Aerodynamics

WOLFSON UNIT
FOR MARINE TECHNOLOGY & INDUSTRIAL AERODYNAMICS

BACKGROUND

Since its inception in 1967 the Wolfson Unit for Marine Technology and Industrial Aerodynamics, which is part of the School of Engineering Sciences at the University of Southampton, has been closely allied to both the Aeronautics/Astronautics and the Ship Science research groups. The Unit acts for these departments undertaking commercial consultancy and testing in industrial aerodynamics, i.e. that which is not directly aeronautical in nature.

For many years the Wolfson Unit has been using the excellent wind tunnels at the University of Southampton, two of them with moving grounds, to carry out testing for a wide variety of organisations operating in many different engineering disciplines. They also make use of wind tunnel facilities at other establishments when this has been justified by the needs of the client.

The testing has not been limited to the wind tunnels, as on many occasions special rigs have been built to model a complete internal flow system or Unit engineers have travelled to a client's site to take measurements on an existing installation.

While wind tunnel or similar test techniques are commonly used to help overcome aerodynamic problems, they can frequently help with the solution of hydrodynamic problems also. Appendages can be modelled at a large scale without free surface effects and the flow can be easily and accurately measured and observed. Testing should be planned at an early stage in the design process, thus saving on development time and cost, and leading to a better design.

The Wolfson Unit engineers, who are employed full time on consulting work, have built up a wealth of experience in overcoming aerodynamic and hydrodynamic problems for their clients. This experience helps them to adapt test techniques or design special tests to match the specifications and budgets of the client.

All work is carried out in secure conditions and full confidentiality is maintained at all times. No details of, or results from, any test programme are ever published without the express permission of the client.

Drag measurement of track cyclists. Client : UK Sport

EXPERIMENTAL MEASUREMENTS

Many different techniques are used to obtain the experimental results desired. These include:-

Measurement of forces and moments using various well proven balances and dynamometers.

Measurement of motions and vibrations using strain gauges and accelerometers.

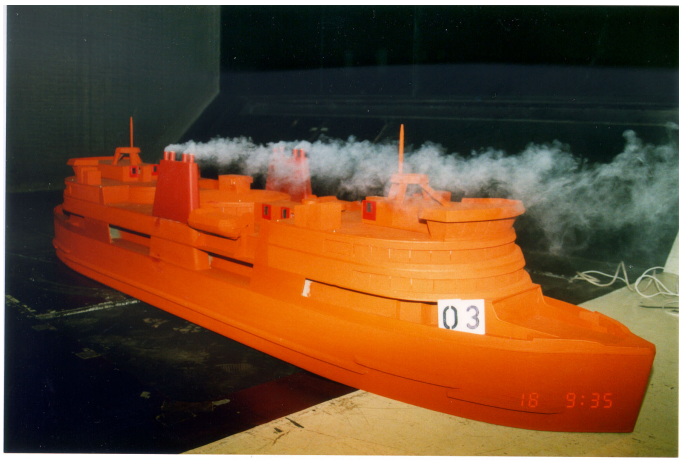
Measurements of air velocity and pressure using hot wire probes, pressure gauges, vane anemometers and laser anemometry (PIV and LDA).

Flow visualisation using smoke, oil films and wool tufts.

Gas dispersion and ventilation studies.

Measurements in smooth or turbulent flow.

On-site measurements of pressure, velocity and temperature.



Exhaust flow visualisation on a RO RO ferry. Client : van der Giessen de Nord

EXAMPLES OF WORK CARRIED OUT

Work has been undertaken for clients operating in many different fields, including:-

Marine

Developments and testing of keels and other appendages, from America's Cup yachts to cruising yachts, at scales and Reynold's Numbers unobtainable in the towing tank.

Evaluation of sails and rigs, including multi-mast rigs for yachts and sail training vessels, ethnic rigs for fishing boats and unconventional rigs for sail assisted ships.

Evaluation of underwater towed instrument pod.

The establishment of the relation between heel angle and heeling force and a study of the effect of gusts on sailing rigs for the Department of Transport for the revised Sail Training Vessel Regulations.

Measurement and visualization of water inflow to ships' propeller to improve the flow and reduce vibration.

Measurement of moments and forces on high speed craft, including wave piercing catamarans and hovercraft.

Flow measurements to show local airflow across flight and passenger decks and to improve the design of funnels and superstructures to prevent the ingestion of exhaust gases by air intakes.

Study of wind induced motions of lifeboats suspended on long falls from offshore platforms.

Aeronautical

Development of an aircraft gas turbine oil cooler duct with ejector.

Measurement of lift and drag forces and moments on aircraft external aerials.

Studies on the external air flows around an airfield fog sensor to prevent internal condensation.

Vehicles

Racing car development using the moving ground.

Measurement and reduction of drag and side force on lorries and trailers.

Study of wheel/car interactions.

Investigation of aerodynamic flow around trains.

Development and manufacture of laser equipment to measure spray generated by lorries on wet roads.

Measurement and reduction of the drag of track cyclists.

Civil

Measurement of forces and pressures on tall structures and bridges.

Study of the dynamic stability of a military bridge launching rail in high winds.

Mapping of local flows around London Docklands development sites to ascertain the effect of new buildings on recreational sailing on the docks.

Wolfson Unit MTIA, University of Southampton, Southampton SO17 1BJ, UK
Tel: +44 (0)23 80585044 Fax: +44 (0)23 80671532
Email: wumtia@soton.ac.uk Website: www.wumtia.soton.ac.uk

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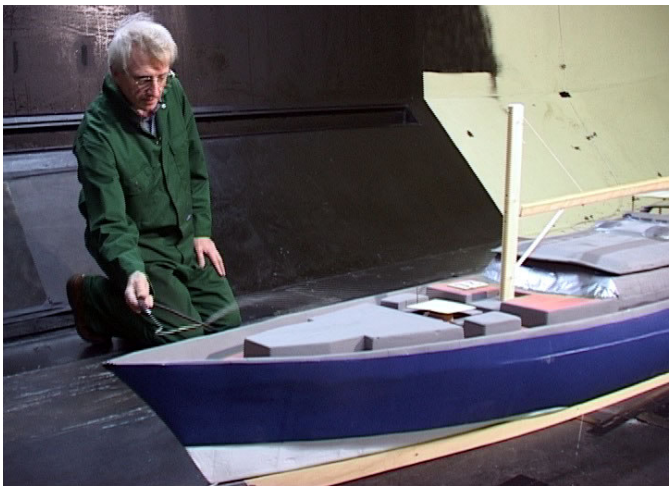


Wind tunnel testing of 'MITseaAH' designed by Pedrick Yacht Design in the University of Southampton Wind Tunnel

Measurement of pressures on roof and wall panels of large buildings and the study of airflow patterns within buildings, in pedestrian areas and around building developments.

Measurement of forces and vibrations on a roof mounted extraction fan cowl at different roof angles and orientations to the wind.

Process

Surveys of flow speed and direction in food freezer tunnels and recommendations for improving efficiency and stopping leaks and icing.

Measurement of flows and pressures in a gas cracker plant and recommendations for its improvement.

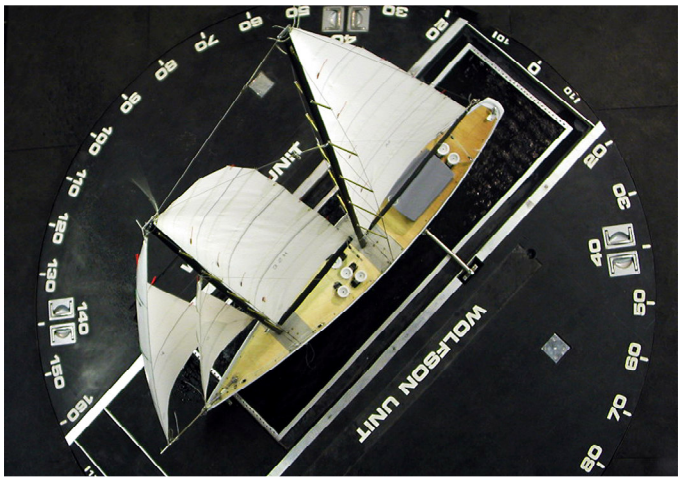
Modelling of furnaces and freezer tunnels and measurements of flow and pressures as part of the design process.

Measurement of the flow in and around combustible gas sensors and studies of their optimum positioning inside ductwork.

Environment

Development of wind energy systems, such as wind turbines.

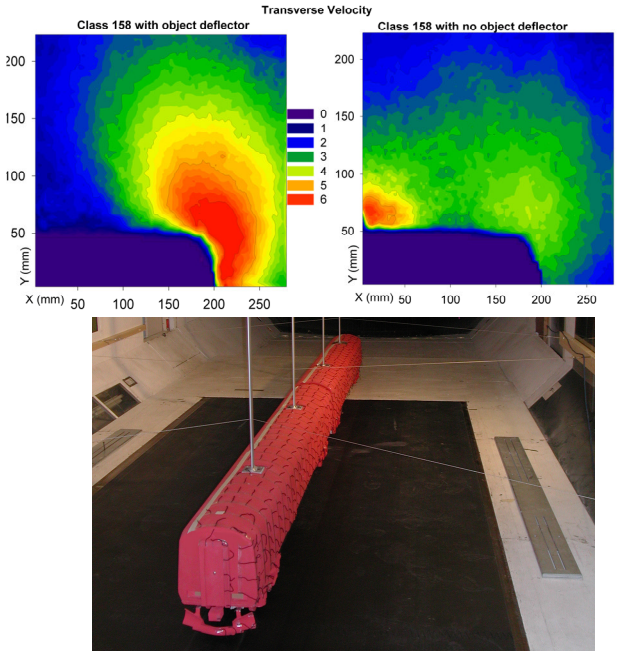
Dispersion studies from chimneys.



Sail wardrobe development for a 120ft schooner designed by Hoek Design in University of Southampton Wind Tunnel

EXPERIMENTAL EQUIPMENT

The Unit has access to a wide range of modern experimental equipment including transducers, dynamometers, anemometers and computerised data acquisition systems. Routine data analysis and results presentation can usually be accomplished during the tests.



Investigation of aerodynamic flow around trains using Particle Imaging Velicometry (PIV). Client : AEA Technologies Rail/RSSB

WIND TUNNEL FACILITIES

The Wolfson Unit uses the wind tunnels adjacent to the University of Southampton for the majority of testing.

Wind Tunnel No. 1:

Low speed section: 4.6m wide x 3.7m high x 3.7m long.

Maximum wind speed: 10m/s.

6 component balance and turntable in tunnel floor.

High speed section: 2.1m wide x 1.5m high x 4.4m long.

Maximum wind speed: 50m/s.

3 component balance in tunnel roof.

Moving ground belt: 1.0m wide x 2.1m long. Maximum belt speed: 25m/s.

Wind Tunnel No. 2:

Working section: 3.5m wide x 2.6m high X 10.5m long.

Maximum wind speed: 55m/s.

6 component balance in tunnel roof., and 4 component balance and turntable in tunnel floor.

Atmospheric boundary layers can be simulated in the long working section.

Moving ground belt: 2.4m wide x 4.8m long. Maximum belt speed: 27m/s.

Small Wind Tunnel:

Working section 0.9m wide x 0.6m high.

Suitable for flow visualization.

Maximum wind speed: 40m/s.

Wind tunnel testing of the Howland Quay Development at Greenland Dock, London. Client: London Docklands Development Corporation

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