



Health & Safety
Executive

3340

**OFFSHORE TECHNOLOGY
REPORT - OTO 97 062**

**Christchurch Bay Tower Data Archive
User Manual**

This report is made available by the Health and Safety Executive as part of a series of reports of work which has been supported by funds provided by the Executive. Neither the Executive, nor the contractors concerned assume any liability for the reports nor do they necessarily reflect the views or policy of the Executive.

Reports in the OTO series can be obtained from HSE Information Services, Information Centre, Broad Lane, Sheffield S3 7HQ
Tel: 0541 545500.

CHRISTCHURCH BAY TOWER DATA ARCHIVE

USER MANUAL

report prepared by

V. H. OWEN

Fluid Mechanics Consultants
6 The Hummicks
Beaulieu
Hampshire SO42 7YU

CONTENTS

- 1 **PROCEDURE FOR USE OF THE DATA**
- 2 **OUTLINE OF THE DATA PROCESSING**
- 3 **DESCRIPTION OF DATA ON CD ROM**
- 4 **EXTRACTION OF DATA FROM CD ROM**

1. PROCEDURE FOR USE OF THE DATA

The information produced by this archiving work for the Christchurch Bay wave force data consists of :

Reports : Principal Report
 Quality Assurance Report (with large files of QA outputs for all records)
 this User Manual

CD ROMs Time series processed data for experiments in 1982, 1986, 1987.
 Processed data statistics
 Raw data statistics
 Torque check results
 Spectra plots
 Probability plots
 Tidal vectors

Only the 'Time series processed data' will normally be needed by the user. The rest of the information are computer files of data that have been produced for quality assurance work, which have been put onto the CD ROMs to provide long term storage of the data.

The recommended PROCEDURE FOR USE OF THE 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 or 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.

2. OUTLINE OF DATA PROCESSING

To describe the storage and access of data it is necessary to outline briefly the stages of processing and the files produced at each stage.

The data recorded at the Tower was on 12" reels of 1" magnetic tape in a PCI coded format. These were decoded into a computer-compatible binary format generated by a Hewlett Packard 2100 series computer system. The decoded data were put onto 10" reels of 1/2" magnetic tape.

The data on the 1/2" tapes was in volts with the only error checking being that done by the original P.C.I. decoding process.

There were tapes from three separate experiments, the 1982 clean vertical cylinder, the 1986 vertical and horizontal cylinders with kelp and the 1987 vertical cylinder with simulated hard marine fouling.

The sampling rate of the recorded data was 12.7 Hz for the 1982 data and 26.5 Hz for the 1986 and 1987 data.

There were several stages in the data pre-processing :

1. Transferring from 1/2" tape to PC compatible DAT tape. Where parity errors occurred a separate file had to be created, so several files may have been required for each complete record. The amount of data lost between each file was established for later processing. Generally less than 0.6 sec of data was lost for each parity error and usually less than 4 parity errors for each record.
2. Combining the groups of transferred files into complete records, adding dummy blocks where parity errors occurred and producing raw data files containing the whole of the original recorded data set. In addition to this, binary files containing heading information, such as times of records and nominal calibration factors and offsets, were checked and corrected where parity errors had occurred.

These files were identified by:

T### #.DAT Binary data in same form as original.
T###_#.HDR Binary heading information.

Where ### identifies the original tape number and # the file on the tape. Both these files are binary and have the same format as the original data.

3. Previously established calibration factor and offsets were then substituted and a new binary file and two ascii files were created.
R###.BIN Raw data ready for processing.
R###.HED Heading and calibration information.
R###.STA Statistics of raw data.

The ### now defines the new record identification number.

The binary file is of raw data, one ascii file of heading/calibration information and the other of raw data statistics. During this stage P.C.I. dropouts were detected and the synchronisation of blocks of data checked. In the case of the 1986 and 1987 data the number of samples were halved to produce raw data files of similar size to the 1982 data. These were the files used for further processing. Where offsets were later found to be incorrect they were adjusted and this stage was repeated.

4. The raw data statistics file is a summary of the measurements made by the various transducers, mainly force measurements. The main processing converts these into x, y and where appropriate z components of force, velocity and acceleration. To verify these a number of plots and tables have been produced for each individual record.
5. Once the data was validated it was prepared for storage on CD.

3. DESCRIPTION OF DATA ON CD ROM

Data have been stored on CD at each of the major stages above. A list of Archive codes is given in section 4.

The processed data from each of the three experiments are stored on a separate CD. To access and use the data it is necessary to have details of the directories and files stored on each one. The directory structure for each CD is similar but the names of the directories are different.

The root directory is CBT followed by a sub-directory name relating to the particular experiment.

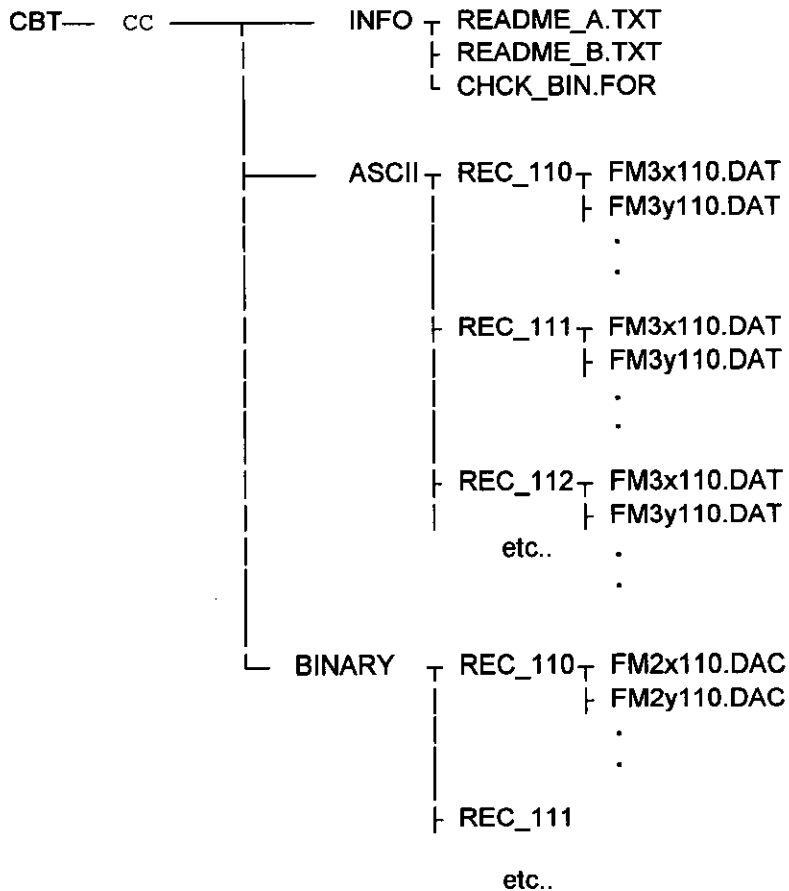
ie. The CD for the Hard marine fouling experiment (conducted at the same time as the Compliant Cylinder experiment) has a directory called 'CC' containing processed data.

The CD for the Kelp experiment has a directory called 'KELP'

and the CD for the clean cylinder experiment has a directory called 'CLEAN'

Each of these directories is divided into 3 sub-directories. One containing a processed data set in ASCII, one containing the same processed data set in BINARY and one with information about the files contained in the other two.

A typical directory tree is shown below :



The directory tree shows that all the time series data for a particular record are contained within one directory. (eg. All the time series data for the experiment record number 110 are stored in directory CBT\CC\ASCII\REC_110)

A complete list of the files on each CD including the directory tree are contained in the INFO directory in the files GENERAL.TXT, README_A.TXT and README_B.TXT.

Below is a list of the files contained in an ASCII directory relating to one record of processed data for the 1987 Hard Marine Fouling experiment. This is followed by a description of each type of file.

INFO_###	.TXT	Processed data statistics
R###RAW	.TXT	Raw data statistics
TOR_MSQ	.TXT	Result of torque checks
CBTTIM	.PLT	Time histories
CBTSPEC	.PLT	Spectra plots
CBTPROB	.PLT	Probability plots
CBTTID	.PLT	Tidal vectors
WA1E###	.DAT/TXT	Surface elevation (wave buoy) m
FM2X###	.DAT/TXT	Large column force level 2 x kN
FM2Y###	.DAT/TXT	Large column force level 2 y kN
FM3X###	.DAT/TXT	Large column force level 3 x kN
FM3Y###	.DAT/TXT	Large column force level 3 y kN
FM4X###	.DAT/TXT	Large column force level 4 x kN
FM4Y###	.DAT/TXT	Large column force level 4 y kN
FM5X###	.DAT/TXT	Large column force level 5 x kN
FM5Y###	.DAT/TXT	Large column force level 5 y kN
FS2X###	.DAT/TXT	Small column force level 2 x kN
FS2Y###	.DAT/TXT	Small column force level 2 y kN
FS3X###	.DAT/TXT	Small column force level 3 x kN
FS3Y###	.DAT/TXT	Small column force level 3 y kN
FS4X###	.DAT/TXT	Small column force level 4 x kN
FS4Y###	.DAT/TXT	Small column force level 4 y kN
FS5X###	.DAT/TXT	Small column force level 5 x kN
FS5Y###	.DAT/TXT	Small column force level 5 y kN
PV2X###	.DAT/TXT	Particle velocity level 2 x m/s
PV2Y###	.DAT/TXT	Particle velocity level 2 y m/s
PV2Z###	.DAT/TXT	Particle velocity level 2 z m/s
PV2X###V	.DAT/TXT	Particle velocity level 2 x m/s
PV2Y###V	.DAT/TXT	Particle velocity level 2 y m/s
PV2Z###V	.DAT/TXT	Particle velocity level 2 z m/s
PV3X###	.DAT/TXT	Particle velocity level 3 x m/s
PV3Y###	.DAT/TXT	Particle velocity level 3 y m/s
PV3Z###	.DAT/TXT	Particle velocity level 3 z m/s
PV3X###V	.DAT/TXT	Particle velocity level 3 x m/s
PV3Y###V	.DAT/TXT	Particle velocity level 3 y m/s
PV3Z###V	.DAT/TXT	Particle velocity level 3 z m/s
PV4X###	.DAT/TXT	Particle velocity level 4 x m/s
PV4Y###	.DAT/TXT	Particle velocity level 4 y m/s
PV4Z###	.DAT/TXT	Particle velocity level 4 z m/s
PV4X###V	.DAT/TXT	Particle velocity level 4 x m/s
PV4Y###V	.DAT/TXT	Particle velocity level 4 y m/s
PV4Z###V	.DAT/TXT	Particle velocity level 4 z m/s
PV5X###V	.DAT/TXT	Particle velocity level 5 x m/s
PV5Y###V	.DAT/TXT	Particle velocity level 5 y m/s
PV5Z###V	.DAT/TXT	Particle velocity level 5 z m/s

PA2X###	.DAT/TXT	Particle acceleration level 2 x	m/s.s
PA2Y###	.DAT/TXT	Particle acceleration level 2 y	m/s.s
PA2Z###	.DAT/TXT	Particle acceleration level 2 z	m/s.s
PA2X###V	.DAT/TXT	Particle acceleration level 2 x	m/s.s
PA2Y###V	.DAT/TXT	Particle acceleration level 2 y	m/s.s
PA2Z###V	.DAT/TXT	Particle acceleration level 2 z	m/s.s
PA3X###	.DAT/TXT	Particle acceleration level 3 x	m/s.s
PA3Y###	.DAT/TXT	Particle acceleration level 3 y	m/s.s
PA3Z###	.DAT/TXT	Particle acceleration level 3 z	m/s.s
PA3X###V	.DAT/TXT	Particle acceleration level 3 x	m/s.s
PA3Y###V	.DAT/TXT	Particle acceleration level 3 y	m/s.s
PA3Z###V	.DAT/TXT	Particle acceleration level 3 z	m/s.s
PA4X###	.DAT/TXT	Particle acceleration level 4 x	m/s.s
PA4Y###	.DAT/TXT	Particle acceleration level 4 y	m/s.s
PA4Z###	.DAT/TXT	Particle acceleration level 4 z	m/s.s
PA4X###V	.DAT/TXT	Particle acceleration level 4 x	m/s.s
PA4Y###V	.DAT/TXT	Particle acceleration level 4 y	m/s.s
PA4Z###V	.DAT/TXT	Particle acceleration level 4 z	m/s.s
PA5X###	.DAT/TXT	Particle acceleration level 5 x	m/s.s
PA5Y###	.DAT/TXT	Particle acceleration level 5 y	m/s.s
PA5Z###	.DAT/TXT	Particle acceleration level 5 z	m/s.s
PA5X###V	.DAT/TXT	Particle acceleration level 5 x	m/s.s
PA5Y###V	.DAT/TXT	Particle acceleration level 5 y	m/s.s
PA5Z###V	.DAT/TXT	Particle acceleration level 5 z	m/s.s

INFO_###.TXT is a file containing a summary of the processed data statistics for all the parameters measured and R###RAW.TXT contains a summary of the raw data statistics for all the parameters measured, where ### represents the number of the record.

TOR_MSQ.TXT contains a summary of the torque and mean square checks made.

Files with .PLT extensions are plot files representing samples of time histories, spectra etc. in HPGL (Hewlett Packard Graphics Language). They contain codes that can be output to PC graphics devices. (Note: They do not contain tables of values that can be plotted) If required the files can be output to various devices using a program called PRINTGL. This program is available as a 'Shareware' product that is provided by Ravitz Software Inc., PO Box 25068, Lexington, KY 40524-5068, USA. (Registration fee about \$40)

The remainder of the files are the time series data and the statistical information for each parameter. The files are in pairs but with different extension characters. The .DAT files contain the data in the units shown in the table and the .TXT files contain statistical information about the file.

The channels are identified by their file names as shown in the list above.

Where V is added to the end of a data file name it indicates that the x component of force used in the processing came from the perforated ball probe mounted vertically (eg. PV3Y###V.DAT) otherwise the horizontally mounted probe was used.

The equivalent BINARY directory contains similar file names but with a .DAC extension for the processed data. In this case the statistical information is contained within the first record of the file. Details of this record are given in section 4. The time series data begin on the second record.

The environmental channels, other than surface elevation, were only subjected to a very basic QA procedure. This involved flagging any detected dropouts with a value of 99999.0 and also calculating the summary statistics.

When they were working they were included in some of the statistical tables. Where their files appear on the CDs they are best ignored.

4. EXTRACTION OF DATA FROM CD ROM

The CDs were produced using a Hewlett Packard 4020i CD writer using standard HP software so the format should be readily compatible with other CD readers.

Data can be accessed from either the ASCII or BINARY directory. The BINARY may not be as readily compatible with other systems as the ASCII although with a suitable system it may be easier to use.

At the end of this section is a list of the archive codes used to identify each CD.

ASCII

Prior to reading any of the processed data files it would be useful to print the .TXT files stored in the INFO directory on each CD. These files give general information about the directory structure and a complete list of the channel identification for the particular experiment.

As described above there are separate directories for each experimental record and a separate data and text file for each measured parameter. The .TXT files are short files that contain statistical information about the parameter and the .DAT files contain all the time series readings. Both files are in ASCII format. The .TXT files can be read using any editing program or printed. The .DAT files containing the time series readings can be imported into any suitable analysis software. (The ASCII files are delimited with CR/LF. Although this uses a little more memory it makes it easier to import.)

eg. PA3X124.DAT is the particle acceleration, level 3, x axis, record 124
PA3X124.TXT contains statistical information for this record. See below.

```
RECORD 124
Partcl acceleration HP m/s.s
Level 3 X axis
Readings in file      =    14592
Sampling rate ( Hz ) =    13.25
Mean                  =    -0.0003
Standard deviation    =    0.6060
Maximum               =    2.2204
Minimum               =   -1.8684
Mean level crossings  =     285
```

As the files are ascii they should be relatively easy to import into packages like MATLAB, MATHEMATICA, EXCEL etc. (An example is given at the end of this section of how to import a data file into EXCEL 5.0)

There are additional text and plot files included in each directory which were used to produce the QA document. These are:

INFO ###	.TXT	Processed data statistics
R###RAW	.TXT	Raw data statistics
TOR_MSQ	.TXT	Result of torque checks
CBTTIM	.PLT	Time histories
CBTSPEC	.PLT	Spectra plots
CBTPROB	.PLT	Probability plots
CBTTID	.PLT	Tidal vectors

The contents of these are described in section 3. If required the .TXT files can either be accessed with an editor or printed out. The text contains control codes for a Hewlett Packard DeskJet 850.

The .PLT files containing the code for plots of the time series samples and spectra etc. are printed in the QA documentation. They can also be viewed by either spooling them to a graphics device using a program such as PRINTGL (see section 3) or imported into an analysis package supporting HPGL. (A wide range of packages support HPGL.) The method used to output multiple plots to one page was to reposition successive plots without paging the plotter. This may cause problems when trying to view using a VDU although it does work using PRINTGL..

BINARY

The files stored in the binary directory have the same name code as those of the ascii directory except that the files have a .DAC extension and the statistical information as well as a parameter code is incorporated in the first record of the file.

The files are binary with one file for each data channel. Each record within the file consists of a block of 128 real single precision (floating point) values represented by 32 bits. The binary files are generated using a fortran77 program creating direct access files with a record length of 512 bytes.

The first record of each file contains channel/parameter identification and statistical information about the file. Succeeding records contain sequential time series data in blocks of 128 values.

The contents of the first record are shown below with all values expressed as floating point numbers.

	location 1	Number of readings in file
	location 2	Sample rate.....samples/sec
*	location 3	Record/Parameter identification
	location 5	Mean
	location 6	Standard deviation
**	location 7	Level/axis identification
	location 9	Maximum
	location 10	Minimum
	location 15	Mean level crossings
	locations 16 to 128	Unused

The first of the 128 values is the number of time series readings within the file (beginning at the start of the second block of 128 values) and the second value is the sampling rate. The other values are self explanatory with the exception of identification codes which are described below.

- * Record/Parameter identification code (stored in location 3 or third value)

This defines the experiment record number and the parameter being measured. The record code is a three digit identification (eg. 014) and the parameter code is a two digit number shown in the list below. The value is stored as ###@@@ where ### is the record and @@ the parameter.

- 01 = Small column force
- 02 = Large column force
- 03 = Particle velocity (using horizontal probe x)
- 04 = Particle acceleration (using horizontal probe x)
- 05 = Particle velocity (using vertical probe x)
- 06 = Particle acceleration (using vertical probe x)
- 07 = Wind speed
- 08 = Wind direction
- 09 = Surface elevation
- 11 = Barometric pressure

- 12 = Tide height (Comex)
- 13 = Horizontal cylinder force... end 1
- 14 = Horizontal cylinder force... end 2
- 15 = Particle velocity horizontal cylinder
- 16 = Particle acceleration horizontal cylinder

eg. 01405. is particle velocity

**** Level and axis code (stored in location 7 or seventh value)**

Stored as #0# where the first # is the level and the second # is the axis code as shown in the table below.

Level code	Axis code
1 = environmental	
2 = level 2	1 = X axis
3 = level 3	2 = Y axis
4 = level 4	3 = Z axis
5 = level 5	
6 = horizontal end 1	
7 = horizontal end 2	

eg. 403 represents level 4 Z axis.

A sample fortran77 program CHCK_BIN.FOR has been included on the CD as an example of how individual blocks of binary data can be read and interpreted. This is a source program and must be compiled on a similar system to run.

ERRATUM

1. The README_B.TXT file on the CDs shows a '0' between the Record/Parameter identification code. There is no '0' between them, as can be seen above.
2. Although CHCK_BIN.FOR has been included on the 1982 and 1987 CDs it is missing from the 1986 CD
3. The wind speed units listed in 1982 processed data statistics are kn and not m/s.

To use a particular data set the appropriate CD can be selected from the archive codes listed below :

RAW DATA

CBT_82R/M1CBT 1982	Clean cylinder experiment Binary
CBT_86R/M1CBT 1986	Kelp experiment Binary
CBT_87R/M1CBT 1987	Hard marine fouling experiment Binary

PROCESSED DATA

CBT_82PA/M1CBT 1982	Clean cylinder experiment Ascii
CBT_82PB/M1CBT 1982	Clean cylinder experiment Binary
CBT_86P/M1CBT 1986	Kelp experiment Ascii and Binary
CBT_87P/M1CBT 1987	Hard marine fouling experiment Ascii and Binary

Due to the amount of data for the 1982 experiment a separate CD was used for the processed ascii data .

To allow the data to be checked an example is given of importing one ASCII data file into EXEL 5.0

1. Select CD with ASCII PROCESSED data eg. CBT_82 PA
2. Run EXCEL
3. Go to FILE menu - OPEN
4. In OPEN box of file menu : select CD drive (probably D:)

select the directory of file to import

eg. CBT ————
 |
 CLEAN
 |
 ASCII
 |
 REC_001

set LIST FILES TYPES to ALL FILES (*.*)

select file eg. FM2X001.DAT

select OK

5. in TEXT IMPORT WIZARD menu select all the defaults by selecting:

NEXT

NEXT

FINISH

The data should now be in a form that can be accessed using EXCEL .

6. The statistics file FM2X001.TXT can be read into EXCEL in a similar way.