INTRODUCING THE CLP POWER WIND/WAVE TUNNEL FACILITY (WWTF)

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1. Introduction

Construction of a new boundary layer wind/wave tunnel has recently been all but completed at Hong Kong University of Science and Technology. The facility will address the need for a local testing laboratory to serve the Hong Kong construction industry and wind related research, and is equipped for measuring building aerodynamic response, cladding and structural pressures, pedestrian level wind environment, and dispersion of pollutant gases. Commissioning of the various instrumentation systems, and characterisation and calibration of the flow quality is currently underway. The facility will be operational for research and commercial testing in the first half of 2000.

2. Tunnel Configuration

The basic configuration of the WWTF is a closed-loop wind tunnel with two parallel wind tunnel test sections. The so-called high-speed section has two 3 m wide working sections located at its upstream and downstream ends, with heights of approximately 1.6 m and 2 m respectively. The 1.6 m high working section is intended to provide smooth flow with very low turbulence for aeronautical type applications, while the 2 m high working section is intended for boundary layer applications. The expansion of the high-speed section from 1.6 m to 2 m was designed to reduce the pressure gradient along the test section.

The length of the high speed section is approximately 30 m, and includes 399 pneumatically operated roughness elements for development of various types of turbulent boundary layer flow. These are arranged in 9 independently controlled panels, and each can be raised from 0 – 150 mm above floor level. The integrated computer control at the 3 m × 2 m working section controls the roughness elements, turntable orientation and fan speed.

The low-speed section is approximately 40 m long with a 5 m wide × 4 m high cross-section. It is located directly above the water tank, which is also approximately 40 m long and 5 m wide and has a depth of 3 m. The water tank is included in the medium-term development plan for the facility, and will include a wave generator and beach. Ten liftable floor sections can be raised to expose the water surface of the water tank for wind-wave interaction studies or simply to be used as a wave tank.

A settling chamber is located prior to a 3:1 contraction at the entrance to the high-speed section. This chamber consists of an upstream honeycomb with a mesh size of 19 mm and a tube length of 160 mm. This is followed by four successive mesh damping screens located at 1 m spacings downstream of the honeycomb, and have mesh sizes of 8, 16, 20, and 25 meshes per 25 mm respectively. The first screen is made up of 0.5 mm diameter wire, and the remaining three screens 0.35 mm diameter wire.

The closed-loop configuration can be converted to an open-loop configuration by virtue of purge doors in the section connecting the low and high-speed sections. In the closed-loop configuration, these doors simply form the walls of the connecting section. In the open-loop configuration, during pollution dispersion studies for example, contaminated air is purged from the low-speed section and fresh air is drawn into the high-speed section. During operation in its closed-loop configuration, the tunnel air temperature is controlled by a heat exchanger located in the low-speed section.

A common fan is used for both high and low-speed sections, and is located at the downstream end of the high-speed section. The fan is a 2.8 m diameter, 170 kW axial flow fan with DC motor. It is intended to be used as a fixed pitch, variable speed fan, although the blades can be adjusted manually if required to provide stable operation.

3. Design Characteristics

The design and performance characteristics are summarised in the following table (from [1]):

Overall size	61.5 m long x 16.5 m wide x 7.5 m high
High speed test section	29.2 m long x 3 m wide x 2 m high
Turbulence intensity	< 0.5%
Flow uniformity	< ±0.5%
Flow angularity	< 0.5°
Contraction ratio	3.33 : 1
Low speed test section	41 m long x 5 m wide x 4 m high
Flow conditioning elements for both test sections	Honeycomb/screens
Water tank	41 m long x 5 m wide x 3 m water depth
Fan type	Axial flow
Blade diameter	2-2.5 m
Power	170 kW
Speed regulation	variable speed + manually variable pitch
Heat exchanger	±1°C

4. Acknowledgements

The construction of the WWTF was made possible by the generous donation of HK$10 million by CLP Power Hong Kong Ltd., and grants awarded by University Research Council of the HKSAR. The authors also acknowledge the contributions of Dr Y. Zohar and Dr S.C. Kot from planning through to completion of the WWTF.

5. References

[1] Zohar, Y. 1999. Performance requirements and conceptual design of the wind wave tunnel facility. WWTF Committee Report, Hong Kong University of Science & Technology.

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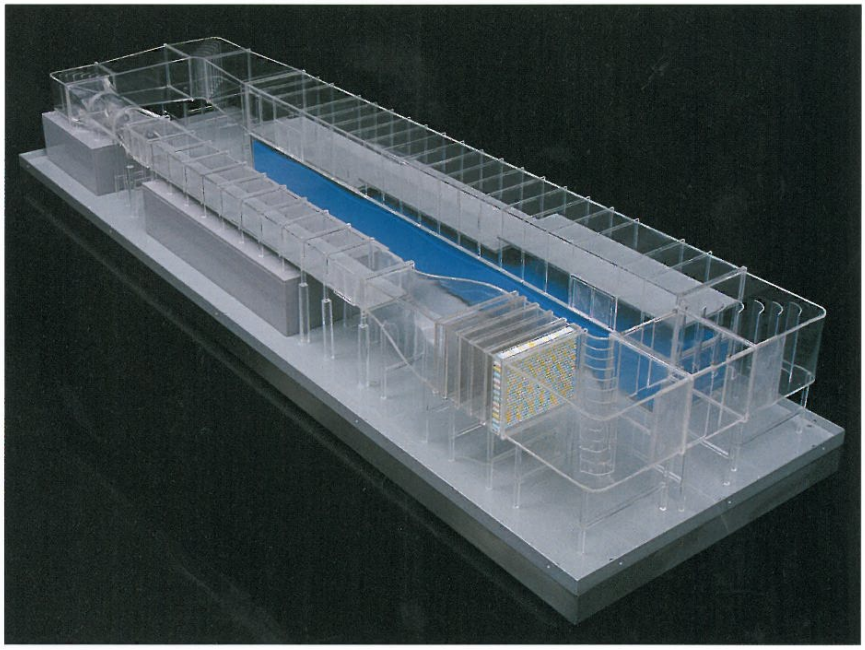
CLP Power
Wind/Wave Tunnel Facility



A new wind/wave tunnel facility is in the final stages of construction at the Hong Kong University of Science and Technology. The facility is a University Central Facility and will be made available to users within and outside of the University for all relevant research and engineering applications. The facility is expected to be operational for wind tunnel testing by the end of 1999.

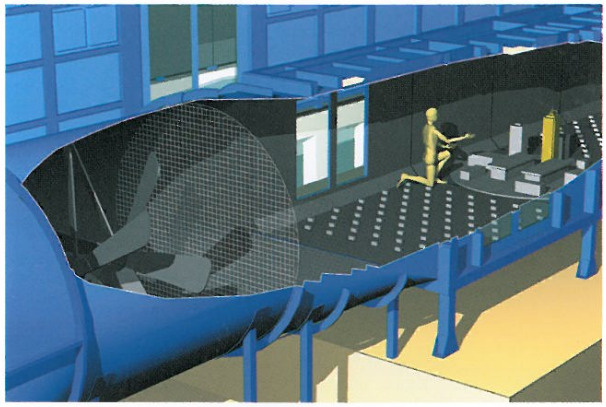
The facility is designed for experimental work on research and engineering applications using the wind tunnel and/or the wave channel. It will provide a sophisticated teaching and research facility for the tertiary community in Hong Kong and a capable tool to solve wind engineering, wave engineering and pollution dispersion problems for the engineering and construction communities and regulatory bodies. The facility will be operated under the supervision of the School of Engineering and have access to all the expertise available in the School of Engineering and the University.

In addition to funding from the University, construction of the wind/wave tunnel facility was also funded by a generous donation of $10 million from the CLP Power Hong Kong Ltd.

CLP Power Wind/Wave Tunnel Facility

Features:

- closed circuit, boundary layer, subsonic wind tunnel
- two dry working sections and a wave channel
- wave channel is underneath the low speed working section and exposed when the floor panels are lifted
- convertible into an open circuit tunnel
- operational features include fully integrated computer tunnel control including fan, turntable, and roughness elements along the high speed section



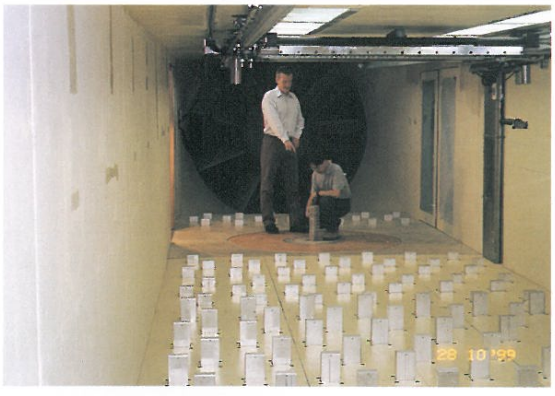
Inside the High Speed Test Section

Technical Data:

- overall dimensions: 61.5 m long, 16.5 m wide and 7.5 m high
- high speed section dimensions: 29.2 m long with 3 m wide by 2 m high cross section
- low speed section dimensions: 41 m long with 5 m wide by 4 m high cross section
- wave channel dimensions: 41 m long, 5 m wide and water depth of about 3 m
- design maximum wind speeds: low speed section: 7.5 m/s (27 km/hr); high speed section 25 m/s (90km/hr).

Instrumentation:

- high frequency force balance
- high speed pressure scanning
- wind velocity measurements
- reference pressure measurement
- displacement and acceleration measurement
- dispersion measurements
- flow visualization
- wave maker



Calibrating the High Speed Test Section

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