclusion of one free update to the analysis and report in the case where the dynamic properties have been modified by the structural engineer.
- Where the acceleration criteria is exceeded, Windtech can assist with the optimisation of the structural design.
- Where applicable, Windtech will provide basic design parameters for the design of tuned mass dampers or tuned liquid dampers to control the building motion to an acceptable level for no additional cost.

Sample Past Projects

- Lodha Bellissimo, Mumbai
- Century Mill Tower, Worli, Mumbai
- Atmosphere, Kolkata
- Lumiere Towers, Sydney
- Q1 Tower, Surfers Paradise
- Soul Apartments, Surfers Paradise
- 1 William Street, Brisbane
- 420 Queen Street, Brisbane
- Queen Victoria Village (2 towers), Melbourne
- OTB Treasury Building, Perth
- International Islamic Tower, Doha
- Icon Tower, Bahrain
- The Address Dubai Mall and Downtown Dubai
- Burj Rafal, Riyadh
- Raffles Place, Shanghai
- Yanlord Plaza, Chengdu
- Kempinski Hotel and Residences, Jeddah
- M & C Tower, Ho Chi Minh City
- Discovery Primea, Manila
- Knightsbridge Tower, Manila
- Trump Tower, Manila
- Tamouh City of Lights, Al Reem Island, Abu Dhabi
- Capital Plaza linked towers, Corniche, Abu Dhabi
- Signature Towers (360m), Business Bay, Dubai
- Raffles Suites and Residences and Fairmont Hotel, Manila
- KL Sentral, Kuala Lumpur
- Ciputra World (3 towers), Jakarta
- Rasuna Tower (280m), Jakarta
- GCNM Tower, Jakarta
- Maybank Headquarters Building, Singapore
- The Sail @ Marina Bay, Singapore
- Parisian, Angullia Park, Singapore
- Ocean Heights Tower (310m) at Dubai Marina
- Kuwait Investment Authority Headquarters, Kuwait
- Marina Business and Financial Centre (5 towers), Singapore

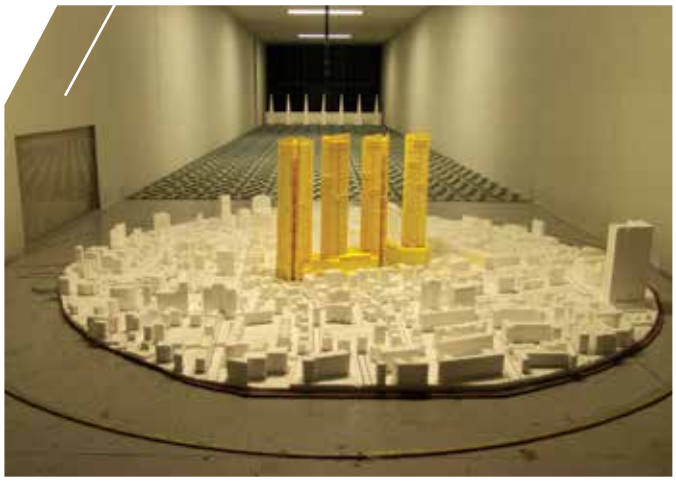
CASE STUDY

Sheth Auris Serenity, Malad (W), Residential Towers, Mumbai

Wind-Induced structural loads and building motion study was undertaken for these four 227m high tower structures. Windtech Consultants used the modal analysis technique to analyse the resonant response of these structures.

The height and shape of these towers is certainly not amenable to code-based predictions of the structural loads and occupant comfort under building motion. The wind tunnel study was able to confirm that occupant comfort will not be an issue with these tower buildings even if the natural frequencies came in lower than expected. The wind tunnel study confirmed Windtech's prediction that the cross-wind response will govern for one of the axes.

Other studies were carried out including a façade pressure study for this project to rationalise the cost of the façade package for these buildings.



CASE STUDY

Greenland Centre, 115 Bathurst St, Sydney

A structural loads and building motion study was undertaken for this complex tower structure which consists of a 43 level residential tower superimposed over an existing 25-level building with the aid of an exoskeleton frame structure. The resulting building is to become the tallest residential building in the Sydney CBD.

Results from an initial wind tunnel study of a concept massing model were used to guide the structural engineer in optimizing the structural system. Windtech Consultants' method of analysis of the wind tunnel results was utilised to account for the complex structural behaviour, including the effect of coupled modal response, while managing to avoid the need for auxiliary damping.

Windtech also carried out studies of the net cladding pressures for the proposed double skin façade system. The mitigation of environmental wind effects, smoke modelling, natural ventilation, internal flow modelling and wind driven rain was also carried out.

Loads on Stadium and Long-Span Roofs for cost effective robust designs

Windtech Consultants offers world's best practice in the study of wind loads and response of stadium roofs and long-span canopy structures, utilising advanced solid state multi-channel simultaneous pressure scanning techniques. The Load Response Correlation technique as well as the direct pressure integration techniques are used.

The advanced solid state multi-channel simultaneous pressure scanning techniques enable the wind tunnel testing to achieve economy and reliability in the design by accurately accounting for both time and spatial variations in loading. This is achieved by monitoring key load effects to determine the most critical load combinations.

If changes are made to the structural system after the initial wind tunnel results and there is a significant resonant component in the response, Windtech can update the study without the need for additional wind tunnel testing. This allows for further design optimisation of the structure to be incorporated.

Sample Past Projects

- Porsche Showroom and Workshops, Abu Dhabi
- The Avenues Mall Roof Structure, Al-Raj, Kuwait
- Eskisehir Stadium, Turkey
- Samsun Stadium, Turkey
- Palaran Stadium, Kalimantan, Indonesia
- Sumatra Stadium, Indonesia
- White Bay Cruise Ship Passenger Terminal, Sydney
- University of NSW Tyree Energy Technologies Building, Sydney
- Queensland State Tennis Centre, Tennyson, Brisbane
- Qantas Aircraft Maintenance Hanger, Brisbane Airport
- Cbus Stadium, Gold Coast
- Nanjing Stadium, China
- Manila Arena (world's largest indoor arena)
- Wellington Sports Centre, New Zealand
- Waikato Velodrome, New Zealand

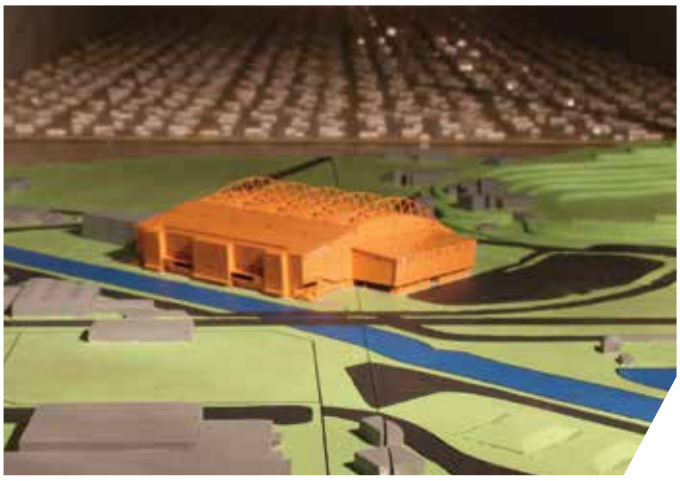
CASE STUDY

Forsyth Barr Stadium, Dunedin, New Zealand

Windtech Consultants carried out a study of the wind loads on the roof structure and cladding for this project. A scale model was prepared including the effect of the significant local topographic effects. A total of 570 pressure taps were used and 106 panels on the external envelope analysed. Each panel consisted of a number of pressure sensors.

The Load Response Correlation technique was used to accurately determine the critical load combinations that affect a range of critical structural members, including the effect of wind drag from the external space frame structures.

An analysis was also carried out to determine the effect of the resonant response of the structure as well as the fatigue loading for a number of critical structural connections.



Full-Scale Testing and Remedial Studies for quality and experience

Performance of Façade Elements

Windtech Consultants carry out the testing of wind sensitive façade elements such as louvre panels, external blinds and fins for wind effects such as;

- Wind-Noise Generation
- Rain-Noise Generation
- Discharge Coefficient and Effective Area
- Performance under Serviceability Wind Loads
- Rain Penetration
- Performance Testing of Fume Jets

Sample Past Projects

- Wolter Fume Jets
- Queensland Childrens Hospital, Brisbane
- External Louvres for Barangaroo, Sydney
- Diethelm Louvres, Singapore
- Louvre panel system for H. H. Robertson, Sydney
- Privacy screens for Harbour Lights, Cairns

CASE STUDY

Wind Noise and Vibration study of the drum screen for the Sebel Harbour Lights, Cairns

Windtech Consultants tested a prototype of the screen with sharp edges for wind from different angles of attack. It was found that the initial prototype sample emitted significant noise. The level of noise and vibration was also measured.

Subsequent tests of a revised prototype, having rounded edges confirmed the effectiveness of the modification in mitigating the wind-noise.

Design and Commissioning of Motion Dampers

Windtech Consultants provide cost effective approaches to the design of motion dampers to control building motion. This is normally carried out in cases where wind tunnel testing indicates an exceedance of the occupant comfort criteria for building motion. Windtech has designed tuned dampers for a number of past and under-construction projects. Our services include testing of prototypes, on-site measurement of the dynamic properties of the tower at an advanced stage of construction and commissioning.

Sample Past Projects

- Bakrie Tower, Jalan Rasuna, Jakarta (280m tall)
- Georgia Apartments, Sydney (100m tall, very slender tower)
- Signature Towers Dubai Business Bay (360m tall)
- Motlak Tower, Jeddah (285m tall)
- Crystal Towers Kuwait (240m tall)

Remedial Studies

Windtech Consultants have been able to draw on their innovative approach and extensive experience in designing cost-effective remediation of various wind effects including for the following:

- Wind Environment Impacts on Outdoor Terraces, Restaurants and Private Spaces
- Thermal and Wind-Driven Stack Effects
- Entry of Wind, Dust and Air Pollution
- Operability of Lobby Doors and Façade Elements
- Lift Door Breakdown due to Wind Pressure
- Wind-Noise and Wind-Induced Vibration
- Air Quality and Ventilation

Environmental Wind Studies improving the habitable environment

Masterplan Studies

In addition to assisting developers, Windtech Consultants have been retained by a number of local government planning bodies to advise on strategic management of potential wind effects.

Masterplan studies highlight potential problem areas and suggest how building massing and land use can assist in mitigating this effect.

Issues include exposure to prevailing winds, dust, air pollution sources and land topography effects.

Sample Past Projects

Windtech have undertaken numerous masterplan studies. These include:

- Walsh Bay Precinct, Sydney
- Barangaroo Precinct, Sydney
- Victoria Square, Sydney
- Queen Victoria Village, Melbourne
- Brighton Parade, Gold Coast
- Badr City, Egypt
- Emaar Development, Karachi
- Al Houra Coastal Resort, Morocco

Windtech have undertaken microclimate studies for over 2,000 projects over the past 24 years. These include:

- Marina South, Singapore
- Plaza Progreso, Guatemala
- Proscenium, Makati City, Manila
- Raffles Square, Shanghai
- Chatswood Interchange, Sydney
- Westfield Sydney City
- Soul Apartments, Gold Coast
- OTB Treasury Building, Perth

Microclimate Studies

Wind tunnel modelling provides the most accurate and definitive assessment of prevailing wind conditions in the surrounding streetscapes and any critical outdoor areas within or adjacent to the site. Windtech Consultants utilises hot-wire anemometry, which is the most accurate technique available.

Wind velocities within and around a development are measured in the wind tunnel and directly related to relevant comfort criteria. If any treatments are required, additional testing is recommended to optimise the extent of these treatments and ensure their effectiveness. This allows for the development of innovative and cost-effective solutions for potential problem areas and at the same time ensure the viability of the project and architectural design intent are not compromised. Initial testing is normally carried out without the effect of planting or other measures. Treatments are gradually added to ensure that the optimum treatment solution is achieved.

Windtech's unique approach and extensive experience in this field enables us to quickly find effective solutions, saving the client significant cost and time due to endless retests or having to implement unnecessary or ineffective treatments.

CASE STUDY

The Age Site, 612 Lonsdale Street, Melbourne

This two tower residential development is located in the Melbourne CBD.

Windtech were engaged following a failed attempt by another wind consultant to address the effect of the site's significant exposure to the prevailing northerly winds without significantly modifying the tower design. Initial tests confirmed the significant effect of the northerly winds, with the flow paths around the development identified. The model was modified to incorporate strategic planting and incorporate porosity in the facade of the podium car park. Testing showed that after some refinement, these treatments were sufficient to bring the wind conditions to within the relevant criteria for the respective areas.

Additional measures were required for the proposed outdoor cafe areas, located at the corner of an undercroft area. The criterion for this area becomes more stringent as it involves stationary activities and required the introduction of a freestanding canopy.

Air Quality Studies

Today, as a consequence of increased environmental awareness, industries producing atmospheric waste are required to comply with strict environmental criteria. Designers are now potentially liable for harm brought about by excessive pollutant concentrations due to unsatisfactory building or site layout. Common applications of this type of study include:

- Power cogenerators, power stations, bus stands, car parks.
- Re-entry of exhaust air-conditioning exhaust.
- The study of the propagation of odour from sources such as sewerage effluent, treatment ponds and chemical wastes.

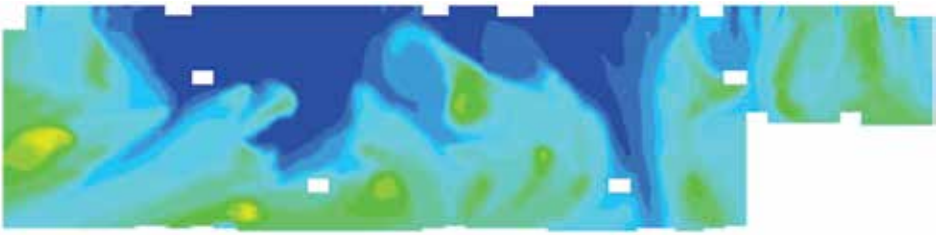
The dispersion patterns of the atmospheric pollutant can be modelled either mathematically or physically. Physical modelling, involving the use of a wind tunnel, can be conducted using either visual techniques or through a quantitative analysis by measuring concentrations of a tracer gas at a number of critical locations by means of spectrometry. Windtech Consultants has undertaken numerous wind tunnel studies to investigate the flow of atmospheric pollutants around buildings such as for kitchen exhausts, air-conditioning exhausts, dispersion of fumes from standby power generators and vehicle exhausts. Flow visualisation is generally recommended (with or without the use of spectrometry) as it allows for the identification of the critical flow mechanisms that have the most significant impacts. This enables the formulation of effective ameliorative measures.

CASE STUDY

Westfield Macquarie Centre Carpark

The aim of this study was to optimise the number and layout of jet fans, taking into account the natural ventilation flow. Windtech used a hybrid technique to provide the best possible prediction of the mixed mode ventilation of car exhausts within this multi-storey car park. Wind tunnel testing was used to provide accurate boundary conditions. CFD was then carried out including the effect of the proposed jet fans.

- Mechanical ventilation was not required for some levels.
- The layout of the mechanical ventilation system was modified on some levels to treat a number of stagnant areas.



Stack Effects

This thermally driven buoyancy flow is commonly experienced at the lower level lift lobbies of tall buildings in hot climates. In cold climates the infiltration of cold air is experienced at the lower levels. This effect can be exacerbated by pressure driven flow effects, especially in hot climates. The airflow movement in warmer climates is also commonly known as the reverse stack effect.

This effect can be utilised to exhaust warmer internal air build-up, however can also cause a number of adverse effects, including:

- Adverse internal wind conditions, even for sealed buildings.
- Wind-induced noise (whistling) within the building.
- Infiltration of humidity, odours and smoke into the building.
- Failure of lift doors due to pressure loading.
- Thermal discomfort for occupants and increased load on HVAC systems (heat gain/loss of a space)

Windtech have carried out studies for developments under design and also post-construction, including on-site verification. Computational modelling is usually undertaken to validate flow effects and alternative treatment strategies are developed.

Wind Entry

Wind entry can have a significant impact on the commercial viability of retail spaces due to internal draft effects. Operating costs are also impacted due to increased load on HVAC systems. Windtech has extensive experience in the prediction and remediation of wind entry.

Treatments options include effective airlock design, internal and/or external treatments.

Environmentally Sustainable Development building for the future

Natural Ventilation

Society and government regulations are encouraging reduced power consumption of new and existing buildings, with natural ventilation enabling a reduced reliance on mechanical ventilation systems. This has been found to benefit both the environment and end user/client through improved sustainability of the design, reduced operating costs and providing higher asset end value.

Windtech Consultants are leaders in the study of natural ventilation in buildings and have provided accurate modeling of natural ventilation for numerous buildings since 1999 using wind tunnel techniques. Our technique has been verified against on-site field measurements. This has also enabled Windtech Consultants to provide detailed design recommendations to achieve effective natural ventilation in situations where it would not be otherwise possible.

Advice and levels of analysis is able to be provided at different stages of the project including:

- Concept Design Phase – Desktop assessment and design input is provided in relation to location of window openings, site orientation and internal layout for optimal ventilation.
- Detailed Design Phase – Wind tunnel modelling is carried out to accurately determine the localised pressures at the opening locations. Analysis of the pressure driven flow can then be undertaken to ensure suitable air quality and thermal comfort is provide. Alternatively, hybrid wind tunnel/CFD modelling is performed when thermal drivers become important or temperatures are of concern.
- Post-Construction Verification – On-site measurements of natural ventilation performance ensures the design and construction for natural ventilation is suitable, preventing the possibility of Sick Building Syndrome (SBS) and verify previously calculated results.

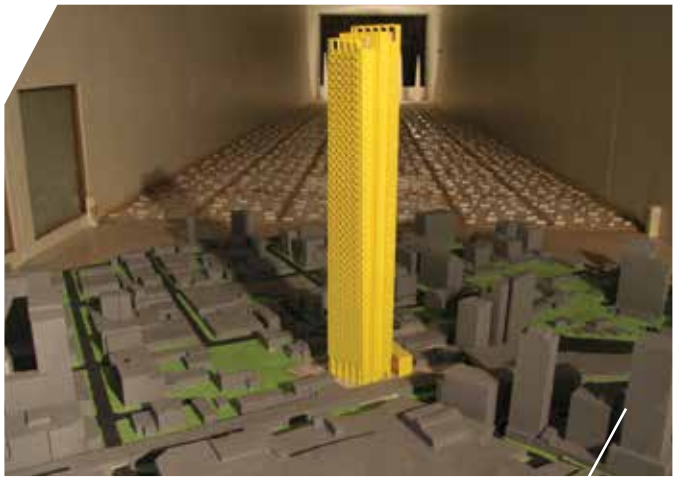
Through extensive research, Windtech have developed their own hybrid Wind Tunnel/CFD analysis technique for the analysis of natural ventilation performance where thermal and solar effects may have an impact on the performance, or for complex internal spaces. Without the input from wind tunnel modelling for boundary conditions, the internal flow performance from CFD models can be quite misleading.

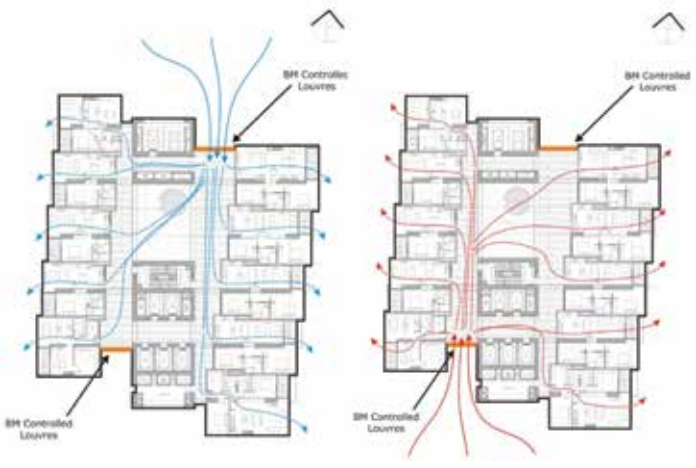
CASE STUDY

Aspire Tower, Sydney

Aspire Tower is a proposed 336m high residential development located in Parramatta, Australia. The project architect, Grimshaw, was in consultation with Windtech throughout the design process to ensure that the design is able to take full advantage of the prevailing winds for the warmer months.

An innovative natural ventilation design approach made use of 6 storey high internal atriums to capture the prevailing winds via controlled openings on the southern and northern aspects. Air from the positively pressurised atrium was then able to flow into the single aspect apartments on the eastern and western aspects. This design approach was verified through detailed wind tunnel modelling, and confirmed that each one of the 700 apartments was able to achieve adequate natural ventilation. The system accounts for adverse secondary effects such as smell, smoke and noise transfer between the spaces.





Thermal Comfort Studies

RESIDENTIAL

Since 1997 Windtech Consultants has been providing consulting services to assist in the design of Environmentally Sustainable Developments.

Windtech Consultants conducts modelling of the energy requirements in residential dwellings for heating and cooling to maintain thermal comfort for the occupants throughout the year. Windtech Consultants are accredited in the use an advanced software package to analyse the thermal comfort for single and multi-unit dwellings. The accuracy of this software has been verified against field measurements. The software is capable of predicting the heating and cooling energy required to maintain thermal comfort throughout the year. This is performed by entering seasonal data relating to the location of the development, wind speed, temperature, humidity as well as information on the sun path. The software is capable of accounting for the effect of shading by other buildings or objects, the type of sub-floor, wall, floor, ceiling and roof construction, orientation, size and type of glazed systems, ventilation, level and type of insulation.

Where the design results in excessive heating and cooling loads, the software enables the identification of the room(s) where the bulk of the heating gain/loss occurs and recommendations are made with regards to the most efficient and cost-effective method for reducing the thermal loads. This can involve one or more of the following methods:

- Strategic use of insulation.
- Alteration of construction materials.
- Adjustment in the configuration of building openings.

Windtech Consultants' expertise was recognised in the inaugural Urban Development Institute of Australia Awards in 2004. Windtech Consultants was associated with four out of the five winning entries.

COMMERCIAL

Windtech have performed specialised modelling studies CFD to predict thermal comfort in office and greenfield factory/ warehouse projects. Windtech provided services in the following areas:

- Optimisation of materials, shading and insulation to assist with energy efficiency ratings of office buildings.
- Assessment of thermal comfort in warehouses and factories, particularly in hot climates
- Optimisation of mixed mode ventilation
- Assessment of the effectiveness of thermally driven ventilation using the stack effect
- Accurate modelling of the effect of wind entry on thermal comfort
- Optimisation of HVAC requirements, accounting for wind entry.

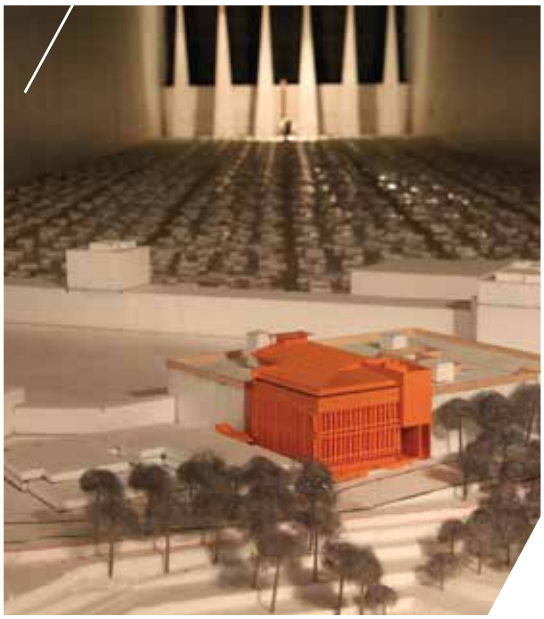
CASE STUDY

Global Change Institute, Univ. of Queensland

The aim of this study was to optimise thermal comfort using natural ventilation and the stack effect. Windtech used a hybrid technique to provide the best possible prediction of the combined effect of wind and thermally driven air flow and their effect on the thermal comfort of the occupants for different seasons, including diurnal effects.

Wind tunnel testing was used to provide accurate boundary conditions. CFD was then performed to model the effect of the heat transmittance and generation as well as its effect on air flows and internal temperatures for different times and seasons. The study concluded with the following findings:

- Heating will be required at night during winter, spring and autumn.
- Cooling is required during summer and autumn and spring days.
- Night flushing is recommended during summer.
- Sealing is recommended during winter.
- An algorithm was also devised for the control of the sunshades to reduce heat loading and capture the prevailing winds.



Special Studies reliability and innovation

Wind Climate and Topography Studies

Windtech have access to a global climate database. Advanced analysis techniques are employed to provide the best possible prediction of both extreme and serviceability winds, including directional effects.

In addition, if the local wind climate for the subject site is likely to be influenced by a significant topographic feature then it is important that its effect be modelled using a smaller scale model and the effect accounted for in the larger scale wind model in the wind tunnel.

These types of studies are mandatory in Hong Kong due to the local landforms.

Bridge Structures

Windtech Consultants have an advanced rig for the testing of bridge section models for aerodynamic stability.

Windtech can also perform full aeroelastic models for cases where there are significant topographic effects or non-symmetry in the overall form of the bridge.

Special Structures

Windtech Consultants has a particular interest in the study of wind effects on special structures. Unusual wind-sensitive structures, large and small, require special modelling. This calls for knowledge of the limitations and an understanding of the principles behind wind tunnel testing. Often a special methodology and testing regime needs to be formulated to arrive at the most accurate results possible.

CASE STUDY

Cauldron for the Asian Games 2006, Doha

This complex moving structure comprised of three slim rings revolving within a main fixed ring located on a 25m high shaft. A 1:50 scale model of the structure was instrumented with pressure taps within each ring and tested in the wind tunnel within a 1:50 scale model of the Khalifa Stadium. The model was tested for different stages of the rings' revolution relative to each other and for the erection mode configuration.

Before commencement of testing, a study was carried out using a 1:300 scale model of the sports precinct to determine the effect of the surrounding structures on the upstream velocity and turbulence intensity profile for wind incident from different wind directions.

The high-frequency force balance technique was important as a check on the results of the Load Response Correlation technique. The need for the Load Response Correlation technique stems from a requirement to determine the relative displacements of the ring elements, as they must operate within very strict limits to avoid the rings colliding with each other (there was an allowance for only a few centimeters gap between the concentric rings). The Load Response Correlation technique is also useful in providing a more accurate set of equivalent static loads for such an unusual structure.

Wind-Driven Rain

Windtech Consultants has substantial experience in the prediction of the footprint of rain due to wind effects. This involves the determination of the distribution of rain particle sizes for the site as well as the relationship between wind and rain events. This information is combined with wind tunnel measurements to arrive at the estimated trajectory path of the rain droplets.

Examples of projects where Windtech undertook this type of study include:

- Wynyard Walk Footbridge
- Star City Casino, Sydney, Australia
- Lakeside Joondalup redevelopment, Perth, Australia
- Soul Apartments, Surfers Paradise, Australia

Erosion Modelling

Windtech Consultants can assist with the modeling of soil or particle erosion due to wind and can advise regarding the extent of wind required to cause significant erosion and methods of mitigation. An example of such a study is the investigation of the erosion of iron ore stockpiles in Bahrain.

Product Development and Testing

Windtech Consultants can assist with product development to optimise the performance of various products or for product certification.

We offer advanced modelling techniques to provide a reliable prediction of performance.

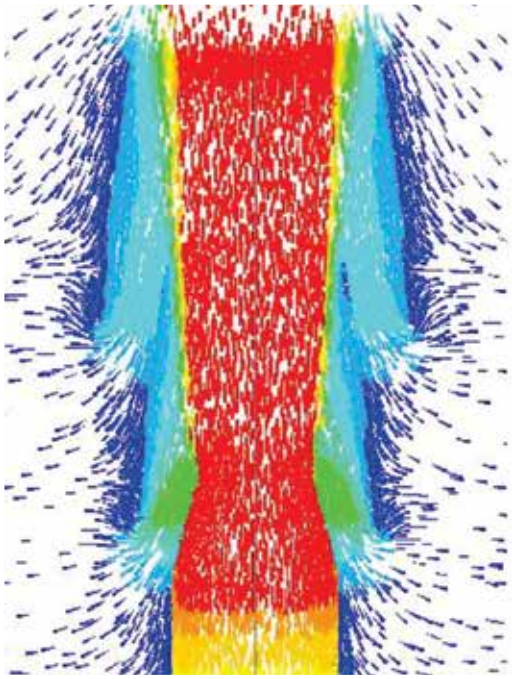
Examples of projects where Windtech can assist with the product development for certification are:

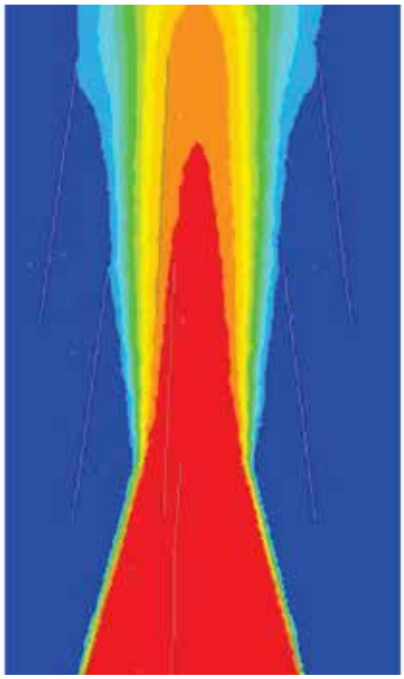
- Design development and testing of fume jets
- Performance of innovative wind turbine designs
- Testing of wind noise and drag on motorbike helmets
- Operability of louvre panels and doors under serviceability wind loads.
- Vehicle Aerodynamics
- Wind drag on outdoor sculptures
- Wind loads on outdoor light fittings
- Wind drag on trees
- Wind loads on solar panels

CASE STUDY

Fume Jet Design Optimisation

Windtech Consultants improved and optimised the function of an induced flow ventilation stack using computational fluid dynamics and wind tunnel testing. Computational fluid dynamics allowed for the rapid and cost effective design of the stack by initially modelling several concepts before optimising the final design. The performance of the ventilation stack was confirmed in the wind tunnel with a small and large scale model using the chemical trace gas method and custom designed 3D printed instrumentation. The final design achieved the specified entrainment ratio with and without cross flow wind.





Solar Studies environmental impacts and comfort

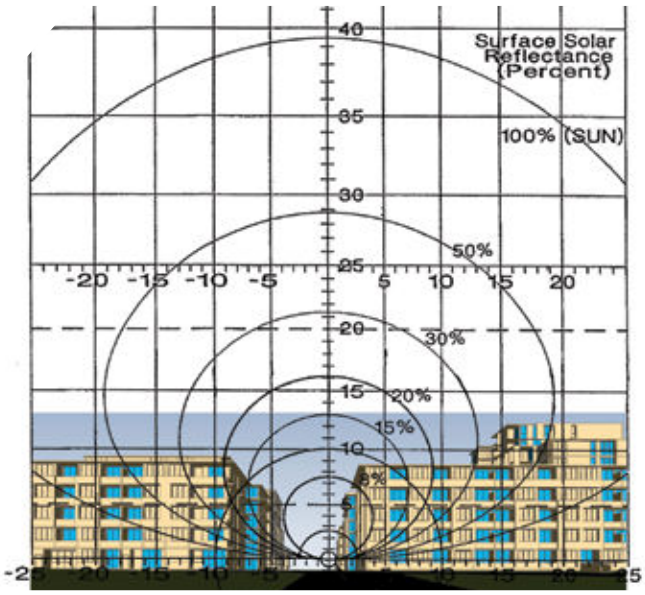
Windtech Consultants provides consulting services in the area of solar effects, including the study of solar reflectivity, solar access, overshadowing and daylight. Windtech Consultants has undertaken over 400 such studies including a Solar Reflectivity Analysis of the Burj Khalifa, Dubai, currently the World's tallest building.

Solar Reflectivity Studies

Solar glare from buildings is known to be a potential hazard to motorists. For this reason, local government authorities now generally require a study of solar reflectivity impact from large building projects with recommendations for solving potential glare problems.

The method adopted by Windtech Consultants to examine solar reflectivity from buildings was developed by David N. H. Hassall. The Hassall technique involves the use of a glare protractor and reflection protractor which determine the amount of glare to be expected from any building surface and the degree of annoyance.

The Hassall technique provides detailed information on the more critical aspects of the study. This in turn makes the study very efficient and also able to provide useful results with recommendations regarding the maximum reflectivity of facade materials being used. The time of occurrence of the critical levels of glare and from which section of the façade is also able to be determined.



Daylight Analysis

Daylight analysis is carried out when concern is expressed with regards to the impact of excessive overshadowing by the surrounding buildings on internal natural lighting. This study is normally required where it is difficult to assess the deemed to comply provisions in various building standards due to the complexity of the openings to the sky, the presence of nearby buildings obstructing sky illumination or where the building has an irregular form.

Assessment of the adequacy of natural lighting from the sky is compared against criteria on which the building codes are based.

Sample Solar Reflectivity and Daylight Analysis Studies

- Burj Khalifa, Dubai (the world's tallest building)
- Domestic Terminal T2, Mascot, Sydney
- GPO Redevelopment, Sydney
- The Forum, St Leonards, Sydney
- Wenona School Performing Arts Complex, North Sydney
- 635 Gardeners Road, Mascot, Sydney
- QV Tower, Little Lonsdale & Russell Sts, Melbourne
- Williams Landing Railway Station, Victoria

Solar Access and Shadow Analysis

Windtech Consultants offers services in the analysis of Solar Access to the various living and outdoor areas and the effect of shadows cast by the development.

Many local government authorities require an assessment of the potential for overshadowing of a new development onto existing neighbouring buildings and communal outdoor areas. This is usually undertaken for the Winter Solstice at 9am, 12noon and 3pm, although some local government authorities will also require the assessment to be undertaken at other times of the year, such as the Equinox.

Windtech prepare a detailed 3D computer model of the subject development and local surrounding area, including neighbouring buildings and significant topographical effects.

The 3D analysis software allows the shadows cast by the sun to be superimposed over the 3D model at various times of the day and year, and images are obtained from the model for the required times from the relevant viewpoints. Consideration is also made as to the effect of other nearby proposed developments, and a comparison is presented between the existing and future conditions.

Furthermore, in addition to Shadow Diagrams, many local government authorities have requirements for how many hours direct solar access each residential apartment should receive to the main living space and adjoining private open space. The 3D computer model is also able to be utilised for this type of assessment.

Sample Solar Access and Shadow Analysis Studies

- Pacific Place and ERA Apartments, Chatswood, Sydney
- 30 The Bond, Hickson Rd, Sydney
- 207 Pacific Highway St Leonards, Sydney
- Campbell Crescent Terrigal, NSW
- Toowoon Bay Rd, Long Jetty, NSW
- Forresters Beach Retirement Village, NSW
- 335 Wharf Rd, Newcastle, NSW
- Hamilton Harbour Development, Brisbane
- 52 Regent St, Chippendale, Sydney
- Redfern Housing Block, Sydney
- Meriton Tower, 531-551 George St, Sydney
- Westfield Sydney City, Sydney
- 185 Macquarie St, Sydney
- 55 Lavender St, Milsons Point, Sydney
- 42 Walker St, Rhodes, Sydney
- Top Ryde City Apartments, Sydney
- 164 Liverpool Rd, Ashfield, Sydney
- Sturt Place, St Ives, Sydney
- 778-782 Military Rd, Mosman, Sydney
- Victoria Square Masterplan, Zetland, Sydney
- V by Crown, Parramatta, Sydney
- Australia Towers, Sydney Olympic Park

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