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**OFFSHORE TECHNOLOGY
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**Christchurch Bay Tower Data Archive
Quality Assurance Report**

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CHRISTCHURCH BAY TOWER DATA ARCHIVE

QUALITY ASSURANCE REPORT

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QUALITY ASSURANCE REPORT

SUMMARY

Wave force experiments at the Christchurch Bay Tower yielded valuable data on wave forces on cylinders under the complex flows experienced in real sea conditions. The last experiments were conducted in 1987, but the data remain an important source of information on the wave forces on cylinders, together with the measured wave particle kinematics. The use of two columns with different diameters enabled the studies to extend over a large range of Keulegan Carpenter numbers and Reynolds numbers. The experiments included clean vertical and horizontal cylinders, cylinders with real kelp fouling, with simulated hard roughness and a flexible cylinder. Considerable effort was devoted to quality control of the measured data.

The experiments were funded mainly by the UK Department of Energy, and ownership of the results has now been transferred to the Offshore Safety Division of the Health and Safety Executive. They have now commissioned the archiving of a set of important records from the experiments, covering clean cylinders, kelp fouling, hard roughness and a horizontal cylinder. The purpose is to make the data available for future work on wave loadings and the related wave particle kinematics.

The raw measured data are not usable without specialist decoding, calibration and certain pre-processing tasks. So, in this archiving work, the data have been processed into parameters such as 2 axis forces and 3 axis wave kinematics. As a result of this project the data are available on CD ROM.

This Quality Assurance (QA) Report is the second of three reports and provides sets of graphical and tabular outputs for each of the 20 minute records which have been processed in this archiving work. The first report is the Principal Report and needs to be used in conjunction with this QA Report. The third report is a User Manual, which is a guide to extraction of the data from the CD ROMs.

The advised procedure for use of the archived data is

1. Familiarise with the experimental data by means of the Principal Report and QA Report.
2. Decide which data is of interest in the following groups
 1982. Clean vertical cylinders, small and large diameters.
 1986. Small diameter vertical and horizontal cylinders, with and without kelp fouling.
 1987. Small diameter vertical cylinder with pyramidal roughness.
3. Decide which records are of interest, by consideration of the wave and current conditions.
4. Request the CD ROMs which contain the data.
Request those QA outputs which apply to the chosen records.
5. Extract data from the CD ROMs with the assistance of the User Manual

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2 THE QA OUTPUTS: *

PART 1. 1982. Clean Vertical Cylinders

PART 2. 1986. Small Vertical and Horizontal Cylinders with Kelp

PART 3. 1987. Small Vertical Cylinders with Pyramidal Roughness

- * The QA OUTPUTS are part of this QA Report, but they are contained in large files and it is recommended that only those outputs are requested which are related to the needs of the user. Please refer to the advised procedure in the Summary of this report.

1. DESCRIPTION OF THE QUALITY ASSURANCE OUTPUTS

This second report deals with quality assurance of the data. The QA outputs consist of three substantial volumes because each 20 minute record has produced 10 pages of tables and graphical outputs. So there are altogether about 1,200 pages. These are in three separate volumes, for the 1982, 1986 and 1987 experiments. When requesting the output time series data, which are on CD ROMs, requests should also be made for the QA outputs for those records which are of interest rather than the complete set, unless all of the experimental data is of interest.

The information in the QA files is outlined below.

1.1 PRELIMINARY PAGES

The preliminary pages consist of the following:

For all the experiments:

- * List of records
- * Current velocity and direction
Channels used for processing
Table of file size, record length, parity errors etc.
Calibration files

Additionally, for the 1986 kelp experiment:

- * Kelp tests
- * Horizontal cylinder and kelp experiment
(Records used in NMI/BMT analysis, with kelp specifications)

Only the pages marked * will be supplied to the user. The rest of the information has been important in this archiving work and has therefore been included in the QA files, but the user should have no need to refer to it.

1.2 RAW DATA STATISTICS

These statistics are for the 20 minute record before the processing, and are for the measured outputs of the individual transducers, but with the voltages converted into engineering units as follows:

Atmospheric pressure	mbar
Surface elevation or waveheight	m
Windspeed	knots
Wind direction	deg. from true N
Large column force	kN
Small column force	kN
Perforated ball force	N

1.3 PROCESSED DATA STATISTICS

At this stage the zeros for individual transducers have been set by means of the routines described in the Principal Report, para 6.2.2.

The forces on each measuring ring of the columns have now been converted to x,y axis readings from the outputs of the array of three transducers.

The particle velocity and acceleration values have been obtained from the measured forces of the perforated ball instruments by means of the process described in the Principal Report, para 4.2.

1.4 TORQUE CHECKS

The measured torque on each force ring has been obtained from the readings of the array of three transducers by means of the process described in the Principal Report, paras 4.1 and 6.2.6. After correction of the zeros the torque, expressed as a percentage offset from the cylinder centreline, is expected to be better than 10% of the radius of attachment of the transducers. If it was higher, then this has been noted in the QA summary sheets. It should be noted that higher torques may be expected when the cylinder surface is rough, either due to the attached kelp or pyramidal roughness.

1.5 MEAN SQUARE CALCULATIONS

For each 20 minute record, mean square parameters for the cylinder force and particle acceleration have been derived. The mean fourth power particle velocity has also been derived. Then the total force coefficient, C_{F*} , and Keulegan Carpenter number, K_* , were obtained by the formulae given in References 3 and 4 of the Principal Report. For a few records the total force coefficients have been compared with values given in the original analyses of the data. The agreement was good for those records examined but it should be noted that the full sets of records chosen for archiving will be different to the sets used in the original analyses and consequently a satisfactory agreement for a few records does not necessarily imply good agreement for all the records that been archived.

1.6 TIME HISTORIES

Some short term plots of time histories of surface elevation, cylinder forces and particle kinematics are presented. These have been inspected for consistency of related channels, such as the readings at the various depth stations. Generally the 'x' components of forces at the various stations are expected to vary together in a consistent manner, but the 'y' component for the small column, being roughly transverse to the wave direction, is strongly influenced by vortex shedding and hence there are normally higher frequency components with some randomness because of this.

1.7 SPECTRA

Spectra for the surface elevation, cylinder forces and particle kinematics are presented on the pages opposite the corresponding time histories.

For the 1982 data, the time histories and spectra for the surface elevation were from the capacitance wave gauge, which was close to the small column.

For the 1986 data, wave information is not available.

For the 1987 data, the wave data was from a wavebuoy situated about 100m from the Tower and consequently it is not possible to relate the time series data to measurements at the small column.

1.8 PROBABILITY DISTRIBUTIONS

Some sample probability distributions for the surface elevation, cylinder forces and particle kinematics have been derived using the method described in the Principal Report, para 8.2.

For the forces and particle kinematics, only data for level 3 are presented. The shapes of these plots would be straight lines for Rayleigh-distributed peaks and so the departures from Rayleighian behaviour can easily be seen. Also of interest is the magnitude of the highest peak for the 20 minute record; sometimes this is considerably higher than the distribution would be expected to indicate.