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SUMMARY OF PRESSURE DATA FOR THIRTEEN AEROFOILS ON THE UNIVERSITY OF GLASGOW'S AEROFOIL DATABASE

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Herein is presented a summary of all experiments in which aerofoils were subjected to a variety of displacements in pitch about the quarter-chord location at low Reynolds numbers.

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UNIVERSITY OF GLASGOW AEROFOIL DATABASE

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Figures

NACA 0015 April 1987, STATIC + UNSTEADY (SINE, RAMP)
Experiments also done on a semi-model
with chord length of 0.3m
in conjunction with Cranfield Institute of Technology.
Ref: Cranfield PhD thesis, academic year 1988-89
by C.E. Oram.

NOMENCLATURE

c	chord
C_m	pitching-moment coefficient
C_n	normal force coefficient
C_p	pressure coefficient
C_t	"thrust" force coefficient
D.P.	dynamic pressure ($\rho V^2/2$)
k	reduced frequency ($\omega c/2V$)
r	reduced pitch-rate ($c/2V)d\alpha/dt$
Re	Reynolds number
TSR	tip speed ratio
RIB	run information block
V	velocity
x/c	chordwise dimension
α	angle of attack
ω	rotational velocity

1 INTRODUCTION

The phenomenon of dynamic stall, the onset of which is largely controlled by the behaviour of the viscous boundary layer on the aerofoil surface, plays an important role in the successful design of the helicopter rotor. During high speed forward flight conditions, the blades on the retreating side of the rotor disc encounter a reduced dynamic pressure, and hence rotor trim requirements dictate a high aerofoil lift coefficient. These high lift coefficients are generated through large angles of incidence, often exceeding the maximum static stall value and so take advantage of the dynamic effects on the stalling process. Aerofoil dynamic stall is imprecisely understood and is currently the subject of extensive experimental and theoretical investigation by, amongst others, **Beddoes**[1]. As has been shown by **Harris and Pruyn**[2], attempts to predict rotor performance without a mathematical model of retreating-blade stall have met with little success. Furthermore, the modelling is complicated by the highly three-dimensional flowfield of the rotor. It is clear, however, that, in order to formulate modelling techniques for use in rotor airload calculations, a basic understanding of the unsteady stall process must be established.

An experimental investigation of retreating-blade stall, together with a boundary-layer analysis on a model rotor, by **McCroskey et al**[3,4] pointed to the modelling of blade dynamic stall by an oscillating aerofoil in the nominally two-dimensional flow environment of a wind tunnel. Many such experiments of aerofoils oscillating through stall have since been performed, and data have been gathered for both analysis of the fluid mechanics of the dynamic stall phenomenon itself and for use in mathematical model development.

In order to raise the level of understanding on aerodynamic behaviour in unsteady conditions, many researchers have collected data from aerofoils tested in wind- and water-tunnels. These experiments are important in providing data for analysis and to aid the investigation of aerodynamic characteristics through computer modelling.

As part of this investigation, in recent years, in the dynamic stall facility at the University of Glasgow[5,6,7], two-dimensional data have been acquired from experiments on a number of aerofoils under a variety of motion types. The aerofoils are represented on the University of Glasgow's aerofoil database by an identification number, representing the chronological order of testing (see **Section 4.2**). The following table lists the aerofoils which have been tested, along with references to the reports in which the data for each series of experiments are displayed:

Model	Aerofoil Section	References
1	NACA 23012	8,9,10,11
2	NACA 23012A	12,13,14
3	NACA 23012B	15,16,17,18
4	NACA 23012C	19,20,21
5	NACA 0015	22,23,24
6	NACA 0018	25,26,27
7	NACA 0021	28,29,30
8	NACA 0025	31,32,33
9	NACA 0030	34,35,36
11	NACA 0012	37,38
12	NACA 0015 (shortened chord)	39
13	AHAVAW	40,41,42
14	GUVA10	43,44,45,46

A fourteenth aerofoil was also tested. However, this aerofoil (Model 10) was built in order to perform a number of specialist tests for an outside client and its data are not included on the University's database.

The thirteen aerofoils with data on the database can be divided into two groups. The first is a family of cambered aerofoils generated

from the NACA 23012 section and intended for the examination on helicopter blades of the transition from trailing-edge to leading-edge stall and the mechanism of reattachment. In addition to the original aerofoil, the family consists of the 12%-thick NACA 23012A and NACA 23012C sections, which are identical to the NACA 23012 over the leading 25% chord but modified downstream of this location to produce reflex trailing-edge camber[12] and greater camber[19] respectively, and the NACA 23012B, which is a 16% thick composite aerofoil derived from the NACA 23012 and an RAE section[15].

The second group is a series of symmetrical sections for use on large-scale vertical-axis wind turbines. Six of these sections are NACA 4-digit symmetrical aerofoils (NACA 0012, NACA 0015, NACA 0018, NACA 0021, NACA 0025, NACA 0030). In addition, Vertical Axis Wind Turbines Limited provided the 21%-thick AHAVAW aerofoil for testing, and the NACA 0018 was modified at the University of Glasgow to yield the 18%-thick GUVA10 section[43] which was also constructed and tested.

Each of these models was built with a chord of length 0.55m. However, as part of the University's research into the effects on the aerodynamic characteristics of model aspect ratio and tunnel blockage, it was decided to repeat a number of these experiments on a model possessing a chord which was half the length of the original. Therefore a NACA 0015 aerofoil of chord length 0.275m was also constructed (Model 12) and tested in steady and unsteady conditions.

The coordinates for each aerofoil section are listed in **Table 1**, and a brief description of the experimental apparatus and techniques is presented below.

2 DESCRIPTION OF TEST FACILITY

2.1 Aerofoil and Wind Tunnel

The general arrangement of the aerofoil in the wind tunnel was as shown in **Figure 1**. Each aerofoil was of span 1.61m and, with the exception of Model 12, of chord length 0.55m. Models 2-14 were constructed of fibre glass mounted on an aluminium spar and filled with an epoxy resin foam. The hand-finished surface was very smooth, and the profile accurate to better than 0.1mm. Model 1 was constructed of laminated mahogany with an instrumented tufnol centre section mounted on a steel spar. Each instrumented model was fitted vertically into the University of Glasgow's "Handley-Page" wind tunnel.

The "Handley-Page" low-speed wind tunnel is an atmospheric-pressure closed-return type with a 1.61x2.13 octagonal working section (**Figure 2**) in which a wind velocity of 61ms^{-1} can be attained. The model was pivoted about its quarter-chord axis on two tubular steel shafts connected to the main support via two self-aligning bearings. A single thrust bearing on the top support beam took all the weight. The dynamic and aerodynamic loadings from the aerofoil were reacted to the tunnel framework by two transversely mounted beams.

2.2 Pitch Drive Mechanism

2.2.1 Actuator

Angular movement of the model was obtained using a linear hydraulic actuator and crank mechanism. The actuator was mounted horizontally below the tunnel working section on the supporting structure, with the crank rigidly connected to the tubular part of the spar by a welded sleeve and keyway. The actuator was a UNIDYNE 907/1 type with a normal dynamic thrust of 6.1KN operated from a supply pressure of 7.0MNm^{-2}. A MOOG 76 series 450 servo valve was used via a UNIDYNE servo controller unit to control the movement of the actuator. A suitable feedback signal for the controller was provided by a precision linear angular displacement transducer geared to the main spar of the model.

2.2.2 Command Signal

The model's angle of attack was incremented by the actuator controller. The input signal during the static tests was provided under software control by the data acquisition unit's own digital-to-analogue converter. This was possible because, during the sampling, the angle of attack was fixed and sufficient time was

available between sampling to set the model at the required angle of attack. The two activities were separate and were performed sequentially.

Such was not the case during the unsteady tests, however, where sampling and control of the model's motion were required simultaneously. Therefore, for experiments on Models 1 and 2, during constant-pitch-rate "ramp" experiments, the input signal was provided by a separate function generator, comprised of an PET microcomputer and an 8-bit digital-to-analogue converter. A ramp signal was obtained by simply incrementing the PET's output lines sequentially from 00000000 to 11111111, while the desired delay between increments was generated by software using a memory location as a counter. During oscillatory experiments, an IEEE-controlled synthesised function generator produced the input signal, the amplitude and frequency of which was set via the MINC microcomputer at the start of each test. The code was written in BASIC.

For all the other models, one function generator was employed to provide the command signal to all unsteady experiments. For Models 3 - 9 it comprised a BBC microcomputer and a 12-bit bipolar digital-to-analogue converter. A second 12-bit bipolar digital-to-analogue converter was used to allow software control of the maximum desired voltage for the given amplitude or arc length. The required output function was digitised into equal time steps in 2's complement code and the frequency of the function was controlled using the internal interrupts of the BBC microcomputer. This code was also written in BASIC.

For Models 11 - 14 it consisted of an AMSTRAD 1512 microcomputer equipped with an ANALOG DEVICES RTI815 multi-function input/output board. The required output function was again digitised into equal time steps in 2's complement code and the frequency of the function was controlled using the internal interrupts of the AMSTRAD microcomputer. The code was written in TURBO PASCAL.

2.3 Instrumentation and Data Logging

2.3.1 Pressure Transducers

To provide the chordwise pressure distribution at mid-span thirty ultra-miniature pressure transducers were installed just below the surface of the centre section of the model. Installed in Models 1 and 2 were silicon strain-gauge pressure transducers (ENTRAN EPI-080-5 and KULITE LSQ-57) of sealed-gauge type with one side of the pressure-sensitive diaphragm sealed to a reference pressure during manufacture. Model 4 possessed ENTRAN EPI-080-5S transducers which were again of sealed-gauge type. Models 5 - 14 were instrumented with KULITE XCS-093-5 PSI G transducers, which were of vented gauge type with one side of the pressure sensitive diaphragm open to the ambient pressure outside the wind-tunnel (via tubes in the model). Model 3 possessed both ENTRAN EPI-080-5S and KULITE XCS-093-5 PSI G transducers. For every model, each transducer was fitted with a temperature compensation module, which minimised the change in zero-offset and sensitivity with temperature.

Because of the different applications intended for the aerofoils of the two families, the distribution of the pressure transducers around the aerofoil surface varied: 21 on the upper surface and 9 on the lower surface for the cambered aerofoils; 15 on each surface for the cambered aerofoils. The locations of the transducers on each model are illustrated in **Figure 3**.

The low voltage outputs from the thirty pressure transducers were suitably amplified and conditioned by a bank of differential amplifiers. The conditioned signals were passed to a "sample and hold" unit[5,47] to overcome the time-skew problem arising from the sequential conversion of the analogue signals into digital form.

2.3.2 Dynamic Pressure

The dynamic pressure in the wind tunnel working section was determined during experiments on Models 1 and 2 by a pitot-static probe mounted on the tunnel side-wall approximately one chord length upstream of the aerofoil's leading edge (p_{stat}). The probe was connected to a FURNESS FC012 micromanometer.

For the remainder of the models (with the exception of Model 7), dynamic pressure was determined by measuring the difference between the static pressure in the working section, 1.2m upstream of the leading edge, and the static pressure in the settling chamber (p_{set}-p_{wall}). The pressure tappings were connected to the micromanometer. For the experiments on Model 7, dynamic pressure was recorded using both methods.

The micromanometer provided an analogue signal suitable for the data acquisition unit's analogue-to-digital converter. The dynamic pressure was recorded as the sample-and-hold unit was triggered to sample the output from the pressure transducers.

2.3.3 Incidence

The instantaneous angle of attack of the aerofoil was determined by an angular displacement transducer geared to the model's main spar. The signal voltage from the transducer was fed into an amplifier/splitter to produce three signals for the following purposes:

i) connection of the multiplexer for recording the aerofoil's angle of attack;

ii) connection of the Schmitt trigger for initiation of data sampling when a preset incidence (voltage) was attained;

iii) a feedback signal to the hydraulic actuator controller.

2.3.4 Data Acquisition Unit

The data acquisition unit was a DEC MINC-11 microcomputer, configured with an LSI-11/32 16-bit microprocessor and laboratory modules which included:

i) an analogue-to-digital converter module, with a 16-channel multiplexer incorporated. The converter was a 12-bit successive approximation type with a conversion time of of 30μs, but the multiplexer's settling time and the need to transfer the data from the analogue-to-digital converter into system memory increased the conversion time to 44μs;

ii) a multiplexer module, of 16 single-ended channels, which increased the number of channels that could be sampled to 32;

iii) a real-time clock module, with two Schmitt triggers. This was used as a time-base generator to accurately set the sampling frequency. For ramp experiments, the sampling frequency was determined at run time from the pitch rate and the requirement that 128 sample sweeps should be obtained when the incidence was increasing and the same number when the aerofoil was sitting at its final incidence. However this specification was qualified by the fact that data were required to be recorded at the final incidence for no longer than 4 seconds and that the maximum sampling frequency which could be attained was 550Hz. For oscillatory tests, the sampling frequency was determined from the frequency of oscillation and the requirement that 128 sample sweeps should be obtained during each cycle. One of the Schmitt triggers was used to initiate data sampling, by setting its reference voltage to a value corresponding to the angular displacement transducer's output for the required starting angle of attack;

iv) a digital-to-analogue converter module which housed four independent 12-bit digital to analogue converters. This was used to provide the command signal for the hydraulic actuator during static tests.

The path of data flow and system layout is shown diagrammatically in **Figure 4**. The main control programs for the tests were written in FORTRAN IV, as described by **Murray-Smith and Galbraith**[48]. The programs prompt the user for specific run information

before calling a specialised subroutine written in MACRO-11 assembly language to receive and store the digitised data. The timing and control of the analogue-to-digital converter and associated circuitry was performed by the processor's hardware, but channel selection and data management were achieved under software control.

Part of the research on Model 12 involved calculating the velocity of the dynamic stall vortex over the aerofoil's upper surface. It was perceived that, for this purpose, it would be necessary to record data at a higher frequency than the 550Hz which could be recorded by the system described above. Therefore, for a number of experiments, the data were converted by a THORN-EMI BE256 unit and logged via an IBM PSI180 microcomputer.

3 TEST SERIES AND PROCEDURE

3.1 Static Experiment

A number of experiments were performed under steady conditions. Once the wind velocity had reached the required value, the aerofoil was rotated about its quarter-chord axis until it was positioned at the incidence at which the first set of data were to be recorded. Usually, this was approximately -2°. The model's angle of attack was then increased in steps of approximately 0.5°. After each increment in incidence, the flow was allowed to stabilise for a few seconds before each transducer's output was sampled 100 times and the mean value for each was stored. After 64 sweeps of data had been recorded, the model was returned to its starting position. Data sampling was maintained at the same rate on the return arc in order to record any delay in the reattachment of flow.

3.2 Unsteady Static Experiment

To record any fluctuations in the post-stall characteristics, the model's angle of attack was set at the required value and then a continuous sample of 256 data sweeps were recorded at a preset frequency (100Hz and 500Hz).

3.3 Ramp Experiment

During a ramp test the aerofoil was rotated about its quarter-chord axis over a preset arc at a constant pitch-rate. Five cycles of 256 data sweeps were recorded during each experiment. Between each ramp, the model sat at the finishing angle for five seconds, moved smoothly back to the starting angle in five seconds and sat at this position for another five seconds. Experiments were performed both when the pitch-rate was positive ("ramp up") and when it was negative ("ramp down").

Although the input signal to the hydraulic controller was a linear function, there were non-linearities in the aerofoil's motion at the beginning and end of the ramp as it built up speed from rest and later returned to rest. It was therefore necessary to calculate the pitch rate which was actually achieved over the range of angles for which the motion was linear. It has been observed that this pitch rate should be calculated by dividing the difference in incidence between 25% of the arc and 50% of the arc by the time taken to travel between these angles.

3.4 Sinusoidal Experiment

For this experiment, the model was rotated about its quarter-chord axis so that its angle of attack varied sinusoidally with time. The amplitude and frequency were controlled by the function generator. During each oscillatory cycle 128 data sweeps were recorded and logged, with data being sampled during ten cycles.

3.5 VAWT Experiment

The VAWT experiment was designed to emulate the incidence time histories encountered by the blade of a vertical-axis wind turbine. A computer algorithm, coded in FORTRAN 77, has been developed at the University of Reading to calculate the blade's angle of attack as a function of its azimuth position. The program can use both single and multiple streamtube models[49] based on SANDIA[50] data for the NACA series of aerofoil characteristics.

At low tip-speed ratios the time history for the single streamtube model is a distorted sine function, but this tends toward a true sine as the tip-speed ratio is increased. The upwind (positive) and downwind (negative) sections of each cycle attain identical peak values of incidence, and, for this single streamtube model, the tip-speed ratio and amplitude are related as follows:

TSR	Amplitude
6.00	5.4
4.00	9.9
3.50	12.2
3.25	13.8
2.80	17.4
2.33	22.6
1.75	32.8

For the multiple streamtube model, the peak values differ. At high values of tip speed ratio (i.e. TSR>3), the maximum absolute value of angle of attack over the downwind section of the cycle is significantly lower than that attained over the upwind section. During these experiments, tip-speed ratio and amplitude are related as follows:

TSR	Amplitude	
	Up-wind	Down-wind
6.00	6.7	-3.0
4.00	11.9	-6.8
3.50	14.4	-9.6
3.25	16.1	-11.7

Both single streamtube and multiple streamtube experiments were performed on Models 5-9. However, with the exception of Models 1, 2 and 4, for which VAWT experiments were not considered relevant, the remainder of the models were tested only with the single streamtube model. The function generator reproduced the angle of attack histories based upon the NACA 0015 aerofoil's characteristics. Data acquisition was performed in an identical manner to that for sinusoidal tests.

3.6 Procedure

Before each individual set of tests, the tunnel was shut down and the air flow allowed to cease before the transducer offsets were logged. Immediately after these values were recorded, the appropriate data acquisition routine was initiated whilst the tunnel was brought up to speed and thence data gathered as prompted by the software. The tunnel was then shut down, offsets logged again and further tests performed in the manner described above.

3.7 Non-Standard Experiments

A number of the experiments were repeated after the test conditions had been modified. For example, in order to investigate the behaviour of the unsteady boundary layer, hot-film probes were attached to the aerofoil surface on Models 1 and 2. During these experiments, the recording of pressure data continued.

Some of the experiments in standard conditions were chosen in order to investigate the flow conditions in the wind tunnel. In addition, for the same reason, a number of experiments were performed on Model 4 with end-plates attached and, on Model 11 with the aerofoil inverted (i.e. a negative incidence range was chosen so that the lower surface could be regarded as the upper surface and vice versa).

A series of static experiments were performed on Models 5-9 with the aerofoil reversed in the tunnel (i.e. with the trailing-edge facing upstream). It was intended that these tests should illustrate the behaviour of the aerofoil facing downstream when a vertical axis wind turbine was at rest.

It was intended that, in a small number of experiments, the boundary layer should be tripped in the leading-edge region. On Models 3 and 7, a thin thread was attached to the aerofoil surface just downstream of the leading edge. However, the results were not satisfactory. Therefore, on Models 12-14, graded sand was deposited at the aerofoil's leading edge. A direct comparison was made between tests with and those without these "trip wires" or "roughness transition strips".

4 EXPERIMENTAL DATA

4.1 Storage of the Data

All data collected by the data acquisition routines were stored in unformatted form on magnetic tape. A library of programs (coded in FORTRAN 77) is available for the reduction, presentation and analysis of the data on a DEC MICROVAX 3400. By applying offsets, gains and calibration values, the data reduction programs convert the cycles of raw data into averaged or unaveraged non-dimensional pressure coefficients. These data have been loaded on to the University of Glasgow's aerofoil database. Airloads are determined by suitably integrating the pressure coefficient values.

Data files which are relevant to current research are easily accessed via the MICROVAX 3400, and data files from the complete series of experiments are stored on both microcassette, for use on the MICROVAX 3400, and magnetic tape media, for use on a DEC Local Area VAX cluster. This VAX cluster consists of one VAX 8250 and two MICROVAX 3600 machines which are linked together with appropriate tape drives and printer, communicating over an Ethernet network. The data are catalogued by both aerofoil and motion type, and are stored both as raw voltages and reduced pressure coefficient values. Data are loaded and archived as each new model is tested so that analysis may begin immediately.

In order to analyse each new aerofoil's dynamic stall data quickly and efficiently, a suite of FORTRAN routines has been coded. All the software and the files containing documentation are stored in a central directory which can be accessed by all members of the research group. The analysis has been performed on a DEC MICROVAX 3400 which is connected to laser printers, plotters and a DEC RF71 hard disc.

4.2 Run Identification Number

The data produced by each experiment is stored in an individual data file on the database. Each experiment (and, hence, each data file) is identified by a unique 8-digit run number (*abcdefgh*). By using the identification numbers described in **Section 1**, the first two digits (*ab*) of the run number represent the test aerofoil.

The next two digits (*cd*) represent the type of test. The second of these digits (*d*) indicates the type of motion (as described in **Sections 3.1-3.5**), as follows:

No.	Motion Type
0	Static
1	Sinusoidal Oscillation
2	Ramp Up
3	Ramp Down
4	Unsteady Static
5	Single-Streamtube VAWT
6	Ship Function
7	Multiple-Streamtube VAWT
8	Any Other Motion Type

The first digit indicating the type of test (*c*) gives additional information on the experiment (see **Section 3.7**) as follows:

No.	Type of Experiment
0	Orthodox Experiment
1	Trip Wire Attached
2	Hot Films Attached
3	Trip Wire and Hot Films Attached
4	Model Reversed in Tunnel
5	End Plates Attached
6	Model Inverted in Tunnel
7	Model Reversed and Inverted
8	Tests with Roughness Transition Strips

Of the remaining four digits, the first three (*efg*) constitute the run number, and the final digit (*h*) signifies the attempt at the experiment under such test conditions.

4.3 Format of the Data

The raw binary data are stored in a data file, the name of which is "R" followed by the last five digits (*defgh*) of the run identification number described in **Section 4.2**. This file consists of blocks of 256 words of information (i.e. 128 real numbers). The first block is the run information block (RIB) and contains all the information pertaining to that particular experiment. Each subsequent block consists of four sets of 32 values, the first value being that of the dynamic pressure in the tunnel, the next 30 being the pressure values around the

aerofoil, and the last being the aerofoil incidence.

The digitised raw values were initially converted to real-valued voltages, which were subsequently reduced into the necessary form with the aid of values in the run information block. The angle of attack and dynamic pressure were obtained from calibrations performed before beginning each model's experiments. The pressure coefficient at each pressure transducer location was calculated from its voltage with the aid of the transducer's calibration value, the channel gain value and the zero offset value for each transducer. The first pair of these sets of values were determined before each model was tested; the offsets were recorded immediately before each experiment (see **Section 3.6**). The data could remain unaveraged or be averaged over the cycles which constituted the full test. However, as described in **Section 5.2**, all the data displayed in this report and the reports listed in **Section 1** have been averaged.

When the data for ramps were reduced, the linear pitch-rate was determined (see **Section 3.3**). In addition, for all motion types, the run information block was emptied of all elements which were required only for data reduction, and some of these elements were replaced by new information. A full list of the contents of the run information block after data reduction are displayed in **Table 2**.

5 RESULTS AND DISCUSSION

5.1 Tunnel Performance

Assessment of the quality of the data can only be made with a clear insight of the tunnel effects. Unfortunately the tunnel performance was such that, for the time scales of the model motion, it was not possible to hold constant the dynamic pressure in the working section whilst altering the blockage due to the pitching of the aerofoil. During the static tests, this variation was as illustrated in **Figure 5**, where it can be seen that there was approximately a 30% reduction in dynamic pressure as the angle of attack was increased from 0° to 30°. As illustrated in **Figures 6** and **7**, this reduction in dynamic pressure decreased as reduced frequency increased.

Figure 8 reveals that, during ramp up experiments, there was a drastic reduction and subsequent unsteadiness in the dynamic pressure during a test. The model was pitched to an incidence of 40° so that uniform ramp conditions existed at stall. Once the aerofoil had stalled, however, all significant data had already been collected and the corresponding dynamic pressure reduction was only in the region of 10%. The subsequent data are of little relevance to the current work and is presented merely for completeness.

5.2 Averaging of the Data

As described in **Section 4.3**, the data in this report are the average of a number of cycles. Individual cycles are presented in **Figures 9** and **10** where it may be seen that, whilst minor random differences do exist from cycle to cycle, the salient features are highlighted by the averaging process. In addition, the sweep at which any event occurred did not vary. Therefore the given data may be considered as typical of aerofoil performance during any given individual cycle. This is particularly relevant when considering the detailed flow phenomena of separation and reattachment.

5.3 Illustration and Tabulation of Test Data

Selected representative test data for each model under each motion type are displayed, model by model, at the end of this report. Compact details every experiment on these models are listed, in the same manner, in **Tables 3** to **15**.

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[22]**Angell, R.K., Musgrove, P.J. and Galbraith, R.A.McD.** Collected data for tests on a NACA 0015 aerofoil. Volume I: Pressure data from ramp function tests, with photographs of oil-flow visualisation tests. Glasgow University Aero Report 8803, February 1988.

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[25]**Angell, R.K., Musgrove, P.J. and Galbraith, R.A.McD.** Collected data for tests on a NACA 0018 aerofoil. Volume I: Pressure data from ramp function tests, with photographs of oil-flow visualisation tests. Glasgow University Aero Report 8815, September 1988.

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[31]**Angell, R.K., Musgrove, P.J. and Galbraith, R.A.McD.** Collected data for tests on a NACA 0025 aerofoil. Volume I: Pressure data from ramp function tests, with photographs of oil-flow visualisation tests. Glasgow University Aero Report 8822, November 1988.

[32]**Angell, R.K., Musgrove, P.J. and Galbraith, R.A.McD.** Collected data for tests on a NACA 0025 aerofoil. Volume II: Pressure data from oscillatory tests. Glasgow University Aero Report 8823, November 1988.

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[34]**Angell, R.K., Musgrove, P.J. and Galbraith, R.A.McD.** Collected data for tests on a NACA 0030 aerofoil. Volume I: Pressure data from ramp function tests, with photographs of oil-flow visualisation tests. Glasgow University Aero Report 8825, November 1988.

[35]**Angell, R.K., Musgrove, P.J. and Galbraith, R.A.McD.** Collected data for tests on a NACA 0030 aerofoil. Volume II: Pressure data from oscillatory tests. Glasgow University Aero Report 8826, November 1988.

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[37]**Galbraith, R.A.McD., Gracey, M.W. and Gilmour, R.** Collected data for tests on a NACA 0012 aerofoil. Volume I: Pressure data from ramp function tests. Glasgow University Aero Report 9207, February 1992.

[38]**Galbraith, R.A.McD., Gracey, M.W. and Gilmour, R.** Collected data for tests on a NACA 0012 aerofoil. Volume II: Pressure data from oscillatory tests. Glasgow University Aero Report 9208, February 1992.

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[42]**Jiang Dachun, Galbraith, R.A.McD., Coton, F.N., Gracey, M.W. and Gilmour, R.** Collected data for tests on an AHAVAW aerofoil. Volume III: Pressure data relevant to the study of large-scale vertical-axis wind-turbines. Glasgow University Aero Report 9214, March 1992.

[43]**Jiang Dachun and Galbraith, R.A.McD.** A new test aerofoil section for vertical axis wind turbines. Glasgow University Aero Report 9012, March 1990.

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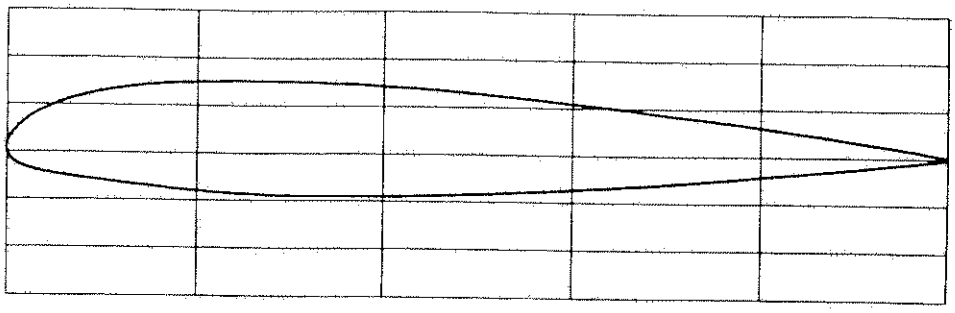
TABLE 1 : AEROFOIL PROFILES AND COORDINATES

TABLE 1.01 : NACA 23012 AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
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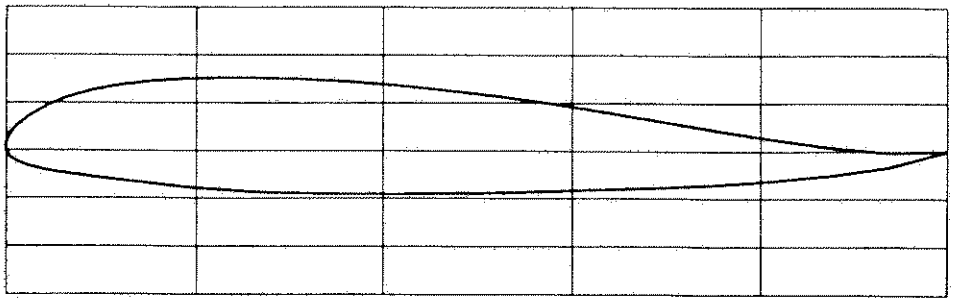
-0.050	0.663	0.324	-0.580
0.195	1.389	0.901	-1.064
0.747	2.169	1.715	-1.465
1.615	2.984	2.755	-1.799
2.806	3.809	4.009	-2.084
4.317	4.612	5.471	-2.338
6.143	5.361	7.141	-2.578
8.268	6.023	9.023	-2.819
10.669	6.573	11.129	-3.072
13.318	6.994	13.477	-3.340
16.180	7.287	16.086	-3.620
19.218	7.467	18.979	-3.895
22.415	7.566	22.156	-4.133
25.817	7.597	25.554	-4.315
29.422	7.561	29.157	-4.438
33.219	7.457	32.955	-4.502
37.198	7.287	36.938	-4.507
41.349	7.052	41.094	-4.456
45.659	6.754	45.414	-4.349
50.117	6.397	49.883	-4.189
54.711	5.983	54.491	-3.978
59.428	5.515	59.224	-3.719
64.256	4.998	64.070	-3.415
69.181	4.433	69.015	-3.068
74.190	3.822	74.046	-2.679
79.269	3.169	79.149	-2.251
84.404	2.473	84.310	-1.782
89.580	1.734	89.514	-1.273
94.785	0.953	94.748	-0.722
100.003	0.126	99.997	-0.126

TABLE 1.02 : NACA 23012A AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
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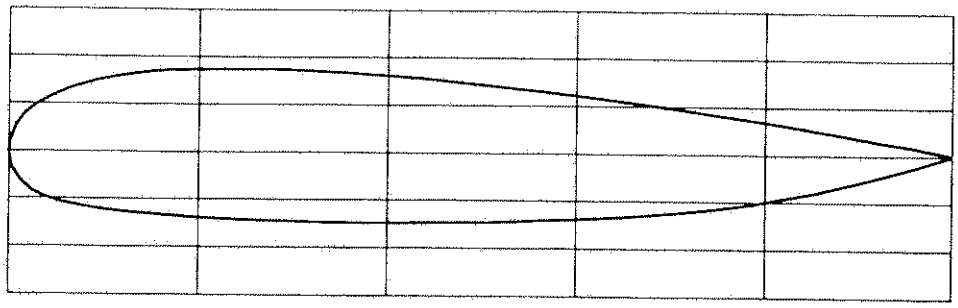
-0.044	0.802	0.436	-0.681
0.337	1.694	1.229	-1.226
1.166	2.657	2.354	-1.658
2.454	3.651	3.791	-2.008
4.207	4.626	5.529	-2.308
6.413	5.523	7.564	-2.588
9.048	6.286	9.910	-2.874
12.069	6.876	12.588	-3.180
15.421	7.276	15.631	-3.508
19.042	7.503	19.077	-3.838
22.902	7.603	22.925	-4.123
27.060	7.597	27.083	-4.333
31.507	7.479	31.530	-4.471
36.224	7.241	36.247	-4.540
41.195	6.872	41.216	-4.547
46.399	6.365	46.418	-4.498
51.816	5.725	51.831	-4.401
57.424	4.964	57.436	-4.261
63.202	4.103	63.209	-4.077
69.125	3.169	69.128	-3.843
75.169	2.202	75.169	-3.544
81.310	1.257	81.306	-3.147
87.521	0.422	87.515	-2.587
93.773	-0.125	93.768	-1.705
100.031	0.051	100.027	-0.050

TABLE 1.03 : NACA 23012B AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
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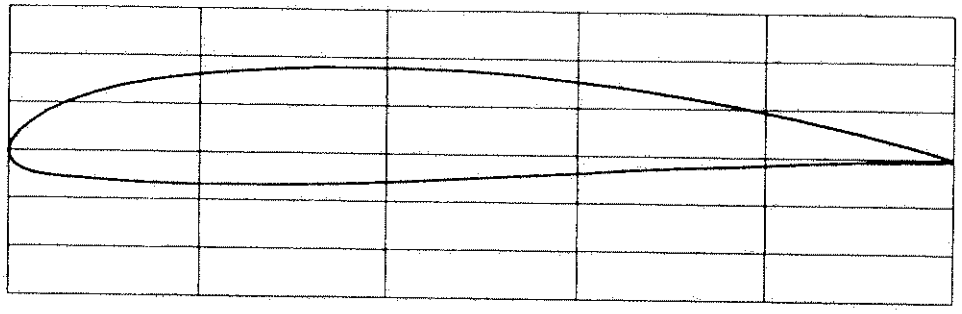
0.110	0.943	0.035	-0.597
0.833	2.795	0.299	-1.697
1.800	4.043	1.221	-3.132
4.138	5.637	2.341	-4.089
5.371	6.220	3.728	-4.784
9.164	7.461	5.403	-5.333
12.135	8.052	7.455	-5.755
13.822	8.282	9.941	-6.111
17.151	8.568	12.811	-6.400
23.186	8.731	16.044	-6.651
25.174	8.724	19.622	-6.874
29.942	8.618	23.495	-7.059
32.324	8.524	27.634	-7.215
37.880	8.213	31.998	-7.324
40.656	8.016	36.540	-7.385
46.998	7.481	41.210	-7.406
50.168	7.175	45.989	-7.360
53.732	6.803	50.807	-7.264
60.859	5.986	55.625	-7.119
64.421	5.544	60.395	-6.925
68.378	5.030	65.076	-6.661
76.290	3.935	69.620	-6.309
80.245	3.356	73.987	-5.847
84.198	2.755	78.129	-5.287
92.103	1.488	85.588	-3.915
96.055	0.819	91.700	-2.459
99.500	0.135	96.256	-1.185
100.000	0.000	100.000	0.000

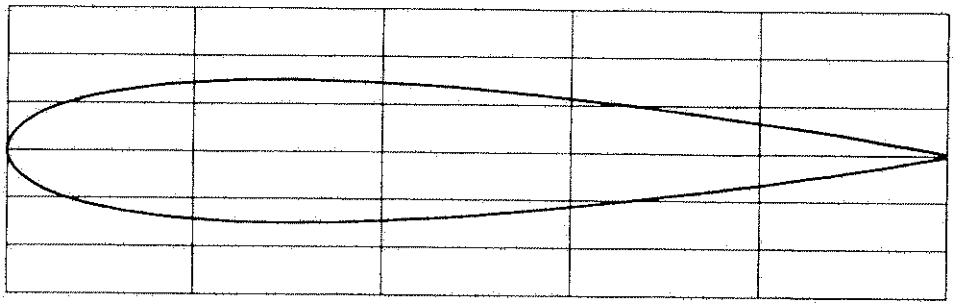
TABLE 1.04 : NACA 23012C AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
0.000	0.000	0.000	0.000
0.341	0.917	0.658	-1.454
1.125	1.933	1.473	-1.949
2.366	3.010	2.615	-2.310
4.071	4.097	4.064	-2.569
6.233	5.137	5.811	-2.757
8.827	6.073	7.855	-2.906
11.814	6.863	10.207	-3.038
15.140	7.489	12.892	-3.167
18.741	7.966	15.943	-3.291
22.585	8.340	19.394	-3.386
24.873	8.530	23.244	-3.402
29.023	8.783	29.525	-3.346
33.468	8.943	33.970	-3.246
38.185	8.986	38.682	-3.063
43.157	8.914	43.641	-2.830
48.363	8.702	48.829	-2.516
53.783	8.335	54.224	-2.187
59.395	7.804	59.803	-1.857
65.178	7.106	65.546	-1.534
71.108	6.243	71.429	-1.224
77.163	5.222	77.430	-0.931
83.317	4.046	83.524	-0.658
89.547	2.684	89.686	-0.419
95.830	1.137	95.892	-0.341
100.000	0.000	100.000	-0.289

TABLE 1.05 : NACA 0015 AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
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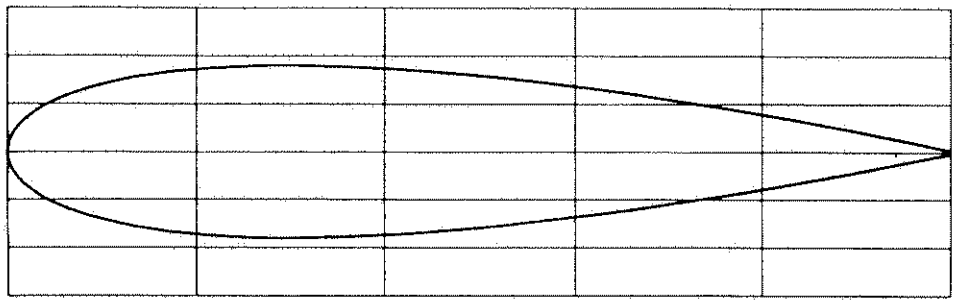
0.137	0.811	0.137	-0.811
0.548	1.596	0.548	-1.596
1.231	2.350	1.231	-2.350
2.185	3.073	2.185	-3.073
3.407	3.759	3.407	-3.759
4.894	4.403	4.894	-4.403
6.642	5.001	6.642	-5.001
8.645	5.547	8.645	-5.547
10.899	6.035	10.899	-6.035
13.397	6.460	13.397	-6.460
16.133	6.817	16.133	-6.817
19.098	7.103	19.098	-7.103
22.285	7.314	22.285	-7.314
25.686	7.447	25.686	-7.447
29.289	7.501	29.289	-7.501
33.087	7.476	33.087	-7.476
37.068	7.373	37.068	-7.373
41.221	7.194	41.221	-7.194
45.536	6.941	45.536	-6.941
50.000	6.618	50.000	-6.618
54.601	6.227	54.601	-6.227
59.326	5.773	59.326	-5.773
64.163	5.259	64.163	-5.259
69.098	4.689	69.098	-4.689
74.118	4.064	74.118	-4.064
79.209	3.388	79.209	-3.388
84.357	2.660	84.357	-2.660
89.547	1.880	89.547	-1.880
94.766	1.047	94.766	-1.047
100.000	0.158	100.000	-0.158

TABLE 1.06 : NACA 0018 AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
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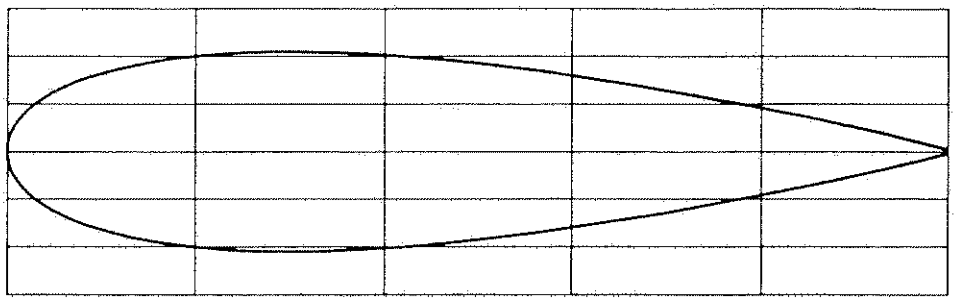
0.137	0.974	0.137	-0.974
0.548	1.915	0.548	-1.915
1.231	2.821	1.231	-2.821
2.185	3.687	2.185	-3.687
3.407	4.510	3.407	-4.510
4.894	5.284	4.894	-5.284
6.642	6.001	6.642	-6.001
8.645	6.656	8.645	-6.656
10.899	7.242	10.899	-7.242
13.397	7.752	13.397	-7.752
16.133	8.181	16.133	-8.181
19.098	8.524	19.098	-8.524
22.285	8.776	22.285	-8.776
25.686	8.936	25.686	-8.936
29.289	9.001	29.289	-9.001
33.087	8.971	33.087	-8.971
37.068	8.848	37.068	-8.848
41.221	8.633	41.221	-8.633
45.536	8.329	45.536	-8.329
50.000	7.941	50.000	-7.941
54.601	7.472	54.601	-7.472
59.326	6.928	59.326	-6.928
64.163	6.311	64.163	-6.311
69.098	5.627	69.098	-5.627
74.118	4.877	74.118	-4.877
79.209	4.065	79.209	-4.065
84.357	3.192	84.357	-3.192
89.547	2.256	89.547	-2.256
94.766	1.256	94.766	-1.256
100.000	0.189	100.000	-0.189

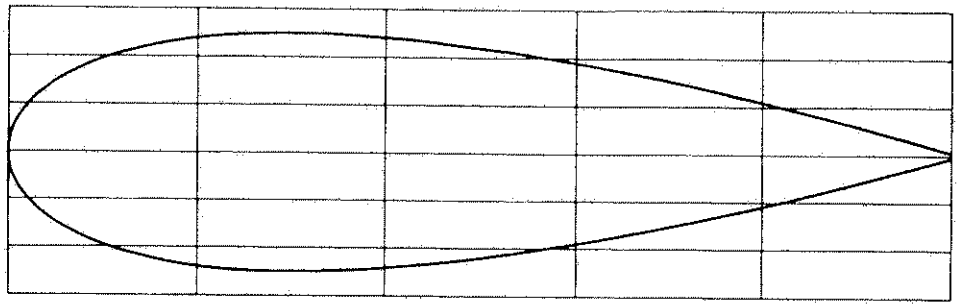
TABLE 1.07 : NACA 0021 AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
0.000	0.000	0.000	0.000
0.137	1.136	0.137	-1.136
0.548	2.234	0.548	-2.234
1.231	3.291	1.231	-3.291
2.185	4.302	2.185	-4.302
3.407	5.262	3.407	-5.262
4.894	6.164	4.894	-6.164
6.642	7.001	6.642	-7.001
8.645	7.765	8.645	-7.765
10.899	8.449	10.899	-8.449
13.397	9.044	13.397	-9.044
16.133	9.544	16.133	-9.544
19.098	9.944	19.098	-9.944
22.285	10.239	22.285	-10.239
25.686	10.425	25.686	-10.425
29.289	10.501	29.289	-10.501
33.087	10.467	33.087	-10.467
37.068	10.323	37.068	-10.323
41.221	10.072	41.221	-10.072
45.536	9.718	45.536	-9.718
50.000	9.265	50.000	-9.265
54.601	8.718	54.601	-8.718
59.326	8.082	59.326	-8.082
64.163	7.363	64.163	-7.363
69.098	6.564	69.098	-6.564
74.118	5.690	74.118	-5.690
79.209	4.743	79.209	-4.743
84.357	3.724	84.357	-3.724
89.547	2.632	89.547	-2.632
94.766	1.465	94.766	-1.465
100.000	0.221	100.000	-0.221

TABLE 1.08 : NACA 0025 AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
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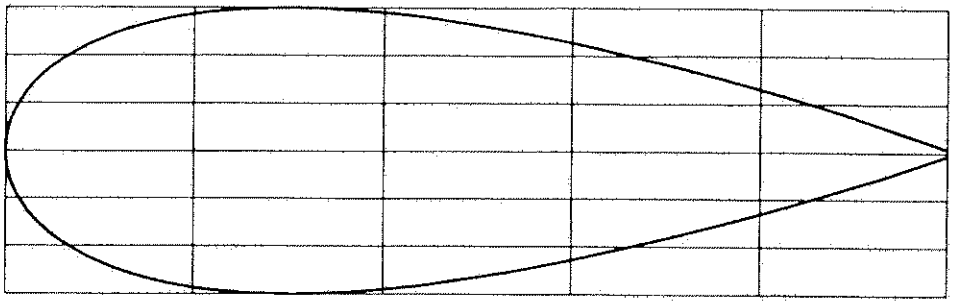
0.137	1.352	0.137	-1.352
0.548	2.659	0.548	-2.659
1.231	3.917	1.231	-3.917
2.185	5.121	2.185	-5.121
3.407	6.264	3.407	-6.264
4.894	7.338	4.894	-7.338
6.642	8.335	6.642	-8.335
8.645	9.244	8.645	-9.244
10.899	10.058	10.899	-10.058
13.397	10.767	13.397	-10.767
16.133	11.362	16.133	-11.362
19.098	11.838	19.098	-11.838
22.285	12.189	22.285	-12.189
25.686	12.411	25.686	-12.411
29.289	12.501	29.289	-12.501
33.087	12.460	33.087	-12.460
37.068	12.289	37.068	-12.289
41.221	11.990	41.221	-11.990
45.536	11.569	45.536	-11.569
50.000	11.029	50.000	-11.029
54.601	10.378	54.601	-10.378
59.326	9.622	59.326	-9.622
64.163	8.765	64.163	-8.765
69.098	7.815	69.098	-7.815
74.118	6.774	74.118	-6.774
79.209	5.647	79.209	-5.647
84.357	4.433	84.357	-4.433
89.547	3.133	89.547	-3.133
94.766	1.745	94.766	-1.745
100.000	0.263	100.000	-0.263

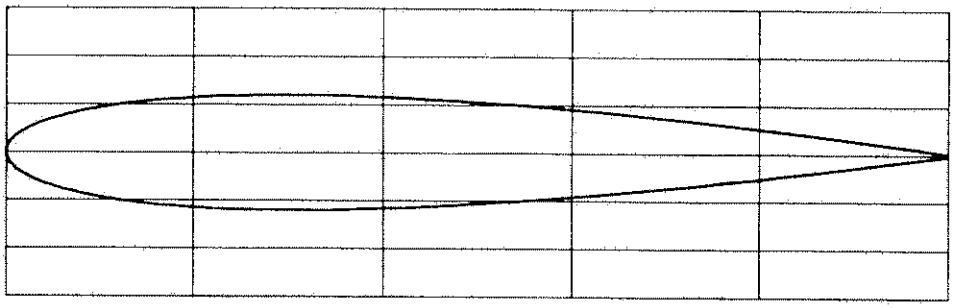
TABLE 1.09 : NACA 0030 AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
0.000	0.000	0.000	0.000
0.137	1.623	0.137	-1.623
0.548	3.191	0.548	-3.191
1.231	4.701	1.231	-4.701
2.185	6.146	2.185	-6.146
3.407	7.517	3.407	-7.517
4.894	8.806	4.894	-8.806
6.642	10.002	6.642	-10.002
8.645	11.093	8.645	-11.093
10.899	12.069	10.899	-12.069
13.397	12.920	13.397	-12.920
16.133	13.635	16.133	-13.635
19.098	14.206	19.098	-14.206
22.285	14.627	22.285	-14.627
25.686	14.893	25.686	-14.893
29.289	15.002	29.289	-15.002
33.087	14.952	33.087	-14.952
37.068	14.747	37.068	-14.747
41.221	14.388	41.221	-14.388
45.536	13.882	45.536	-13.882
50.000	13.235	50.000	-13.235
54.601	12.454	54.601	-12.454
59.326	11.546	59.326	-11.546
64.163	10.518	64.163	-10.518
69.098	9.378	69.098	-9.378
74.118	8.129	74.118	-8.129
79.209	6.776	79.209	-6.776
84.357	5.320	84.357	-5.320
89.547	3.760	89.547	-3.760
94.766	2.093	94.766	-2.093
100.000	0.315	100.000	-0.315

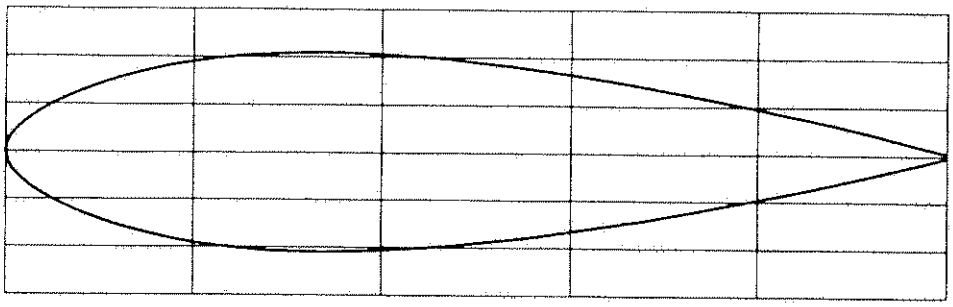
TABLE 1.10 : NACA 0012 AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
0.000	0.000	0.000	0.000
0.137	0.649	0.137	-0.649
0.548	1.276	0.548	-1.276
1.231	1.880	1.231	-1.880
2.185	2.458	2.185	-2.458
3.407	3.007	3.407	-3.007
4.894	3.522	4.894	-3.522
6.642	4.001	6.642	-4.001
8.645	4.437	8.645	-4.437
10.899	4.828	10.899	-4.828
13.397	5.168	13.397	-5.168
16.133	5.454	16.133	-5.454
19.098	5.682	19.098	-5.682
22.285	5.851	22.285	-5.851
25.686	5.957	25.686	-5.957
29.289	6.001	29.289	-6.001
33.087	5.981	33.087	-5.981
37.068	5.899	37.068	-5.899
41.221	5.755	41.221	-5.755
45.536	5.553	45.536	-5.553
50.000	5.294	50.000	-5.294
54.601	4.982	54.601	-4.982
59.326	4.618	59.326	-4.618
64.163	4.207	64.163	-4.207
69.098	3.751	69.098	-3.751
74.118	3.252	74.118	-3.252
79.209	2.710	79.209	-2.710
84.357	2.128	84.357	-2.128
89.547	1.504	89.547	-1.504
94.766	0.837	94.766	-0.837
100.000	0.126	100.000	-0.126

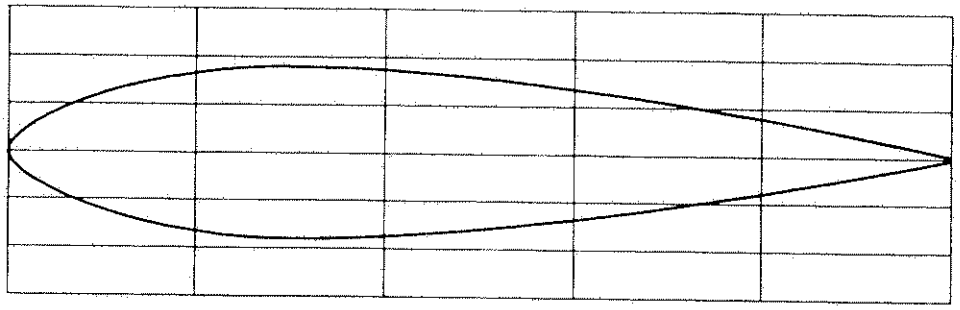
TABLE 1.11 : AHAVAW AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
0.000	0.000	0.000	0.000
0.081	0.643	0.081	-0.643
0.324	1.270	0.324	-1.270
0.729	1.868	0.729	-1.868
1.295	2.458	1.295	-2.458
2.021	3.074	2.021	-3.074
2.906	3.713	2.906	-3.713
3.948	4.366	3.948	-4.366
5.146	5.027	5.146	-5.027
6.498	5.685	6.498	-5.685
8.002	6.333	8.002	-6.333
9.655	6.962	9.655	-6.962
11.454	7.565	11.454	-7.565
13.398	8.132	13.398	-8.132
15.481	8.656	15.481	-8.656
17.702	9.128	17.702	-9.128
20.056	9.539	20.056	-9.539
22.539	9.882	22.539	-9.882
25.149	10.153	25.149	-10.153
27.880	10.348	27.880	-10.348
30.728	10.464	30.728	-10.464
33.688	10.500	33.688	-10.500
36.756	10.454	36.756	-10.454
39.926	10.330	39.926	-10.330
43.194	10.132	43.194	-10.132
46.553	9.863	46.553	-9.863
50.000	9.528	50.000	-9.528
53.528	9.129	53.528	-9.129
57.131	8.669	57.131	-8.669
60.803	8.150	60.803	-8.150
64.539	7.577	64.539	-7.577
68.333	6.952	68.333	-6.952
72.178	6.277	72.178	-6.277
76.068	5.554	76.068	-5.554
79.997	4.783	79.997	-4.783
83.959	3.967	83.959	-3.967
87.946	3.104	87.946	-3.104
91.953	2.193	91.953	-2.193
95.973	1.232	95.973	-1.232
100.000	0.220	100.000	-0.220

TABLE 1.12 : GUVA10 AEROFOIL PROFILE AND COORDINATES



Coordinates in %Chord

Upper Surface		Lower Surface	
Station	Ordinate	Station	Ordinate
0.000	0.000	0.000	0.000
0.120	0.567	0.120	-0.567
0.482	1.131	0.482	-1.131
1.082	1.750	1.082	-1.750
1.921	2.416	1.921	-2.416
2.997	3.112	2.997	-3.112
4.306	3.823	4.306	-3.823
5.846	4.537	5.846	-4.537
7.612	5.243	7.612	-5.243
9.601	5.928	9.601	-5.928
11.808	6.582	11.808	-6.582
14.227	7.193	14.227	-7.193
16.853	7.748	16.853	-7.748
19.679	8.232	19.679	-8.232
22.699	8.624	22.699	-8.624
25.905	8.887	25.905	-8.887
29.289	8.997	29.289	-8.997
32.844	8.986	32.844	-8.986
36.561	8.868	36.561	-8.868
40.430	8.680	40.430	-8.680
44.443	8.413	44.443	-8.413
48.590	8.071	48.590	-8.071
52.860	7.657	52.860	-7.657
57.244	7.175	57.244	-7.175
61.732	6.628	61.732	-6.628
66.311	6.020	66.311	-6.020
70.972	5.353	70.972	-5.353
75.702	4.630	75.702	-4.630
80.491	3.853	80.491	-3.853
85.327	3.021	85.327	-3.021
90.198	2.134	90.198	-2.134
95.093	1.191	95.093	-1.191
100.000	0.189	100.000	-0.189

TABLE 2 : CONTENTS OF DATA FILES' RUN INFORMATION BLOCK

RIB LOCATION	STATIC / UNSTEADY STATIC	SINUSOIDAL / VAWT	RAMP UP / RAMP DOWN
1	Run Number		
2	Date of Test : Day		
3	Date of Test : Month		
4	Date of Test : Year		
5	Temperature (^{o}Celsius)		
6	Barometric Pressure (mm Hg)		
7	Motion Type (**0/4**)	Motion Type (**1/5**)	Motion Type (**2/3**)
8	Starting Incidence (^{o})/ Angle Of Attack	Mean Incidence (^{o})	Starting Incidence (^{o})
9	Arc (^{o})/*Empty*	Amplitude (^{o})	Ramp Arc (^{o})
10	*Empty*	Oscillation Frequency (Hz)	Linear Pitch-Rate ($^{o}s^{-1}$)
11	Number of Sweeps per Cycle		
12	Number of Values per Cycle		
13	Number of Cycles		
14	*Empty*		
15	*Empty*		
16	*Empty*		
17	*Empty*		
18	Sampling Frequency (Hz)		
19	Dynamic Pressure (Volts)		
20	Reynolds Number		
21	Mach Number		
22	*Empty*	Reduced Frequency	Reduced Pitch-Rate
23	Wind Velocity (ms^{-1})		
24	*Empty*		
25	*Empty*		
26	Averaged (**1**) or Unaveraged (**0**)		
27	*Empty*		
28	*Empty*		
29	Dynamic Pressure (Nm^{-2})		
30	Model Number		
31	Identification Number of File Containing Coefficients from Calibrations of Angular Displacement Transducer and Dynamic Pressure in Wind Tunnel		
32	*Empty*	*Empty*	Requested Pitch-Rate ($^{o}s^{-1}$)
33-64	Transducer Calibration Values		
65-96	Channel Gain Values		
97-128	Transducer Offset Values		

TABLE 3 : EXPERIMENTS ON NACA 23012 (MODEL 1)

TABLE 3.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 3.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Reynolds No. x 10^{-6}	0.8	1.0	1.2	1.4	1.5	1.6	1.8	2.0
Angle of Attack	-2^{o} to 30^{o}							

(all permutations)

TABLE 3.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (^{o})	Sweep (^{o})	Reynolds No. x 10^{-6}
00011	-2	32	1.00
00021	-2	32	0.98
00031	-2	32	0.98
00041	-2	32	0.99
00051	-2	32	0.99
00061	-2	32	1.00
00071	-2	32	1.49
00081	-2	32	1.49
00091	-2	32	1.48
00101	-2	32	1.47
00111	-2	32	1.43
00121	-2	32	1.50
00131	-2	32	1.48
00141	-2	32	1.47
00151	-2	32	1.48
00161	-2	32	0.78
00171	-2	32	0.99
00181	-2	32	1.18
00191	-2	32	1.39
00201	-2	32	1.47
00211	-2	32	1.58
00221	-2	32	1.76
00231	-2	32	1.93
00241	-2	32	1.46
00261	-2	32	1.44
00271	-2	32	1.43
00281	-2	32	1.43
00291	-2	32	1.42

TABLE 3.1.2 : LIST OF STATIC EXPERIMENTS (concluded)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^{-6}
00301	-2	32	0.94
00311	-2	32	0.95
00321	-2	32	1.90
00331	-2	32	1.46
00341	-2	32	1.01
00351	-2	32	1.50
00361	-2	32	1.92
00371	-2	32	0.96
00391	-2	32	1.91
00401	-2	32	0.97
00411	-2	32	1.46
00421	-2	32	1.93
00431	-2	32	1.54
00502	-2	32	1.50
00512	-2	32	1.47
00522	-2	32	1.47
00532	-2	32	1.47
00592	-2	32	1.46
00602	-2	32	1.44
00612	-2	32	1.45
00622	-2	32	1.44
00632	-2	32	1.45
00642	-2	32	1.46
00981	-2	32	1.46
01001	-2	32	1.49
01011	-2	32	1.45
01041	-2	32	1.47

TABLE 3.2 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 3.2.1 : SUMMARY OF RAMPS FROM -1° TO 39° AT A REYNOLDS NUMBER OF 1.5x10^6 (nominal)

Starting Incidence	-1°							
Finishing Incidence	39°							
Pitch Rate (°s^{-1})	0.6	1.2	2.4	3.6	4.8	7.5	15.0	30.0
	45.0	60.0	75.0	90.0	105.0	120.0	135.0	150.0
	165.0	180.0	195.0	210.0	225.0	240.0	255.0	270.0
	285.0	300.0	315.0	330.0	345.0	360.0	375.0	
Reynolds Number	1.5 x 10^6							

(all permutations)

TABLE 3.2.2 : SUMMARY OF RAMPS FROM 0° TO 40° AT A REDUCED PITCH RATE OF 0.02 (nominal)

Starting Incidence	0°									
Finishing Incidence	40°									
Reduced Pitch Rate	0.02									
Reynolds No. x 10^{-6}	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5

(all permutations)

TABLE 3.2.3 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
20341	-1	40	0.6	0.0001	1.51
20351	-1	40	7.7	0.0009	1.52
20362	-1	40	15.0	0.0018	1.48
20372	-1	40	30.6	0.0037	1.49
20382	-1	40	45.0	0.0054	1.51
20392	-1	40	59.8	0.0073	1.49
20402	-1	40	76.6	0.0095	1.50
20412	-1	40	87.7	0.0108	1.50
20422	-1	40	103.5	0.0127	1.50
20432	-1	40	119.4	0.0146	1.50
20442	-1	40	132.9	0.0163	1.50
20452	-1	40	148.7	0.0184	1.49
20462	-1	40	163.0	0.0200	1.50
20472	-1	40	176.6	0.0216	1.50
20482	-1	40	189.5	0.0232	1.50
20492	-1	40	202.3	0.0248	1.49
20902	-1	40	222.6	0.0271	1.52
20912	-1	40	228.1	0.0276	1.52
20922	-1	40	247.3	0.0298	1.53
20931	-1	40	261.2	0.0321	1.51
20942	-1	40	270.8	0.0329	1.51
20952	-1	40	274.6	0.0336	1.51
20962	-1	40	284.7	0.0346	1.51
20972	-1	40	295.7	0.0359	1.51
20982	-1	40	304.0	0.0371	1.50
20992	-1	40	319.5	0.0390	1.50
21001	-1	40	333.7	0.0408	1.51
24011	0	40	161.8	0.0197	1.52
24021	0	40	156.5	0.0205	1.41
24031	0	40	141.5	0.0199	1.31
24041	0	40	131.5	0.0201	1.21
24051	0	40	120.2	0.0201	1.10
24061	0	40	109.0	0.0197	1.02
24071	0	40	102.9	0.0210	0.90
24081	0	40	86.0	0.0197	0.80
24091	0	40	77.4	0.0202	0.70
24101	0	40	68.9	0.0213	0.60
24111	0	40	56.3	0.0207	0.50

TABLE 3.3 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 3.3.1 : SUMMARY OF RAMP DOWN EXPERIMENTS (nominal)

Starting Incidence	30°							
Finishing Incidence	-1°							
Pitch Rate ($^{o}s^{-1}$)	-0.6	-1.2	-2.4	-3.6	-4.8	-7.5	-15.0	-30.0
	-45.0	-60.0	-75.0	-90.0	-105.0	-120.0	-135.0	-150.0
	-165.0	-180.0	-195.0	-210.0	-225.0	-240.0	-255.0	-270.0
	-285.0	-300.0	-315.0	-330.0	-345.0	-360.0	-375.0	
Reynolds Number	1.5×10^{6}							

(all permutations)

TABLE 3.3.2 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
30301	30	-31	-4.6	-0.0007	1.24
30311	30	-31	-3.6	-0.0005	1.24
30321	30	-31	-2.4	-0.0003	1.24
30331	30	-31	-1.2	-0.0002	1.24
30341	30	-31	-0.6	-0.0001	1.23
30351	30	-31	-5.7	-0.0008	1.23
30361	30	-31	-11.7	-0.0017	1.22
30371	30	-31	-23.0	-0.0034	1.23
30381	30	-31	-34.2	-0.0051	1.23
30391	30	-31	-45.4	-0.0066	1.25
30401	30	-31	-56.0	-0.0082	1.23
30411	30	-31	-65.8	-0.0098	1.22
30421	30	-31	-76.7	-0.0112	1.24
30431	30	-31	-85.7	-0.0125	1.24
30441	30	-31	-95.3	-0.0139	1.24
30751	30	-31	-79.7	-0.0098	1.50
30761	30	-31	-91.2	-0.0111	1.52
30771	30	-31	-104.3	-0.0128	1.50
30781	30	-31	-113.5	-0.0140	1.50
30791	30	-31	-121.0	-0.0149	1.49
30801	30	-31	-127.3	-0.0157	1.49
30811	30	-31	-139.3	-0.0169	1.51
30821	30	-31	-146.6	-0.0179	1.51
31011	30	-31	-154.9	-0.0191	1.51
31021	30	-31	-163.7	-0.0199	1.53
31031	30	-31	-176.1	-0.0215	1.52
31051	30	-31	-192.0	-0.0236	1.51
31061	30	-31	-200.7	-0.0245	1.52
31071	30	-31	-203.2	-0.0248	1.52
31081	30	-31	-203.9	-0.0248	1.52
31091	30	-31	-214.1	-0.0260	1.52
31101	30	-31	-223.1	-0.0274	1.51
31111	30	-31	-228.7	-0.0279	1.52

TABLE 3.4 : DETAILS OF SINUSOIDAL EXPERIMENTS

TABLE 3.4.1 : SUMMARY OF SINUSOIDAL EXPERIMENTS (nominal)

Mean Incidence	6°	8°	10°	12°	13°	14°	15°	16°	18°	20°
Amplitude	2°		4°		6°		8°		10°	
Reduced Frequency	0.01		0.05		0.10		0.15		0.20	
Reynolds Number	1.0×10^6					1.5×10^6				

(all permutations)

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
10011	6	2	0.010	1.01
10021	6	4	0.010	1.02
10031	6	6	0.010	1.01
10041	6	8	0.010	1.01
10051	6	10	0.010	1.01
10061	8	2	0.010	1.00
10071	8	4	0.010	1.00
10081	8	6	0.010	1.00
10091	8	8	0.010	1.01
10101	8	10	0.010	1.00
10111	10	2	0.011	0.97
10121	10	4	0.010	1.00
10131	10	6	0.010	1.00
10141	10	8	0.010	1.01
10151	10	10	0.010	1.01
10161	12	2	0.010	1.00
10171	12	4	0.010	1.01
10181	12	6	0.010	1.00
10191	12	8	0.010	1.01
10201	12	10	0.010	1.00
10211	13	2	0.010	1.01
10221	13	4	0.010	1.01
10231	13	6	0.010	1.01
10241	13	8	0.010	1.00
10251	13	10	0.010	1.01
10261	14	2	0.010	1.00
10271	14	4	0.010	1.00
10281	14	6	0.010	1.01
10291	14	8	0.010	1.01
10301	14	10	0.010	1.01
10311	15	2	0.010	1.01
10321	15	4	0.010	1.02
10331	15	6	0.010	1.01
10341	15	8	0.010	1.01
10351	15	10	0.010	1.02

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
10361	16	2	0.010	1.00
10371	16	4	0.010	1.00
10381	16	6	0.010	1.01
10391	16	8	0.010	1.00
10401	16	10	0.010	1.01
10411	18	2	0.010	1.01
10421	18	4	0.010	1.02
10431	18	6	0.010	1.00
10441	18	8	0.010	1.00
10451	18	10	0.010	1.01
10461	20	2	0.010	1.00
10471	20	4	0.010	1.02
10481	20	6	0.010	1.01
10491	20	8	0.010	1.00
10501	20	10	0.011	0.98
10511	6	2	0.052	1.01
10521	6	4	0.052	1.01
10531	6	6	0.052	1.01
10541	6	8	0.052	1.01
10551	6	10	0.051	1.01
10561	8	2	0.052	1.01
10571	8	4	0.052	1.01
10581	8	6	0.051	1.02
10591	8	8	0.052	1.00
10601	8	10	0.052	1.01
10611	10	2	0.052	1.00
10621	10	4	0.051	1.01
10631	10	6	0.052	1.01
10641	10	8	0.052	1.00
10651	10	10	0.052	1.00
10661	12	2	0.053	0.99
10671	12	4	0.052	1.00
10681	12	6	0.052	1.00
10691	12	8	0.052	1.00
10701	12	10	0.052	1.00
10711	13	2	0.052	1.00
10721	13	4	0.052	1.00
10731	13	6	0.051	1.01
10741	13	8	0.052	1.00
10751	13	10	0.052	1.00
10761	14	2	0.052	1.00
10771	14	4	0.052	1.00
10781	14	6	0.052	1.00
10791	14	8	0.052	1.01
10801	14	10	0.051	1.02
10811	15	2	0.052	0.99
10821	15	4	0.052	1.01
10831	15	6	0.052	1.01
10841	15	8	0.052	1.01
10851	15	10	0.051	1.01
10861	16	2	0.052	1.00
10871	16	4	0.051	1.01

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
10881	16	6	0.051	1.02
10891	16	8	0.052	1.00
10901	16	10	0.052	1.01
10911	18	2	0.052	1.00
10921	18	4	0.052	1.01
10931	18	6	0.051	1.01
10941	18	8	0.052	1.01
10951	18	10	0.052	1.00
10961	20	2	0.052	1.02
10971	20	4	0.051	1.03
10981	20	6	0.051	1.03
10991	20	8	0.051	1.02
11001	20	10	0.051	1.02
11011	6	2	0.104	1.02
11021	6	4	0.103	1.03
11031	6	6	0.103	1.03
11041	6	8	0.103	1.03
11051	6	10	0.102	1.03
11061	8	2	0.104	1.02
11071	8	4	0.103	1.03
11081	8	6	0.102	1.03
11091	8	8	0.101	1.04
11101	8	10	0.101	1.04
11111	10	2	0.104	1.01
11121	10	4	0.104	1.02
11131	10	6	0.103	1.02
11141	10	8	0.102	1.03
11151	10	10	0.102	1.03
11161	12	2	0.104	1.02
11171	12	4	0.102	1.03
11181	12	6	0.102	1.03
11191	12	8	0.102	1.03
11201	12	10	0.101	1.04
11211	14	2	0.104	1.01
11221	14	4	0.103	1.02
11231	14	6	0.102	1.03
11241	14	8	0.103	1.02
11251	14	10	0.101	1.02
11261	13	2	0.104	1.02
11271	13	4	0.103	1.03
11281	13	6	0.102	1.03
11291	13	8	0.102	1.03
11301	13	10	0.101	1.04
11311	15	2	0.103	1.02
11321	15	4	0.102	1.03
11331	15	6	0.102	1.03
11341	15	8	0.102	1.03
11351	15	10	0.102	1.03
11361	16	2	0.103	1.02
11371	16	4	0.103	1.03
11381	16	6	0.103	1.03
11391	16	8	0.102	1.03

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11401	16	10	0.102	1.03
11411	18	2	0.106	1.00
11421	18	4	0.104	1.01
11431	18	6	0.103	1.02
11441	18	8	0.103	1.02
11451	18	10	0.102	1.03
11461	20	2	0.103	1.02
11471	20	4	0.103	1.03
11481	20	6	0.102	1.03
11491	20	8	0.102	1.04
11501	20	10	0.101	1.04
11511	6	2	0.156	1.03
11521	6	4	0.155	1.03
11531	6	6	0.155	1.03
11541	6	8	0.154	1.04
11551	6	10	0.153	1.04
11561	8	2	0.156	1.02
11571	8	4	0.156	1.03
11581	8	6	0.155	1.03
11591	8	8	0.154	1.04
11601	8	10	0.154	1.03
11611	10	2	0.155	1.03
11621	10	4	0.155	1.03
11631	10	6	0.154	1.03
11641	10	8	0.153	1.04
11651	10	10	0.153	1.04
11661	12	2	0.155	1.03
11671	12	4	0.154	1.03
11681	12	6	0.154	1.04
11691	12	8	0.153	1.04
11701	12	10	0.153	1.04
11711	13	2	0.154	1.03
11721	13	4	0.153	1.04
11731	13	6	0.152	1.04
11741	13	8	0.152	1.05
11751	13	10	0.151	1.05
11761	14	2	0.154	1.03
11771	14	4	0.153	1.04
11781	14	6	0.152	1.04
11791	14	8	0.152	1.04
11801	14	10	0.151	1.05
11811	15	2	0.155	1.02
11821	15	4	0.154	1.02
11831	15	6	0.154	1.03
11841	15	8	0.153	1.03
11851	15	10	0.153	1.03
11861	16	2	0.156	1.01
11871	16	4	0.154	1.02
11881	16	6	0.154	1.02
11891	16	8	0.154	1.02
11901	16	10	0.153	1.03
11911	18	2	0.155	1.01

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11921	18	4	0.156	1.01
11931	18	6	0.154	1.02
11941	18	8	0.154	1.02
11951	18	10	0.154	1.02
11961	20	2	0.156	1.00
11971	20	4	0.154	1.02
11981	20	6	0.153	1.02
11991	20	8	0.154	1.02
12001	20	10	0.150	1.04
12011	6	2	0.205	1.04
12021	6	4	0.204	1.04
12031	6	6	0.203	1.04
12041	6	8	0.202	1.05
12051	6	10	0.207	1.02
12061	8	2	0.207	1.02
12071	8	4	0.206	1.03
12081	8	6	0.206	1.03
12091	8	8	0.205	1.03
12101	8	10	0.204	1.04
12111	10	2	0.206	1.02
12121	10	4	0.206	1.02
12131	10	6	0.205	1.03
12141	10	8	0.205	1.03
12151	10	10	0.204	1.03
12161	12	2	0.205	1.02
12171	12	4	0.205	1.03
12181	12	6	0.205	1.02
12191	12	8	0.204	1.03
12201	12	10	0.203	1.03
12211	13	2	0.206	1.02
12221	13	4	0.205	1.02
12231	13	6	0.205	1.03
12241	13	8	0.204	1.03
12251	13	10	0.203	1.04
12261	14	2	0.208	1.01
12271	14	4	0.204	1.03
12281	14	6	0.204	1.03
12291	14	8	0.204	1.03
12301	14	10	0.203	1.04
12311	15	2	0.206	1.02
12321	15	4	0.204	1.03
12331	15	6	0.203	1.04
12341	15	8	0.202	1.04
12351	15	10	0.202	1.04
12361	16	2	0.205	1.02
12371	16	4	0.204	1.03
12381	16	6	0.202	1.04
12391	16	8	0.202	1.04
12401	16	10	0.203	1.03
12411	18	2	0.207	1.01
12421	18	4	0.205	1.02
12431	18	6	0.204	1.02

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12441	18	8	0.203	1.03
12451	18	10	0.203	1.03
12461	20	2	0.206	1.01
12471	20	4	0.201	1.04
12481	20	6	0.204	1.02
12491	20	8	0.200	1.04
12501	20	10	0.199	1.05
12511	6	2	0.010	1.53
12521	6	4	0.010	1.53
12531	6	6	0.010	1.51
12541	6	8	0.010	1.53
12551	6	10	0.010	1.53
12561	8	2	0.010	1.52
12571	8	4	0.010	1.52
12581	8	6	0.010	1.52
12591	8	8	0.010	1.50
12601	8	10	0.010	1.52
12611	10	2	0.010	1.50
12621	10	4	0.010	1.53
12631	10	6	0.010	1.51
12641	10	8	0.010	1.49
12651	10	10	0.010	1.51
12661	12	2	0.010	1.50
12671	12	4	0.010	1.52
12681	12	6	0.010	1.50
12691	12	8	0.010	1.52
12701	12	10	0.010	1.53
12711	13	2	0.010	1.50
12721	13	4	0.010	1.51
12731	13	6	0.010	1.52
12741	13	8	0.010	1.49
12751	13	10	0.010	1.50
12761	14	2	0.010	1.49
12771	14	4	0.010	1.50
12781	14	6	0.010	1.50
12791	14	8	0.010	1.48
12801	14	10	0.010	1.50
12811	15	2	0.010	1.53
12821	15	4	0.010	1.52
12831	15	6	0.010	1.53
12841	15	8	0.010	1.52
12851	15	10	0.010	1.52
12861	16	2	0.010	1.50
12871	16	4	0.010	1.51
12881	16	6	0.010	1.52
12891	16	8	0.010	1.50
12901	16	10	0.010	1.51
12911	18	2	0.010	1.49
12921	18	4	0.010	1.51
12931	18	6	0.010	1.50
12941	18	8	0.010	1.51
12951	18	10	0.010	1.50

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12961	20	2	0.010	1.47
12971	20	4	0.010	1.51
12981	20	6	0.010	1.52
12991	20	8	0.010	1.51
13001	20	10	0.010	1.51
13011	6	2	0.052	1.51
13021	6	4	0.051	1.53
13031	6	6	0.051	1.53
13041	6	8	0.052	1.50
13051	6	10	0.052	1.51
13061	8	2	0.052	1.50
13071	8	4	0.052	1.51
13081	8	6	0.051	1.51
13091	8	8	0.052	1.50
13101	8	10	0.051	1.51
13111	10	2	0.052	1.48
13121	10	4	0.052	1.49
13131	10	6	0.051	1.50
13141	10	8	0.052	1.49
13151	10	10	0.051	1.50
13161	12	2	0.053	1.46
13171	12	4	0.052	1.50
13181	12	6	0.051	1.50
13191	12	8	0.051	1.51
13201	12	10	0.051	1.50
13211	13	2	0.051	1.55
13221	13	4	0.051	1.56
13231	13	6	0.052	1.52
13241	13	8	0.052	1.53
13251	13	10	0.051	1.53
13261	14	2	0.052	1.51
13271	14	4	0.052	1.52
13281	14	6	0.052	1.52
13291	14	8	0.052	1.50
13301	14	10	0.052	1.52
13311	15	2	0.052	1.51
13321	15	4	0.051	1.52
13331	15	6	0.051	1.53
13341	15	8	0.052	1.50
13351	15	10	0.051	1.52
13361	16	2	0.052	1.50
13371	16	4	0.052	1.52
13381	16	6	0.051	1.53
13391	16	8	0.051	1.53
13401	16	10	0.051	1.53
13411	18	2	0.052	1.48
13421	18	4	0.052	1.50
13431	18	6	0.052	1.51
13441	18	8	0.052	1.50
13451	18	10	0.052	1.50
13461	20	2	0.052	1.49
13471	20	4	0.051	1.53

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13481	20	6	0.051	1.53
13491	20	8	0.050	1.54
13501	20	10	0.051	1.51
13511	6	2	0.104	1.52
13521	6	4	0.103	1.53
13531	6	6	0.103	1.52
13541	6	8	0.103	1.52
13551	6	10	0.102	1.52
13561	8	2	0.104	1.53
13571	8	4	0.103	1.52
13581	8	6	0.102	1.52
13591	8	8	0.102	1.53
13601	8	10	0.102	1.52
13611	10	2	0.104	1.50
13621	10	4	0.102	1.52
13631	10	6	0.102	1.52
13641	10	8	0.101	1.53
13651	10	10	0.102	1.51
13661	12	2	0.104	1.49
13671	12	4	0.104	1.50
13681	12	6	0.103	1.50
13691	12	8	0.104	1.49
13701	12	10	0.103	1.50
13711	13	2	0.104	1.53
13721	13	4	0.103	1.54
13731	13	6	0.103	1.53
13741	13	8	0.104	1.52
13751	13	10	0.104	1.52
13761	14	2	0.104	1.51
13771	14	4	0.104	1.51
13781	14	6	0.103	1.52
13791	14	8	0.104	1.51
13801	14	10	0.104	1.52
13811	15	2	0.104	1.51
13821	15	4	0.103	1.52
13831	15	6	0.103	1.52
13841	15	8	0.104	1.51
13851	15	10	0.102	1.53
13861	16	2	0.103	1.51
13871	16	4	0.103	1.51
13881	16	6	0.103	1.52
13891	16	8	0.103	1.52
13901	16	10	0.103	1.51
13911	18	2	0.104	1.51
13921	18	4	0.103	1.52
13932	18	6	0.104	1.50
13941	18	8	0.103	1.51
13951	18	10	0.103	1.52
13961	20	2	0.104	1.50
13971	20	4	0.104	1.49
13981	20	6	0.105	1.49
13991	20	8	0.104	1.50

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
14001	20	10	0.103	1.51
14061	8	2	0.156	1.50
14071	8	4	0.154	1.51
14081	8	6	0.155	1.50
14091	8	8	0.156	1.49
14101	8	10	0.155	1.50
14111	10	2	0.156	1.50
14121	10	4	0.157	1.48
14131	10	6	0.156	1.49
14141	10	8	0.156	1.49
14151	10	10	0.156	1.49
14161	12	2	0.157	1.52
14171	12	4	0.156	1.53
14181	12	6	0.155	1.53
14191	12	8	0.157	1.52
14201	12	10	0.155	1.52
14211	13	2	0.157	1.50
14221	13	4	0.156	1.52
14231	13	6	0.156	1.51
14241	13	8	0.155	1.52
14251	13	10	0.155	1.51
14261	14	2	0.155	1.53
14271	14	4	0.154	1.54
14281	14	6	0.154	1.54
14291	14	8	0.155	1.52
14301	14	10	0.154	1.53
14311	15	2	0.154	1.52
14321	15	4	0.154	1.52
14331	15	6	0.154	1.53
14341	15	8	0.154	1.52
14351	15	10	0.153	1.53
14361	16	2	0.155	1.51
14371	16	4	0.154	1.52
14381	16	6	0.152	1.53
14391	16	8	0.153	1.53
14401	16	10	0.153	1.52
14411	18	2	0.155	1.50
14421	18	4	0.154	1.51
14431	18	6	0.154	1.50
14441	18	8	0.156	1.48
14451	18	10	0.155	1.49
14461	20	2	0.156	1.49
14471	20	4	0.154	1.50
14481	20	6	0.154	1.50
14491	20	8	0.155	1.49
14501	20	10	0.111	1.51
14511	6	2	0.207	1.52
14521	6	4	0.206	1.53
14531	6	6	0.205	1.53
14541	6	8	0.207	1.52
14551	6	10	0.207	1.52
14561	8	2	0.208	1.51

TABLE 3.4.2 : LIST OF SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
14571	8	4	0.205	1.53
14581	8	6	0.205	1.53
14591	8	8	0.204	1.54
14601	8	10	0.203	1.54
14611	10	2	0.207	1.51
14621	10	4	0.205	1.52
14631	10	6	0.205	1.52
14641	10	8	0.205	1.52
14651	10	10	0.204	1.53
14661	12	2	0.209	1.49
14671	12	4	0.206	1.51
14681	12	6	0.206	1.51
14691	12	8	0.206	1.51
14701	12	10	0.206	1.51
14711	13	2	0.208	1.50
14721	13	4	0.207	1.50
14731	13	6	0.206	1.51
14741	13	8	0.206	1.51
14751	13	10	0.205	1.51
14761	14	2	0.206	1.53
14771	14	4	0.204	1.54
14781	14	6	0.204	1.54
14791	14	8	0.206	1.52
14801	14	10	0.206	1.52
14811	15	2	0.208	1.51
14821	15	4	0.208	1.51
14831	15	6	0.206	1.51
14841	15	8	0.206	1.51
14851	15	10	0.206	1.51
14861	16	2	0.209	1.49
14871	16	4	0.207	1.51
14881	16	6	0.206	1.51
14891	16	8	0.205	1.51
14901	16	10	0.206	1.51
14911	18	2	0.208	1.49
14921	18	4	0.207	1.50
14931	18	6	0.205	1.51
14941	18	8	0.204	1.52
14951	18	10	0.205	1.51
14961	20	2	0.207	1.49
14971	20	4	0.205	1.51
14981	20	6	0.205	1.51
14991	20	8	0.205	1.51
15001	20	10	0.206	1.50

TABLE 4 : EXPERIMENTS ON NACA 23012A (MODEL 2)

TABLE 4.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 4.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Reynolds Number	1.5×10^6
Angle of Attack	-2^o to 30^o

TABLE 4.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^{-6}
00101	-2	32	1.51

TABLE 4.2 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 4.2.1 : SUMMARY OF RAMP UP EXPERIMENTS (nominal)

Starting Incidence	-1^o						
Finishing Incidence	40^o						
Pitch Rate ($^o s^{-1}$)	3.0	4.5	6.0	7.5	15.0	30.0	45.0
	60.0	75.0	90.0	100.0	115.0	130.0	145.0
	160.0	175.0	190.0	200.0	230.0	245.0	260.0
	275.0	290.0	300.0	315.0	330.0	345.0	360.0
Reynolds Number	1.5×10^6						

(all permutations)

TABLE 4.2.2 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (^{o})	Arc (^{o})	Pitch Rate ($^o s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
20031	-1	41	2.9	0.0004	1.50
20041	-1	41	4.4	0.0006	1.50
20051	-1	41	6.0	0.0007	1.50
20061	-1	41	7.4	0.0009	1.51
20071	-1	41	14.9	0.0018	1.53
20081	-1	41	30.0	0.0037	1.51
20091	-1	41	45.0	0.0055	1.53
20101	-1	41	60.0	0.0075	1.51
20111	-1	41	75.3	0.0092	1.53
20121	-1	41	89.9	0.0111	1.51
20131	-1	41	102.5	0.0125	1.53
20141	-1	41	115.1	0.0142	1.51
20151	-1	41	129.6	0.0158	1.53
20161	-1	41	146.4	0.0181	1.51
20171	-1	41	159.6	0.0195	1.53
20181	-1	41	173.6	0.0215	1.51
20191	-1	40	189.5	0.0232	1.53
20201	-1	40	199.8	0.0244	1.53
20221	-1	41	229.1	0.0282	1.52
20231	-1	41	242.6	0.0296	1.48
20241	-1	40	258.5	0.0311	1.48
20251	-1	41	263.6	0.0319	1.48
20261	-1	40	276.8	0.0335	1.47
20271	-1	41	286.6	0.0346	1.48
20281	-1	41	298.5	0.0358	1.49
20291	-1	40	315.9	0.0385	1.46
20301	-1	41	324.9	0.0181	0.81
20311	-1	41	337.2	0.0411	1.47

TABLE 4.3 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 4.3.1 : SUMMARY OF RAMP DOWN EXPERIMENTS (nominal)

Starting Incidence	40°				
Finishing Incidence	-1°				
Pitch Rate ($^{\circ}s^{-1}$)	-5.0	-15.0	-30.0	-45.0	-60.0
	-75.0	-90.0	-150.0	-250.0	-350.0
Reynolds Number	$1.5x10^{6}$				

(all permutations)

TABLE 4.3.2 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start ($^{\circ}$)	Arc ($^{\circ}$)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
30321	40	-41	-325.2	-0.0403	1.47
30331	40	-41	-233.9	-0.0285	1.49
30341	40	-41	-148.6	-0.0185	1.46
30351	40	-41	-84.1	-0.0105	1.46
30361	40	-41	-71.1	-0.0088	1.48
30371	40	-41	-57.6	-0.0072	1.46
30381	40	-41	-43.5	-0.0054	1.48
30392	40	-41	-29.1	-0.0036	1.47
30402	40	-41	-14.6	-0.0018	1.47
30411	40	-41	-4.5	-0.0006	1.45

TABLE 4.4 : DETAILS OF SINUSOIDAL EXPERIMENTS

TABLE 4.4.1 : SUMMARY OF OSCILLATIONS ABOUT 10° (nominal)

Mean Incidence	10°							
Amplitude	4°		6°		8°		10°	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 4.4.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10° (nominal)

Mean Incidence	4°	6°	8°	15°	20°			
Amplitude	10°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 4.4.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8° (nominal)

Mean Angle	4°	6°	8°	10°	12°	17°
Amplitude	8°					
Reduced Frequency	0.100					
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 4.4.4 : LIST OF SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
10011	10	4	0.011	1.42
10021	10	4	0.025	1.48
10031	10	4	0.051	1.48
10041	10	4	0.080	1.44
10051	10	4	0.104	1.49
10061	10	4	0.128	1.51
10071	10	4	0.155	1.50
10081	10	4	0.180	1.51
10111	10	6	0.025	1.49
10121	10	6	0.052	1.50
10131	10	6	0.078	1.50
10141	10	6	0.103	1.51
10151	10	6	0.130	1.49
10161	10	6	0.156	1.49
10171	10	6	0.181	1.49
10191	10	8	0.010	1.49
10201	10	8	0.026	1.49
10211	10	8	0.052	1.49
10221	10	8	0.077	1.50
10231	10	8	0.103	1.50
10241	10	8	0.128	1.51
10251	10	8	0.157	1.48
10261	10	8	0.182	1.49
10291	10	10	0.026	1.50
10301	10	10	0.051	1.50
10311	10	10	0.077	1.49
10331	10	10	0.128	1.51
10341	10	10	0.155	1.48
10351	10	10	0.181	1.49
10361	4	10	0.010	1.49
10371	4	10	0.026	1.48
10381	4	10	0.049	1.43
10391	4	10	0.076	1.51
10401	4	10	0.103	1.49
10411	4	10	0.128	1.50
10421	4	10	0.155	1.49
10431	4	10	0.181	1.49
10451	6	10	0.026	1.48
10461	6	10	0.052	1.47
10471	6	10	0.077	1.48
10481	6	10	0.103	1.48
10491	6	10	0.128	1.46
10501	6	10	0.155	1.48
10511	6	10	0.180	1.49
10521	8	10	0.010	1.50
10531	8	10	0.026	1.46
10561	8	10	0.104	1.47
10571	8	10	0.129	1.49
10581	8	10	0.157	1.46
10591	8	10	0.183	1.46

TABLE 4.4 : LIST OF SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
10601	15	10	0.010	1.47
10611	15	10	0.026	1.46
10621	15	10	0.052	1.47
10631	15	10	0.078	1.48
10641	15	10	0.105	1.46
10651	15	10	0.130	1.48
10661	15	10	0.157	1.46
10671	15	10	0.181	1.47
10681	20	10	0.010	1.46
10691	20	10	0.026	1.46
10701	20	10	0.052	1.46
10711	20	10	0.078	1.47
10721	20	10	0.105	1.46
10731	20	10	0.130	1.47
10741	20	10	0.157	1.46
10751	20	10	0.181	1.47
10761	10	10	0.010	1.48
10771	10	10	0.026	1.50
10781	10	10	0.052	1.48
10791	10	10	0.078	1.49
10801	10	10	0.104	1.49
10811	10	10	0.131	1.48
10821	10	10	0.157	1.48
10831	10	10	0.182	1.49
10841	20	10	0.022	1.47
10851	20	10	0.032	1.48
10861	20	10	0.043	1.47
10871	20	10	0.054	1.48
10881	4	8	0.104	1.51
10891	6	8	0.105	1.50
10901	8	8	0.105	1.50
10911	10	8	0.102	1.54
10921	12	8	0.103	1.53
10931	17	8	0.103	1.53

TABLE 5 : EXPERIMENTS ON NACA 23012B (MODEL 3)

TABLE 5.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 5.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Reynolds Number	0.8×10^6	1.0×10^6	1.5×10^6	2.0×10^6
Angle of Attack	-2^o to 30^o			

(all permutations)

TABLE 5.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^{-6}
00801	-5	30	1.56
00811	-5	30	1.51
00821	-5	30	1.53
00921	-5	35	1.49
00931	-5	30	1.50
00932	-5	25	1.49
01181	-5	35	1.49
01411	-5	30	0.81
01421	-5	30	1.01
01431	-5	30	1.51
01801	-5	30	1.47
01811	-5	30	1.49
02911	-5	30	1.52
02921	-5	30	1.93
03341	-5	35	1.49
03351	-5	40	1.48
03363	-5	40	1.49
03371	-10	40	1.48
03381	26	-30	1.49
03391	10	10	1.48
03743	-5	40	1.48
03991	-5	40	1.51
04271	-5	40	1.47
04281	-5	40	1.70

TABLE 5.1.2 : LIST OF STATIC EXPERIMENTS (concluded)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^{-6}
04291	-5	39	1.93
04301	-10	45	1.50
04302	-5	40	1.51
05211	-5	40	1.45
05221	-5	40	1.45
05231	5	-20	1.43
05241	5	11	1.46
05251	5	-21	1.46
05261	-17	51	1.47
05271	0	-16	1.47
05281	-5	40	1.89
05282	-5	40	1.86
05361	-5	40	1.45
05371	25	3	1.46
07001	-20	38	1.42
07011	18	-38	1.42
07021	-20	38	1.41
*105381	-5	34	1.45
*105391	25	28	1.44
*105421	-5	34	1.44
*105431	-5	34	1.46
*105441	-5	34	1.45
*105451	22	32	1.45
*105461	5	-16	1.44
*105791	-5	34	1.46
*105801	5	-16	1.46
*105812	-5	34	1.46
*105821	5	-16	1.45
*105831	-5	34	1.49
*105841	5	-16	1.48
*105941	0	40	1.50
*105951	5	-16	1.51

(*experiments with trip wire attached)

TABLE 5.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 5.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Incidence Range	-10^{o} to 38^{o}		
Sampling Frequency (Hz)	100	250	500
Reynolds Number	1.5×10^{6}		

(all permutations)

TABLE 5.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (^{o})	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40011	-10	250	1.49
40021	-8	250	1.49
40031	-8	250	1.49
40041	-5	250	1.48
40051	-3	250	1.48
40061	-2	250	1.48
40071	-2	250	1.48
40081	-1	250	1.48
40091	0	250	1.48
40101	2	250	1.48
40111	2	250	1.48
40121	3	250	1.48
40131	4	250	1.48
40141	6	250	1.48
40151	7	250	1.48
40161	9	250	1.48
40171	11	250	1.49
40181	11	250	1.49
40191	12	250	1.49
40201	13	250	1.49

TABLE 5.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (continued)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40211	13	250	1.49
40221	14	250	1.48
40231	16	250	1.48
40241	16	250	1.48
40251	17	250	1.48
40261	17	250	1.48
40271	18	250	1.48
40281	20	250	1.48
40291	21	250	1.48
40301	23	250	1.48
40311	25	250	1.48
40321	27	250	1.48
40331	29	250	1.48
40341	31	250	1.48
40351	34	250	1.48
40361	36	250	1.48
40371	38	250	1.49
40501	0	100	1.48
40511	2	100	1.47
40521	4	100	1.47
40531	6	100	1.47
40541	8	100	1.47
40551	10	100	1.47
40561	12	100	1.47
40571	13	100	1.47
40581	14	100	1.46
40591	15	100	1.46
40601	16	100	1.46
40611	18	100	1.46
40621	20	100	1.46
40631	24	100	1.46
40641	30	100	1.46
40651	0	500	1.49
40671	4	500	1.49
40681	6	500	1.49
40691	8	500	1.48
40701	10	500	1.48

TABLE 5.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (concluded)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40711	12	500	1.48
40721	13	500	1.48
40731	14	500	1.48
40741	15	500	1.48
40751	16	500	1.48
40761	18	500	1.48
40771	20	500	1.48
40781	24	500	1.48
40791	30	500	1.48
45341	26	50	1.45
45351	26	50	1.45
*145401	26	50	1.44
*145411	26	50	1.44
*145471	-5	500	1.46
*145481	0	500	1.45
*145491	5	500	1.45
*145501	10	500	1.45
*145511	15	500	1.45
*145521	19	500	1.42
*145531	25	500	1.42
*145541	28	500	1.42
*145551	30	500	1.42
*145561	35	500	1.42
*145851	-5	500	1.48
*145861	0	500	1.47
*145871	5	500	1.47
*145881	10	500	1.48
*145891	14	500	1.47
*145901	20	500	1.47
*145911	25	500	1.47
*145921	30	500	1.47
*145931	35	500	1.47

(*experiments with trip wire)

TABLE 5.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 5.3.1 : SUMMARY OF RAMPS FROM -6° TO 35° (nominal)

Pitch Rate ($^{o}s^{-1}$)	Reynolds No. x 10^{-6}	Pitch Rate ($^{o}s^{-1}$)	Reynolds No. x 10^{-6}	Pitch Rate ($^{o}s^{-1}$)	Reynolds No. x 10^{-6}
0.75	1.5	100.0	1.0 1.5	260.0	1.5
1.5	1.5	115.0	1.5	275.0	1.5
3.0	1.5	130.0	1.5	290.0	1.5
4.5	1.5	145.0	1.5	300.0	1.0 1.5
6.0	1.5	160.0	1.5	315.0	1.5
7.5	1.5	175.0	1.5	330.0	1.5
15.0	1.5	190.0	1.5	345.0	1.5
30.0	1.5	200.0	1.0 1.5	360.0	1.0 1.5
45.0	1.0 1.5	215.0	1.5	375.0	1.5
60.0	1.5	230.0	1.5	390.0	1.5
75.0	1.5	245.0	1.5	400.0	1.0 1.5
90.0	1.5			415.0	1.5

(all permutations)

TABLE 5.3.2 : SUMMARY OF SHORT RAMPS (nominal)

Starting Incidence	0°									
Finishing Incidence	4°		8°		12°		20°		30°	
Pitch Rate ($^{o}s^{-1}$)	50	100	200	250	300	350	400	450	500	550
Reynolds Number	1.5×10^{6}									

(all permutations)

TABLE 5.3.3 : SUMMARY OF RAMPS FOR WHICH COMBINATION OF ARC LENGTH AND PITCH RATE IS CONSTANT (actual)

Ramp Arc		4°	8°	12°	20°	30°	
Pitch Rate ($^{o}s^{-1}$)		140	240	290	370	450	
Reynolds Number $\times 10^{-6}$	0.40	0.55	0.70	0.85	1.00	1.15	1.30

(all permutations)

TABLE 5.3.4 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
23001	-6	41	0.7	0.0001	1.50
23011	-6	41	1.5	0.0002	1.49
23021	-6	41	3.0	0.0003	1.49
23031	-6	41	4.4	0.0005	1.49
23041	-6	41	6.0	0.0007	1.47
23051	-6	41	7.5	0.0009	1.47
23061	-6	41	14.8	0.0017	1.46
23071	-6	41	29.2	0.0034	1.46
23081	-6	41	44.7	0.0053	1.46
23091	-6	41	58.7	0.0069	1.46
23101	-6	41	74.3	0.0087	1.46
23111	-6	41	91.5	0.0107	1.46
23121	-6	41	100.6	0.0117	1.48
23131	-6	41	114.3	0.0133	1.47
23141	-6	41	127.8	0.0149	1.47
23151	-6	41	143.8	0.0166	1.50
23161	-6	41	157.7	0.0181	1.49
23171	-6	41	173.1	0.0199	1.49
23181	-6	41	185.9	0.0215	1.49
23191	-6	41	197.6	0.0229	1.48
23201	-6	41	211.8	0.0245	1.48
23211	-6	41	223.9	0.0259	1.48
23221	-6	41	240.2	0.0276	1.50
23231	-6	41	253.1	0.0291	1.50
23241	-6	41	263.5	0.0303	1.50
23251	-6	41	280.7	0.0322	1.50
23261	-6	41	286.5	0.0332	1.49
23271	-6	41	299.4	0.0347	1.49
23281	-6	41	317.6	0.0368	1.49
23291	-6	41	328.1	0.0380	1.48
23301	-6	41	333.0	0.0385	1.50
23311	-6	41	366.5	0.0423	1.49
23321	-6	41	397.7	0.0459	1.49
23331	-6	41	423.5	0.0489	1.49
24311	0	4	58.1	0.0067	1.49
24321	0	4	112.6	0.0130	1.49
24331	0	4	145.2	0.0167	1.49
24411	0	8	47.8	0.0055	1.45
24421	0	8	108.2	0.0125	1.44
24431	0	8	193.8	0.0224	1.44
24441	0	8	210.2	0.0243	1.44

TABLE 5.3.4 : LIST OF RAMP UP EXPERIMENTS (continued)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
24451	0	8	212.9	0.0246	1.44
24511	0	12	51.8	0.0060	1.46
24521	0	12	94.0	0.0108	1.45
24531	0	12	195.8	0.0226	1.45
24541	0	12	259.6	0.0299	1.45
24551	0	12	271.5	0.0313	1.45
24561	0	12	276.0	0.0319	1.45
24571	0	12	274.5	0.0317	1.45
24581	0	12	292.5	0.0338	1.45
24591	0	12	299.0	0.0345	1.45
24601	0	12	304.4	0.0351	1.45
24611	0	20	49.4	0.0057	1.48
24621	0	20	97.9	0.0113	1.48
24631	0	20	219.8	0.0253	1.48
24641	0	20	301.6	0.0346	1.48
24651	0	20	327.0	0.0375	1.48
24661	0	20	344.9	0.0398	1.47
24671	0	20	350.5	0.0405	1.47
24681	0	20	374.0	0.0431	1.47
24691	0	20	364.0	0.0420	1.47
24701	0	20	372.9	0.0430	1.47
24711	0	30	49.5	0.0057	1.47
24721	0	30	100.2	0.0115	1.47
24731	0	30	200.4	0.0229	1.46
24741	0	30	325.3	0.0372	1.46
24751	0	30	375.9	0.0430	1.46
24761	0	30	395.6	0.0458	1.45
24771	0	30	422.5	0.0489	1.45
24781	0	30	430.6	0.0498	1.45
24791	0	30	443.6	0.0513	1.45
24801	0	30	455.5	0.0527	1.44
24861	0	12	286.5	0.1232	0.40
24871	0	20	361.7	0.1556	0.40
24881	0	30	447.5	0.1925	0.40
24891	0	4	147.4	0.0635	0.40
24901	0	8	237.9	0.1024	0.40
24911	0	4	154.1	0.0430	0.62
24921	0	8	241.5	0.0675	0.62
24931	0	12	290.1	0.0810	0.62
24941	0	20	377.6	0.1055	0.62
24951	0	30	442.2	0.1235	0.62

TABLE 5.3.4 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
24961	0	4	158.6	0.0396	0.69
24971	0	8	232.6	0.0580	0.69
24981	0	12	281.1	0.0701	0.69
24991	0	20	357.2	0.0891	0.69
25001	0	30	438.6	0.1094	0.69
25011	0	4	120.6	0.0245	0.85
25021	0	8	245.1	0.0498	0.85
25031	0	12	288.3	0.0586	0.85
25041	0	20	368.6	0.0749	0.85
25051	0	30	439.6	0.0894	0.85
25061	0	4	131.8	0.0237	0.96
25071	0	8	254.1	0.0458	0.96
25081	0	12	291.9	0.0526	0.96
25091	0	20	364.8	0.0657	0.96
25101	0	30	448.5	0.0808	0.96
25111	0	4	107.2	0.0156	1.19
25121	0	8	246.0	0.0358	1.19
25131	0	12	290.1	0.0422	1.19
25141	0	20	370.7	0.0540	1.19
25151	0	30	452.5	0.0659	1.19
25161	0	4	137.6	0.0180	1.32
25171	0	8	232.6	0.0304	1.32
25181	0	12	293.6	0.0384	1.31
25191	0	20	371.2	0.0486	1.31
25201	0	30	452.5	0.0592	1.31
26081	-5	41	49.5	0.0086	0.98
26091	-5	41	98.9	0.0172	0.98
26101	-5	41	198.3	0.0345	0.98
26111	-5	41	287.5	0.0501	0.98
26121	-5	41	366.5	0.0638	0.98
26131	-5	41	427.0	0.0743	0.98
*125691	-5	41	49.6	0.0057	1.45
*125701	-5	41	98.9	0.0112	1.44
*125711	-5	41	198.6	0.0226	1.44
*125721	-5	41	291.4	0.0331	1.44
*125731	-5	41	367.1	0.0417	1.44

(*experiments with trip wire attached)

TABLE 5.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 5.4.1 : SUMMARY OF RAMPS FROM 36° TO -5° (nominal)

Pitch Rate ($^{o}s^{-1}$)	Reynolds No. x 10^{-6}	Pitch Rate ($^{o}s^{-1}$)	Reynolds No. x 10^{-6}	Pitch Rate ($^{o}s^{-1}$)	Reynolds No. x 10^{-6}
-0.75	1.5	-100.0	1.0 1.5	-260.0	1.5
-1.5	1.5	-115.0	1.5	-275.0	1.5
-3.0	1.5	-130.0	1.5	-290.0	1.5
-4.5	1.5	-145.0	1.5	-300.0	1.0 1.5
-6.0	1.5	-160.0	1.5	-315.0	1.5
-7.5	1.5	-175.0	1.5	-330.0	1.5
-15.0	1.5	-190.0	1.5	-345.0	1.5
-30.0	1.5	-200.0	1.0 1.5	-360.0	1.0 1.5
-45.0	1.0 1.5	-215.0	1.5	-375.0	1.5
-60.0	1.5	-230.0	1.5	-390.0	1.5
-75.0	1.5	-245.0	1.5	-400.0	1.0 1.5
-90.0	1.5			-415.0	1.5

(all permutations)

TABLE 5.4.2 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
33401	35	-41	-0.7	-0.0001	1.49
33411	35	-41	-1.5	-0.0002	1.50
33421	35	-41	-2.9	-0.0003	1.47
33431	35	-41	-4.4	-0.0005	1.48
33441	35	-41	-6.0	-0.0007	1.48
33451	35	-41	-7.2	-0.0008	1.48
33461	35	-41	-15.0	-0.0017	1.48
33471	35	-41	-29.1	-0.0034	1.48
33481	35	-41	-43.9	-0.0051	1.48
33491	35	-41	-58.4	-0.0068	1.48
33501	35	-41	-71.0	-0.0082	1.47
33511	35	-41	-85.8	-0.0099	1.47
33521	35	-41	-94.7	-0.0110	1.47

TABLE 5.4.2 : LIST OF RAMP DOWN EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
33531	35	-41	-107.0	-0.0124	1.47
33541	35	-41	-120.7	-0.0140	1.47
33551	35	-41	-135.6	-0.0157	1.47
33561	35	-41	-148.7	-0.0172	1.47
33571	35	-41	-159.5	-0.0184	1.47
33581	35	-41	-172.4	-0.0200	1.47
33591	35	-41	-181.5	-0.0210	1.47
33601	35	-41	-195.2	-0.0226	1.47
33611	35	-41	-205.7	-0.0238	1.47
33621	35	-41	-217.7	-0.0253	1.46
33631	35	-41	-226.1	-0.0262	1.46
33641	35	-41	-243.8	-0.0283	1.46
33651	35	-41	-255.3	-0.0296	1.46
33661	35	-41	-262.7	-0.0305	1.46
33671	35	-41	-273.8	-0.0318	1.46
33681	35	-41	-288.1	-0.0334	1.46
33691	35	-41	-302.7	-0.0351	1.46
33701	35	-41	-302.7	-0.0353	1.46
33711	35	-41	-347.7	-0.0405	1.45
33721	35	-41	-384.7	-0.0448	1.45
33731	35	-41	-412.1	-0.0479	1.45
36141	36	-41	-48.2	-0.0083	1.00
36151	36	-41	-95.4	-0.0164	1.00
36161	36	-41	-182.8	-0.0314	1.00
36171	36	-41	-263.9	-0.0453	1.00
36181	36	-41	-357.7	-0.0614	1.00
36191	36	-41	-415.8	-0.0714	1.00
*135741	36	-41	-48.4	-0.0055	1.45
*135751	36	-41	-94.7	-0.0107	1.45
*135761	36	-41	-179.4	-0.0202	1.45
*135771	36	-41	-265.8	-0.0300	1.45
*135781	36	-41	-351.1	-0.0396	1.45

(*experiments with trip wire attached)

TABLE 5.5 : DETAILS OF SINUSOIDAL EXPERIMENTS

TABLE 5.5.1 : SUMMARY OF OSCILLATIONS ABOUT 10^{o} (nominal)

Mean Incidence	10^{o}								
Amplitude	4^{o}		6^{o}		8^{o}	10^{o}		15^{o}	20^{o}
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
Reynolds Number	1.5×10^{6}								

(all permutations)

TABLE 5.5.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10^{o} (nominal)

Mean Incidence	4^{o}		6^{o}		8^{o}	10^{o}		15^{o}	20^{o}
Amplitude	10^{o}								
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
Reynolds Number	1.5×10^{6}								

(all permutations)

TABLE 5.5.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8^{o} (nominal)

Mean Incidence	0^{o}	5^{o}	6^{o}	7^{o}	8^{o}	9^{o}	10^{o}	11^{o}	12^{o}
Amplitude	8^{o}								
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
Reynolds Number	1.5×10^{6}								

(all permutations)

Mean Incidence	13^{o}	14^{o}	15^{o}	16^{o}	20^{o}	25^{o}
Amplitude	8^{o}					
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200
Reynolds Number	1.5×10^{6}								

(all permutations)

TABLE 5.5.4 : SUMMARY OF HIGH FREQUENCY OSCILLATIONS (nominal)

Mean Incidence	0°			4°		
Amplitude	2°			4°		
Oscillation Frequency (Hz)	1.0	2.5	5.0	7.5	10.0	12.5
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 5.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
10831	4	10	0.010	1.48
10841	6	10	0.010	1.47
10851	8	10	0.010	1.47
10861	10	10	0.010	1.47
10871	10	10	0.010	1.47
10872	10	10	0.010	1.49
10881	4	10	0.025	1.48
10891	6	10	0.025	1.48
10901	8	10	0.025	1.47
10911	10	10	0.025	1.47
10912	10	10	0.024	1.49
10941	4	10	0.052	1.47
10951	6	10	0.052	1.46
10961	8	10	0.052	1.46
10971	10	10	0.052	1.46
10972	10	10	0.051	1.48
10981	4	10	0.076	1.50
10991	6	10	0.076	1.50
11001	8	10	0.076	1.50
11011	10	10	0.075	1.50
11012	10	10	0.076	1.50
11021	4	10	0.101	1.49
11031	6	10	0.101	1.49
11041	8	10	0.101	1.49
11051	10	10	0.101	1.49
11052	10	10	0.101	1.49
11061	4	10	0.126	1.50

TABLE 5.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11071	6	10	0.126	1.49
11081	8	10	0.126	1.49
11091	10	10	0.126	1.49
11092	10	10	0.132	1.68
11101	4	10	0.151	1.50
11111	6	10	0.151	1.50
11121	8	10	0.151	1.50
11131	10	10	0.151	1.50
11132	10	10	0.152	1.49
11141	4	10	0.177	1.50
11151	6	10	0.177	1.49
11161	8	10	0.177	1.49
11171	10	10	0.177	1.49
11172	10	10	0.177	1.50
11191	4	10	0.203	1.50
11201	6	10	0.203	1.49
11211	8	10	0.202	1.49
11221	10	10	0.202	1.49
11222	10	10	0.202	1.50
11231	15	10	0.010	1.49
11241	20	10	0.010	1.49
11251	15	10	0.024	1.48
11261	20	10	0.024	1.48
11271	15	10	0.051	1.47
11281	20	10	0.051	1.47
11291	15	10	0.076	1.49
11301	20	10	0.076	1.49
11311	15	10	0.101	1.49
11321	20	10	0.101	1.49
11331	15	10	0.126	1.50
11341	20	10	0.126	1.49
11351	15	10	0.152	1.49
11361	20	10	0.152	1.49
11361	20	10	0.152	1.49
11381	20	10	0.177	1.50
11391	15	10	0.202	1.50
11392	15	10	0.203	1.45
11401	20	10	0.202	1.49
11441	10	4	0.010	1.49
11451	10	6	0.010	1.48
11461	10	8	0.010	1.48
11471	10	12	0.010	1.48
11481	10	4	0.025	1.50

TABLE 5.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11491	10	6	0.025	1.49
11501	10	8	0.025	1.49
11511	10	12	0.025	1.49
11521	10	4	0.051	1.49
11531	10	6	0.050	1.48
11541	10	8	0.050	1.48
11551	10	12	0.050	1.48
11561	10	4	0.076	1.49
11571	10	6	0.076	1.48
11581	10	8	0.076	1.48
11591	10	12	0.076	1.48
11601	10	4	0.101	1.49
11611	10	6	0.101	1.48
11621	10	8	0.101	1.48
11631	10	12	0.101	1.48
11641	10	4	0.126	1.50
11651	10	6	0.126	1.49
11661	10	8	0.126	1.49
11671	10	12	0.126	1.49
11681	10	4	0.152	1.49
11691	10	6	0.151	1.49
11701	10	8	0.151	1.49
11711	10	12	0.151	1.49
11721	10	4	0.177	1.49
11731	10	6	0.177	1.49
11741	10	8	0.177	1.49
11751	10	12	0.177	1.49
11761	10	4	0.203	1.49
11771	10	6	0.203	1.49
11781	10	8	0.203	1.49
11791	10	12	0.203	1.49
11821	5	8	0.010	1.48
11831	6	8	0.010	1.47
11841	7	8	0.010	1.47
11851	8	8	0.010	1.47
11861	9	8	0.010	1.46
11871	10	8	0.010	1.46
11881	11	8	0.010	1.46
11891	12	8	0.010	1.46
11901	13	8	0.010	1.45
11911	14	8	0.010	1.45
11921	15	8	0.010	1.45
11931	16	8	0.010	1.45
11941	5	8	0.025	1.48
11951	6	8	0.025	1.48
11961	7	8	0.025	1.47
11971	8	8	0.025	1.47
11981	9	8	0.025	1.47
11991	10	8	0.025	1.47
12001	11	8	0.025	1.47
12011	12	8	0.025	1.47
12021	13	8	0.025	1.47

TABLE 5.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12031	14	8	0.025	1.47
12041	15	8	0.025	1.47
12051	16	8	0.025	1.47
12061	5	8	0.051	1.47
12071	6	8	0.051	1.47
12081	7	8	0.051	1.47
12091	8	8	0.051	1.47
12101	9	8	0.051	1.47
12111	10	8	0.051	1.47
12121	11	8	0.051	1.47
12131	12	8	0.051	1.47
12141	13	8	0.051	1.47
12151	14	8	0.051	1.47
12161	15	8	0.051	1.47
12171	16	8	0.051	1.47
12181	5	8	0.076	1.48
12191	6	8	0.076	1.48
12201	7	8	0.076	1.48
12211	8	8	0.076	1.48
12221	9	8	0.076	1.48
12231	10	8	0.076	1.48
12241	11	8	0.076	1.48
12251	12	8	0.076	1.47
12261	13	8	0.076	1.47
12271	14	8	0.076	1.47
12281	15	8	0.076	1.47
12291	16	8	0.076	1.47
12301	5	8	0.102	1.47
12311	6	8	0.102	1.47
12321	7	8	0.102	1.47
12331	8	8	0.102	1.47
12341	9	8	0.102	1.47
12351	10	8	0.102	1.47
12361	11	8	0.102	1.47
12371	12	8	0.102	1.47
12381	13	8	0.102	1.47
12391	14	8	0.102	1.47
12401	15	8	0.102	1.47
12411	16	8	0.102	1.47
12431	6	8	0.127	1.48
12441	7	8	0.127	1.48
12451	8	8	0.127	1.48
12461	9	8	0.127	1.48
12471	10	8	0.127	1.48
12481	11	8	0.128	1.48
12491	12	8	0.128	1.48
12501	13	8	0.128	1.48
12511	14	8	0.128	1.48
12521	15	8	0.128	1.47

TABLE 5.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12531	16	8	0.128	1.47
12541	5	8	0.153	1.49
12551	6	8	0.152	1.48
12561	7	8	0.152	1.48
12571	8	8	0.152	1.48
12581	9	8	0.152	1.48
12591	10	8	0.152	1.48
12601	11	8	0.153	1.49
12611	12	8	0.152	1.48
12621	13	8	0.152	1.48
12631	14	8	0.152	1.48
12641	15	8	0.152	1.48
12651	16	8	0.152	1.48
12661	5	8	0.178	1.49
12671	6	8	0.178	1.48
12681	7	8	0.178	1.48
12691	8	8	0.178	1.48
12701	9	8	0.178	1.48
12711	10	8	0.178	1.48
12721	11	8	0.178	1.49
12731	12	8	0.178	1.48
12741	13	8	0.178	1.48
12751	14	8	0.178	1.48
12761	15	8	0.178	1.48
12771	16	8	0.178	1.48
12801	7	8	0.204	1.48
12891	15	8	0.203	1.49
13752	0	2	0.041	1.50
13762	4	2	0.041	1.49
13772	4	4	0.041	1.49
13782	0	4	0.041	1.49
13792	0	2	0.104	1.49
13802	4	2	0.104	1.48
13812	4	4	0.104	1.48
13822	0	4	0.104	1.48
13832	0	2	0.208	1.49
13842	4	2	0.208	1.49
13852	4	4	0.208	1.49
13862	0	4	0.208	1.49
13872	0	2	0.317	1.46
13882	4	2	0.317	1.46
13892	4	4	0.317	1.46
13902	0	4	0.317	1.46
13912	0	2	0.413	1.50
13922	4	2	0.412	1.50
13932	4	4	0.412	1.50
13942	0	4	0.412	1.49
13952	0	2	0.927	1.50
13962	4	2	0.926	1.50
13972	4	4	0.926	1.50
13982	0	4	0.926	1.50
14001	0	8	0.010	1.49

TABLE 5.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
14011	20	8	0.010	1.49
14021	25	8	0.010	1.49
14031	0	8	0.026	1.46
14041	20	8	0.025	1.46
14051	25	8	0.025	1.45
14061	0	8	0.051	1.46
14071	20	8	0.051	1.46
14081	25	8	0.051	1.46
14091	0	8	0.076	1.46
14101	20	8	0.076	1.46
14111	25	8	0.076	1.46
14121	0	8	0.102	1.46
14131	20	8	0.102	1.45
14141	25	8	0.102	1.45
14151	0	8	0.127	1.46
14161	20	8	0.127	1.46
14171	25	8	0.127	1.46
14181	0	8	0.153	1.45
14191	20	8	0.153	1.45
14201	25	8	0.153	1.45
14211	0	8	0.178	1.46
14221	20	8	0.178	1.45
14231	25	8	0.178	1.45
15961	5	8	0.150	0.99
15971	6	8	0.150	0.99
15981	7	8	0.150	0.99
15991	8	8	0.150	0.99
16001	9	8	0.150	0.99
16011	10	8	0.150	0.99
16031	12	8	0.149	1.00
16041	13	8	0.149	1.00
16051	14	8	0.149	1.00
16061	15	8	0.149	1.00
16071	16	8	0.149	1.00
*115571	5	8	0.104	1.44
*115581	6	8	0.103	1.43
*115591	7	8	0.103	1.43
*115601	8	8	0.103	1.43
*115611	9	8	0.103	1.43
*115621	10	8	0.104	1.43
*115631	11	8	0.104	1.43
*115641	12	8	0.104	1.43
*115651	13	8	0.104	1.43
*115661	14	8	0.104	1.43
*115671	15	8	0.104	1.43
*115681	16	8	0.104	1.43

(*experiment with trip wire attached)

TABLE 5.6 : DETAILS OF SINGLE STREAMTUBE VAWT EXPERIMENTS

TABLE 5.6.1 : SUMMARY OF VAWT EXPERIMENTS AT MEAN INCIDENCE OF 0^o (nominal)

Mean Incidence	0^o					
Tip Speed Ratio	1.75	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.40		0.50		0.60	
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 5.6.2 : SUMMARY OF VAWT EXPERIMENTS AT VARYING MEAN INCIDENCES (nominal)

Mean Incidence	-6^o	-4^o	-2^o	2^o	4^o	6^o
Tip Speed Ratio	3.25					
Reduced Frequency	0.50					
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 5.6.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
56701	0	6.00	0.051	1.44
56711	0	4.00	0.051	1.43
56721	0	3.50	0.051	1.43
56731	0	3.25	0.051	1.43
56741	0	2.80	0.051	1.43
56751	0	1.75	0.051	1.43
56761	0	6.00	0.040	1.44
56771	0	4.00	0.040	1.44
56781	0	3.50	0.040	1.44
56791	0	3.25	0.040	1.44

TABLE 5.6.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (concluded)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
56801	0	2.80	0.040	1.43
56811	0	1.75	0.040	1.43
56821	0	6.00	0.061	1.43
56831	0	4.00	0.061	1.43
56841	0	3.50	0.061	1.43
56851	0	3.25	0.061	1.43
56861	0	2.80	0.061	1.43
56881	0	6.00	0.051	1.49
56891	0	4.00	0.051	1.48
56901	0	3.50	0.050	1.48
56911	0	3.25	0.050	1.48
56921	0	2.80	0.050	1.48
56931	0	1.75	0.050	1.48
56941	-6	3.25	0.051	1.49
56951	-4	3.25	0.051	1.49
56961	-2	3.25	0.051	1.49
56971	2	3.25	0.051	1.49
56981	4	3.25	0.051	1.49
56991	6	3.25	0.051	1.49

TABLE 6 : EXPERIMENTS ON NACA 23012C (MODEL 4)

TABLE 6.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 6.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Reynolds Number	1.0×10^6	1.5×10^6	2.0×10^6
Angle of Attack	-2° to 30°		

(all permutations)

TABLE 6.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start ($^\circ$)	Sweep ($^\circ$)	Reynolds No. x 10^{-6}
05011	-2	32	1.52
05341	-2	32	1.49
05351	-2	32	1.00
05361	-2	32	1.97
06611	-2	32	1.51
07911	-5	32	1.52

TABLE 6.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 6.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Angle of Attack	-8°	-4°	0°	2°	4°	6°	8°	9°	10°	11°	12°	13°	14°
Sampling Frequency	100 Hz												
Reynolds Number	1.5×10^6												

(all permutations)

Angle of Attack	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	26°	32°
Sampling Frequency	100 Hz											
Reynolds Number	1.5×10^6											

(all permutations)

TABLE 6.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
47221	-8	100	1.49
47231	-4	100	1.49
47241	0	100	1.48
47251	2	100	1.48
47261	4	100	1.48
47271	6	100	1.48
47281	8	100	1.48
47291	9	100	1.48
47301	10	100	1.48
47311	11	100	1.48
47321	12	100	1.49
47331	13	100	1.49
47341	14	100	1.48
47351	15	100	1.48
47361	16	100	1.48
47371	17	100	1.48
47381	18	100	1.48
47391	19	100	1.48
47401	20	100	1.48
47411	21	100	1.48
47421	22	100	1.48
47431	23	100	1.48
47441	24	100	1.48
47451	26	100	1.48
47461	32	100	1.48

TABLE 6.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 6.3.1 : SUMMARY OF RAMPS FROM -1° TO 40° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
0.75	1.5	75.0	1.5	215.0	1.5
1.5	1.5	90.0	1.5	230.0	1.5
3.0	1.5	100.0	1.0 1.5 2.0	245.0	1.5
4.5	1.5	115.0	1.5	260.0	1.5
6.0	1.5	130.0	1.5	275.0	1.5
7.5	1.5	145.0	1.5	290.0	1.5
15.0	1.5	160.0	1.5	300.0	1.0 1.5 2.0
30.0	1.0 1.5 2.0	175.0	1.5	315.0	1.5
45.0	1.5	190.0	1.5	330.0	1.5
60.0	1.5	200.0	1.0 1.5 2.0	345.0	1.5

(all permutations)

TABLE 6.3.2 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate (°s^{-1})	Reduced Pitch Rate	Reynolds No. x 10^{-6}
27531	-1	41	29.5	0.0052	1.00
27541	-1	41	99.6	0.0173	1.00
27551	-1	41	190.3	0.0331	1.00
27561	-1	41	271.9	0.0473	1.00
27571	-1	41	0.7	0.0001	1.50
27581	-1	41	1.5	0.0002	1.48
27591	-1	41	3.0	0.0003	1.47
27601	-1	41	4.4	0.0005	1.47
27611	-1	41	6.0	0.0007	1.46
27621	-1	41	7.3	0.0008	1.46

TABLE 6.3.2 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
27631	-1	41	14.8	0.0017	1.48
27641	-1	41	29.4	0.0034	1.47
27651	-1	41	44.3	0.0051	1.47
27661	-1	41	59.5	0.0070	1.46
27671	-1	41	74.4	0.0087	1.46
27681	-1	41	89.7	0.0105	1.46
27691	-1	41	99.8	0.0116	1.46
27701	-1	41	113.2	0.0132	1.46
27711	-1	41	128.5	0.0149	1.48
27721	-1	41	141.8	0.0164	1.47
27731	-1	41	156.5	0.0181	1.47
27741	-1	41	167.1	0.0194	1.47
27751	-1	41	180.4	0.0210	1.47
27761	-1	41	189.1	0.0220	1.47
27771	-1	41	203.2	0.0237	1.47
27781	-1	41	214.7	0.0250	1.46
27791	-1	41	229.0	0.0267	1.47
27801	-1	41	241.2	0.0281	1.47
27811	-1	41	247.8	0.0288	1.47
27821	-1	41	260.3	0.0303	1.46
27831	-1	41	267.2	0.0311	1.47
27841	-1	41	273.1	0.0318	1.47
27851	-1	41	286.4	0.0333	1.47
27861	-1	41	292.9	0.0341	1.46
27871	-1	41	29.5	0.0026	1.93
27881	-1	41	98.0	0.0086	1.92
27891	-1	41	185.3	0.0163	1.92
27901	-1	41	257.9	0.0226	1.91
*529351	-1	41	89.9	0.0105	1.47
*529361	-1	41	261.6	0.0304	1.47

(*experiments with end plates attached)

TABLE 6.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 6.4.1 : SUMMARY OF RAMPS FROM 40° TO -1° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
-0.75	1.5	-75.0	1.5	-215.0	1.5
-1.5	1.5	-90.0	1.5	-230.0	1.5
-3.0	1.5	-100.0	1.0 1.5 2.0	-245.0	1.5
-4.5	1.5	-115.0	1.5	-260.0	1.5
-6.0	1.5	-130.0	1.5	-275.0	1.5
-7.5	1.5	-145.0	1.5	-290.0	1.5
-15.0	1.5	-160.0	1.5	-300.0	1.0 1.5 2.0
-30.0	1.0 1.5 2.0	-175.0	1.5	-315.0	1.5
-45.0	1.5	-190.0	1.5	-330.0	1.5
-60.0	1.5	-200.0	1.0 1.5 2.0	-345.0	1.5

(all permutations)

TABLE 6.4.2 : SUMMARY OF RAMPS FROM TO -5° (nominal)

Starting Incidence	*14°	16°	*18°	20°	22°	*25°	27°	30°	*35°
Finishing Incidence	-5°								
Pitch Rate	-50°s^{-1}			-150°s^{-1}			-250°s^{-1}		
Reynolds Number	1.5 x 10^6								

(all permutations; *experiments repeated with end plates attached)

TABLE 6.4.3 : SUMMARY OF RAMPS FROM 30° (nominal)

Starting Incidence	30°						
Finishing Incidence	-10°	0°	5°	10°	15°	20°	25°
Pitch Rate	-50°s^{-1}		-150°s^{-1}		-250°s^{-1}		
Reynolds Number	1.5 x 10^6						

(all permutations, with and without end plates attached)

TABLE 6.4.4 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
37921	40	-41	-0.7	-0.0001	1.51
37931	40	-41	-1.4	-0.0002	1.49
37941	40	-41	-2.9	-0.0003	1.48
37951	40	-41	-4.3	-0.0005	1.48
37961	40	-41	-5.8	-0.0007	1.48
37971	40	-41	-7.2	-0.0008	1.47
37981	40	-41	-14.3	-0.0017	1.48
37991	40	-41	-28.3	-0.0033	1.48
38001	40	-41	-43.0	-0.0050	1.48
38011	40	-41	-56.0	-0.0066	1.48
38021	40	-41	-69.2	-0.0081	1.47
38031	40	-41	-81.9	-0.0096	1.47
38041	40	-41	-91.4	-0.0107	1.47
38051	40	-41	-104.6	-0.0122	1.47
38061	40	-41	-116.6	-0.0137	1.49
38071	40	-41	-128.2	-0.0150	1.48
38081	40	-41	-141.2	-0.0165	1.48
38091	40	-41	-153.5	-0.0180	1.48
38101	40	-41	-167.4	-0.0196	1.48
38111	40	-41	-175.7	-0.0206	1.48
38121	40	-41	-187.3	-0.0219	1.48
38131	40	-41	-198.8	-0.0233	1.47
38141	40	-41	-209.5	-0.0244	1.49
38151	40	-41	-217.7	-0.0253	1.48
38161	40	-41	-226.6	-0.0263	1.48
38171	40	-41	-235.9	-0.0274	1.48
38181	40	-41	-240.9	-0.0280	1.49
38191	40	-41	-256.2	-0.0297	1.48
38201	40	-41	-262.5	-0.0305	1.48
38211	40	-41	-270.7	-0.0314	1.48
38221	35	-40	-278.1	-0.0324	1.51
38231	35	-40	-156.0	-0.0181	1.50
38241	30	-35	-279.4	-0.0325	1.50
38251	30	-35	-161.5	-0.0188	1.50
38261	27	-32	-279.8	-0.0326	1.50
38271	27	-32	-160.5	-0.0187	1.49
38281	25	-30	-278.0	-0.0323	1.49
38291	25	-30	-161.1	-0.0187	1.49
38301	22	-27	-275.1	-0.0322	1.49
38311	20	-25	-269.0	-0.0314	1.48
38321	18	-23	-263.9	-0.0308	1.48
38331	16	-21	-253.4	-0.0295	1.48
38341	14	-19	-248.6	-0.0290	1.48
38351	30	-40	-282.0	-0.0330	1.48
38361	30	-40	-162.3	-0.0189	1.48
38371	30	-40	-48.8	-0.0057	1.48
38381	30	-30	-273.8	-0.0321	1.47
38391	30	-30	-157.6	-0.0185	1.47
38401	30	-30	-48.5	-0.0057	1.47
38411	30	-25	-269.9	-0.0315	1.48
38421	30	-25	-150.7	-0.0176	1.47
38431	30	-25	-48.2	-0.0056	1.47
38441	30	-20	-264.1	-0.0309	1.47
38451	30	-20	-150.0	-0.0175	1.47

TABLE 6.4.4 : LIST OF RAMP DOWN EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
38461	30	-20	-46.9	-0.0055	1.47
38471	30	-15	-238.0	-0.0279	1.47
38481	30	-15	-137.4	-0.0161	1.47
38491	30	-15	-45.9	-0.0054	1.47
38501	30	-10	-193.6	-0.0227	1.47
38511	30	-10	-143.6	-0.0168	1.47
38521	30	-10	-47.9	-0.0056	1.46
38531	30	-5	-120.2	-0.0141	1.47
38541	30	-5	-95.8	-0.0112	1.46
38551	30	-5	-42.9	-0.0050	1.46
*539001	30	-40	-303.3	-0.0355	1.48
*539011	30	-40	-159.1	-0.0186	1.47
*539021	30	-40	-48.9	-0.0057	1.47
*539031	30	-30	-272.1	-0.0312	1.49
*539041	30	-30	-174.3	-0.0200	1.49
*539051	30	-30	-45.7	-0.0052	1.48
*539061	30	-25	-243.4	-0.0281	1.47
*539071	30	-25	-179.6	-0.0207	1.47
*539081	30	-25	-47.5	-0.0055	1.47
*539091	30	-20	-222.0	-0.0257	1.54
*539101	30	-20	-180.7	-0.0209	1.54
*539111	30	-20	-48.2	-0.0056	1.54
*539121	30	-15	-192.5	-0.0222	1.53
*539131	30	-15	-163.6	-0.0189	1.53
*539141	30	-15	-47.2	-0.0055	1.53
*539151	30	-10	-167.5	-0.0194	1.52
*539161	30	-10	-151.9	-0.0176	1.52
*539171	30	-10	-42.2	-0.0049	1.52
*539181	30	-5	-98.9	-0.0114	1.51
*539191	30	-5	-96.1	-0.0111	1.51
*539201	30	-5	-55.6	-0.0064	1.51
*539211	35	-40	-306.4	-0.0355	1.51
*539221	35	-40	-161.7	-0.0187	1.51
*539231	35	-40	-46.7	-0.0054	1.50
*539241	25	-30	-269.0	-0.0311	1.50
*539251	25	-30	-181.7	-0.0210	1.50
*539261	25	-30	-49.5	-0.0057	1.49
*539271	18	-23	-242.7	-0.0280	1.50
*539281	18	-23	-179.3	-0.0207	1.50
*539291	18	-23	-49.9	-0.0058	1.50
*539301	14	-19	-217.2	-0.0251	1.49
*539311	14	-19	-176.0	-0.0203	1.49
*539321	14	-19	-50.4	-0.0058	1.49
*539501	35	-40	-47.0	-0.0055	1.53
*539511	35	-40	-285.3	-0.0332	1.52

(*experiments with end plates attached)

TABLE 6.5 : DETAILS OF SINUSOIDAL EXPERIMENTS

TABLE 6.5.1 : SUMMARY OF OSCILLATIONS ABOUT 10^o (nominal)

Mean Incidence	10^o							
Amplitude	4^o		6^o		8^o		10^o	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 6.5.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10^o (nominal)

Mean Incidence	4^o		6^o		8^o		10^o	15^o	20^o
Amplitude	10^o								
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175	
Reynolds Number	1.5×10^6								

(all permutations)

TABLE 6.5.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8^o, WITH REYNOLDS NUMBER FIXED (nominal)

Mean Incidence	3^o	4^o	5^o	6^o	7^o	8^o	9^o	10^o
Amplitude	8^o							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

Mean Incidence	11^o	12^o	13^o	14^o	15^o	16^o	17^o	20^o
Amplitude	8^o							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 6.5.4 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REDUCED FREQUENCY FIXED (nominal)

Mean Incidence	3°	4°	5°	6°	7°	8°	9°	10°
Amplitude	8°							
Reduced Frequency	0.100							
Reynolds Number	1.0×10^6			1.5×10^6			2.0×10^6	

(all permutations)

Mean Incidence	11°	12°	13°	14°	15°	16°	17°	20°
Amplitude	8°							
Reduced Frequency	0.100							
Reynolds Number	1.0×10^6			1.5×10^6			2.0×10^6	

(all permutations)

TABLE 6.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
15021	10	4	0.010	1.50
15031	10	6	0.010	1.49
15041	10	8	0.010	1.49
15051	10	10	0.010	1.49
15061	10	4	0.025	1.49
15071	10	6	0.025	1.49
15081	10	8	0.025	1.48
15091	10	10	0.025	1.48
15101	10	4	0.051	1.49
15111	10	6	0.051	1.49
15121	10	8	0.051	1.49
15131	10	10	0.051	1.49
15141	10	4	0.076	1.49
15151	10	6	0.076	1.49
15161	10	8	0.076	1.49
15171	10	10	0.076	1.49
15181	10	4	0.101	1.50
15191	10	6	0.101	1.49
15201	10	8	0.101	1.49
15211	10	10	0.101	1.49

TABLE 6.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
15221	10	4	0.127	1.50
15231	10	6	0.126	1.49
15241	10	8	0.126	1.49
15251	10	10	0.126	1.49
15261	10	4	0.152	1.49
15271	10	6	0.152	1.49
15281	10	8	0.152	1.49
15291	10	10	0.152	1.49
15301	10	4	0.178	1.49
15311	10	6	0.178	1.49
15321	10	8	0.178	1.49
15331	10	10	0.178	1.49
15371	4	10	0.010	1.49
15381	6	10	0.010	1.48
15391	8	10	0.010	1.48
15401	15	10	0.010	1.48
15411	20	10	0.010	1.47
15421	4	10	0.025	1.48
15431	6	10	0.025	1.47
15441	8	10	0.025	1.47
15451	15	10	0.025	1.47
15461	20	10	0.025	1.47
15471	4	10	0.050	1.48
15481	6	10	0.050	1.47
15491	8	10	0.050	1.47
15501	15	10	0.050	1.47
15511	20	10	0.050	1.47
15521	4	10	0.076	1.48
15531	6	10	0.076	1.47
15541	8	10	0.076	1.47
15551	15	10	0.076	1.47
15561	20	10	0.076	1.47
15571	4	10	0.101	1.47
15581	6	10	0.101	1.47
15591	8	10	0.101	1.47
15601	15	10	0.101	1.47
15611	20	10	0.101	1.47
15621	4	10	0.126	1.48
15631	6	10	0.126	1.47
15641	8	10	0.126	1.47
15651	15	10	0.126	1.47
15661	20	10	0.126	1.47
15671	4	10	0.152	1.47
15681	6	10	0.152	1.47
15691	8	10	0.152	1.47
15701	15	10	0.152	1.47
15711	20	10	0.152	1.47
15721	4	10	0.177	1.48
15731	6	10	0.176	1.47
15741	8	10	0.176	1.47
15751	15	10	0.176	1.47

TABLE 6.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
15761	20	10	0.176	1.47
15771	3	8	0.010	1.49
15781	4	8	0.010	1.48
15791	5	8	0.010	1.48
15801	6	8	0.010	1.48
15811	7	8	0.010	1.48
15821	8	8	0.010	1.47
15831	9	8	0.010	1.47
15841	11	8	0.010	1.47
15851	12	8	0.010	1.48
15861	13	8	0.010	1.47
15871	14	8	0.010	1.47
15881	15	8	0.010	1.48
15881	15	8	0.010	1.48
15891	16	8	0.010	1.47
15901	17	8	0.010	1.47
15911	20	8	0.010	1.46
15921	3	8	0.025	1.47
15931	4	8	0.025	1.47
15941	5	8	0.025	1.47
15951	6	8	0.025	1.47
15961	7	8	0.025	1.47
15971	8	8	0.025	1.46
15981	9	8	0.025	1.46
15991	11	8	0.025	1.46
16001	12	8	0.025	1.48
16011	13	8	0.025	1.47
16021	14	8	0.025	1.47
16031	15	8	0.025	1.47
16041	16	8	0.025	1.47
16051	17	8	0.025	1.47
16061	20	8	0.025	1.47
16071	3	8	0.100	1.00
16081	4	8	0.100	1.00
16091	5	8	0.100	1.00
16101	6	8	0.100	1.00
16111	7	8	0.100	1.00
16121	8	8	0.100	1.00
16131	9	8	0.100	1.00
16142	10	8	0.101	1.00
16152	11	8	0.101	1.00
16162	12	8	0.101	1.00
16172	13	8	0.101	1.00
16182	14	8	0.101	1.00
16192	15	8	0.101	1.00
16202	16	8	0.101	1.00
16212	17	8	0.101	1.00
16221	3	8	0.051	1.49
16231	4	8	0.051	1.49
16241	5	8	0.051	1.48
16251	6	8	0.050	1.48

TABLE 6.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
16261	7	8	0.050	1.48
16271	8	8	0.050	1.48
16281	9	8	0.050	1.48
16291	11	8	0.050	1.48
16301	12	8	0.050	1.48
16311	13	8	0.050	1.49
16321	14	8	0.050	1.48
16331	15	8	0.050	1.48
16341	16	8	0.050	1.48
16351	17	8	0.050	1.48
16361	20	8	0.050	1.48
16371	3	8	0.076	1.48
16381	4	8	0.076	1.48
16391	5	8	0.076	1.48
16401	6	8	0.076	1.47
16411	7	8	0.076	1.47
16421	8	8	0.076	1.47
16431	9	8	0.076	1.47
16441	11	8	0.076	1.47
16451	12	8	0.076	1.47
16461	13	8	0.076	1.48
16471	14	8	0.076	1.47
16481	15	8	0.076	1.47
16491	16	8	0.076	1.47
16501	17	8	0.076	1.47
16511	20	8	0.076	1.47
16521	3	8	0.102	1.93
16531	4	8	0.102	1.93
16541	5	8	0.102	1.93
16551	6	8	0.102	1.93
16561	7	8	0.102	1.93
16571	8	8	0.102	1.92
16581	9	8	0.102	1.92
16591	10	8	0.102	1.92
16601	11	8	0.102	1.92
16621	3	8	0.101	1.50
16631	4	8	0.101	1.49
16641	5	8	0.101	1.49
16651	6	8	0.101	1.49
16661	7	8	0.101	1.49
16671	8	8	0.101	1.49
16681	9	8	0.101	1.49
16691	11	8	0.101	1.49
16701	12	8	0.101	1.49
16711	13	8	0.102	1.49
16721	14	8	0.102	1.49
16731	15	8	0.102	1.49
16741	16	8	0.102	1.49
16751	17	8	0.102	1.48
16761	20	8	0.102	1.48
16771	3	8	0.127	1.49

TABLE 6.5.5 : LIST OF SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
16781	4	8	0.127	1.49
16791	5	8	0.127	1.49
16801	6	8	0.127	1.49
16811	7	8	0.127	1.49
16821	8	8	0.127	1.49
16831	9	8	0.127	1.49
16841	11	8	0.127	1.49
16851	12	8	0.127	1.49
16861	13	8	0.127	1.49
16871	14	8	0.127	1.49
16881	15	8	0.127	1.49
16891	16	8	0.127	1.48
16901	17	8	0.127	1.48
16911	20	8	0.127	1.48
16921	3	8	0.152	1.50
16931	4	8	0.151	1.49
16941	5	8	0.151	1.49
16951	6	8	0.151	1.49
16961	7	8	0.151	1.49
16971	8	8	0.151	1.49
16981	9	8	0.151	1.49
16991	11	8	0.151	1.49
17001	12	8	0.151	1.49
17011	13	8	0.151	1.49
17021	14	8	0.151	1.49
17031	15	8	0.151	1.49
17041	16	8	0.151	1.49
17051	17	8	0.151	1.49
17051	17	8	0.151	1.49
17061	20	8	0.151	1.49
17071	3	8	0.178	1.50
17081	4	8	0.178	1.49
17091	5	8	0.177	1.49
17101	6	8	0.177	1.49
17111	7	8	0.177	1.49
17121	8	8	0.177	1.49
17131	9	8	0.177	1.49
17141	11	8	0.177	1.49
17151	12	8	0.177	1.49
17161	13	8	0.177	1.49
17171	14	8	0.177	1.49
17181	15	8	0.177	1.49
17191	16	8	0.177	1.49
17201	17	8	0.177	1.49
17211	20	8	0.177	1.49
17471	12	8	0.102	1.94
17481	13	8	0.102	1.94
17491	14	8	0.102	1.94
17501	15	8	0.102	1.94
17511	16	8	0.102	1.94
17521	17	8	0.102	1.93

TABLE 7 : EXPERIMENTS ON NACA 0015 WITH CHORD OF LENGTH 0.55m (MODEL 5)

TABLE 7.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 7.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Starting Incidence	0^o		180^o	
Incidence Sweep	24^o		-24^o	
Reynolds Number	0.8×10^6	1.1×10^6	1.5×10^6	2.0×10^6

(all permutations)

TABLE 7.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^{-6}
00011	0	24	0.82
00012	0	24	0.81
00013	0	24	0.83
00021	0	-24	0.82
00022	0	-24	0.80
00023	0	-24	0.82
00031	0	24	1.11
00032	0	24	1.10
00033	0	24	1.13
00041	0	-24	1.10
00042	0	-24	1.10
00043	0	-24	1.12
00051	0	24	1.51
00051	0	24	1.48
00051	0	24	1.52
00061	0	-24	1.50
00062	0	-24	1.47
00063	0	-24	1.53
00071	0	24	1.97
00081	0	-24	1.94
00082	0	-24	1.98
400091	180	25	0.79
400101	180	-24	0.79
400111	180	25	1.11
400121	180	-25	1.11
400131	180	25	1.48
400141	180	-25	1.48
400151	180	25	1.90
400161	180	-25	1.90

TABLE 7.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 7.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Angle of Attack	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

TABLE 7.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40171	0	100	1.50
40181	1	100	1.50
40191	2	100	1.50
40201	3	100	1.50
40211	4	100	1.50
40221	5	100	1.50
40231	6	100	1.50
40241	7	100	1.49
40251	8	100	1.49
40261	9	100	1.49
40271	10	100	1.49
40281	11	100	1.49
40291	12	100	1.49
40301	13	100	1.49
40311	14	100	1.49
40321	15	100	1.49
40331	16	100	1.49
40341	17	100	1.49
40351	18	100	1.49
40361	19	100	1.49
40371	20	100	1.49
40381	21	100	1.48

TABLE 7.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (concluded)

Run Number	Angle of Attack (^{o})	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40391	22	100	1.48
40401	23	100	1.48
40411	24	100	1.48
40421	25	100	1.48
40431	26	100	1.48
40441	27	100	1.48
40451	28	100	1.49
40461	29	100	1.49
40471	30	100	1.48
40481	31	100	1.48
40491	32	100	1.48
40501	33	100	1.48
40511	34	100	1.48
40521	35	100	1.48
40531	0	500	1.48
40541	1	500	1.48
40551	2	500	1.48
40561	3	500	1.48
40571	4	500	1.48
40581	5	500	1.48
40591	6	500	1.47
40601	7	500	1.47
40611	8	500	1.47
40621	9	500	1.47
40631	10	500	1.47
40641	11	500	1.47
40651	12	500	1.47
40661	13	500	1.47
40671	14	500	1.49
40681	15	500	1.49
40691	16	500	1.49
40701	17	500	1.49
40711	18	500	1.49
40721	19	500	1.49
40731	20	500	1.49
40741	21	500	1.49
40751	22	500	1.49
40761	23	500	1.49
40771	24	500	1.48
40781	25	500	1.48
40791	26	500	1.48
40801	27	500	1.48
40811	28	500	1.49
40821	29	500	1.49
40831	30	500	1.48
40841	31	500	1.48
40851	32	500	1.48
40861	33	500	1.48
40871	34	500	1.48
40881	35	500	1.48

TABLE 7.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 7.3.1 : SUMMARY OF RAMPS FROM -1° TO 40° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
0.75	1.5	75.0	1.5	215.0	1.5
1.5	1.5	90.0	1.5	230.0	1.5
3.0	1.5	100.0	1.0 1.5 2.0	245.0	1.5
4.5	1.5	115.0	1.5	260.0	1.5
6.0	1.5	130.0	1.5	275.0	1.5
7.5	1.5	145.0	1.5	290.0	1.5
15.0	1.5	160.0	1.5	300.0	1.0 1.5 2.0
30.0	1.0 1.5 2.0	175.0	1.5	315.0	1.5
45.0	1.5	190.0	1.5	330.0	1.5
60.0	1.5	200.0	1.0 1.5 2.0	345.0	1.5

(all permutations)

TABLE 7.3.2 : SUMMARY OF SHORT RAMPS (nominal)

Starting Incidence	0°								
Finishing Incidence	4°		8°		12°		30°		
Pitch Rate ($^{o}s^{-1}$)	50	100	200	300	350	400*	450*	500*	550*
Reynolds Number	1.5×10^{6}								

(all permutations, except * (not for finishing incidence of 30°))

TABLE 7.3.3 : SUMMARY OF IMPULSE RAMPS (nominal)

Starting Incidence	0°			
Finishing Incidence	4°	8°	12°	
Pitch Rate ($^{o}s^{-1}$)	**STEP**			
Reynolds Number	0.50×10^{6}	0.75×10^{6}	1.00×10^{6}	1.25×10^{6}

(all permutations)

TABLE 7.3.4 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25001	0	4	44.9	0.0054	1.50
25011	0	4	77.2	0.0092	1.49
25021	0	4	78.4	0.0094	1.49
25031	0	4	80.0	0.0095	1.49
25091	0	8	45.2	0.0054	1.50
25101	0	8	80.4	0.0096	1.49
25111	0	8	138.5	0.0165	1.49
25121	0	8	148.3	0.0176	1.49
25141	0	8	149.6	0.0178	1.49
25151	0	8	153.2	0.0183	1.48
25161	0	8	155.7	0.0186	1.48
25171	0	8	141.4	0.0169	1.48
25181	0	8	148.4	0.0177	1.48
25201	0	12	81.1	0.0096	1.48
25211	0	12	158.8	0.0188	1.48
25221	0	12	203.1	0.0241	1.48
25241	0	12	197.7	0.0233	1.48
25251	0	12	204.1	0.0241	1.48
25261	0	12	201.8	0.0238	1.48
25271	0	12	195.4	0.0230	1.48
25281	0	30	49.5	0.0058	1.49
25291	0	30	98.8	0.0116	1.48
25301	0	30	184.8	0.0217	1.48
25311	0	30	254.1	0.0298	1.48
25321	0	30	281.3	0.0330	1.48
25331	-1	41	0.7	0.0001	1.49
25341	-1	41	1.5	0.0002	1.49
25351	-1	41	2.9	0.0003	1.48
25361	-1	41	4.4	0.0005	1.48
25371	-1	41	6.0	0.0007	1.48
25381	-1	41	7.5	0.0009	1.48
25391	-1	41	15.0	0.0017	1.48
25401	-1	41	29.7	0.0034	1.47
25411	-1	41	44.2	0.0051	1.47
25421	-1	41	59.5	0.0069	1.48
25431	-1	41	75.0	0.0087	1.47
25441	-1	41	90.4	0.0104	1.47
25451	-1	41	100.9	0.0116	1.47
25461	-1	41	115.2	0.0133	1.47
25471	-1	41	129.5	0.0153	1.48
25481	-1	41	146.2	0.0172	1.47
25491	-1	41	159.0	0.0187	1.47
25501	-1	41	173.0	0.0203	1.47
25511	-1	41	184.7	0.0217	1.47

TABLE 7.3.4 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25521	-1	41	195.4	0.0230	1.47
25531	-1	41	205.8	0.0242	1.46
25541	-1	41	225.1	0.0264	1.46
25551	-1	41	234.5	0.0274	1.47
25561	-1	41	245.9	0.0287	1.47
25571	-1	41	259.1	0.0302	1.47
25581	-1	41	267.7	0.0312	1.46
25591	-1	41	276.5	0.0321	1.48
25601	-1	41	289.5	0.0336	1.47
25611	-1	41	300.9	0.0349	1.47
25621	-1	41	305.2	0.0354	1.47
25631	-1	41	29.6	0.0052	0.99
25641	-1	41	101.0	0.0178	0.99
25651	-1	41	194.8	0.0343	0.99
25661	-1	41	276.4	0.0487	0.99
25671	-1	41	29.6	0.0027	1.91
25681	-1	41	100.6	0.0090	1.88
25691	-1	41	190.6	0.0170	1.88
25701	-1	41	277.0	0.0248	1.87
25711	0	4	103.8	0.0152	1.17
25721	0	8	181.9	0.0266	1.17
25731	0	12	217.1	0.0318	1.17
25741	0	4	82.1	0.0141	1.01
25751	0	8	158.5	0.0272	1.01
25761	0	12	214.6	0.0368	1.01
25771	0	4	94.0	0.0256	0.64
25781	0	8	164.9	0.0449	0.64
25791	0	12	212.4	0.0579	0.64
25801	0	4	82.1	0.0283	0.50
25811	0	8	174.5	0.0602	0.50
25821	0	12	212.1	0.0731	0.50

TABLE 7.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 7.4.1 : SUMMARY OF RAMPS FROM 40° TO -1° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
-0.75	1.5	-75.0	1.5	-215.0	1.5
-1.5	1.5	-90.0	1.5	-230.0	1.5
-3.0	1.5	-100.0	1.0 1.5	-245.0	1.5
-4.5	1.5	-115.0	1.5	-260.0	1.5
-6.0	1.5	-130.0	1.5	-275.0	1.5
-7.5	1.5	-145.0	1.5	-290.0	1.5
-15.0	1.5	-160.0	1.5	-300.0	1.0 1.5
-30.0	1.0 1.5	-175.0	1.5	-315.0	1.5
-45.0	1.5	-190.0	1.5	-330.0	1.5
-60.0	1.5	-200.0	1.0 1.5	-345.0	1.5

(all permutations)

TABLE 7.4.2 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate (°s^{-1})	Reduced Pitch Rate	Reynolds No. x 10^{-6}
36331	40	-41	-0.7	-0.0001	1.49
36341	40	-41	-1.5	-0.0002	1.48
36351	40	-41	-3.0	-0.0003	1.47
36361	40	-41	-4.4	-0.0005	1.47
36371	40	-41	-5.9	-0.0007	1.46
36381	40	-41	-7.2	-0.0008	1.46
36391	40	-41	-14.4	-0.0017	1.47
36401	40	-41	-28.7	-0.0033	1.46
36411	40	-41	-43.9	-0.0050	1.46
36421	40	-41	-56.8	-0.0065	1.48
36431	40	-41	-71.0	-0.0081	1.47
36441	40	-41	-86.0	-0.0098	1.47
36451	40	-41	-93.0	-0.0106	1.47

TABLE 7.4.2 : LIST OF RAMP DOWN EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
36461	40	-41	-104.6	-0.0119	1.47
36471	40	-41	-118.1	-0.0136	1.47
36481	40	-41	-132.1	-0.0152	1.46
36491	40	-41	-145.3	-0.0167	1.46
36501	40	-41	-156.5	-0.0180	1.46
36511	40	-41	-169.3	-0.0193	1.48
36521	40	-41	-179.0	-0.0204	1.47
36531	40	-41	-188.0	-0.0214	1.47
36541	40	-41	-197.9	-0.0225	1.47
36551	40	-41	-210.7	-0.0241	1.47
36561	40	-41	-218.4	-0.0249	1.47
36571	40	-41	-233.6	-0.0266	1.46
36581	40	-41	-242.9	-0.0277	1.46
36591	40	-41	-250.8	-0.0285	1.48
36601	40	-41	-260.5	-0.0296	1.48
36611	40	-41	-279.4	-0.0317	1.47
36621	40	-41	-289.3	-0.0328	1.47
36631	40	-41	-28.9	-0.0051	0.99
36641	40	-41	-93.0	-0.0166	0.98
36651	40	-41	-178.0	-0.0317	0.98
36661	40	-41	-261.4	-0.0466	0.98

TABLE 7.5 : DETAILS OF GENERAL SINUSOIDAL EXPERIMENTS

TABLE 7.5.1 : SUMMARY OF OSCILLATIONS ABOUT 10° (nominal)

Mean Incidence	10°							
Amplitude	4°		6°		8°		10°	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 7.5.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10° (nominal)

Mean Incidence	4°	6°	8°	10°	15°	20°		
Amplitude	10°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 7.5.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REYNOLDS NUMBER FIXED (nominal)

Mean Incidence	3°	4°	5°	6°	7°	8°	9°	10°
Amplitude	8°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

Mean Incidence	11°	12°	13°	14°	15°	17°	20°
Amplitude	8°						
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 7.5.4 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REDUCED FREQUENCY FIXED (nominal)

Mean Incidence	7°	8°	9°	10°	11°	12°	13°	14°	15°	17°	20°
Amplitude	8°										
Reduced Frequency	0.100										
Reynolds Number	1.0×10^6					1.5×10^6				2.0×10^6	

(all permutations)

TABLE 7.5.5 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12001	10	4	0.011	1.49
12011	10	6	0.011	1.48
12021	10	8	0.011	1.48
12031	10	10	0.011	1.48
12041	10	4	0.026	1.49
12051	10	6	0.026	1.48
12061	10	8	0.026	1.48
12071	10	10	0.026	1.48
12081	10	4	0.053	1.49
12091	10	6	0.052	1.48
12101	10	8	0.052	1.48
12111	10	10	0.052	1.48
12121	10	4	0.078	1.49
12131	10	6	0.078	1.49
12141	10	8	0.078	1.48
12151	10	10	0.078	1.48
12161	10	4	0.104	1.48
12171	10	6	0.104	1.48
12181	10	8	0.104	1.48
12191	10	10	0.104	1.48
12201	10	4	0.130	1.48

TABLE 7.5.5 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12211	10	6	0.130	1.48
12221	10	8	0.130	1.48
12231	10	10	0.130	1.48
12241	10	4	0.156	1.48
12251	10	6	0.156	1.48
12261	10	8	0.156	1.48
12271	10	10	0.156	1.48
12281	10	4	0.182	1.48
12291	10	6	0.182	1.47
12301	10	8	0.182	1.47
12311	10	10	0.182	1.47
12371	3	8	0.011	1.49
12381	4	8	0.010	1.48
12391	5	8	0.010	1.47
12401	6	8	0.010	1.47
12411	7	8	0.010	1.47
12421	8	8	0.010	1.48
12431	9	8	0.010	1.48
12441	11	8	0.010	1.47
12451	12	8	0.010	1.47
12461	13	8	0.010	1.47
12471	14	8	0.010	1.48
12481	15	8	0.010	1.48
12491	17	8	0.010	1.48
12501	20	8	0.010	1.48
12511	3	8	0.026	1.48
12521	4	8	0.026	1.47
12531	5	8	0.026	1.47
12541	6	8	0.026	1.47
12551	7	8	0.026	1.47
12561	8	8	0.026	1.48
12571	9	8	0.026	1.48
12581	11	8	0.026	1.48
12591	12	8	0.026	1.48
12601	13	8	0.026	1.47
12621	15	8	0.025	1.48
12631	17	8	0.025	1.48
12641	20	8	0.025	1.48
12651	3	8	0.051	1.48
12661	4	8	0.051	1.48
12671	5	8	0.051	1.48
12681	6	8	0.051	1.48
12691	7	8	0.051	1.48
12701	8	8	0.051	1.48
12711	9	8	0.051	1.47
12721	11	8	0.051	1.47
12731	12	8	0.051	1.47

TABLE 7.5.5 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12741	13	8	0.051	1.47
12751	14	8	0.051	1.48
12761	15	8	0.051	1.48
12771	17	8	0.051	1.48
12781	20	8	0.051	1.48
12791	3	8	0.077	1.50
12801	4	8	0.077	1.49
12811	5	8	0.077	1.49
12821	6	8	0.077	1.49
12831	7	8	0.077	1.49
12841	8	8	0.078	1.48
12851	9	8	0.078	1.47
12861	11	8	0.078	1.47
12871	12	8	0.078	1.47
12881	13	8	0.078	1.47
12891	14	8	0.078	1.47
12901	15	8	0.078	1.47
12911	17	8	0.078	1.47
12921	20	8	0.078	1.47
12931	3	8	0.103	1.48
12941	4	8	0.103	1.48
12951	5	8	0.103	1.48
12961	6	8	0.103	1.48
12971	7	8	0.103	1.48
12981	8	8	0.102	1.48
12991	9	8	0.102	1.48
13001	11	8	0.102	1.48
13011	12	8	0.102	1.48
13021	13	8	0.102	1.48
13031	14	8	0.102	1.49
13041	15	8	0.102	1.48
13051	17	8	0.102	1.48
13061	20	8	0.102	1.48
13071	3	8	0.129	1.48
13081	4	8	0.128	1.48
13091	5	8	0.128	1.48
13101	6	8	0.128	1.47
13111	7	8	0.128	1.47
13121	8	8	0.128	1.47
13131	9	8	0.128	1.47
13141	11	8	0.128	1.49
13151	12	8	0.128	1.48
13161	13	8	0.128	1.48
13171	14	8	0.128	1.48
13181	15	8	0.128	1.48

TABLE 7.5.5 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13191	17	8	0.128	1.48
13201	20	8	0.127	1.48
13211	3	8	0.157	1.48
13221	4	8	0.157	1.47
13231	5	8	0.157	1.47
13241	6	8	0.156	1.47
13251	7	8	0.156	1.47
13261	8	8	0.156	1.47
13271	9	8	0.156	1.47
13281	11	8	0.155	1.49
13291	12	8	0.154	1.49
13301	13	8	0.154	1.49
13311	14	8	0.154	1.49
13321	15	8	0.154	1.49
13331	17	8	0.154	1.49
13341	20	8	0.154	1.49
13351	3	8	0.180	1.49
13361	4	8	0.180	1.49
13371	5	8	0.180	1.49
13381	6	8	0.180	1.49
13391	7	8	0.180	1.49
13401	8	8	0.180	1.49
13411	9	8	0.180	1.49
13421	11	8	0.180	1.48
13431	12	8	0.180	1.48
13441	13	8	0.180	1.48
13451	14	8	0.180	1.48
13461	15	8	0.180	1.48
13471	17	8	0.180	1.48
13481	20	8	0.180	1.48
13631	7	8	0.102	1.01
13641	8	8	0.102	1.01
13651	9	8	0.102	1.01
13661	10	8	0.102	1.01
13671	11	8	0.102	1.01
13681	12	8	0.102	1.01
13691	13	8	0.102	1.01
13701	14	8	0.102	1.01
13711	15	8	0.102	1.01
13721	17	8	0.102	1.01
13731	20	8	0.102	1.01
13741	7	8	0.104	1.97
13751	8	8	0.103	1.95
13761	9	8	0.103	1.94
13771	10	8	0.103	1.94
13781	11	8	0.103	1.94

TABLE 7.5.5 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13791	12	8	0.103	1.94
13811	13	8	0.103	1.94
13821	14	8	0.103	1.94
13831	15	8	0.103	1.93
13841	17	8	0.103	1.93
13851	20	8	0.103	1.93
13871	4	10	0.011	1.48
13881	6	10	0.011	1.47
13891	8	10	0.011	1.47
13901	15	10	0.010	1.46
13911	20	10	0.010	1.46
13921	4	10	0.026	1.49
13931	6	10	0.026	1.48
13941	8	10	0.026	1.48
13951	15	10	0.026	1.48
13961	20	10	0.026	1.48
13971	4	10	0.051	1.49
13981	6	10	0.051	1.48
13991	8	10	0.051	1.48
14001	15	10	0.051	1.48
14011	20	10	0.051	1.48
14021	4	10	0.077	1.49
14031	6	10	0.077	1.48
14041	8	10	0.077	1.48
14051	15	10	0.077	1.48
14061	20	10	0.077	1.48
14071	4	10	0.102	1.48
14081	6	10	0.102	1.48
14091	8	10	0.102	1.48
14101	15	10	0.102	1.48
14111	20	10	0.102	1.48
14121	4	10	0.128	1.49
14131	6	10	0.127	1.49
14141	8	10	0.127	1.48
14151	15	10	0.127	1.48
14161	20	10	0.127	1.48
14171	4	10	0.153	1.49
14181	6	10	0.153	1.48
14191	8	10	0.153	1.48
14201	15	10	0.153	1.48
14211	20	10	0.153	1.48
14221	4	10	0.179	1.48
14231	6	10	0.179	1.48
14241	8	10	0.179	1.48
14251	15	10	0.179	1.48
14261	20	10	0.179	1.48

TABLE 7.6 : DETAILS OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS

TABLE 7.6.1 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.05						
Reynolds Number	0.8×10^6		1.1×10^6		1.5×10^6		2.0×10^6

(all permutations)

TABLE 7.6.2 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.02		0.04		0.05	0.06	0.075
Reynolds Number	1.5×10^6						

(all permutations)

TABLE 7.6.3 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT MEAN INCIDENCE OF 180^o (nominal)

Mean Incidence	180^o			
Amplitude	4^o	6^o	8^o	10^o
Reduced Frequency	0.04	0.05		0.06
Reynolds Number	1.5×10^6			

(all permutations)

TABLE 7.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11001	0	5.4	0.050	0.80
11021	0	9.9	0.050	0.80
11041	0	12.2	0.050	0.80
11061	0	13.8	0.050	0.80
11081	0	17.4	0.050	0.80
19001	0	22.6	0.050	0.80
19021	0	32.8	0.050	0.80
11101	0	5.4	0.051	1.09
11121	0	9.9	0.051	1.09
11141	0	12.2	0.051	1.09
11161	0	13.8	0.050	1.10
11181	0	17.4	0.050	1.09
19041	0	22.6	0.050	1.10
19061	0	32.8	0.050	1.10
11201	0	5.4	0.041	1.49
11221	0	9.9	0.041	1.49
11241	0	12.2	0.041	1.48
11261	0	13.8	0.041	1.47
11281	0	17.4	0.041	1.47
19081	0	22.6	0.041	1.48
19101	0	32.8	0.041	1.47
11301	0	5.4	0.051	1.46
11321	0	9.9	0.051	1.46
11341	0	12.2	0.051	1.47
11361	0	13.8	0.051	1.47
11381	0	17.4	0.051	1.46
19121	0	22.6	0.051	1.47
19141	0	32.8	0.051	1.46
11401	0	5.4	0.061	1.51
11421	0	9.9	0.061	1.50
11441	0	12.2	0.061	1.50
11461	0	13.8	0.061	1.50
11481	0	17.4	0.061	1.51
19161	0	22.6	0.061	1.49
19181	0	32.8	0.061	1.49
11501	0	5.4	0.051	1.98
11521	0	9.9	0.051	1.95
11541	0	12.2	0.051	1.95
11561	0	13.8	0.052	1.95
11581	0	17.4	0.051	1.93
19201	0	22.6	0.051	1.92

TABLE 7.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
19301	0	5.4	0.078	1.47
19321	0	9.9	0.078	1.46
19341	0	12.2	0.078	1.46
19361	0	13.8	0.078	1.46
19381	0	17.4	0.078	1.45
19401	0	22.6	0.078	1.45
19441	0	5.4	0.020	1.49
19461	0	9.9	0.020	1.48
19481	0	12.2	0.020	1.49
19501	0	13.8	0.020	1.48
19521	0	17.4	0.020	1.47
19541	0	22.6	0.020	1.48
19561	0	32.8	0.020	1.47
411601	180	4	0.050	0.80
411611	180	6	0.050	0.80
411621	180	8	0.050	1.10
411631	180	10	0.050	1.10
411661	180	4	0.041	1.48
411671	180	6	0.041	1.47
411681	180	8	0.051	1.47
411691	180	10	0.051	1.46
411721	180	4	0.061	1.49
411731	180	6	0.061	1.49
411741	180	8	0.051	1.92
411751	180	10	0.078	1.47

TABLE 7.7 : DETAILS OF SINGLE STREAMTUBE VAWT EXPERIMENTS

TABLE 7.7.1 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.05						
Reynolds Number	$0.8x10^6$		$1.1x10^6$		$1.5x10^6$		$2.0x10^6$

(all permutations)

TABLE 7.7.2 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.02		0.04	0.05		0.06	0.075
Reynolds Number	$1.5x10^6$						

(all permutations)

TABLE 7.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51011	0	6.00	0.050	0.80
51031	0	4.00	0.050	0.80
51051	0	3.50	0.050	0.80
51071	0	3.25	0.050	0.80
51091	0	2.80	0.050	0.80
59011	0	2.33	0.050	0.80
59031	0	1.75	0.050	0.80
51111	0	6.00	0.051	1.09
51131	0	4.00	0.051	1.09
51151	0	3.50	0.051	1.09
51171	0	3.25	0.050	1.09
51191	0	2.80	0.050	1.09
59051	0	2.33	0.050	1.10
59071	0	1.75	0.050	1.10

TABLE 7.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (concluded)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51211	0	6.00	0.041	1.49
51231	0	4.00	0.041	1.48
51251	0	3.50	0.041	1.48
51271	0	3.25	0.041	1.47
51291	0	2.80	0.041	1.47
59091	0	2.33	0.041	1.47
59111	0	1.75	0.041	1.47
51311	0	6.00	0.051	1.46
51331	0	4.00	0.051	1.46
51351	0	3.50	0.051	1.46
51371	0	3.25	0.051	1.46
51391	0	2.80	0.051	1.46
59131	0	2.33	0.051	1.46
59151	0	1.75	0.050	1.46
51411	0	6.00	0.061	1.50
51431	0	4.00	0.061	1.50
51451	0	3.50	0.061	1.49
51471	0	3.25	0.061	1.50
51491	0	2.80	0.061	1.50
59171	0	2.33	0.061	1.49
59191	0	1.75	0.061	1.49
51511	0	6.00	0.051	1.95
51531	0	4.00	0.051	1.94
51551	0	3.50	0.051	1.94
51571	0	3.25	0.051	1.93
51591	0	2.80	0.051	1.92
59211	0	2.33	0.051	1.92
59311	0	6.00	0.078	1.46
59331	0	4.00	0.078	1.46
59351	0	3.50	0.078	1.46
59371	0	3.25	0.078	1.46
59391	0	2.80	0.078	1.45
59411	0	2.33	0.078	1.45
59451	0	6.00	0.020	1.48
59471	0	4.00	0.020	1.48
59491	0	3.50	0.020	1.48
59511	0	3.25	0.020	1.47
59531	0	2.80	0.020	1.47
59551	0	2.33	0.020	1.47
59571	0	1.75	0.020	1.47

TABLE 7.8 : DETAILS OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS

TABLE 7.8.1 : SUMMARY OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (nominal)

Mean Incidence	0^o			
Tip Speed Ratio	3.25	3.50	4.00	6.00
Reduced Frequency	0.040	0.050	0.060	
Reynolds Number	1.5×10^6			

(all permutations)

TABLE 7.8.2 : LIST OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
71781	0	6.00	0.041	1.53
71791	0	4.00	0.041	1.52
71801	0	3.50	0.041	1.52
71811	0	3.25	0.041	1.51
71821	0	6.00	0.052	1.49
71831	0	4.00	0.052	1.48
71841	0	3.50	0.052	1.48
71851	0	3.25	0.052	1.48
71861	0	6.00	0.062	1.48
71871	0	4.00	0.062	1.48
71881	0	3.50	0.062	1.48
71891	0	3.25	0.062	1.47

TABLE 8 : EXPERIMENTS ON NACA 0018 (MODEL 6)

TABLE 8.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 8.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Starting Incidence	0^o		180^o	
Incidence Sweep	30^o		-30^o	
Reynolds Number	0.8×10^6	1.1×10^6	1.5×10^6	2.0×10^6

(all permutations)

TABLE 8.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^{-6}
00011	0	30	0.81
00012	0	30	0.80
00021	0	-30	0.81
00031	0	30	1.08
00032	0	30	1.15
00041	0	-30	1.09
00051	0	30	1.53
00052	0	30	1.54
00061	0	-30	1.48
00071	0	30	1.96
00072	0	30	2.00
00081	0	-30	1.91
400091	180	30	0.82
400101	180	-30	0.82
400111	180	30	1.09
400121	180	-30	1.09
400131	180	30	1.45
400141	180	-30	1.44
400151	180	30	1.94
400161	180	-30	1.92

TABLE 8.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 8.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Angle of Attack	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

TABLE 8.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40171	0	100	1.52
40181	1	100	1.51
40191	2	100	1.51
40201	3	100	1.51
40211	4	100	1.51
40221	5	100	1.51
40231	6	100	1.51
40241	7	100	1.51
40251	8	100	1.50
40261	9	100	1.50
40271	10	100	1.50
40281	11	100	1.50
40291	12	100	1.50
40301	13	100	1.50
40311	14	100	1.51
40321	15	100	1.50
40331	16	100	1.50
40341	17	100	1.50
40351	18	100	1.50
40361	19	100	1.50
40371	20	100	1.50
40381	21	100	1.50

TABLE 8.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (concluded)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40391	22	100	1.50
40401	23	100	1.50
40411	24	100	1.50
40421	25	100	1.50
40431	26	100	1.50
40441	27	100	1.50
40451	28	100	1.50
40461	29	100	1.50
40471	30	100	1.49
40481	31	100	1.49
40491	32	100	1.49
40501	33	100	1.49
40511	34	100	1.49
40521	35	100	1.49
40531	0	500	1.49
40541	1	500	1.49
40551	2	500	1.49
40561	3	500	1.49
40571	4	500	1.49
40581	5	500	1.49
40591	6	500	1.49
40601	7	500	1.49
40611	8	500	1.49
40621	9	500	1.49
40631	10	500	1.49
40641	11	500	1.49
40651	12	500	1.49
40661	13	500	1.48
40671	14	500	1.48
40681	15	500	1.48
40691	16	500	1.48
40701	17	500	1.48
40711	18	500	1.48
40721	19	500	1.48
40731	20	500	1.48
40741	21	500	1.48
40751	22	500	1.48
40761	23	500	1.47
40771	24	500	1.47
40781	25	500	1.47
40791	26	500	1.47
40801	27	500	1.47
40811	28	500	1.48
40821	29	500	1.48
40831	30	500	1.48
40841	31	500	1.48
40851	32	500	1.48
40861	33	500	1.48
40871	34	500	1.48
40881	35	500	1.48

TABLE 8.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 8.3.1 : SUMMARY OF RAMPS FROM -1° TO 40° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
0.75	1.5	75.0	1.5	215.0	1.5
1.5	1.5	90.0	1.5	230.0	1.5
3.0	1.5	100.0	1.0 1.5 2.0	245.0	1.5
4.5	1.5	115.0	1.5	260.0	1.5
6.0	1.5	130.0	1.5	275.0	1.5
7.5	1.5	145.0	1.5	290.0	1.5
15.0	1.5	160.0	1.5	300.0	1.0 1.5 2.0
30.0	1.0 1.5 2.0	175.0	1.5	315.0	1.5
45.0	1.5	190.0	1.5	330.0	1.5
60.0	1.5	200.0	1.0 1.5 2.0	345.0	1.5

(all permutations)

TABLE 8.3.2 : SUMMARY OF SHORT RAMPS (nominal)

Starting Incidence	0°								
Finishing Incidence	4°		8°		12°		30°		
Pitch Rate (°s^{-1})	50	100	200	300	350	400*	450*	500*	550*
Reynolds Number	1.5 x 10^6								

(all permutations, except * (not for finishing incidence of 4° or 30°))

TABLE 8.3.3 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25001	0	4	33.1	0.0039	1.49
25011	0	4	47.7	0.0056	1.49
25021	0	4	50.9	0.0059	1.48
25031	0	4	48.1	0.0056	1.48
25091	0	8	46.1	0.0054	1.49
25101	0	8	74.3	0.0086	1.49
25111	0	8	99.0	0.0115	1.49
25121	0	8	101.8	0.0118	1.48
25141	0	8	100.9	0.0117	1.49
25151	0	8	101.9	0.0118	1.49
25161	0	8	113.3	0.0131	1.49
25171	0	8	99.2	0.0115	1.49
25181	0	8	107.1	0.0124	1.49
25191	0	12	46.7	0.0054	1.49
25201	0	12	82.9	0.0096	1.49
25211	0	12	130.4	0.0150	1.48
25221	0	12	152.3	0.0175	1.48
25231	0	12	158.0	0.0182	1.49
25241	0	12	159.7	0.0184	1.48
25251	0	12	155.2	0.0179	1.48
25261	0	12	163.1	0.0188	1.48
25271	0	12	155.2	0.0179	1.48
25281	0	30	49.5	0.0057	1.48
25291	0	30	96.0	0.0111	1.47
25301	0	30	171.1	0.0198	1.47
25311	0	30	227.6	0.0263	1.47
25321	0	30	249.3	0.0288	1.47
25331	-1	41	0.7	0.0001	1.46
25341	-1	41	1.5	0.0002	1.47
25351	-1	41	3.0	0.0003	1.46
25361	-1	41	4.4	0.0005	1.46
25371	-1	41	5.9	0.0007	1.45
25381	-1	41	7.4	0.0009	1.45
25391	-1	41	14.7	0.0017	1.47
25401	-1	41	29.5	0.0034	1.46
25411	-1	41	45.0	0.0052	1.46
25421	-1	41	59.6	0.0069	1.47
25431	-1	41	73.8	0.0085	1.46
25441	-1	41	89.9	0.0104	1.46
25451	-1	41	99.7	0.0115	1.46

TABLE 8.3.3 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (^{o})	Arc (^{o})	Pitch Rate ($^o s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25461	-1	41	113.1	0.0131	1.46
25471	-1	41	126.1	0.0145	1.47
25481	-1	41	140.8	0.0162	1.46
25491	-1	41	155.9	0.0179	1.46
25501	-1	41	165.4	0.0190	1.46
25511	-1	41	179.2	0.0207	1.46
25521	-1	41	187.3	0.0216	1.46
25531	-1	41	199.7	0.0230	1.45
25541	-1	41	213.7	0.0246	1.45
25551	-1	41	225.7	0.0261	1.45
25561	-1	41	238.0	0.0275	1.45
25571	-1	41	245.2	0.0283	1.44
25581	-1	41	256.9	0.0296	1.44
25591	-1	41	263.6	0.0305	1.45
25601	-1	41	281.2	0.0325	1.44
25611	-1	41	287.5	0.0332	1.44
25621	-1	41	294.8	0.0341	1.44
25631	-1	41	50.1	0.0084	1.00
25641	-1	41	98.3	0.0165	1.00
25651	-1	41	183.9	0.0309	0.99
25691	-1	41	182.7	0.0162	1.86
25701	-1	41	244.6	0.0216	1.85

TABLE 8.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 8.4.1 : SUMMARY OF RAMPS FROM 40^{o} TO -1^{o} (nominal)

Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$
-0.75		-75.0		-215.0	
-1.5		-90.0		-230.0	
-3.0		-100.0		-245.0	
-4.5		-115.0		-260.0	
-6.0	1.5	-130.0	1.5	-275.0	1.5
-7.5		-145.0		-290.0	
-15.0		-160.0		-300.0	
-30.0		-175.0		-315.0	
-45.0		-190.0		-330.0	
-60.0		-200.0		-345.0	

(all permutations)

TABLE 8.4.2 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (^{o})	Arc (^{o})	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
36331	40	-41	-0.7	-0.0001	1.50
36341	40	-41	-1.4	-0.0002	1.49
36351	40	-41	-2.9	-0.0003	1.48
36361	40	-41	-4.3	-0.0005	1.48
36371	40	-41	-5.7	-0.0007	1.48
36381	40	-41	-7.3	-0.0008	1.48
36391	40	-41	-14.3	-0.0017	1.48
36401	40	-41	-28.5	-0.0033	1.47
36411	40	-41	-41.8	-0.0048	1.47
36421	40	-41	-55.2	-0.0064	1.47

TABLE 8.4.2 : LIST OF RAMP DOWN EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
36431	40	-41	-69.4	-0.0080	1.47
36441	40	-41	-81.9	-0.0095	1.47
36451	40	-41	-93.4	-0.0108	1.47
36461	40	-41	-104.0	-0.0120	1.47
36471	40	-41	-117.4	-0.0137	1.46
36481	40	-41	-128.5	-0.0149	1.46
36491	40	-41	-141.8	-0.0165	1.45
36501	40	-41	-152.3	-0.0177	1.45
36511	40	-41	-164.3	-0.0191	1.45
36521	40	-41	-172.4	-0.0201	1.45
36531	40	-41	-181.0	-0.0211	1.45
36541	40	-41	-189.8	-0.0221	1.45
36551	40	-41	-201.0	-0.0233	1.46
36561	40	-41	-211.1	-0.0244	1.46
36571	40	-41	-221.5	-0.0256	1.46
36581	40	-41	-231.5	-0.0267	1.45
36591	40	-41	-258.9	-0.0300	1.46
36601	40	-41	-265.7	-0.0307	1.45
36611	40	-41	-283.1	-0.0327	1.45
36621	40	-41	-296.6	-0.0343	1.45

TABLE 8.5 : DETAILS OF GENERAL SINUSOIDAL EXPERIMENTS

TABLE 8.5.1 : SUMMARY OF OSCILLATIONS ABOUT 10^o (nominal)

Mean Incidence	10^o							
Amplitude	4^o		6^o		8^o		10^o	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 8.5.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10^o (nominal)

Mean Incidence	4^o		6^o		8^o		10^o		15^o		20^o	
Amplitude	10^o											
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175				
Reynolds Number	1.5×10^6											

(all permutations)

TABLE 8.5.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8^o, WITH REYNOLDS NUMBER FIXED (nominal)

Mean Incidence	3^o	4^o	5^o	6^o	7^o	8^o	9^o	10^o
Amplitude	8^o							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

Mean Incidence	11^o	12^o	13^o	14^o	15^o	17^o	20^o
Amplitude	8^o						
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 8.5.4 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REDUCED FREQUENCY FIXED (nominal)

Mean Incidence	7°	8°	9°	10°	11°	12°	13°	14°	15°	17°	20°
Amplitude	8°										
Reduced Frequency	0.100										
Reynolds Number	1.0×10^6					1.5×10^6				2.0×10^6	

(all permutations)

TABLE 8.5.5 : SUMMARY OF FAST OSCILLATIONS (nominal)

Mean Incidence	0°			4°		
Amplitude	2°			4°		
Frequency (Hz)	1.0	2.5	5.0	7.5	10.0	12.5
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 8.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12001	10	4	0.010	1.50
12011	10	6	0.010	1.49
12021	10	8	0.010	1.48
12031	10	10	0.010	1.48
12041	10	4	0.025	1.48
12051	10	6	0.025	1.48
12061	10	8	0.025	1.47
12071	10	10	0.025	1.47
12081	10	4	0.051	1.48
12091	10	6	0.051	1.47
12101	10	8	0.051	1.47
12111	10	10	0.051	1.47
12121	10	4	0.077	1.46
12131	10	6	0.077	1.45
12141	10	8	0.077	1.45
12151	10	10	0.077	1.45
12161	10	4	0.102	1.47
12171	10	6	0.102	1.46
12181	10	8	0.102	1.46
12191	10	10	0.102	1.46

TABLE 8.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12201	10	4	0.128	1.46
12211	10	6	0.128	1.46
12221	10	8	0.128	1.46
12231	10	10	0.128	1.46
12241	10	4	0.154	1.46
12251	10	6	0.153	1.46
12261	10	8	0.153	1.46
12271	10	10	0.153	1.46
12281	10	4	0.179	1.46
12291	10	6	0.179	1.46
12301	10	8	0.179	1.46
12311	10	10	0.179	1.46
12371	3	8	0.010	1.49
12381	4	8	0.010	1.48
12391	5	8	0.010	1.47
12401	6	8	0.010	1.47
12411	7	8	0.010	1.47
12421	8	8	0.010	1.48
12431	9	8	0.010	1.47
12441	11	8	0.010	1.47
12451	12	8	0.010	1.46
12461	13	8	0.010	1.46
12471	14	8	0.010	1.46
12481	15	8	0.010	1.46
12491	17	8	0.010	1.45
12501	20	8	0.010	1.45
12511	3	8	0.026	1.44
12521	4	8	0.026	1.43
12531	5	8	0.026	1.43
12541	6	8	0.026	1.43
12551	7	8	0.026	1.43
12561	8	8	0.026	1.45
12571	9	8	0.026	1.45
12581	11	8	0.026	1.44
12591	12	8	0.026	1.44
12601	13	8	0.026	1.44
12621	15	8	0.026	1.44
12631	17	8	0.026	1.44
12641	20	8	0.026	1.44
12651	3	8	0.051	1.48
12661	4	8	0.051	1.47
12671	5	8	0.051	1.47
12681	6	8	0.051	1.47
12691	7	8	0.051	1.45
12701	8	8	0.051	1.45
12711	9	8	0.051	1.45
12721	11	8	0.051	1.45
12731	12	8	0.051	1.45
12741	13	8	0.051	1.45
12751	14	8	0.051	1.45
12761	15	8	0.051	1.44

TABLE 8.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12771	17	8	0.051	1.44
12781	20	8	0.051	1.44
12791	3	8	0.077	1.48
12801	4	8	0.077	1.47
12811	5	8	0.077	1.47
12821	6	8	0.077	1.47
12831	7	8	0.077	1.47
12841	8	8	0.076	1.48
12851	9	8	0.076	1.47
12861	11	8	0.076	1.47
12871	12	8	0.076	1.47
12881	13	8	0.076	1.47
12891	14	8	0.076	1.47
12901	15	8	0.076	1.47
12911	17	8	0.076	1.47
12921	20	8	0.076	1.47
12931	3	8	0.102	1.46
12941	4	8	0.102	1.46
12951	5	8	0.102	1.46
12961	6	8	0.102	1.46
12971	7	8	0.102	1.46
12981	8	8	0.102	1.46
12991	9	8	0.102	1.46
13001	11	8	0.102	1.46
13011	12	8	0.102	1.45
13021	13	8	0.102	1.45
13031	14	8	0.102	1.46
13041	15	8	0.102	1.46
13051	17	8	0.102	1.46
13061	20	8	0.102	1.46
13071	3	8	0.128	1.45
13081	4	8	0.128	1.45
13091	5	8	0.128	1.45
13101	6	8	0.128	1.45
13111	7	8	0.128	1.45
13121	8	8	0.128	1.45
13131	9	8	0.128	1.45
13141	11	8	0.128	1.45
13151	12	8	0.128	1.45
13161	13	8	0.128	1.44
13171	14	8	0.128	1.44
13181	15	8	0.128	1.44
13191	17	8	0.128	1.44
13201	20	8	0.128	1.44
13211	3	8	0.154	1.46
13221	4	8	0.154	1.45
13231	5	8	0.154	1.45
13241	6	8	0.154	1.45
13251	7	8	0.154	1.45
13261	8	8	0.154	1.45
13271	9	8	0.154	1.45

TABLE 8.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13281	11	8	0.153	1.47
13291	12	8	0.153	1.46
13301	13	8	0.153	1.46
13311	14	8	0.152	1.46
13321	15	8	0.152	1.46
13331	17	8	0.152	1.46
13341	20	8	0.152	1.46
13351	3	8	0.178	1.47
13361	4	8	0.178	1.46
13371	5	8	0.177	1.46
13381	6	8	0.177	1.46
13391	7	8	0.177	1.46
13401	8	8	0.177	1.46
13411	9	8	0.177	1.46
13421	11	8	0.177	1.47
13431	12	8	0.177	1.47
13441	13	8	0.177	1.47
13451	14	8	0.177	1.47
13461	15	8	0.177	1.47
13471	17	8	0.177	1.47
13481	20	8	0.177	1.47
13631	7	8	0.102	0.99
13641	8	8	0.102	0.99
13651	9	8	0.102	0.99
13661	10	8	0.102	0.99
13671	11	8	0.102	0.98
13681	12	8	0.102	0.98
13691	13	8	0.102	0.99
13701	14	8	0.102	0.99
13711	15	8	0.102	0.99
13721	17	8	0.102	0.99
13731	20	8	0.102	0.99
13741	7	8	0.107	1.85
13751	8	8	0.107	1.83
13761	9	8	0.107	1.83
13771	10	8	0.107	1.83
13781	11	8	0.107	1.83
13791	12	8	0.107	1.83
13811	13	8	0.107	1.85
13821	14	8	0.107	1.83
13831	15	8	0.107	1.83
13841	17	8	0.107	1.83
13851	20	8	0.107	1.83
13871	4	10	0.010	1.47
13881	6	10	0.010	1.46
13891	8	10	0.010	1.45
13901	15	10	0.010	1.45
13911	20	10	0.010	1.45
13921	4	10	0.025	1.46
13931	6	10	0.025	1.46
13941	8	10	0.025	1.46

TABLE 8.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13951	15	10	0.025	1.45
13961	20	10	0.025	1.45
13971	4	10	0.051	1.46
13981	6	10	0.051	1.46
13991	8	10	0.051	1.46
14001	15	10	0.051	1.46
14011	20	10	0.051	1.46
14021	4	10	0.076	1.46
14031	6	10	0.076	1.45
14041	8	10	0.076	1.45
14051	15	10	0.076	1.45
14061	20	10	0.076	1.45
14071	4	10	0.102	1.45
14081	6	10	0.102	1.45
14091	8	10	0.102	1.45
14101	15	10	0.102	1.45
14111	20	10	0.102	1.45
14121	4	10	0.129	1.46
14131	6	10	0.129	1.45
14141	8	10	0.129	1.45
14151	15	10	0.129	1.45
14161	20	10	0.129	1.45
14171	4	10	0.153	1.47
14181	6	10	0.152	1.47
14191	8	10	0.152	1.47
14201	15	10	0.152	1.47
14211	20	10	0.152	1.47
14221	4	10	0.179	1.46
14231	6	10	0.179	1.45
14241	8	10	0.179	1.45
14251	15	10	0.179	1.45
14261	20	10	0.179	1.45
14272	0	2	0.042	1.51
14282	4	2	0.042	1.50
14292	4	4	0.042	1.50
14302	0	4	0.042	1.50
14312	0	2	0.105	1.50
14322	4	2	0.104	1.49
14332	4	4	0.104	1.49
14342	0	4	0.104	1.49
14352	0	2	0.211	1.48
14372	4	4	0.210	1.48
14382	0	4	0.210	1.48
14391	0	2	0.314	1.50
14401	4	2	0.313	1.49
14411	4	4	0.313	1.49
14421	0	4	0.313	1.49
14432	0	2	0.418	1.49
14442	4	2	0.418	1.49
14452	4	4	0.417	1.49
14462	0	4	0.417	1.49

TABLE 8.6 : DETAILS OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS

TABLE 8.6.1 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.05						
Reynolds Number	0.8×10^6		1.1×10^6		1.5×10^6		2.0×10^6

(all permutations)

TABLE 8.6.2 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.02	0.04	0.05	0.06	0.075		
Reynolds Number	1.5×10^6						

(all permutations)

TABLE 8.6.3 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT MEAN INCIDENCE OF 180^o (nominal)

Mean Incidence	180^o			
Amplitude	4^o	6^o	8^o	10^o
Reduced Frequency	0.04	0.05	0.06	
Reynolds Number	1.5×10^6			

(all permutations)

TABLE 8.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11001	0	5.4	0.053	0.77
11021	0	9.9	0.053	0.77
11041	0	12.2	0.053	0.77
11061	0	13.8	0.054	0.76
11081	0	17.4	0.054	0.76
19001	0	22.6	0.054	0.76
19021	0	32.8	0.054	0.76
11101	0	5.4	0.048	1.16
11121	0	9.9	0.048	1.16
11141	0	12.2	0.048	1.15
11161	0	13.8	0.048	1.15
11181	0	17.4	0.048	1.15
19041	0	22.6	0.047	1.16
19061	0	32.8	0.047	1.16
11201	0	5.4	0.041	1.48
11221	0	9.9	0.041	1.47
11241	0	12.2	0.041	1.47
11261	0	13.8	0.042	1.46
11281	0	17.4	0.042	1.45
19081	0	22.6	0.041	1.46
19101	0	32.8	0.041	1.46
11301	0	5.4	0.052	1.47
11321	0	9.9	0.052	1.46
11341	0	12.2	0.052	1.46
11361	0	13.8	0.052	1.46
11381	0	17.4	0.052	1.45
19121	0	22.6	0.052	1.45
19141	0	32.8	0.052	1.44
11401	0	5.4	0.062	1.45
11421	0	9.9	0.062	1.45
11441	0	12.2	0.062	1.44
11461	0	13.8	0.062	1.45
11481	0	17.4	0.062	1.44
19161	0	22.6	0.062	1.45
19181	0	32.8	0.062	1.44
11501	0	5.4	0.054	1.85
11521	0	9.9	0.054	1.83
11541	0	12.2	0.054	1.82
11561	0	13.8	0.054	1.83
11581	0	17.4	0.054	1.81
19201	0	22.6	0.054	1.82
19221	0	32.8	0.054	1.80

TABLE 8.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
19301	0	5.4	0.078	1.44
19321	0	9.9	0.078	1.43
19341	0	12.2	0.078	1.43
19361	0	13.8	0.078	1.44
19381	0	17.4	0.078	1.43
19401	0	22.6	0.078	1.43
19421	0	32.8	0.078	1.43
19441	0	5.4	0.020	1.46
19461	0	9.9	0.020	1.45
19481	0	12.2	0.020	1.44
19501	0	13.8	0.020	1.44
19521	0	17.4	0.020	1.44
19541	0	22.6	0.020	1.43
19561	0	32.8	0.020	1.43
411601	180	4	0.055	1.45
411611	180	6	0.055	1.44
411621	180	8	0.055	1.44
411631	180	10	0.055	1.44
411661	180	4	0.069	1.44
411671	180	6	0.069	1.43
411681	180	8	0.069	1.43
411691	180	10	0.069	1.43
411721	180	4	0.082	1.45
411731	180	6	0.082	1.45
411741	180	8	0.082	1.44
411751	180	10	0.082	1.44

TABLE 8.7 : DETAILS OF SINGLE STREAMTUBE VAWT EXPERIMENTS

TABLE 8.7.1 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.05						
Reynolds Number	$0.8x10^6$		$1.1x10^6$		$1.5x10^6$		$2.0x10^6$

(all permutations)

TABLE 8.7.2 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.02		0.04	0.05		0.06	0.075
Reynolds Number	$1.5x10^6$						

(all permutations)

TABLE 8.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51011	0	6.00	0.053	0.77
51031	0	4.00	0.053	0.77
51051	0	3.50	0.053	0.77
51071	0	3.25	0.054	0.76
51091	0	2.80	0.054	0.76
59011	0	2.33	0.054	0.76
59031	0	1.75	0.054	0.76
51111	0	6.00	0.048	1.16
51131	0	4.00	0.048	1.15
51151	0	3.50	0.048	1.15
51171	0	3.25	0.048	1.15
51191	0	2.80	0.048	1.15
59051	0	2.33	0.047	1.16
59071	0	1.75	0.047	1.16

TABLE 8.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (concluded)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51211	0	6.00	0.041	1.48
51231	0	4.00	0.041	1.47
51251	0	3.50	0.041	1.47
51271	0	3.25	0.042	1.46
51291	0	2.80	0.042	1.45
59091	0	2.33	0.041	1.46
59111	0	1.75	0.041	1.46
51311	0	6.00	0.052	1.46
51331	0	4.00	0.052	1.46
51351	0	3.50	0.052	1.46
51371	0	3.25	0.052	1.45
51391	0	2.80	0.052	1.45
59131	0	2.33	0.052	1.45
59151	0	1.75	0.052	1.44
51411	0	6.00	0.062	1.45
51431	0	4.00	0.062	1.45
51451	0	3.50	0.062	1.44
51471	0	3.25	0.062	1.44
51491	0	2.80	0.062	1.44
59171	0	2.33	0.062	1.44
59191	0	1.75	0.062	1.44
51511	0	6.00	0.054	1.83
51531	0	4.00	0.054	1.83
51551	0	3.50	0.054	1.82
51571	0	3.25	0.054	1.82
51591	0	2.80	0.054	1.81
59211	0	2.33	0.054	1.80
59231	0	1.75	0.054	1.80
59311	0	6.00	0.078	1.43
59331	0	4.00	0.078	1.43
59351	0	3.50	0.078	1.43
59371	0	3.25	0.078	1.43
59391	0	2.80	0.078	1.43
59411	0	2.33	0.078	1.43
59431	0	1.75	0.078	1.43
59451	0	6.00	0.020	1.45
59471	0	4.00	0.020	1.45
59491	0	3.50	0.020	1.44
59511	0	3.25	0.020	1.44
59531	0	2.80	0.020	1.44
59551	0	2.33	0.020	1.43
59571	0	1.75	0.020	1.43

TABLE 8.8 : DETAILS OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS

TABLE 8.8.1 : SUMMARY OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (nominal)

Mean Incidence	0^o			
Tip Speed Ratio	2.80	3.25	4.00	6.00
Reduced Frequency	0.040	0.050	0.060	
Reynolds Number	1.5×10^6			

(all permutations)

TABLE 8.8.2 : LIST OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
71781	0	6.00	0.04	1.53
71791	0	4.00	0.04	1.52
71801	0	3.25	0.04	1.51
71811	0	2.80	0.04	1.51
71821	0	6.00	0.05	1.51
71831	0	4.00	0.05	1.51
71841	0	3.25	0.05	1.51
71851	0	2.80	0.05	1.50
71861	0	6.00	0.06	1.51
71871	0	4.00	0.06	1.50
71881	0	3.25	0.06	1.50
71891	0	2.80	0.06	1.50

TABLE 9 : EXPERIMENTS ON NACA 0021 (MODEL 7)

Unless otherwise stated, the dynamic pressure was recorded by the pitot-static tube (see **Section 2.3.2**).

TABLE 9.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 9.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Starting Incidence	0°		180°	
Incidence Sweep	25°		-25°	
Reynolds Number	0.8×10^6	1.1×10^6	1.5×10^6	2.0×10^6

(all permutations)

TABLE 9.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start ($^\circ$)	Sweep ($^\circ$)	Reynolds No. x 10^{-6}
00011	0	25	0.78
00012	0	25	0.77
00013	0	25	0.77
00021	0	-25	0.78
00031	0	25	1.06
00032	0	25	1.07
00041	0	-25	1.05
00051	0	25	1.43
00052	0	25	1.45
00061	0	-25	1.44
00071	0	25	1.91
00072	0	25	1.89
00081	0	-25	1.89
400091	180	25	0.81
400101	180	-25	0.82
400111	180	25	1.09
400121	180	-25	1.07
400131	180	25	1.47
400141	180	-25	1.47
400151	180	25	1.96
400161	180	-25	1.93

TABLE 9.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 9.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Angle of Attack	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

TABLE 9.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40171	0	100	1.42
40181	1	100	1.42
40191	2	100	1.42
40201	3	100	1.41
40211	4	100	1.41
40221	5	100	1.41
40231	6	100	1.41
40241	7	100	1.41
40251	8	100	1.41
40261	9	100	1.41
40271	10	100	1.41
40281	11	100	1.41
40291	12	100	1.41
40301	13	100	1.41
40311	14	100	1.42
40321	15	100	1.41
40331	16	100	1.41
40341	17	100	1.41
40351	18	100	1.41
40361	19	100	1.41
40371	20	100	1.41
40381	21	100	1.41

TABLE 9.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (concluded)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40391	22	100	1.41
40401	23	100	1.41
40411	24	100	1.41
40421	25	100	1.41
40431	26	100	1.41
40441	27	100	1.41
40451	28	100	1.46
40461	29	100	1.45
40471	30	100	1.45
40481	31	100	1.45
40491	32	100	1.45
40501	33	100	1.45
40511	34	100	1.45
40521	35	100	1.45
40531	0	500	1.45
40541	1	500	1.45
40551	2	500	1.45
40561	3	500	1.45
40571	4	500	1.45
40581	5	500	1.45
40591	6	500	1.44
40601	7	500	1.44
40611	8	500	1.44
40621	9	500	1.44
40631	10	500	1.44
40641	11	500	1.44
40651	12	500	1.44
40661	13	500	1.44
40671	14	500	1.44
40681	15	500	1.44
40691	16	500	1.44
40701	17	500	1.44
40711	18	500	1.44
40721	19	500	1.44
40731	20	500	1.44
40741	21	500	1.44
40751	22	500	1.44
40761	23	500	1.44
40771	24	500	1.44
40781	25	500	1.44
40791	26	500	1.44
40801	27	500	1.44
40811	28	500	1.45
40821	30	500	1.44
40831	31	500	1.44
40841	32	500	1.44
40851	33	500	1.40
40861	34	500	1.44
40871	35	500	1.44

TABLE 9.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 9.3.1 : SUMMARY OF RAMPS FROM -1° TO 40° (nominal)

Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$
0.75	1.5	75.0	1.5	215.0	1.5
1.5	1.5	90.0	1.5	230.0	1.5
3.0	1.5	100.0	1.0 1.5 2.0	245.0	1.5
4.5	1.5	115.0	1.5	260.0	1.5
6.0	1.5	130.0	1.5	275.0	1.5
7.5	1.5	145.0	1.5	290.0	1.5
15.0	1.5	160.0	1.5	300.0	1.0 1.5 2.0
30.0	1.0 1.5 2.0	175.0	1.5	315.0	1.5
45.0	1.5	190.0	1.5	330.0	1.5
60.0	1.5	200.0	1.0 1.5 2.0	345.0	1.5

(all permutations)

TABLE 9.3.2 : SUMMARY OF SHORT RAMPS (nominal)

Starting Incidence	0°								
Finishing Incidence	4°		8°		12°		30°		
Pitch Rate ($^{\circ}s^{-1}$)	50	100	200	300	350	400*	450*	500*	550*
Reynolds Number	1.5×10^6								

(all permutations, except * (not for finishing incidence of 30°))

TABLE 9.3.3 : SUMMARY OF IMPULSE RAMPS (nominal)

Starting Incidence	0°			
Finishing Incidence	4°	8°	12°	
Pitch Rate ($^{\circ}s^{-1}$)	**STEP**			
Reynolds Number	0.50×10^6	0.75×10^6	1.00×10^6	1.25×10^6

(all permutations)

TABLE 9.3.4 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25001	0	4	60.1	0.0066	1.46
25011	0	4	104.6	0.0115	1.45
25021	0	4	122.0	0.0134	1.45
25031	0	4	154.0	0.0170	1.45
25041	0	4	124.2	0.0137	1.44
25051	0	4	116.8	0.0129	1.44
25061	0	4	128.6	0.0142	1.44
25071	0	4	132.5	0.0146	1.44
25081	0	4	122.0	0.0135	1.44
25091	0	8	47.6	0.0053	1.43
25101	0	8	87.0	0.0096	1.43
25111	0	8	165.2	0.0182	1.42
25121	0	8	181.1	0.0200	1.42
25141	0	8	173.8	0.0192	1.43
25151	0	8	175.2	0.0193	1.42
25161	0	8	172.3	0.0190	1.42
25171	0	8	187.5	0.0207	1.42
25181	0	8	170.9	0.0188	1.42
25191	0	12	48.5	0.0053	1.43
25201	0	12	88.1	0.0097	1.42
25211	0	12	188.8	0.0207	1.42
25221	0	12	221.4	0.0243	1.42
25231	0	12	237.9	0.0261	1.43
25241	0	12	225.1	0.0247	1.42
25251	0	12	228.9	0.0251	1.42
25261	0	12	235.2	0.0258	1.42
25271	0	12	236.6	0.0259	1.42
25281	0	30	50.1	0.0055	1.47
25291	0	30	99.9	0.0109	1.46
25301	0	30	195.5	0.0214	1.46
25311	0	30	276.1	0.0302	1.45
25321	0	30	313.2	0.0342	1.45
25331	-1	41	0.7	0.0001	1.45
25341	-1	41	1.5	0.0002	1.43
25351	-1	41	3.0	0.0003	1.42
25361	-1	41	4.5	0.0005	1.43
25371	-1	41	5.9	0.0006	1.43
25381	-1	41	7.4	0.0008	1.42
25391	-1	41	15.1	0.0017	1.42
25401	-1	41	29.3	0.0032	1.42
25411	-1	41	44.5	0.0049	1.42
25421	-1	41	59.8	0.0066	1.42
25431	-1	41	74.0	0.0081	1.42
25441	-1	41	89.1	0.0098	1.42
25451	-1	41	99.3	0.0109	1.42
25461	-1	41	114.1	0.0125	1.41
25471	-1	41	130.7	0.0148	1.44
25481	-1	41	143.9	0.0163	1.44
25491	-1	41	160.5	0.0181	1.44
25501	-1	41	175.4	0.0198	1.43
25511	-1	41	185.9	0.0208	1.45

TABLE 9.3.4 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25521	-1	41	199.2	0.0223	1.45
25531	-1	41	214.6	0.0240	1.45
25541	-1	41	230.2	0.0257	1.45
25551	-1	41	241.0	0.0271	1.45
25561	-1	41	255.6	0.0287	1.44
25571	-1	41	273.6	0.0307	1.44
25581	-1	41	284.3	0.0319	1.44
25591	-1	41	295.5	0.0335	1.43
25601	-1	41	306.0	0.0346	1.43
25611	-1	41	315.1	0.0356	1.43
25621	-1	41	330.8	0.0374	1.42
25631	-1	41	29.4	0.0049	0.98
25641	-1	41	101.3	0.0168	0.98
25651	-1	41	199.2	0.0349	0.98
25661	-1	41	293.2	0.0500	1.01
25671	-1	41	29.1	0.0026	1.94
25681	-1	41	99.7	0.0090	1.87
25691	-1	41	199.7	0.0174	1.92
25711	0	4	107.3	0.0155	1.20
25721	0	8	187.6	0.0270	1.20
25731	0	12	239.7	0.0345	1.20
25741	0	4	112.6	0.0200	0.98
25751	0	8	186.1	0.0331	0.97
25761	0	12	232.0	0.0413	0.97
25771	0	4	101.3	0.0245	0.72
25781	0	8	181.6	0.0440	0.72
25791	0	12	240.9	0.0583	0.72
25801	0	4	116.2	0.0397	0.51
25811	0	8	189.1	0.0646	0.51
25821	0	12	242.3	0.0828	0.51
*127051	-1	26	98.9	0.0114	1.46
*127061	-1	26	266.9	0.0308	1.45

(*experiments with trip wire attached)

TABLE 9.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 9.4.1 : SUMMARY OF RAMPS FROM 40° TO -1° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
-0.75		-75.0		-215.0	
-1.5		-90.0		-230.0	
-3.0		-100.0		-245.0	
-4.5		-115.0		-260.0	
-6.0	1.5	-130.0	1.5	-275.0	1.5
-7.5		-145.0		-290.0	
-15.0		-160.0		-300.0	
-30.0		-175.0		-315.0	
-45.0		-190.0		-330.0	
-60.0		-200.0		-345.0	

(all permutations)

TABLE 9.4.2 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate (°s^{-1})	Reduced Pitch Rate	Reynolds No. x 10^{-6}
36331	40	-41	-0.7	-0.0001	1.44
36341	40	-41	-1.5	-0.0002	1.38
36351	40	-41	-2.9	-0.0003	1.41
36361	40	-41	-4.4	-0.0005	1.42
36371	40	-41	-5.8	-0.0007	1.41
36381	40	-41	-7.4	-0.0008	1.41
36391	40	-41	-14.6	-0.0017	1.41
36401	40	-41	-29.0	-0.0033	1.40
36411	40	-41	-42.9	-0.0049	1.40
36421	40	-41	-57.5	-0.0065	1.40

TABLE 9.4.2 : LIST OF RAMP DOWN EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
36431	40	-41	-70.5	-0.0080	1.40
36441	40	-41	-87.0	-0.0098	1.40
36451	40	-41	-95.4	-0.0108	1.40
36461	40	-41	-105.6	-0.0119	1.41
36471	40	-41	-119.4	-0.0135	1.40
36481	40	-41	-137.1	-0.0154	1.40
36491	40	-41	-149.5	-0.0168	1.40
36501	40	-41	-161.1	-0.0181	1.40
36511	40	-41	-171.9	-0.0191	1.42
36521	40	-41	-181.1	-0.0201	1.42
36531	40	-41	-194.7	-0.0216	1.42
36541	40	-41	-207.5	-0.0230	1.42
36551	40	-41	-220.6	-0.0245	1.42
36561	40	-41	-231.5	-0.0264	1.38
36571	40	-41	-249.4	-0.0276	1.42
36581	40	-41	-266.3	-0.0295	1.42
36591	40	-41	-275.3	-0.0306	1.42
36601	40	-41	-296.2	-0.0329	1.41
36611	40	-41	-310.8	-0.0345	1.41
36621	40	-41	-328.3	-0.0364	1.41
*137071	25	-26	-93.0	-0.0108	1.45
*137081	25	-26	-265.5	-0.0307	1.45

(*experiments with trip wire attached)

TABLE 9.5 : DETAILS OF GENERAL SINUSOIDAL EXPERIMENTS

TABLE 9.5.1 : SUMMARY OF OSCILLATIONS ABOUT 10^{o} (nominal)

Mean Incidence	10^{o}							
Amplitude	4^{o}		6^{o}		8^{o}		10^{o}	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^{6}							

(all permutations)

TABLE 9.5.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10^{o} (nominal)

Mean Incidence	4^{o}	6^{o}	8^{o}	10^{o}	15^{o}	20^{o}		
Amplitude	10^{o}							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^{6}							

(all permutations)

TABLE 9.5.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8^{o}, WITH REYNOLDS NUMBER FIXED (nominal)

Mean Incidence	3^{o}	4^{o}	5^{o}	6^{o}	7^{o}	8^{o}	9^{o}	10^{o}
Amplitude	8^{o}							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^{6}							

(all permutations)

Mean Incidence	11^{o}	12^{o}	13^{o}	14^{o}	15^{o}	17^{o}	20^{o}
Amplitude	8^{o}						
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^{6}							

(all permutations)

TABLE 9.5.4 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REDUCED FREQUENCY FIXED (nominal)

Mean Incidence	7°	8°	9°	10°	11°	12°	13°	14°	15°	17°	20°
Amplitude	8°										
Reduced Frequency	0.100										
Reynolds Number	1.0×10^6					1.5×10^6				2.0×10^6	

(all permutations)

TABLE 9.5.5 : SUMMARY OF FAST OSCILLATIONS (nominal)

Mean Incidence	0°			4°		
Amplitude	2°			4°		
Frequency (Hz)	1.0	2.5	5.0	7.5	10.0	12.5
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 9.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12001	10	4	0.010	1.38
12011	10	6	0.010	1.37
12021	10	8	0.010	1.37
12031	10	10	0.010	1.37
12041	10	4	0.025	1.37
12051	10	6	0.025	1.36
12061	10	8	0.025	1.36
12071	10	10	0.025	1.36
12081	10	4	0.050	1.37
12091	10	6	0.050	1.37
12101	10	8	0.050	1.36
12111	10	10	0.050	1.36
12121	10	4	0.075	1.38
12131	10	6	0.075	1.37
12141	10	8	0.075	1.37
12151	10	10	0.075	1.37
12161	10	4	0.101	1.37
12171	10	6	0.100	1.37
12181	10	8	0.100	1.37
12191	10	10	0.100	1.37
12201	10	4	0.125	1.38

TABLE 9.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12211	10	6	0.125	1.37
12221	10	8	0.125	1.37
12231	10	10	0.125	1.37
12241	10	4	0.150	1.37
12251	10	6	0.150	1.37
12261	10	8	0.150	1.37
12271	10	10	0.150	1.37
12281	10	4	0.176	1.37
12291	10	6	0.176	1.36
12301	10	8	0.176	1.36
12311	10	10	0.176	1.36
12371	3	8	0.010	1.45
12381	4	8	0.010	1.44
12391	5	8	0.010	1.44
12401	6	8	0.010	1.43
12411	7	8	0.010	1.43
12421	8	8	0.010	1.42
12431	9	8	0.010	1.42
12441	11	8	0.010	1.42
12451	12	8	0.010	1.41
12461	13	8	0.010	1.41
12471	14	8	0.010	1.41
12481	15	8	0.010	1.41
12491	17	8	0.010	1.40
12501	20	8	0.010	1.40
12511	3	8	0.024	1.41
12521	4	8	0.024	1.40
12531	5	8	0.024	1.40
12541	6	8	0.024	1.40
12551	7	8	0.024	1.40
12561	8	8	0.024	1.40
12571	9	8	0.024	1.40
12581	11	8	0.024	1.40
12591	12	8	0.024	1.39
12601	13	8	0.024	1.39
12611	14	8	0.025	1.39
12621	15	8	0.024	1.38
12631	17	8	0.024	1.38
12641	20	8	0.024	1.38
12651	3	8	0.049	1.43
12661	4	8	0.049	1.42
12671	5	8	0.049	1.42
12681	6	8	0.049	1.42
12691	7	8	0.049	1.42
12701	8	8	0.049	1.41
12711	9	8	0.049	1.41
12721	11	8	0.049	1.41
12731	12	8	0.049	1.41
12741	13	8	0.049	1.41
12751	14	8	0.049	1.40
12761	15	8	0.049	1.40
12771	17	8	0.049	1.40

TABLE 9.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12781	20	8	0.049	1.40
12791	3	8	0.074	1.40
12801	4	8	0.074	1.39
12811	5	8	0.074	1.39
12821	6	8	0.074	1.39
12831	7	8	0.074	1.39
12841	8	8	0.074	1.40
12851	9	8	0.073	1.40
12861	11	8	0.073	1.40
12871	12	8	0.073	1.40
12881	13	8	0.073	1.40
12891	14	8	0.073	1.41
12901	15	8	0.073	1.40
12911	17	8	0.073	1.40
12921	20	8	0.073	1.40
12931	3	8	0.096	1.45
12941	4	8	0.096	1.45
12951	5	8	0.096	1.45
12961	6	8	0.096	1.45
12971	7	8	0.096	1.45
12981	8	8	0.097	1.44
12991	9	8	0.097	1.44
13001	11	8	0.097	1.44
13011	12	8	0.097	1.44
13021	13	8	0.097	1.44
13031	14	8	0.097	1.44
13041	15	8	0.097	1.44
13051	17	8	0.097	1.44
13061	20	8	0.097	1.44
13071	3	8	0.121	1.45
13081	4	8	0.120	1.44
13091	5	8	0.120	1.44
13101	6	8	0.120	1.44
13111	7	8	0.120	1.44
13121	8	8	0.120	1.44
13131	9	8	0.120	1.44
13141	11	8	0.121	1.44
13151	12	8	0.121	1.44
13161	13	8	0.121	1.44
13171	14	8	0.121	1.43
13181	15	8	0.121	1.43
13191	17	8	0.121	1.43
13201	20	8	0.121	1.43
13211	3	8	0.141	1.49
13221	4	8	0.141	1.48
13231	5	8	0.145	1.44
13241	6	8	0.141	1.48
13251	7	8	0.145	1.44
13261	8	8	0.145	1.44
13271	9	8	0.141	1.48
13281	11	8	0.142	1.47
13291	12	8	0.142	1.47

TABLE 9.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13301	13	8	0.142	1.47
13311	14	8	0.142	1.47
13321	15	8	0.142	1.47
13331	17	8	0.150	1.47
13341	20	8	0.142	1.47
13351	3	8	0.168	1.47
13361	4	8	0.168	1.46
13371	5	8	0.168	1.46
13381	6	8	0.168	1.46
13391	7	8	0.168	1.46
13401	8	8	0.168	1.46
13411	9	8	0.168	1.46
13421	11	8	0.169	1.45
13431	12	8	0.169	1.45
13441	13	8	0.169	1.45
13451	14	8	0.169	1.45
13461	15	8	0.169	1.45
13471	17	8	0.169	1.44
13481	20	8	0.169	1.44
13631	7	8	0.096	0.98
13641	8	8	0.096	0.98
13651	9	8	0.096	0.98
13661	10	8	0.096	0.98
13671	11	8	0.096	0.98
13681	12	8	0.096	0.98
13691	13	8	0.097	0.97
13701	14	8	0.097	0.97
13711	15	8	0.097	0.97
13721	17	8	0.097	0.97
13731	20	8	0.097	0.97
13741	7	8	0.098	1.92
13751	8	8	0.098	1.90
13761	9	8	0.098	1.89
13771	10	8	0.098	1.89
13781	11	8	0.098	1.89
13791	12	8	0.098	1.89
13811	13	8	0.098	1.90
13821	14	8	0.098	1.89
13831	15	8	0.097	1.88
13841	17	8	0.097	1.88
13851	20	8	0.097	1.88
13871	4	10	0.010	1.45
13881	6	10	0.010	1.44
13891	8	10	0.010	1.44
13901	15	10	0.010	1.44
13911	20	10	0.010	1.44
13921	4	10	0.024	1.44
13931	6	10	0.024	1.43
13941	8	10	0.024	1.43
13951	15	10	0.024	1.43
13961	20	10	0.024	1.43
13971	4	10	0.048	1.44

TABLE 9.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13981	6	10	0.048	1.44
13991	8	10	0.048	1.44
14001	15	10	0.048	1.44
14011	20	10	0.048	1.44
14021	4	10	0.072	1.45
14031	6	10	0.072	1.44
14041	8	10	0.072	1.44
14051	15	10	0.072	1.44
14061	20	10	0.072	1.44
14071	4	10	0.097	1.46
14081	6	10	0.097	1.45
14091	8	10	0.097	1.45
14101	15	10	0.097	1.45
14111	20	10	0.096	1.45
14121	4	10	0.121	1.46
14131	6	10	0.120	1.45
14141	8	10	0.120	1.45
14151	15	10	0.120	1.45
14161	20	10	0.120	1.45
14171	4	10	0.145	1.45
14181	6	10	0.144	1.45
14191	8	10	0.144	1.45
14201	15	10	0.144	1.45
14211	20	10	0.144	1.45
14221	4	10	0.169	1.45
14231	6	10	0.169	1.45
14241	8	10	0.169	1.45
14251	15	10	0.169	1.45
14261	20	10	0.169	1.45
14271	0	2	0.042	1.45
14281	4	2	0.042	1.45
14291	4	4	0.042	1.44
14301	0	4	0.042	1.44
14311	0	2	0.104	1.45
14321	4	2	0.104	1.45
14331	4	4	0.104	1.45
14341	0	4	0.103	1.45
14351	0	2	0.208	1.44
14361	4	2	0.208	1.44
14371	4	4	0.208	1.44
14381	0	4	0.208	1.44
14391	0	2	0.312	1.45
14401	4	2	0.312	1.44
14411	4	4	0.312	1.44
14421	0	4	0.312	1.44
14431	0	2	0.415	1.44
14441	4	2	0.415	1.44
14451	4	4	0.415	1.44
*117011	5	8	0.076	1.45
*117021	10	8	0.076	1.45
*117031	15	8	0.076	1.45

(*experiments with trip wire attached)

TABLE 9.6 : DETAILS OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS

TABLE 9.6.1 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.05						
Reynolds Number	0.8×10^6		1.1×10^6		1.5×10^6		2.0×10^6

(all permutations)

TABLE 9.6.2 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.02	0.04		0.05		0.06	0.075
Reynolds Number	1.5×10^6						

(all permutations)

TABLE 9.6.3 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT MEAN INCIDENCE OF 180^o (nominal)

Mean Incidence	180^o			
Amplitude	4^o	6^o	8^o	10^o
Reduced Frequency	0.04	0.05		0.06
Reynolds Number	1.5×10^6			

(all permutations)

TABLE 9.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11001	0	5.4	0.051	0.77
11002	0	5.4	0.051	0.81
11021	0	9.9	0.051	0.77
11022	0	9.9	0.051	0.80
11041	0	12.2	0.051	0.77
11042	0	12.2	0.051	0.81
11061	0	13.8	0.051	0.77
11062	0	13.8	0.052	0.80
11081	0	17.4	0.051	0.76
11082	0	17.4	0.052	0.80
19001	0	22.6	0.051	0.77
19002	0	22.6	0.052	0.80
19021	0	32.8	0.051	0.77
19022	0	32.8	0.052	0.80
11101	0	5.4	0.048	1.10
11102	0	5.4	0.056	1.00
11121	0	9.9	0.048	1.09
11122	0	9.9	0.056	1.00
11141	0	12.2	0.048	1.09
11142	0	12.2	0.055	1.00
11161	0	13.8	0.049	1.06
11162	0	13.8	0.055	1.00
11181	0	17.4	0.049	1.06
11182	0	17.4	0.055	1.00
19041	0	22.6	0.049	1.07
19042	0	22.6	0.056	0.99
19061	0	32.8	0.049	1.06
19062	0	32.8	0.056	0.99
11201	0	5.4	0.040	1.44
11202	0	5.4	0.041	1.51
11221	0	9.9	0.040	1.44
11222	0	9.9	0.041	1.49
11241	0	12.2	0.040	1.43
11242	0	12.2	0.041	1.49
11261	0	13.8	0.040	1.43
11262	0	13.8	0.041	1.48
11281	0	17.4	0.040	1.43
11282	0	17.4	0.041	1.47
19081	0	22.6	0.040	1.45
19082	0	22.6	0.041	1.47
19101	0	32.8	0.040	1.44
19102	0	32.8	0.041	1.47
11301	0	5.4	0.050	1.44
11302	0	5.4	0.052	1.47
11321	0	9.9	0.050	1.44
11322	0	9.9	0.051	1.46
11341	0	12.2	0.050	1.43
11342	0	12.2	0.051	1.46

(xxxx1 : dynamic pressure measured by p_{stat}
xxxx2 : dynamic pressure measured by $p_{set} - p_{wall}$)

TABLE 9.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11361	0	13.8	0.049	1.44
11362	0	13.8	0.051	1.47
11381	0	17.4	0.049	1.44
11382	0	17.4	0.051	1.47
19121	0	22.6	0.050	1.43
19122	0	22.6	0.051	1.46
19141	0	32.8	0.050	1.42
19142	0	32.8	0.051	1.46
11401	0	5.4	0.060	1.43
11402	0	5.4	0.062	1.48
11421	0	9.9	0.060	1.42
11422	0	9.9	0.062	1.47
11441	0	12.2	0.060	1.42
11442	0	12.2	0.062	1.47
11461	0	13.8	0.059	1.43
11462	0	13.8	0.062	1.47
11481	0	17.4	0.059	1.42
11482	0	17.4	0.062	1.46
19161	0	22.6	0.059	1.43
19162	0	22.6	0.062	1.47
19181	0	32.8	0.059	1.42
19182	0	32.8	0.062	1.46
11501	0	5.4	0.050	1.90
11521	0	9.9	0.050	1.88
11541	0	12.2	0.050	1.87
11561	0	13.8	0.050	1.87
11581	0	17.4	0.050	1.85
19201	0	22.6	0.050	1.85
19221	0	32.8	0.050	1.83
19302	0	5.4	0.077	1.47
19322	0	9.9	0.076	1.46
19342	0	12.2	0.076	1.46
19362	0	13.8	0.076	1.46
19382	0	17.4	0.076	1.46
19402	0	22.6	0.077	1.46
19422	0	32.8	0.076	1.46
411601	180	4	0.052	1.46
411611	180	6	0.052	1.45
411621	180	8	0.052	1.45
411631	180	10	0.052	1.45
411661	180	4	0.065	1.45
411671	180	6	0.065	1.45
411681	180	8	0.065	1.45
411691	180	10	0.065	1.45
411721	180	4	0.079	1.45
411731	180	6	0.079	1.45
411741	180	8	0.079	1.45
411751	180	10	0.079	1.44

(xxxx1 : dynamic pressure measured by p_{stat}
xxxx2 : dynamic pressure measured by $p_{set} - p_{wall}$)

TABLE 9.7 : DETAILS OF SINGLE STREAMTUBE VAWT EXPERIMENTS

TABLE 9.7.1 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.05						
Reynolds Number	$0.8x10^6$		$1.1x10^6$		$1.5x10^6$		$2.0x10^6$

(all permutations)

TABLE 9.7.2 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.02		0.04		0.05	0.06	0.075
Reynolds Number	$1.5x10^6$						

(all permutations)

TABLE 9.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS
(actual)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51011	0	6.00	0.051	0.77
51012	0	6.00	0.051	0.80
51031	0	4.00	0.051	0.77
51032	0	4.00	0.051	0.81
51051	0	3.50	0.051	0.77
51052	0	3.50	0.051	0.81
51071	0	3.25	0.051	0.76
51072	0	3.25	0.052	0.80
51091	0	2.80	0.051	0.76
51092	0	2.80	0.052	0.80
59011	0	2.33	0.051	0.77
59012	0	2.33	0.052	0.80
59031	0	1.75	0.051	0.77
59032	0	1.75	0.052	0.80
51111	0	6.00	0.048	1.09
51112	0	6.00	0.056	1.00
51131	0	4.00	0.048	1.09
51132	0	4.00	0.055	1.00
51151	0	3.50	0.048	1.09
51152	0	3.50	0.055	1.00
51171	0	3.25	0.049	1.06
51172	0	3.25	0.055	1.00
51191	0	2.80	0.049	1.06
51192	0	2.80	0.055	1.00
59051	0	2.33	0.049	1.06
59052	0	2.33	0.056	0.99
59071	0	1.75	0.049	1.06
59072	0	1.75	0.056	0.99
51211	0	6.00	0.040	1.44
51212	0	6.00	0.041	1.50
51231	0	4.00	0.040	1.43
51232	0	4.00	0.041	1.49
51251	0	3.50	0.038	1.43
51252	0	3.50	0.041	1.49
51271	0	3.25	0.040	1.43
51272	0	3.25	0.041	1.48
51291	0	2.80	0.040	1.42
51292	0	2.80	0.041	1.47
59091	0	2.33	0.040	1.45
59092	0	2.33	0.041	1.47
59111	0	1.75	0.040	1.44
59112	0	1.75	0.041	1.46

(xxxx1 : dynamic pressure measured by p_{stat}
xxxx2: dynamic pressure measured by $p_{set} - p_{wall}$)

TABLE 9.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (concluded)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51311	0	6.00	0.050	1.44
51312	0	6.00	0.052	1.46
51331	0	4.00	0.050	1.43
51332	0	4.00	0.051	1.46
51351	0	3.50	0.050	1.43
51352	0	3.50	0.051	1.46
51371	0	3.25	0.049	1.44
51372	0	3.25	0.051	1.47
51391	0	2.80	0.049	1.43
51392	0	2.80	0.051	1.46
59131	0	2.33	0.050	1.43
59132	0	2.33	0.051	1.46
59151	0	1.75	0.050	1.42
59152	0	1.75	0.051	1.46
51411	0	6.00	0.060	1.42
51412	0	6.00	0.062	1.47
51431	0	4.00	0.060	1.42
51432	0	4.00	0.062	1.47
51451	0	3.50	0.060	1.42
51452	0	3.50	0.062	1.47
51471	0	3.25	0.059	1.42
51472	0	3.25	0.062	1.47
51491	0	2.80	0.059	1.42
51492	0	2.80	0.062	1.46
59171	0	2.33	0.059	1.42
59172	0	2.33	0.062	1.46
59191	0	1.75	0.059	1.42
59192	0	1.75	0.062	1.46
51511	0	6.00	0.050	1.88
51531	0	4.00	0.050	1.87
51551	0	3.50	0.050	1.87
51571	0	3.25	0.050	1.86
51591	0	2.80	0.050	1.85
59211	0	2.33	0.050	1.83
59231	0	1.75	0.050	1.82
59312	0	6.00	0.077	1.47
59332	0	4.00	0.076	1.46
59352	0	3.50	0.076	1.46
59372	0	3.25	0.076	1.46
59392	0	2.80	0.076	1.46
59412	0	2.33	0.076	1.46
59432	0	1.75	0.076	1.45

(xxxx1 : dynamic pressure measured by p_{stat}
xxxx2 : dynamic pressure measured by $p_{set} - p_{wall}$)

TABLE 9.8 : DETAILS OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS

TABLE 9.8.1 : SUMMARY OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (nominal)

Mean Incidence	0^o			
Tip Speed Ratio	3.25	3.50	4.00	6.00
Reduced Frequency	0.04	0.05	0.06	
Reynolds Number	1.5×10^6			

(all permutations)

TABLE 9.8.2 : LIST OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
71781	0	6.00	0.040	1.41
71791	0	4.00	0.039	1.40
71801	0	3.50	0.039	1.40
71811	0	3.25	0.039	1.40
71821	0	6.00	0.050	1.40
71831	0	4.00	0.050	1.40
71841	0	3.50	0.050	1.39
71851	0	3.25	0.050	1.39
71861	0	6.00	0.059	1.41
71871	0	4.00	0.059	1.41
71881	0	3.50	0.059	1.41
71891	0	3.25	0.059	1.41

TABLE 10 : EXPERIMENTS ON NACA 0025 (MODEL 8)

TABLE 10.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 10.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Starting Incidence	0^o		180^o	
Incidence Sweep	25^o		-25^o	
Reynolds Number	0.8×10^6	1.1×10^6	1.5×10^6	2.0×10^6

(all permutations)

TABLE 10.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (^{o})	Sweep (^{o})	Reynolds No. x 10^{-6}
00011	0	25	0.82
00012	0	25	0.83
00013	0	40	0.85
00021	0	-25	0.82
00022	0	-25	0.82
00031	0	25	1.12
00032	0	25	1.14
00033	0	40	1.13
00041	0	-25	1.09
00042	0	-25	1.09
00051	0	25	1.51
00052	0	25	1.53
00053	0	40	1.55
00061	0	-25	1.51
00062	0	-25	1.51
00071	0	25	2.01
00072	0	25	1.94
00081	0	-25	1.97
00082	0	-25	1.90
400091	180	25	0.82
400101	180	-25	0.80
400111	180	25	1.09
400121	180	-25	1.09
400131	180	25	1.49
400141	180	-25	1.48
400151	180	25	1.89
400161	180	-25	1.87

TABLE 10.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 10.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Angle of Attack	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

TABLE 10.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40171	0	100	1.54
40181	1	100	1.53
40191	2	100	1.53
40201	3	100	1.53
40211	4	100	1.53
40221	5	100	1.53
40231	6	100	1.53
40241	7	100	1.53
40251	8	100	1.53
40261	9	100	1.53
40271	10	100	1.53
40281	11	100	1.53
40291	12	100	1.53
40301	13	100	1.53
40311	14	100	1.53
40321	15	100	1.52
40331	16	100	1.52
40341	17	100	1.52
40351	18	100	1.52
40361	19	100	1.52
40371	20	100	1.52
40381	21	100	1.52

TABLE 10.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (concluded)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40391	22	100	1.52
40401	23	100	1.52
40411	24	100	1.52
40421	25	100	1.52
40431	26	100	1.52
40441	27	100	1.52
40451	28	100	1.52
40461	29	100	1.52
40471	30	100	1.52
40481	31	100	1.52
40491	32	100	1.52
40501	33	100	1.52
40511	34	100	1.51
40521	35	100	1.51
40531	0	500	1.52
40541	1	500	1.51
40551	2	500	1.51
40561	3	500	1.51
40571	4	500	1.51
40581	5	500	1.51
40591	6	500	1.51
40601	7	500	1.51
40611	8	500	1.51
40621	9	500	1.51
40631	10	500	1.51
40641	11	500	1.51
40651	12	500	1.51
40661	13	500	1.51
40671	14	500	1.51
40681	15	500	1.51
40691	16	500	1.51
40701	17	500	1.51
40711	18	500	1.51
40721	19	500	1.51
40731	20	500	1.51
40741	21	500	1.51
40751	22	500	1.51
40761	23	500	1.51
40771	24	500	1.51
40781	25	500	1.51
40791	26	500	1.51
40801	27	500	1.51
40811	28	500	1.51
40821	29	500	1.51
40831	30	500	1.51
40841	31	500	1.51
40851	32	500	1.51
40861	33	500	1.50
40871	34	500	1.50
40881	35	500	1.50

TABLE 10.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 10.3.1 : SUMMARY OF RAMPS FROM -1° TO 40° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
0.75	1.5	75.0	1.5	215.0	1.5
1.5	1.5	90.0	1.5	230.0	1.5
3.0	1.5	100.0	1.0 1.5 2.0	245.0	1.5
4.5	1.5	115.0	1.5	260.0	1.5
6.0	1.5	130.0	1.5	275.0	1.5
7.5	1.5	145.0	1.5	290.0	1.5
15.0	1.5	160.0	1.5	300.0	1.0 1.5 2.0
30.0	1.0 1.5 2.0	175.0	1.5	315.0	1.5
45.0	1.5	190.0	1.5	330.0	1.5
60.0	1.5	200.0	1.0 1.5 2.0	345.0	1.5

(all permutations)

TABLE 10.3.2 : SUMMARY OF SHORT RAMPS (nominal)

Starting Incidence	0°								
Finishing Incidence	4°		8°		12°		30°		
Pitch Rate (°s^{-1})	50	100	200	300	350	400*	450*	500*	550*
Reynolds Number	1.5 x 10^6								

(all permutations, except * (not for finishing incidence of 4° or 30°))

TABLE 10.3.3 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25001	0	4	38.5	0.0045	1.52
25011	0	4	70.7	0.0082	1.51
25021	0	4	75.1	0.0087	1.51
25031	0	4	71.8	0.0083	1.51
25091	0	8	49.7	0.0058	1.51
25101	0	8	80.0	0.0093	1.51
25111	0	8	138.8	0.0161	1.50
25121	0	8	149.7	0.0174	1.50
25141	0	8	137.0	0.0159	1.51
25151	0	8	143.2	0.0166	1.50
25161	0	8	139.6	0.0162	1.50
25171	0	8	145.5	0.0168	1.50
25181	0	8	141.0	0.0163	1.50
25191	0	12	49.2	0.0058	1.49
25201	0	12	90.2	0.0105	1.49
25211	0	12	163.3	0.0191	1.49
25221	0	12	196.3	0.0229	1.48
25232	0	12	204.1	0.0240	1.56
25242	0	12	198.4	0.0233	1.55
25252	0	12	206.4	0.0243	1.55
25262	0	12	198.5	0.0233	1.55
25272	0	12	198.8	0.0233	1.55
25281	0	30	51.4	0.0060	1.55
25291	0	30	100.6	0.0118	1.55
25301	0	30	192.4	0.0226	1.54
25311	0	30	260.6	0.0306	1.54
25321	0	30	289.9	0.0340	1.54
25331	-1	41	0.7	0.0001	1.49
25341	-1	41	1.5	0.0002	1.47
25351	-1	41	3.0	0.0003	1.47
25361	-1	41	4.5	0.0005	1.47
25371	-1	41	6.1	0.0007	1.47
25381	-1	41	7.6	0.0009	1.47
25391	-1	41	15.0	0.0017	1.47
25401	-1	41	30.1	0.0035	1.46
25411	-1	41	45.7	0.0053	1.46
25421	-1	41	60.7	0.0070	1.46
25431	-1	41	75.5	0.0087	1.45
25441	-1	41	91.4	0.0106	1.45
25451	-1	41	101.0	0.0117	1.45
25461	-1	41	115.6	0.0134	1.45

TABLE 10.3.3 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25471	-1	41	130.1	0.0151	1.45
25481	-1	41	144.1	0.0167	1.44
25491	-1	41	158.8	0.0184	1.44
25501	-1	41	171.7	0.0199	1.44
25511	-1	41	185.9	0.0217	1.45
25521	-1	41	194.7	0.0226	1.45
25531	-1	41	208.4	0.0242	1.45
25541	-1	41	222.6	0.0259	1.44
25551	-1	41	235.9	0.0280	1.58
25561	-1	41	248.1	0.0294	1.57
25571	-1	41	260.6	0.0308	1.57
25581	-1	41	271.4	0.0321	1.56
25591	-1	41	277.7	0.0328	1.57
25601	-1	41	291.2	0.0343	1.56
25611	-1	41	301.1	0.0354	1.56
25621	-1	41	307.6	0.0362	1.56
25631	-1	41	30.0	0.0052	1.09
25641	-1	41	101.3	0.0175	1.08
25651	-1	41	198.1	0.0342	1.08
25661	-1	41	280.0	0.0483	1.08
25671	-1	41	49.8	0.0044	2.06
25681	-1	41	101.0	0.0088	2.03
25691	-1	41	194.6	0.0170	2.03
25701	-1	41	273.5	0.0239	2.02

TABLE 10.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 10.4.1 : SUMMARY OF RAMPS FROM 40° TO -1° (nominal)

Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$
-0.75		-75.0		-215.0	
-1.5		-90.0		-230.0	
-3.0		-100.0		-245.0	
-4.5		-115.0		-260.0	
-6.0	1.5	-130.0	1.5	-275.0	1.5
-7.5		-145.0		-290.0	
-15.0		-160.0		-300.0	
-30.0		-175.0		-315.0	
-45.0		-190.0		-330.0	
-60.0		-200.0		-345.0	

(all permutations)

TABLE 10.4.2 : SUMMARY OF RAMPS TO -5° (nominal)

Starting Incidence	35°	30°	27°	25°	*22°	*20°	*18°	*16°	*14°
Finishing Incidence	-5°								
Pitch Rate ($^{o}s^{-1}$)	-300					-150*			
Reynolds Number	1.5×10^{6}								

(all permutations except those marked *)

TABLE 10.4.3 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
36331	40	-41	-0.7	-0.0001	1.46
36341	40	-41	-1.5	-0.0002	1.45
36351	40	-41	-2.9	-0.0003	1.44
36361	40	-41	-4.4	-0.0005	1.44
36371	40	-41	-5.8	-0.0007	1.44
36381	40	-41	-7.3	-0.0008	1.44
36391	40	-41	-14.5	-0.0017	1.46
36401	40	-41	-29.1	-0.0034	1.45
36411	40	-41	-43.6	-0.0050	1.45
36421	40	-41	-57.2	-0.0066	1.46
36431	40	-41	-71.2	-0.0082	1.45
36441	40	-41	-83.6	-0.0096	1.45
36451	40	-41	-93.4	-0.0108	1.45
36461	40	-41	-106.0	-0.0122	1.45
36471	40	-41	-120.7	-0.0140	1.46
36481	40	-41	-133.4	-0.0155	1.45
36491	40	-41	-143.8	-0.0167	1.45
36501	40	-41	-156.5	-0.0181	1.45
36511	40	-41	-165.5	-0.0191	1.46
36521	40	-41	-172.9	-0.0199	1.46
36531	40	-41	-180.9	-0.0208	1.46
36541	40	-41	-197.1	-0.0227	1.46
36551	40	-41	-208.7	-0.0242	1.46
36561	40	-41	-221.5	-0.0257	1.45
36571	40	-41	-234.1	-0.0271	1.45
36581	40	-41	-248.5	-0.0288	1.45
36591	40	-41	-258.7	-0.0299	1.45
36601	40	-41	-273.7	-0.0316	1.45
36611	40	-41	-285.1	-0.0329	1.45
36621	40	-41	-303.0	-0.0350	1.45
36831	35	-40	-303.8	-0.0356	1.52
36841	30	-35	-295.2	-0.0346	1.51
36851	27	-32	-291.7	-0.0341	1.51
36861	25	-30	-289.4	-0.0337	1.52
36871	22	-27	-283.1	-0.0335	1.58
36881	20	-25	-275.8	-0.0321	1.51
36891	18	-23	-269.8	-0.0313	1.51
36901	16	-21	-255.1	-0.0296	1.51
36911	14	-19	-249.6	-0.0290	1.51
36921	35	-40	-157.6	-0.0185	1.53
36931	30	-35	-160.0	-0.0188	1.52
36941	27	-32	-162.6	-0.0190	1.51
36951	25	-30	-160.4	-0.0187	1.52

TABLE 10.5 : DETAILS OF GENERAL SINUSOIDAL EXPERIMENTS

TABLE 10.5.1 : SUMMARY OF OSCILLATIONS ABOUT 10^o (nominal)

Mean Incidence	10^o							
Amplitude	4^o		6^o		8^o		10^o	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 10.5.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10^o (nominal)

Mean Incidence	4^o	6^o	8^o	10^o	15^o	20^o
Amplitude	10^o					
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 10.5.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8^o, WITH REYNOLDS NUMBER FIXED (nominal)

Mean Incidence	3^o	4^o	5^o	6^o	7^o	8^o	9^o	10^o
Amplitude	8^o							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

Mean Incidence	11^o	12^o	13^o	14^o	15^o	17^o	20^o
Amplitude	8^o						
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 10.5.4 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REDUCED FREQUENCY FIXED (nominal)

Mean Incidence	7°	8°	9°	10°	11°	12°	13°	14°	15°	17°	20°
Amplitude	8°										
Reduced Frequency	0.100										
Reynolds Number	1.0×10^6					1.5×10^6				2.0×10^6	

(all permutations)

TABLE 10.5.5 : SUMMARY OF FAST OSCILLATIONS (nominal)

Mean Incidence	0°			4°		
Amplitude	2°			4°		
Frequency (Hz)	1.0	2.5	5.0	7.5	10.0	12.5
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 10.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12001	10	4	0.010	1.55
12011	10	6	0.010	1.54
12021	10	8	0.010	1.54
12031	10	10	0.010	1.54
12041	10	4	0.026	1.53
12051	10	6	0.026	1.52
12061	10	8	0.026	1.52
12071	10	10	0.026	1.52
12081	10	4	0.052	1.52
12091	10	6	0.051	1.52
12101	10	8	0.051	1.52
12111	10	10	0.051	1.52
12121	10	4	0.077	1.52
12131	10	6	0.077	1.51
12141	10	8	0.077	1.51
12151	10	10	0.077	1.51
12161	10	4	0.103	1.51
12171	10	6	0.103	1.51
12181	10	8	0.103	1.51
12191	10	10	0.103	1.51

TABLE 10.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12201	10	4	0.129	1.50
12211	10	6	0.129	1.50
12221	10	8	0.129	1.50
12231	10	10	0.129	1.50
12241	10	4	0.156	1.49
12251	10	6	0.156	1.49
12261	10	8	0.155	1.49
12271	10	10	0.155	1.49
12281	10	4	0.182	1.49
12291	10	6	0.181	1.48
12301	10	8	0.181	1.48
12311	10	10	0.181	1.48
12371	3	8	0.010	1.50
12381	4	8	0.010	1.49
12391	5	8	0.010	1.49
12401	6	8	0.010	1.48
12411	7	8	0.010	1.48
12421	8	8	0.010	1.48
12431	9	8	0.010	1.48
12441	11	8	0.010	1.47
12461	13	8	0.010	1.47
12471	14	8	0.010	1.47
12481	15	8	0.010	1.46
12491	17	8	0.010	1.46
12501	20	8	0.010	1.46
12511	3	8	0.026	1.56
12521	4	8	0.026	1.55
12531	5	8	0.026	1.55
12541	6	8	0.026	1.55
12551	7	8	0.026	1.54
12561	8	8	0.026	1.54
12571	9	8	0.026	1.53
12581	11	8	0.026	1.53
12591	12	8	0.026	1.53
12601	13	8	0.026	1.53
12621	15	8	0.026	1.54
12631	17	8	0.026	1.53
12641	20	8	0.026	1.53
12651	3	8	0.052	1.54
12661	4	8	0.052	1.54
12671	5	8	0.052	1.53
12681	6	8	0.052	1.53
12691	7	8	0.051	1.53
12701	8	8	0.052	1.52
12711	9	8	0.052	1.52
12721	11	8	0.052	1.51
12731	12	8	0.052	1.51
12741	13	8	0.052	1.51
12751	14	8	0.051	1.53
12761	15	8	0.051	1.53
12771	17	8	0.051	1.53

TABLE 10.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12781	20	8	0.051	1.53
12791	3	8	0.077	1.54
12801	4	8	0.077	1.53
12811	5	8	0.077	1.53
12821	6	8	0.077	1.53
12831	7	8	0.077	1.53
12841	8	8	0.077	1.52
12851	9	8	0.077	1.52
12861	11	8	0.077	1.52
12871	12	8	0.077	1.52
12881	13	8	0.077	1.52
12891	14	8	0.077	1.52
12901	15	8	0.077	1.52
12911	17	8	0.077	1.52
12921	20	8	0.077	1.51
12931	3	8	0.103	1.52
12941	4	8	0.103	1.51
12951	5	8	0.103	1.51
12961	6	8	0.103	1.51
12971	7	8	0.103	1.51
12981	8	8	0.104	1.50
12991	9	8	0.103	1.50
13001	11	8	0.103	1.50
13011	12	8	0.103	1.50
13021	13	8	0.103	1.50
13031	14	8	0.103	1.50
13041	15	8	0.103	1.50
13051	17	8	0.103	1.50
13061	20	8	0.103	1.50
13071	3	8	0.129	1.51
13081	4	8	0.129	1.51
13091	5	8	0.129	1.51
13101	6	8	0.129	1.51
13111	7	8	0.129	1.51
13121	8	8	0.129	1.51
13131	9	8	0.129	1.51
13141	11	8	0.128	1.52
13151	12	8	0.128	1.51
13161	13	8	0.128	1.51
13171	14	8	0.128	1.51
13181	15	8	0.128	1.51
13191	17	8	0.128	1.51
13201	20	8	0.128	1.51
13211	3	8	0.155	1.50
13221	4	8	0.155	1.50
13231	5	8	0.155	1.50
13241	6	8	0.155	1.50
13251	7	8	0.155	1.50
13261	8	8	0.155	1.50
13271	9	8	0.155	1.50
13281	11	8	0.155	1.51

TABLE 10.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13291	12	8	0.154	1.50
13301	13	8	0.154	1.50
13311	14	8	0.154	1.50
13321	15	8	0.154	1.50
13331	17	8	0.154	1.50
13341	20	8	0.154	1.50
13351	3	8	0.180	1.50
13361	4	8	0.180	1.50
13371	5	8	0.180	1.50
13381	6	8	0.180	1.50
13391	7	8	0.180	1.50
13401	8	8	0.180	1.50
13411	9	8	0.180	1.50
13421	11	8	0.180	1.50
13431	12	8	0.180	1.50
13441	13	8	0.180	1.50
13451	14	8	0.180	1.49
13461	15	8	0.180	1.50
13471	17	8	0.180	1.49
13481	20	8	0.180	1.49
13631	7	8	0.103	1.05
13641	8	8	0.103	1.05
13651	9	8	0.103	1.05
13661	10	8	0.103	1.05
13671	11	8	0.103	1.05
13681	12	8	0.103	1.05
13691	13	8	0.102	1.06
13701	14	8	0.102	1.05
13711	15	8	0.102	1.05
13721	17	8	0.103	1.05
13731	20	8	0.103	1.05
13741	7	8	0.104	1.98
13751	8	8	0.104	1.96
13761	9	8	0.104	1.96
13771	10	8	0.103	1.96
13781	11	8	0.103	1.96
13791	12	8	0.103	1.95
13811	13	8	0.103	1.96
13821	14	8	0.103	1.95
13831	15	8	0.103	1.94
13841	17	8	0.103	1.94
13851	20	8	0.103	1.94
13871	4	10	0.010	1.48
13881	6	10	0.010	1.48
13891	8	10	0.010	1.47
13901	15	10	0.010	1.47
13911	20	10	0.010	1.47
13921	4	10	0.026	1.47
13931	6	10	0.026	1.47
13941	8	10	0.026	1.47
13951	15	10	0.026	1.47

TABLE 10.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13961	20	10	0.026	1.47
13971	4	10	0.051	1.47
13981	6	10	0.051	1.47
13991	8	10	0.051	1.47
14001	15	10	0.051	1.46
14011	20	10	0.051	1.46
14021	4	10	0.077	1.47
14031	6	10	0.077	1.47
14041	8	10	0.077	1.47
14051	15	10	0.077	1.47
14061	20	10	0.077	1.47
14071	4	10	0.102	1.47
14081	6	10	0.102	1.47
14091	8	10	0.102	1.47
14101	15	10	0.102	1.47
14111	20	10	0.102	1.47
14121	4	10	0.127	1.48
14131	6	10	0.127	1.48
14141	8	10	0.127	1.48
14151	15	10	0.127	1.48
14161	20	10	0.127	1.48
14171	4	10	0.153	1.47
14181	6	10	0.153	1.47
14191	8	10	0.153	1.47
14201	15	10	0.153	1.47
14211	20	10	0.153	1.47
14221	4	10	0.178	1.48
14231	6	10	0.178	1.47
14241	8	10	0.178	1.47
14251	15	10	0.178	1.47
14261	20	10	0.178	1.47
14272	0	2	0.042	1.47
14282	4	2	0.042	1.47
14292	4	4	0.042	1.47
14302	0	4	0.042	1.47
14312	0	2	0.105	1.47
14322	4	2	0.105	1.47
14332	4	4	0.105	1.47
14342	0	4	0.105	1.47
14352	0	2	0.209	1.48
14372	4	4	0.209	1.47
14382	0	4	0.209	1.47
14391	0	2	0.312	1.48
14401	4	2	0.312	1.48
14411	4	4	0.312	1.48
14421	0	4	0.312	1.48
14432	0	2	0.416	1.48
14442	4	2	0.416	1.48
14452	4	4	0.416	1.48
14462	0	4	0.416	1.48

TABLE 10.6 : DETAILS OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS

TABLE 10.6.1 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.05						
Reynolds Number	0.8×10^6		1.1×10^6		1.5×10^6		2.0×10^6

(all permutations)

TABLE 10.6.2 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.02	0.04		0.05		0.06	0.075
Reynolds Number	1.5×10^6						

(all permutations)

TABLE 10.6.3 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT MEAN INCIDENCE OF 180^o (nominal)

Mean Incidence	180^o			
Amplitude	4^o	6^o	8^o	10^o
Reduced Frequency	0.04	0.05		0.06
Reynolds Number	1.5×10^6			

(all permutations)

TABLE 10.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (actual)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
11001	0	5.4	0.050	0.81
11021	0	9.9	0.050	0.81
11041	0	12.2	0.050	0.81
11061	0	13.8	0.050	0.81
11081	0	17.4	0.050	0.81
19001	0	22.6	0.050	0.81
19021	0	32.8	0.050	0.81
11101	0	5.4	0.051	1.10
11121	0	9.9	0.050	1.09
11141	0	12.2	0.050	1.09
11161	0	13.8	0.050	1.09
11181	0	17.4	0.050	1.09
19041	0	22.6	0.050	1.09
19061	0	32.8	0.050	1.09
11201	0	5.4	0.041	1.47
11221	0	9.9	0.041	1.46
11241	0	12.2	0.041	1.46
11261	0	13.8	0.041	1.47
11281	0	17.4	0.041	1.47
19081	0	22.6	0.041	1.46
19101	0	32.8	0.041	1.45
11301	0	5.4	0.052	1.45
11321	0	9.9	0.051	1.44
11341	0	12.2	0.051	1.44
11361	0	13.8	0.052	1.44
11381	0	17.4	0.051	1.44
19121	0	22.6	0.052	1.44
19141	0	32.8	0.052	1.44
11401	0	5.4	0.062	1.45
11421	0	9.9	0.062	1.44
11441	0	12.2	0.062	1.44
11461	0	13.8	0.061	1.45
11481	0	17.4	0.061	1.44
19161	0	22.6	0.061	1.45
19181	0	32.8	0.061	1.44
11501	0	5.4	0.052	1.94
11521	0	9.9	0.051	1.92
11541	0	12.2	0.051	1.91
11561	0	13.8	0.051	1.92
11581	0	17.4	0.051	1.90
19201	0	22.6	0.052	1.91
19221	0	32.8	0.051	1.89

TABLE 10.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (concluded)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
19301	0	5.4	0.077	1.47
19321	0	9.9	0.077	1.47
19341	0	12.2	0.077	1.46
19361	0	13.8	0.078	1.46
19381	0	17.4	0.078	1.46
19401	0	22.6	0.077	1.45
19421	0	32.8	0.077	1.45
19441	0	5.4	0.020	1.49
19461	0	9.9	0.020	1.48
19481	0	12.2	0.020	1.47
19501	0	13.8	0.020	1.47
19521	0	17.4	0.020	1.46
19541	0	22.6	0.020	1.46
19561	0	32.8	0.020	1.46
411601	180	4	0.054	1.46
411611	180	6	0.054	1.45
411621	180	8	0.054	1.45
411631	180	10	0.054	1.45
411661	180	4	0.067	1.46
411671	180	6	0.067	1.45
411681	180	8	0.067	1.45
411691	180	10	0.067	1.45
411721	180	4	0.081	1.45
411731	180	6	0.081	1.44
411741	180	8	0.081	1.44
411751	180	10	0.081	1.44

TABLE 10.7 : DETAILS OF SINGLE STREAMTUBE VAWT EXPERIMENTS

TABLE 10.7.1 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.05						
Reynolds Number	0.8×10^6		1.1×10^6		1.5×10^6		2.0×10^6

(all permutations)

TABLE 10.7.2 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.02		0.04	0.05		0.06	0.075
Reynolds Number	1.5×10^6						

(all permutations)

TABLE 10.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51011	0	6.00	0.050	0.81
51031	0	4.00	0.050	0.81
51051	0	3.50	0.050	0.81
51071	0	3.25	0.050	0.81
51091	0	2.80	0.050	0.81
59011	0	2.33	0.050	0.81
59031	0	1.75	0.050	0.81
51111	0	6.00	0.050	1.09
51131	0	4.00	0.050	1.09
51151	0	3.50	0.050	1.09
51171	0	3.25	0.050	1.09
51191	0	2.80	0.050	1.09
59051	0	2.33	0.050	1.09
59071	0	1.75	0.050	1.09

TABLE 10.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (concluded)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51211	0	6.00	0.041	1.46
51231	0	4.00	0.041	1.46
51251	0	3.50	0.041	1.46
51271	0	3.25	0.041	1.47
51291	0	2.80	0.041	1.46
59091	0	2.33	0.041	1.45
59111	0	1.75	0.041	1.45
51311	0	6.00	0.051	1.45
51331	0	4.00	0.051	1.44
51351	0	3.50	0.051	1.44
51371	0	3.25	0.051	1.44
51391	0	2.80	0.051	1.44
59131	0	2.33	0.052	1.44
59151	0	1.75	0.052	1.44
51411	0	6.00	0.062	1.44
51431	0	4.00	0.062	1.44
51451	0	3.50	0.062	1.44
51471	0	3.25	0.061	1.44
51491	0	2.80	0.061	1.44
59171	0	2.33	0.061	1.44
59191	0	1.75	0.061	1.44
51511	0	6.00	0.051	1.93
51531	0	4.00	0.051	1.92
51551	0	3.50	0.051	1.91
51571	0	3.25	0.051	1.91
51591	0	2.80	0.051	1.90
59211	0	2.33	0.051	1.90
59231	0	1.75	0.051	1.89
59311	0	6.00	0.077	1.47
59331	0	4.00	0.077	1.46
59351	0	3.50	0.077	1.46
59371	0	3.25	0.078	1.46
59391	0	2.80	0.078	1.46
59411	0	2.33	0.077	1.45
59431	0	1.75	0.077	1.45
59451	0	6.00	0.020	1.48
59471	0	4.00	0.020	1.48
59491	0	3.50	0.020	1.47
59511	0	3.25	0.020	1.47
59531	0	2.80	0.020	1.46
59551	0	2.33	0.020	1.46
59571	0	1.75	0.020	1.46

TABLE 10.8 : DETAILS OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS

TABLE 10.8.1 : SUMMARY OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (nominal)

Mean Incidence	0^o			
Tip Speed Ratio	2.80	3.25	4.00	6.00
Reduced Frequency	0.040	0.050	0.060	
Reynolds Number	1.5×10^6			

(all permutations)

TABLE 10.8.2 : LIST OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
71781	0	6.00	0.041	1.47
71791	0	4.00	0.041	1.47
71801	0	3.25	0.041	1.46
71811	0	2.80	0.041	1.46
71821	0	6.00	0.051	1.47
71831	0	4.00	0.051	1.46
71841	0	3.25	0.051	1.46
71851	0	2.80	0.051	1.46
71861	0	6.00	0.062	1.46
71871	0	4.00	0.062	1.46
71881	0	3.25	0.062	1.45
71891	0	2.80	0.061	1.45

TABLE 11 : EXPERIMENTS ON NACA 0030 (MODEL 9)

TABLE 11.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 11.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Starting Incidence	0^o		180^o	
Incidence Sweep	25^o		-25^o	
Reynolds Number	0.8×10^6	1.1×10^6	1.5×10^6	2.0×10^6

(all permutations)

TABLE 11.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^{-6}
00011	0	25	0.84
00012	0	25	0.81
00021	0	-25	0.84
00022	0	-25	0.81
00031	0	25	1.14
00032	0	25	1.09
00041	0	-25	1.14
00042	0	-25	1.09
00051	0	25	1.55
00052	0	25	1.52
00061	0	-25	1.53
00062	0	-25	1.50
00071	0	25	2.04
00081	0	-25	2.01
400091	180	30	0.79
400101	182	-32	0.79
400111	178	32	1.12
400121	185	-35	1.12
400131	175	35	1.52
400141	185	-35	1.50
400151	175	35	1.92
400161	185	-35	1.92

TABLE 11.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 11.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Angle of Attack	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

Angle of Attack	24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°
Sampling Frequency	100 Hz						500 Hz					
Reynolds Number	1.5×10^6											

(all permutations)

TABLE 11.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40171	0	100	1.47
40181	1	100	1.47
40191	2	100	1.47
40201	3	100	1.47
40211	4	100	1.47
40221	5	100	1.47
40231	6	100	1.47
40241	7	100	1.46
40251	8	100	1.46
40261	9	100	1.46
40271	10	100	1.46
40281	11	100	1.46
40291	12	100	1.46
40301	13	100	1.46
40311	14	100	1.46
40321	15	100	1.46
40331	16	100	1.46
40341	17	100	1.46
40351	18	100	1.46
40361	19	100	1.46
40371	20	100	1.46
40381	21	100	1.46

TABLE 11.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (concluded)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40391	22	100	1.46
40401	23	100	1.46
40411	24	100	1.46
40421	25	100	1.46
40431	26	100	1.46
40441	27	100	1.46
40451	28	100	1.47
40461	29	100	1.46
40471	30	100	1.46
40481	31	100	1.46
40491	32	100	1.46
40501	33	100	1.46
40511	34	100	1.46
40521	35	100	1.46
40531	0	500	1.46
40541	1	500	1.46
40551	2	500	1.46
40561	3	500	1.46
40571	4	500	1.45
40581	5	500	1.45
40591	6	500	1.45
40601	7	500	1.45
40611	8	500	1.45
40621	9	500	1.45
40631	10	500	1.45
40641	11	500	1.45
40651	12	500	1.45
40661	13	500	1.45
40671	14	500	1.46
40681	15	500	1.46
40691	16	500	1.46
40701	17	500	1.46
40711	18	500	1.46
40721	19	500	1.45
40731	20	500	1.45
40741	21	500	1.45
40751	22	500	1.45
40761	23	500	1.45
40771	24	500	1.45
40781	25	500	1.45
40791	26	500	1.45
40801	27	500	1.45
40811	28	500	1.46
40821	29	500	1.46
40831	30	500	1.46
40841	31	500	1.46
40851	32	500	1.46
40861	33	500	1.46
40871	34	500	1.46
40881	35	500	1.46

TABLE 11.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 11.3.1 : SUMMARY OF RAMPS FROM -1° TO 40° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
0.75	1.5	75.0	1.5	215.0	1.5
1.5	1.5	90.0	1.5	230.0	1.5
3.0	1.5	100.0	1.0 1.5 2.0	245.0	1.5
4.5	1.5	115.0	1.5	260.0	1.5
6.0	1.5	130.0	1.5	275.0	1.5
7.5	1.5	145.0	1.5	290.0	1.5
15.0	1.5	160.0	1.5	300.0	1.0 1.5 2.0
30.0	1.0 1.5 2.0	175.0	1.5	315.0	1.5
45.0	1.5	190.0	1.5	330.0	1.5
60.0	1.5	200.0	1.0 1.5 2.0	345.0	1.5

(all permutations)

TABLE 11.3.2 : SUMMARY OF SHORT RAMPS (nominal)

Starting Incidence	0°								
Finishing Incidence	4°		8°		12°		30°		
Pitch Rate ($^{\circ}s^{-1}$)	50	100	200	300	350	400*	450*	500*	550*
Reynolds Number	1.5 x 10^6								

(all permutations, except * (not for finishing incidence of 4° or 30°))

TABLE 11.3.3 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25001	0	4	42.5	0.0049	1.46
25011	0	4	73.3	0.0084	1.46
25021	0	4	85.9	0.0098	1.46
25031	0	4	96.0	0.0110	1.46
25091	0	8	49.3	0.0056	1.46
25101	0	8	82.2	0.0094	1.46
25111	0	8	140.5	0.0161	1.45
25121	0	8	149.1	0.0170	1.45
25141	0	8	159.1	0.0182	1.45
25151	0	8	152.9	0.0175	1.45
25161	0	8	154.2	0.0176	1.45
25171	0	8	158.0	0.0181	1.45
25181	0	8	160.6	0.0184	1.45
25191	0	12	49.2	0.0057	1.46
25201	0	12	90.4	0.0104	1.46
25211	0	12	157.5	0.0181	1.46
25221	0	12	194.6	0.0224	1.46
25231	0	12	201.5	0.0232	1.46
25241	0	12	199.2	0.0229	1.46
25251	0	12	205.8	0.0237	1.45
25261	0	12	204.6	0.0235	1.45
25271	0	12	203.6	0.0234	1.45
25281	0	30	49.9	0.0057	1.45
25291	0	30	100.7	0.0116	1.45
25301	0	30	189.5	0.0218	1.45
25311	0	30	264.6	0.0304	1.45
25321	0	30	289.4	0.0332	1.45
25331	-1	41	0.7	0.0001	1.53
25341	-1	41	1.5	0.0002	1.50
25351	-1	41	3.0	0.0003	1.49
25361	-1	41	4.5	0.0005	1.52
25371	-1	41	6.0	0.0007	1.51
25381	-1	41	7.5	0.0009	1.50
25391	-1	41	14.9	0.0017	1.51
25401	-1	41	29.9	0.0034	1.50
25411	-1	41	44.7	0.0051	1.50
25421	-1	41	60.0	0.0069	1.51
25431	-1	41	75.2	0.0087	1.50
25441	-1	41	91.0	0.0105	1.50
25451	-1	41	100.8	0.0116	1.49
25461	-1	41	115.7	0.0133	1.49

TABLE 11.3.3 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
25471	-1	41	129.7	0.0147	1.45
25481	-1	41	144.0	0.0163	1.45
25491	-1	41	158.7	0.0180	1.45
25501	-1	41	170.8	0.0193	1.45
25511	-1	41	185.4	0.0210	1.45
25521	-1	41	193.0	0.0219	1.44
25531	-1	41	207.0	0.0235	1.44
25541	-1	41	220.3	0.0250	1.44
25551	-1	41	235.7	0.0269	1.44
25561	-1	41	247.2	0.0282	1.43
25571	-1	41	259.7	0.0296	1.43
25581	-1	41	272.9	0.0311	1.43
25591	-1	41	280.6	0.0319	1.44
25601	-1	41	290.5	0.0330	1.44
25611	-1	41	303.0	0.0344	1.44
25621	-1	41	311.4	0.0353	1.43
25631	-1	41	30.0	0.0051	0.97
25641	-1	41	100.0	0.0169	0.97
25651	-1	41	193.0	0.0326	0.97
25661	-1	41	279.2	0.0472	0.97
25671	-1	41	30.0	0.0026	1.90
25681	-1	41	99.9	0.0086	1.87
25691	-1	41	194.5	0.0168	1.87
25701	-1	41	283.3	0.0245	1.86

TABLE 11.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 11.4.1 : SUMMARY OF RAMPS FROM 40° TO -1° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
-0.75	1.5	-75.0	1.5	-215.0	1.5
-1.5	1.5	-90.0	1.5	-230.0	1.5
-3.0	1.5	-100.0	1.5	-245.0	1.5
-4.5	1.5	-115.0	1.5	-260.0	1.5
-6.0	1.5	-130.0	1.5	-275.0	1.5
-7.5	1.5	-145.0	1.5	-290.0	1.5
-15.0	1.5	-160.0	1.5	-300.0	1.0 1.5
-30.0	1.0 1.5	-175.0	1.5	-315.0	1.5
-45.0	1.5	-190.0	1.5	-330.0	1.5
-60.0	1.5	-200.0	1.0 1.5	-345.0	1.5

(all permutations)

TABLE 11.4.2 : SUMMARY OF RAMPS FROM 30° (nominal)

Starting Incidence	30°						
Finishing Incidence	-10°	0°	5°	10°	15°	20°	25°
Pitch Rate($^{o}s^{-1}$)	-50		-150		-300		
Reynolds Number	1.5 x 10^{6}						

(all permutations)

TABLE 11.4.3 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate (°s^{-1})	Reduced Pitch Rate	Reynolds No. x 10^{-6}
36331	40	-41	-0.7	-0.0001	1.49
36341	40	-41	-1.4	-0.0002	1.49
36351	40	-41	-2.9	-0.0003	1.48
36361	40	-41	-4.3	-0.0005	1.47
36371	40	-41	-5.7	-0.0007	1.46
36381	40	-41	-7.2	-0.0008	1.46
36391	40	-41	-14.4	-0.0017	1.46
36401	40	-41	-28.7	-0.0033	1.45
36411	40	-41	-42.5	-0.0049	1.45
36421	40	-41	-56.3	-0.0065	1.45
36431	40	-41	-69.7	-0.0080	1.45
36441	40	-41	-83.4	-0.0096	1.45
36451	40	-41	-92.0	-0.0105	1.45
36461	40	-41	-102.6	-0.0117	1.45
36471	40	-41	-117.7	-0.0135	1.46
36481	40	-41	-132.7	-0.0152	1.45
36491	40	-41	-144.8	-0.0166	1.45
36501	40	-41	-155.6	-0.0179	1.45
36511	40	-41	-167.8	-0.0191	1.46
36521	40	-41	-172.6	-0.0196	1.46
36531	40	-41	-183.6	-0.0209	1.46
36541	40	-41	-193.7	-0.0220	1.45
36551	40	-41	-207.3	-0.0238	1.44
36561	40	-41	-217.7	-0.0250	1.44
36571	40	-41	-233.7	-0.0268	1.44
36581	40	-41	-250.5	-0.0287	1.44
36591	40	-41	-257.6	-0.0292	1.46
36601	40	-41	-268.4	-0.0304	1.45
36611	40	-41	-288.4	-0.0327	1.45
36621	40	-41	-298.5	-0.0338	1.45
36631	40	-41	-28.5	-0.0048	0.97
36651	40	-41	-170.6	-0.0289	0.97
36661	40	-41	-264.1	-0.0448	0.97
36861	30	-40	-301.2	-0.0345	1.44
36871	30	-40	-164.3	-0.0188	1.44
36881	30	-40	-49.4	-0.0056	1.44
36891	30	-30	-281.6	-0.0320	1.45
36901	30	-30	-157.4	-0.0179	1.45
36911	30	-30	-49.3	-0.0056	1.44
36921	30	-25	-272.5	-0.0309	1.44
36931	30	-25	-151.6	-0.0172	1.44
36941	30	-25	-48.0	-0.0054	1.44
36951	30	-20	-261.4	-0.0296	1.44
36961	30	-20	-145.8	-0.0165	1.44
36971	30	-20	-48.4	-0.0055	1.44
36981	30	-15	-241.5	-0.0274	1.44
36991	30	-15	-146.1	-0.0166	1.44
37001	30	-15	-46.8	-0.0053	1.43
37011	30	-10	-210.1	-0.0238	1.43
37021	30	-10	-154.7	-0.0175	1.43
37031	30	-10	-47.4	-0.0054	1.43
37041	30	-5	-127.8	-0.0145	1.43
37051	30	-5	-110.8	-0.0126	1.43
37061	30	-5	-40.6	-0.0046	1.43

TABLE 11.5 : DETAILS OF GENERAL SINUSOIDAL EXPERIMENTS

TABLE 11.5.1 : SUMMARY OF OSCILLATIONS ABOUT 10° (nominal)

Mean Incidence	10°							
Amplitude	4°		6°		8°		10°	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 11.5.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10° (nominal)

Mean Incidence	4°	6°	8°	10°	15°	20°		
Amplitude	10°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 11.5.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REYNOLDS NUMBER FIXED (nominal)

Mean Incidence	3°	4°	5°	6°	7°	8°	9°	10°
Amplitude	8°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

Mean Incidence	11°	12°	13°	14°	15°	17°	20°	
Amplitude	8°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 11.5.4 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REDUCED FREQUENCY FIXED (nominal)

Mean Incidence	7°	8°	9°	10°	11°	12°	13°	14°	15°	17°	20°
Amplitude	8°										
Reduced Frequency	0.100										
Reynolds Number	1.0×10^6					1.5×10^6				2.0×10^6	

(all permutations)

TABLE 11.5.5 : SUMMARY OF FAST OSCILLATIONS (nominal)

Mean Incidence	0°			4°		
Amplitude	2°			4°		
Frequency (Hz)	1.0	2.5	5.0	7.5	10.0	12.5
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 11.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12001	10	4	0.010	1.56
12011	10	6	0.010	1.54
12021	10	8	0.010	1.54
12031	10	10	0.010	1.54
12041	10	4	0.026	1.54
12051	10	6	0.026	1.53
12061	10	8	0.026	1.53
12071	10	10	0.026	1.53
12081	10	4	0.051	1.53
12091	10	6	0.051	1.53
12101	10	8	0.051	1.52
12111	10	10	0.051	1.52
12121	10	4	0.077	1.52
12131	10	6	0.077	1.52
12141	10	8	0.077	1.52
12151	10	10	0.077	1.51
12161	10	4	0.103	1.52
12171	10	6	0.102	1.51
12181	10	8	0.102	1.51
12191	10	10	0.102	1.51

TABLE 11.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12201	10	4	0.128	1.52
12211	10	6	0.128	1.52
12221	10	8	0.128	1.51
12231	10	10	0.128	1.51
12241	10	4	0.153	1.52
12251	10	6	0.153	1.51
12261	10	8	0.153	1.51
12271	10	10	0.153	1.51
12281	10	4	0.178	1.52
12291	10	6	0.178	1.51
12301	10	8	0.178	1.51
12311	10	10	0.178	1.51
12371	3	8	0.010	1.51
12381	4	8	0.010	1.50
12391	5	8	0.010	1.50
12401	6	8	0.010	1.50
12411	7	8	0.010	1.49
12421	8	8	0.010	1.50
12431	9	8	0.010	1.49
12441	11	8	0.010	1.49
12451	12	8	0.010	1.49
12461	13	8	0.010	1.48
12471	14	8	0.010	1.49
12481	15	8	0.010	1.48
12491	17	8	0.010	1.48
12501	20	8	0.010	1.48
12511	3	8	0.025	1.48
12521	4	8	0.025	1.48
12531	5	8	0.025	1.48
12541	6	8	0.025	1.48
12551	7	8	0.025	1.47
12561	8	8	0.025	1.48
12571	9	8	0.025	1.48
12581	11	8	0.025	1.47
12591	12	8	0.025	1.47
12601	13	8	0.025	1.47
12621	15	8	0.025	1.47
12631	17	8	0.025	1.47
12641	20	8	0.025	1.47
12651	3	8	0.051	1.50
12661	4	8	0.051	1.49
12671	5	8	0.051	1.49
12681	6	8	0.051	1.49
12691	7	8	0.051	1.49
12701	8	8	0.051	1.49
12711	9	8	0.051	1.48
12721	11	8	0.051	1.48
12731	12	8	0.051	1.48
12741	13	8	0.051	1.48
12751	14	8	0.051	1.48
12761	15	8	0.051	1.48

TABLE 11.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12771	17	8	0.051	1.47
12781	20	8	0.051	1.47
12791	3	8	0.076	1.48
12801	4	8	0.076	1.48
12811	5	8	0.076	1.48
12821	6	8	0.076	1.48
12831	7	8	0.076	1.48
12841	8	8	0.076	1.49
12851	9	8	0.076	1.48
12861	11	8	0.076	1.48
12871	12	8	0.076	1.48
12881	13	8	0.076	1.48
12891	14	8	0.076	1.48
12901	15	8	0.076	1.48
12911	17	8	0.076	1.48
12921	20	8	0.076	1.48
12931	3	8	0.101	1.48
12941	4	8	0.101	1.48
12951	5	8	0.101	1.48
12961	6	8	0.101	1.48
12971	7	8	0.101	1.48
12981	8	8	0.101	1.48
12991	9	8	0.101	1.48
13001	11	8	0.101	1.48
13011	12	8	0.101	1.48
13021	13	8	0.101	1.48
13031	14	8	0.101	1.47
13041	15	8	0.101	1.47
13051	17	8	0.101	1.47
13061	20	8	0.101	1.47
13071	3	8	0.127	1.48
13081	4	8	0.127	1.47
13091	5	8	0.127	1.47
13101	6	8	0.127	1.47
13111	7	8	0.127	1.47
13121	8	8	0.127	1.47
13131	9	8	0.127	1.47
13141	11	8	0.127	1.47
13151	12	8	0.127	1.47
13161	13	8	0.127	1.47
13171	14	8	0.127	1.47
13181	15	8	0.127	1.47
13191	17	8	0.127	1.47
13201	20	8	0.127	1.47
13211	3	8	0.154	1.48
13221	4	8	0.153	1.47
13231	5	8	0.153	1.47
13241	6	8	0.153	1.47
13251	7	8	0.153	1.47
13261	8	8	0.153	1.47
13271	9	8	0.153	1.47

TABLE 11.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13281	11	8	0.153	1.48
13291	12	8	0.152	1.48
13301	13	8	0.152	1.48
13311	14	8	0.152	1.48
13321	15	8	0.152	1.48
13331	17	8	0.152	1.48
13341	20	8	0.152	1.48
13351	3	8	0.180	1.49
13361	4	8	0.179	1.48
13371	5	8	0.179	1.48
13381	6	8	0.179	1.48
13391	7	8	0.179	1.48
13401	8	8	0.179	1.48
13411	9	8	0.179	1.47
13421	11	8	0.179	1.48
13431	12	8	0.179	1.47
13441	13	8	0.179	1.47
13451	14	8	0.179	1.47
13461	15	8	0.179	1.47
13471	17	8	0.179	1.47
13481	20	8	0.179	1.47
13631	7	8	0.102	1.01
13641	8	8	0.102	1.01
13651	9	8	0.102	1.01
13661	10	8	0.102	1.01
13671	11	8	0.102	1.01
13681	12	8	0.102	1.01
13691	13	8	0.102	1.01
13701	14	8	0.102	1.01
13711	15	8	0.102	1.01
13721	17	8	0.102	1.01
13731	20	8	0.102	1.01
13741	7	8	0.102	1.95
13751	8	8	0.101	1.93
13761	9	8	0.101	1.93
13771	10	8	0.101	1.93
13781	11	8	0.101	1.93
13791	12	8	0.101	1.92
13811	13	8	0.102	1.92
13821	14	8	0.102	1.90
13831	15	8	0.102	1.90
13841	17	8	0.102	1.90
13851	20	8	0.102	1.90
13871	4	10	0.010	1.47
13881	6	10	0.010	1.46
13891	8	10	0.010	1.46
13901	15	10	0.010	1.46
13911	20	10	0.010	1.46
13921	4	10	0.025	1.46
13931	6	10	0.025	1.46
13941	8	10	0.025	1.46

TABLE 11.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13951	15	10	0.025	1.46
13961	20	10	0.025	1.46
13971	4	10	0.051	1.47
13981	6	10	0.051	1.47
13991	8	10	0.051	1.47
14001	15	10	0.051	1.47
14011	20	10	0.051	1.47
14021	4	10	0.076	1.47
14031	6	10	0.076	1.47
14041	8	10	0.076	1.47
14051	15	10	0.076	1.47
14061	20	10	0.076	1.47
14071	4	10	0.101	1.48
14081	6	10	0.101	1.48
14091	8	10	0.101	1.48
14101	15	10	0.101	1.48
14111	20	10	0.101	1.48
14121	4	10	0.126	1.48
14131	6	10	0.126	1.48
14141	8	10	0.126	1.48
14151	15	10	0.126	1.48
14161	20	10	0.126	1.48
14171	4	10	0.152	1.48
14181	6	10	0.152	1.48
14191	8	10	0.152	1.48
14201	15	10	0.152	1.48
14211	20	10	0.152	1.48
14221	4	10	0.178	1.49
14231	6	10	0.178	1.48
14241	8	10	0.178	1.48
14251	15	10	0.178	1.48
14261	20	10	0.178	1.48
14272	0	2	0.042	1.46
14282	4	2	0.042	1.46
14292	4	4	0.042	1.46
14302	0	4	0.042	1.46
14312	0	2	0.104	1.46
14322	4	2	0.104	1.46
14332	4	4	0.104	1.46
14342	0	4	0.104	1.46
14352	0	2	0.210	1.47
14372	4	4	0.210	1.46
14382	0	4	0.210	1.46
14391	0	2	0.310	1.47
14401	4	2	0.310	1.46
14411	4	4	0.310	1.46
14421	0	4	0.310	1.46
14432	0	2	0.420	1.47
14442	4	2	0.420	1.47
14452	4	4	0.420	1.47
14462	0	4	0.420	1.47

TABLE 11.6 : DETAILS OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS

TABLE 11.6.1 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0°						
Amplitude	5.4°	10.0°	12.2°	13.8°	17.4°	22.6°	32.8°
Reduced Frequency	0.05						
Reynolds Number	0.8×10^6		1.1×10^6		1.5×10^6		2.0×10^6

(all permutations)

TABLE 11.6.2 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0°						
Amplitude	5.4°	10.0°	12.2°	13.8°	17.4°	22.6°	32.8°
Reduced Frequency	0.02		0.04	0.05		0.06	0.075
Reynolds Number	1.5×10^6						

(all permutations)

TABLE 11.6.3 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT MEAN INCIDENCE OF 180° (nominal)

Mean Incidence	180°					
Amplitude	4°	6°	8°	10°	12°	14°
Reduced Frequency	0.04		0.05		0.06	
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 11.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11001	0	5.4	0.050	0.81
11021	0	9.9	0.050	0.80
11041	0	12.2	0.050	0.80
11061	0	13.8	0.050	0.80
11081	0	17.4	0.050	0.80
19001	0	22.6	0.050	0.79
19021	0	32.8	0.050	0.79
11101	0	5.4	0.050	1.10
11121	0	9.9	0.050	1.09
11141	0	12.2	0.050	1.09
11161	0	13.8	0.050	1.09
11181	0	17.4	0.050	1.09
19041	0	22.6	0.050	1.09
19061	0	32.8	0.050	1.09
11201	0	5.4	0.041	1.48
11221	0	9.9	0.041	1.47
11241	0	12.2	0.041	1.47
11261	0	13.8	0.041	1.47
11281	0	17.4	0.041	1.46
19081	0	22.6	0.041	1.47
19101	0	32.8	0.040	1.46
11301	0	5.4	0.051	1.48
11321	0	9.9	0.051	1.47
11341	0	12.2	0.051	1.47
11361	0	13.8	0.051	1.47
11381	0	17.4	0.051	1.46
19121	0	22.6	0.051	1.47
19141	0	32.8	0.051	1.46
11401	0	5.4	0.062	1.48
11421	0	9.9	0.062	1.48
11441	0	12.2	0.062	1.47
11461	0	13.8	0.062	1.48
11481	0	17.4	0.062	1.47
19161	0	22.6	0.062	1.47
19181	0	32.8	0.062	1.47
11501	0	5.4	0.053	1.90
11521	0	9.9	0.052	1.88
11541	0	12.2	0.052	1.87
11561	0	13.8	0.053	1.87
11581	0	17.4	0.053	1.85
19201	0	22.6	0.053	1.86
19221	0	32.8	0.053	1.84

TABLE 11.6.4 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
19301	0	5.4	0.077	1.47
19321	0	9.9	0.077	1.46
19341	0	12.2	0.077	1.46
19361	0	13.8	0.077	1.46
19381	0	17.4	0.077	1.46
19401	0	22.6	0.077	1.46
19421	0	32.8	0.077	1.45
19441	0	5.4	0.021	1.48
19461	0	9.9	0.021	1.48
19481	0	12.2	0.021	1.47
19501	0	13.8	0.020	1.48
19521	0	17.4	0.020	1.47
19541	0	22.6	0.020	1.47
19561	0	32.8	0.020	1.46
411601	180	4	0.055	1.48
411611	180	6	0.055	1.48
411621	180	8	0.055	1.48
411631	180	10	0.055	1.48
411641	180	12	0.055	1.48
411642	180	14	0.055	1.47
411661	180	4	0.069	1.48
411671	180	6	0.069	1.48
411681	180	8	0.069	1.48
411691	180	10	0.069	1.47
411701	180	12	0.069	1.47
411711	180	14	0.069	1.47
411721	180	4	0.082	1.49
411731	180	6	0.082	1.48
411741	180	8	0.082	1.48
411751	180	10	0.082	1.48
411761	180	12	0.081	1.48
411771	180	14	0.081	1.48

TABLE 11.7 : DETAILS OF SINGLE STREAMTUBE VAWT EXPERIMENTS

TABLE 11.7.1 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^{o}						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.05						
Reynolds Number	$0.8x10^{6}$		$1.1x10^{6}$		$1.5x10^{6}$		$2.0x10^{6}$

(all permutations)

TABLE 11.7.2 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^{o}						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.02		0.04	0.05		0.06	0.075
Reynolds Number	$1.5x10^{6}$						

(all permutations)

TABLE 11.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51011	0	6.00	0.050	0.81
51031	0	4.00	0.050	0.80
51051	0	3.50	0.050	0.80
51071	0	3.25	0.050	0.80
51091	0	2.80	0.050	0.80
59011	0	2.33	0.050	0.79
59031	0	1.75	0.050	0.79
51111	0	6.00	0.050	1.09
51131	0	4.00	0.050	1.09
51151	0	3.50	0.050	1.09
51171	0	3.25	0.050	1.09
51191	0	2.80	0.050	1.09
59051	0	2.33	0.050	1.09
59071	0	1.75	0.050	1.09

TABLE 11.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (concluded)

Run Number	Mean θ	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
51211	0	6.00	0.041	1.47
51231	0	4.00	0.041	1.47
51251	0	3.50	0.041	1.46
51271	0	3.25	0.041	1.46
51291	0	2.80	0.041	1.46
59091	0	2.33	0.040	1.46
59111	0	1.75	0.040	1.46
51311	0	6.00	0.051	1.48
51331	0	4.00	0.051	1.47
51351	0	3.50	0.051	1.47
51371	0	3.25	0.051	1.47
51391	0	2.80	0.051	1.46
59131	0	2.33	0.051	1.46
59151	0	1.75	0.051	1.46
51411	0	6.00	0.062	1.48
51431	0	4.00	0.062	1.47
51451	0	3.50	0.062	1.47
51471	0	3.25	0.062	1.47
51491	0	2.80	0.062	1.47
59171	0	2.33	0.062	1.47
59191	0	1.75	0.062	1.47
51511	0	6.00	0.053	1.88
51531	0	4.00	0.052	1.87
51551	0	3.50	0.052	1.87
51571	0	3.25	0.053	1.86
51591	0	2.80	0.053	1.85
59211	0	2.33	0.053	1.85
59231	0	1.75	0.053	1.84
59311	0	6.00	0.077	1.46
59331	0	4.00	0.077	1.46
59351	0	3.50	0.077	1.46
59371	0	3.25	0.077	1.46
59391	0	2.80	0.077	1.46
59411	0	2.33	0.077	1.45
59431	0	1.75	0.077	1.45
59451	0	6.00	0.021	1.48
59471	0	4.00	0.021	1.47
59491	0	3.50	0.021	1.47
59511	0	3.25	0.020	1.47
59531	0	2.80	0.020	1.47
59551	0	2.33	0.020	1.46
59571	0	1.75	0.020	1.46

TABLE 11.8 : DETAILS OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS

TABLE 11.8.1 : SUMMARY OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (nominal)

Mean Incidence	0^{o}			
Tip Speed Ratio	2.80	3.25	4.00	6.00
Reduced Frequency	0.040	0.050	0.060	
Reynolds Number	1.5×10^{6}			

(all permutations)

TABLE 11.8.2 : LIST OF MULTIPLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean $(^{o})$	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
71801	0	6.00	0.041	1.45
71791	0	4.00	0.041	1.44
71801	0	3.25	0.041	1.44
71811	0	2.80	0.041	1.44
71821	0	6.00	0.051	1.44
71831	0	4.00	0.051	1.44
71841	0	3.25	0.051	1.44
71851	0	2.80	0.051	1.44
71861	0	6.00	0.061	1.44
71871	0	4.00	0.061	1.44
71881	0	3.25	0.061	1.44
71891	0	2.80	0.061	1.43

TABLE 12 : EXPERIMENTS ON NACA 0012 (MODEL 11)

TABLE 12.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 12.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Reynolds Number	1.0×10^6	1.5×10^6	2.0×10^6
Angle of Attack	-2° to 30°		

(all permutations)

TABLE 12.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^6
00011	-5	30	1.52
00021	-5	30	1.53
00031	-5	30	0.99
00041	-5	30	2.05
00051	-5	30	1.52
00061	-2	30	1.51
00071	-2	30	1.51
00221	-2	30	1.55
00851	-2	30	1.47
00861	-28	30	1.52
01341	-28	30	1.42
01351	-5	30	1.54
01731	-5	30	1.52
01741	-5	30	1.46
01751	-5	30	1.97
01761	-5	30	1.57
01851	-5	30	1.51
01861	-5	30	1.01
01951	-5	30	1.50
02871	-5	30	1.50
02881	-5	30	1.53
02971	-5	30	1.48
03201	-5	30	1.45
03361	-5	30	1.46
03751	-5	30	1.47
04131	-5	30	0.98
04301	-5	30	1.89
04471	-5	30	1.43

TABLE 12.2 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 12.2.1 : SUMMARY OF RAMPS FROM -1° TO 40° and 1° TO -40° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
0.75	1.5	75.0	1.5	215.0	1.5
1.5	1.5	90.0	1.5	230.0	1.5
3.0	1.5	100.0	1.0 1.5 2.0	245.0	1.5
4.5	1.5	115.0	1.5	260.0	1.5
6.0	1.5	130.0	1.5	275.0	1.5
7.5	1.5	145.0	1.5	290.0	1.5
15.0	1.5	160.0	1.5	300.0	1.0 1.5 2.0
30.0	1.0 1.5 2.0	175.0	1.5	315.0	1.5
45.0	1.5	190.0	1.5	330.0	1.5
60.0	1.5	200.0	1.0 1.5 2.0	345.0	1.5

(all permutations over both positive and negative incidence ranges)

TABLE 12.2.2 : SUMMARY OF RAMPS FROM -1° TO BETWEEN 23° AND 33° (nominal)

Finishing Incidence	23°	25°	27°	29°	31°	33°
Pitch Rate (°s^{-1})	100	150	200	250	300	350	400
Reynolds Number	1.5 x 10^6						

(all permutations)

TABLE 12.2.3 : SUMMARY OF RAMPS FROM -1° TO BETWEEN 15° AND 22° (nominal)

Finishing Incidence	15°	16°	17°	18°	19°	20°	21°	22°
Pitch Rate (°s^{-1})	125				175			
Reynolds Number	1.5 x 10^6							

(all permutations)

TABLE 12.2.4 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^6
20082	-1	41	357.0	0.0415	1.50
20092	-1	41	328.0	0.0380	1.49
20102	-1	41	339.8	0.0394	1.49
20112	-1	41	301.1	0.0270	0.79
20122	-1	41	311.2	0.0360	1.49
20132	-1	41	276.0	0.0319	1.48
20142	-1	41	278.5	0.0329	1.47
20152	-1	41	244.3	0.0288	1.46
20162	-1	41	241.4	0.0284	1.46
20172	-1	41	212.1	0.0249	1.45
20182	-1	41	210.5	0.0245	1.49
20192	-1	41	189.2	0.0220	1.48
20202	-1	41	183.9	0.0214	1.48
20212	-1	41	159.6	0.0185	1.48
20232	-1	41	153.8	0.0180	1.46
20242	-1	41	132.8	0.0156	1.46
20252	-1	41	124.2	0.0145	1.46
20262	-1	41	99.0	0.0116	1.46
20272	-1	41	94.5	0.0110	1.49
20282	-1	41	77.8	0.0091	1.48
20292	-1	41	58.2	0.0068	1.48
20302	-1	41	45.3	0.0053	1.47
20312	-1	41	28.0	0.0033	1.47
20322	-1	41	14.7	0.0017	1.47
20332	-1	41	6.9	0.0008	1.46
20342	-1	41	5.9	0.0007	1.46
20352	-1	41	4.3	0.0005	1.52
20362	-1	41	2.9	0.0003	1.52
20372	-1	41	1.4	0.0002	1.51
21361	-1	23	312.1	0.0363	1.53
21371	-1	25	326.2	0.0379	1.52
21381	-1	27	345.0	0.0401	1.52
21391	-1	29	326.4	0.0379	1.52
21401	-1	31	352.7	0.0416	1.46
21411	-1	33	355.9	0.0420	1.45
21421	-1	23	318.7	0.0375	1.50
21431	-1	27	312.0	0.0366	1.50
21441	-1	29	331.4	0.0389	1.49
21451	-1	31	331.9	0.0389	1.49
21461	-1	33	314.6	0.0369	1.49
21471	-1	23	280.0	0.0332	1.49
21481	-1	25	281.1	0.0333	1.48
21491	-1	27	292.6	0.0346	1.48
21501	-1	29	277.3	0.0328	1.48
21511	-1	31	298.8	0.0353	1.48
21521	-1	23	249.1	0.0293	1.49
21531	-1	25	239.0	0.0281	1.48

TABLE 12.2.4 : LIST OF RAMP UP EXPERIMENTS (continued)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^6
21541	-1	27	226.7	0.0266	1.48
21551	-1	29	248.6	0.0292	1.48
21561	-1	31	228.0	0.0268	1.48
21571	-1	23	186.1	0.0219	1.48
21581	-1	25	186.7	0.0219	1.48
21591	-1	26	194.7	0.0228	1.48
21601	-1	27	251.9	0.0296	1.48
21611	-1	29	184.2	0.0216	1.48
21621	-1	23	137.3	0.0163	1.46
21631	-1	24	137.6	0.0163	1.46
21641	-1	25	147.5	0.0175	1.46
21651	-1	26	140.6	0.0166	1.46
21661	-1	27	146.1	0.0173	1.46
21671	-1	22	117.3	0.0138	1.46
21681	-1	23	118.5	0.0140	1.46
21691	-1	24	112.3	0.0132	1.46
21701	-1	25	119.3	0.0141	1.46
21711	-1	26	114.4	0.0135	1.46
21721	-1	25	311.5	0.0368	1.46
21771	-1	41	281.5	0.0493	1.02
21781	-1	41	199.6	0.0349	1.02
21791	-1	41	107.7	0.0189	1.02
21801	-1	41	27.1	0.0047	1.02
21811	-1	41	292.7	0.0262	1.96
21821	-1	41	195.5	0.0175	1.94
21831	-1	41	107.7	0.0096	1.94
21841	-1	41	28.0	0.0025	1.93
22461	-1	15	166.1	0.0197	1.53
22471	-1	16	163.7	0.0194	1.53
22481	-1	17	171.4	0.0202	1.52
22491	-1	18	163.0	0.0192	1.52
22501	-1	19	161.9	0.0192	1.47
22511	-1	20	164.1	0.0194	1.52
22521	-1	21	176.3	0.0208	1.51
22531	-1	22	165.9	0.0195	1.51
22541	-1	15	136.4	0.0163	1.49
22551	-1	16	126.8	0.0151	1.48
22561	-1	17	134.4	0.0160	1.48
22571	-1	18	125.1	0.0149	1.48
22581	-1	19	134.3	0.0160	1.48
22591	-1	20	129.8	0.0154	1.48
22601	-1	22	134.8	0.0160	1.47
24481	-1	41	7.0	0.0008	1.43
24491	-1	41	13.0	0.0015	1.42
24501	-1	41	28.2	0.0034	1.41
24511	-1	41	51.5	0.0062	1.39
24521	-1	41	69.4	0.0084	1.38
24531	-1	41	74.1	0.0089	1.38

TABLE 12.2.4 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^6
*21051	1	-41	-337.8	-0.0399	1.47
*21061	1	-41	-344.8	-0.0407	1.47
*21071	1	-41	-318.6	-0.0376	1.46
*21081	1	-41	-318.6	-0.0375	1.47
*21091	1	-41	-294.8	-0.0346	1.47
*21101	1	-41	-297.4	-0.0349	1.47
*21111	1	-41	-261.0	-0.0308	1.46
*21121	1	-41	-261.8	-0.0308	1.46
*21131	1	-41	-232.0	-0.0273	1.46
*21141	1	-41	-232.0	-0.0273	1.45
*21151	1	-41	-204.1	-0.0239	1.46
*21161	1	-41	-203.9	-0.0239	1.46
*21171	1	-41	-175.2	-0.0205	1.46
*21181	1	-41	-169.6	-0.0199	1.45
*21191	1	-41	-146.6	-0.0174	1.45
*21201	1	-41	-139.6	-0.0165	1.44
*21211	1	-41	-116.2	-0.0137	1.44
*21221	1	-41	-106.8	-0.0126	1.44
*21231	1	-41	-90.4	-0.0106	1.45
*21241	1	-41	-79.5	-0.0094	1.44
*21251	1	-41	-57.6	-0.0068	1.44
*21261	1	-41	-44.9	-0.0053	1.44
*21271	1	-41	-28.6	-0.0034	1.43
*21281	1	-41	-14.8	-0.0018	1.43
*21291	1	-41	-7.1	-0.0008	1.42
*21301	1	-41	-5.9	-0.0007	1.42
*21311	1	-41	-4.2	-0.0005	1.43
*21321	1	-41	-3.0	-0.0004	1.43
*21331	1	-41	-1.4	-0.0002	1.43

(* "inverted" ramp up)

TABLE 12.3 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 12.3.1 : SUMMARY OF RAMPS FROM 40° TO -1° and 40° TO -1° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
-0.75	1.5	-75.0	1.5	-215.0	1.5
-1.5	1.5	-90.0	1.5	-230.0	1.5
-3.0	1.5	-100.0	1.0 1.5 2.0	-245.0	1.5
-4.5	1.5	-115.0	1.5	-260.0	1.5
-6.0	1.5	-130.0	1.5	-275.0	1.5
-7.5	1.5	-145.0	1.5	-290.0	1.5
-15.0	1.5	-160.0	1.5	-300.0	1.0 1.5 2.0
-30.0	1.0 1.5 2.0	-175.0	1.5	-315.0	1.5
-45.0	1.5	-190.0	1.5	-330.0	1.5
-60.0	1.5	-200.0	1.0 1.5 2.0	-345.0	1.5

(all permutations over both positive and negative incidence ranges)

TABLE 12.3.2 : SUMMARY OF RAMPS FROM 30° TO -10° (nominal)

Starting Incidence	30°						
Finishing Incidence	-10°						
Pitch Rate (°s^{-1})	-1	-45	-100	-145	-200	-260	-330
Reynolds Number	1.5x10^6						

(all permutations)

TABLE 12.3.3 : SUMMARY OF RAMPS TO -10° AT 330°s^{-1} (nominal)

Starting Incidence	24°	22°	20°	18°	16°	14°	12°	10°	8°	6°	4°
Finishing Incidence	-10°										
Pitch Rate	-330°s^{-1}										
Reynolds Number	1.5x10^6										

(all permutations)

TABLE 12.3.4 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No x 10^6
30381	40	-41	-329.1	-0.0391	1.50
30391	40	-41	-292.3	-0.0346	1.49
30401	40	-41	-306.2	-0.0363	1.48
30411	40	-41	-264.5	-0.0311	1.50
30421	40	-41	-278.4	-0.0326	1.49
30431	40	-41	-256.5	-0.0301	1.49
30441	40	-41	-258.9	-0.0304	1.49
30451	40	-41	-232.8	-0.0273	1.48
30461	40	-41	-229.1	-0.0269	1.48
30471	40	-41	-214.0	-0.0251	1.47
30481	40	-41	-214.3	-0.0253	1.47
30491	40	-41	-178.7	-0.0210	1.46
30501	40	-41	-178.7	-0.0210	1.46
30511	40	-41	-161.7	-0.0190	1.46
30521	40	-41	-153.0	-0.0179	1.47
30531	40	-41	-136.6	-0.0160	1.46
30541	40	-41	-125.7	-0.0147	1.46
30551	40	-41	-100.5	-0.0118	1.46
30561	40	-41	-89.3	-0.0106	1.48
30571	40	-41	-71.0	-0.0084	1.47
30581	40	-41	-61.0	-0.0072	1.46
30591	40	-41	-43.5	-0.0051	1.46
30601	40	-41	-30.8	-0.0036	1.48
30611	40	-41	-14.4	-0.0017	1.47
30621	40	-41	-7.4	-0.0009	1.47
30631	40	-41	-5.6	-0.0007	1.47
30641	40	-41	-4.5	-0.0005	1.46
30651	40	-41	-3.0	-0.0004	1.46
30661	40	-41	-1.1	-0.0001	1.46
30671	30	-40	-340.1	-0.0400	1.53
30681	30	-40	-242.4	-0.0284	1.52
30691	30	-40	-193.3	-0.0227	1.51
30701	30	-40	-139.9	-0.0166	1.50
30711	30	-40	-100.4	-0.0119	1.50
30721	30	-40	-42.3	-0.0050	1.49
30731	30	-40	-1.1	-0.0001	1.49

TABLE 12.3.4 : LIST OF RAMP DOWN EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($°s^{-1}$)	Reduced Pitch Rate	Reynolds No x 10^6
30741	24	-34	-324.1	-0.0382	1.48
30751	22	-32	-336.8	-0.0397	1.48
30761	20	-30	-317.5	-0.0374	1.48
30771	18	-28	-332.6	-0.0391	1.48
30781	16	-26	-307.7	-0.0360	1.48
30791	12	-22	-296.2	-0.0346	1.48
30801	10	-20	-301.4	-0.0352	1.48
30811	8	-18	-293.2	-0.0345	1.47
30821	6	-16	-276.6	-0.0326	1.47
30831	4	-14	-246.3	-0.0290	1.46
31871	40	-41	-252.7	-0.0446	1.00
31881	40	-41	-173.7	-0.0306	1.00
31891	40	-41	-96.7	-0.0171	1.00
31901	40	-41	-27.5	-0.0048	1.00
31911	40	-41	-258.1	-0.0232	1.97
31921	40	-41	-178.1	-0.0159	1.95
31931	40	-41	-96.3	-0.0086	1.94
31941	40	-41	-27.6	-0.0025	1.93
*30871	-30	40	352.8	0.0419	1.49
*30881	-30	40	241.7	0.0287	1.49
*30891	-30	40	193.7	0.0230	1.49
*30901	-30	40	142.1	0.0168	1.49
*30911	-30	40	100.2	0.0118	1.49
*30921	-30	40	42.7	0.0050	1.49
*30931	-30	40	1.1	0.0001	1.48
*30941	-24	34	325.8	0.0385	1.47
*30951	-22	32	344.9	0.0408	1.47
*30961	-20	30	324.8	0.0383	1.47
*30971	-18	28	328.8	0.0388	1.47
*30981	-16	26	308.0	0.0363	1.47
*30991	-14	24	313.5	0.0369	1.47
*31001	-12	22	300.3	0.0353	1.47
*31011	-10	20	293.9	0.0346	1.47
*31021	-8	18	268.2	0.0315	1.47
*31031	-6	16	270.9	0.0318	1.47
*31041	-4	14	252.8	0.0297	1.46

(* "inverted" ramp down)

TABLE 12.4 : DETAILS OF SINUSOIDAL EXPERIMENTS

TABLE 12.4.1 : SUMMARY OF OSCILLATIONS ABOUT 10° (nominal)

Mean Incidence	10°							
Amplitude	4°		6°		8°		10°	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 12.4.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10° (nominal)

Mean Incidence	4°		6°		8°		15°	20°
Amplitude	10°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 12.4.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REYNOLDS NUMBER FIXED (nominal)

Mean Incidence	3°	4°	5°	6°	7°	8°	9°	10°
Amplitude	8°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

Mean Incidence	11°	12°	13°	14°	15°	16°	17°	20°
Amplitude	8°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 12.4.4 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REDUCED FREQUENCY FIXED (nominal)

Mean Incidence	3°	4°	5°	6°	7°	8°	9°	10°
Amplitude	8°							
Reduced Frequency	0.100							
Reynolds Number	1.0×10^6			1.5×10^6			2.0×10^6	

(all permutations)

Mean Incidence	11°	12°	13°	14°	15°	16°	17°	20°
Amplitude	8°							
Reduced Frequency	0.100							
Reynolds Number	1.0×10^6			1.5×10^6			2.0×10^6	

(all permutations)

TABLE 12.4.5 : LIST OF SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No x 10^6
11962	10	4	0.010	1.49
11972	10	6	0.010	1.48
11982	10	8	0.010	1.48
11992	10	10	0.010	1.48
12002	10	4	0.025	1.45
12012	10	6	0.025	1.45
12022	10	8	0.025	1.45
12032	10	10	0.025	1.45
12052	10	4	0.050	1.42
12062	10	6	0.050	1.42
12072	10	8	0.050	1.42
12082	10	10	0.050	1.41
12092	10	4	0.073	1.46
12102	10	6	0.073	1.45
12112	10	8	0.073	1.45
12122	10	10	0.073	1.45
12132	10	4	0.099	1.43
12142	10	6	0.099	1.43
12152	10	8	0.099	1.43
12162	10	10	0.099	1.43

TABLE 12.4.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No x 10^6
12172	10	4	0.124	1.44
12182	10	6	0.124	1.43
12192	10	8	0.124	1.43
12202	10	10	0.124	1.43
12212	10	4	0.149	1.43
12222	10	6	0.149	1.43
12232	10	8	0.149	1.43
12242	10	10	0.149	1.43
12252	10	4	0.174	1.43
12262	10	6	0.174	1.43
12272	10	8	0.174	1.43
12282	10	10	0.174	1.43
12302	4	10	0.010	1.43
12312	6	10	0.010	1.42
12322	8	10	0.010	1.42
12332	15	10	0.010	1.42
12342	20	10	0.010	1.42
12352	4	10	0.025	1.49
12362	6	10	0.025	1.48
12372	8	10	0.025	1.48
12382	15	10	0.025	1.48
12392	20	10	0.025	1.48
12402	4	10	0.050	1.48
12412	6	10	0.050	1.47
12422	8	10	0.050	1.47
12432	15	10	0.050	1.47
12442	20	10	0.050	1.47
12622	4	10	0.075	1.46
12632	6	10	0.075	1.46
12642	8	10	0.075	1.46
12652	15	10	0.075	1.46
12662	20	10	0.075	1.46
12672	4	10	0.101	1.46
12682	6	10	0.101	1.46
12692	8	10	0.101	1.45
12702	15	10	0.100	1.45
12712	20	10	0.100	1.45
12722	4	10	0.124	1.47
12732	6	10	0.124	1.46
12742	8	10	0.124	1.46
12752	15	10	0.124	1.46
12762	20	10	0.124	1.46
12772	4	10	0.152	1.45
12782	6	10	0.152	1.45
12792	8	10	0.151	1.44
12802	15	10	0.151	1.44
12812	20	10	0.151	1.44

TABLE 12.4.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No x 10^6
12822	4	10	0.173	1.47
12832	6	10	0.173	1.47
12842	8	10	0.173	1.47
12852	15	10	0.173	1.46
12862	20	10	0.173	1.46
12891	3	8	0.010	1.45
12901	4	8	0.010	1.45
12911	5	8	0.010	1.45
12921	6	8	0.010	1.44
12931	7	8	0.010	1.44
12941	8	8	0.010	1.44
12951	9	8	0.010	1.44
12961	11	8	0.010	1.44
12981	12	8	0.010	1.45
12991	13	8	0.010	1.44
13001	14	8	0.010	1.44
13011	15	8	0.010	1.44
13021	16	8	0.010	1.44
13031	17	8	0.010	1.43
13041	20	8	0.010	1.43
13051	3	8	0.025	1.42
13061	4	8	0.025	1.42
13071	5	8	0.025	1.42
13081	6	8	0.025	1.42
13091	7	8	0.025	1.42
13101	8	8	0.025	1.42
13111	9	8	0.025	1.42
13121	11	8	0.025	1.41
13131	12	8	0.025	1.43
13141	13	8	0.025	1.43
13151	14	8	0.025	1.42
13161	15	8	0.025	1.42
13171	16	8	0.025	1.42
13181	17	8	0.025	1.42
13191	20	8	0.025	1.42
13211	3	8	0.049	1.45
13221	4	8	0.049	1.45
13231	5	8	0.049	1.44
13241	6	8	0.049	1.44
13251	7	8	0.049	1.44
13261	8	8	0.049	1.44
13271	9	8	0.049	1.44
13281	11	8	0.049	1.44
13291	12	8	0.051	1.41
13301	13	8	0.051	1.40
13311	14	8	0.051	1.40
13321	15	8	0.051	1.40
13331	16	8	0.051	1.40
13341	17	8	0.050	1.40
13351	20	8	0.050	1.40

TABLE 12.4.5 : LIST OF SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No x 10^6
13371	3	8	0.074	1.46
13381	4	8	0.074	1.45
13391	5	8	0.074	1.45
13401	6	8	0.074	1.45
13411	7	8	0.074	1.45
13421	8	8	0.074	1.45
13431	9	8	0.074	1.45
13441	11	8	0.074	1.45
13451	12	8	0.076	1.41
13461	13	8	0.076	1.40
13471	15	8	0.076	1.40
13491	16	8	0.076	1.40
13501	17	8	0.076	1.40
13511	20	8	0.076	1.40
13521	3	8	0.101	1.42
13531	4	8	0.101	1.42
13541	5	8	0.101	1.42
13551	6	8	0.101	1.41
13561	7	8	0.101	1.41
13571	8	8	0.100	1.41
13581	9	8	0.100	1.41
13591	11	8	0.100	1.41
13601	12	8	0.100	1.42
13611	13	8	0.100	1.41
13621	14	8	0.100	1.41
13631	15	8	0.100	1.41
13641	16	8	0.100	1.41
13651	17	8	0.100	1.41
13661	20	8	0.100	1.41
13671	3	8	0.101	1.41
13681	4	8	0.126	1.40
13691	5	8	0.126	1.40
13701	6	8	0.126	1.40
13711	7	8	0.126	1.40
13721	8	8	0.126	1.40
13731	9	8	0.126	1.40
13741	11	8	0.126	1.40
13761	12	8	0.125	1.46
13771	13	8	0.125	1.46
13781	14	8	0.124	1.45
13791	15	8	0.124	1.45
13801	16	8	0.124	1.45
13811	17	8	0.124	1.45
13821	20	8	0.124	1.45
13831	3	8	0.151	1.46
13841	4	8	0.151	1.45
13851	5	8	0.151	1.45
13861	6	8	0.151	1.45
13871	7	8	0.151	1.45
13881	8	8	0.150	1.45
13891	9	8	0.150	1.45

TABLE 12.4.5 : LIST OF SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No x 10^6
13901	11	8	0.150	1.45
13911	12	8	0.149	1.46
13921	13	8	0.149	1.46
13931	14	8	0.149	1.46
13941	15	8	0.149	1.46
13951	16	8	0.149	1.46
13961	17	8	0.149	1.46
13971	20	8	0.149	1.45
13981	3	8	0.175	1.45
13991	4	8	0.175	1.45
14001	5	8	0.175	1.45
14011	6	8	0.175	1.44
14021	7	8	0.175	1.44
14031	8	8	0.175	1.44
14041	9	8	0.175	1.44
14051	11	8	0.175	1.44
14061	12	8	0.174	1.45
14071	13	8	0.174	1.44
14081	14	8	0.174	1.44
14091	15	8	0.174	1.44
14101	16	8	0.174	1.44
14111	17	8	0.174	1.44
14121	20	8	0.174	1.44
14141	3	8	0.100	0.97
14151	4	8	0.100	0.97
14161	5	8	0.100	0.97
14171	6	8	0.101	0.97
14181	7	8	0.100	0.97
14191	8	8	0.100	0.97
14201	9	8	0.100	0.97
14211	10	8	0.100	0.97
14221	11	8	0.100	0.97
14231	12	8	0.100	0.97
14241	13	8	0.100	0.97
14251	14	8	0.101	0.97
14261	15	8	0.100	0.97
14271	16	8	0.100	0.97
14281	17	8	0.100	0.97
14291	20	8	0.100	0.97
14311	3	8	0.100	1.87
14321	4	8	0.100	1.87
14331	5	8	0.100	1.87
14341	6	8	0.099	1.86
14351	7	8	0.099	1.86
14361	8	8	0.099	1.86
14371	9	8	0.099	1.86
14381	10	8	0.099	1.86
14391	11	8	0.101	1.84
14401	12	8	0.101	1.83
14411	13	8	0.101	1.83
14421	14	8	0.100	1.83
14431	15	8	0.100	1.83
14441	16	8	0.100	1.82
14451	17	8	0.100	1.82
14461	20	8	0.100	1.82

TABLE 13 : EXPERIMENTS ON NACA 0015 WITH CHORD OF LENGTH 0.275m (MODEL 12)

TABLE 13.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 13.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Reynolds Number	1.0×10^6	1.5×10^6	2.0×10^6
Angle of Attack	-2^o to 30^o		

(all permutations)

TABLE 13.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (^{o})	Sweep (^{o})	Reynolds No. x 10^{-6}
00411	-2	32	1.04
00421	-2	32	1.01
00431	-2	32	0.98
00441	30	32	0.90
00451	-2	32	1.01
00461	-2	32	0.78
00471	-2	32	0.77
00481	-2	32	0.77
00491	-2	32	1.06
00511	-2	32	0.95
00531	-2	32	0.85
00551	-2	32	0.76
00571	-2	32	0.66
00591	-2	32	0.55
00611	-2	32	0.83
00781	-2	32	0.83
00831	-2	32	1.08
01111	-2	32	2.15
01211	-2	32	1.69
01251	-2	32	1.58
01381	-2	32	1.58
01661	-2	32	1.57
01721	-2	32	2.13
*801971	-2	32	2.20
*801981	-2	32	1.77

*experiments with roughness transition strips

TABLE 13.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 13.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Angle of Attack	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°
Sampling Frequency	500 Hz											
Reynolds Number	2.0×10^6											

(all permutations)

Angle of Attack	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°
Sampling Frequency	500 Hz											
Reynolds Number	2.0×10^6											

(all permutations)

Angle of Attack	24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°	35°
Sampling Frequency	500 Hz											
Reynolds Number	2.0×10^6											

(all permutations)

TABLE 13.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40841	0	500	1.06
40851	1	500	1.06
40861	2	500	1.05
40871	3	500	1.04
40881	4	500	1.04
40891	5	500	1.04
40901	6	500	1.04
40911	7	500	1.04
40921	8	500	1.04
40931	9	500	1.03
40941	10	500	1.03
40951	11	500	1.03
40961	12	500	1.03
40971	13	500	2.06
40981	14	500	2.08
40991	15	500	2.07
41001	16	500	2.06
41011	17	500	2.07

TABLE 13.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (concluded)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
41021	18	500	2.07
41031	19	500	2.06
41041	20	500	2.06
41051	21	500	2.06
41061	22	500	2.05
41071	23	500	2.05
41081	24	500	2.04
41091	25	500	2.04
41101	26	500	2.04
41121	27	500	2.12
41131	28	500	2.11
41141	29	500	2.10
41151	30	500	2.10
41161	31	500	2.09
41171	32	500	2.09
41181	33	500	2.09
41191	34	500	2.08
41201	35	500	2.08

TABLE 13.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 13.3.1 : SUMMARY OF FAST RAMPS (nominal)

Starting Incidence	-1^o											
Finishing Incidence	40^o											
Pitch Rate ($^o s^{-1}$)	180	210	240	270	300	335	370	400	435	470	500	530
Reynolds Number	0.8×10^6						1.0×10^6					

(all permutations, with and without roughness transition strips)

TABLE 13.3.2 : SUMMARY OF SLOW RAMPS (nominal)

Starting Incidence	-1^o													
Finishing Incidence	40^o													
Pitch Rate ($^o s^{-1}$)	2	4	8	12	16	20	30	40	60	80	100	120	150	160
Reynolds Number	0.8×10^6													

(all permutations, without roughness transition strips)

TABLE 13.3.3 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (^{o})	Arc (^{o})	Pitch Rate ($^o s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
20023	-1	41	1.9	0.0001	0.78
20033	-1	41	3.8	0.0002	0.78
20043	-1	41	7.7	0.0004	0.77
20053	-1	41	11.9	0.0007	0.77
20063	-1	41	16.0	0.0009	0.77
20073	-1	41	20.4	0.0011	0.77
20083	-1	41	37.6	0.0021	0.76
20093	-1	41	79.8	0.0044	0.76
20103	-1	41	123.4	0.0069	0.76
20113	-1	41	168.3	0.0094	0.76
20123	-1	41	197.9	0.0110	0.76
20133	-1	41	252.5	0.0140	0.76
20143	-1	41	284.2	0.0159	0.77
20153	-1	41	320.1	0.0179	0.76
20163	-1	41	355.2	0.0198	0.76
20173	-1	41	366.3	0.0204	0.76
20183	-1	41	444.8	0.0249	0.76
20194	-1	41	442.3	0.0247	0.76
21221	-1	40	463.9	0.0257	0.80
21231	-1	40	501.4	0.0278	0.80
21241	-1	41	534.5	0.0297	0.80
21261	-1	41	16.6	0.0009	0.80
21271	-1	40	20.5	0.0011	0.80
21281	-1	41	29.2	0.0016	0.79
21291	-1	40	40.7	0.0023	0.79
21301	-1	41	57.8	0.0032	0.80

TABLE 13.3.3 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
21311	-1	41	80.6	0.0045	0.79
21321	-1	40	98.3	0.0054	0.80
21331	-1	40	124.2	0.0069	0.80
21341	-1	40	151.8	0.0083	0.81
21351	-1	40	183.5	0.0100	0.80
21361	-1	40	213.1	0.0117	0.80
21371	-1	40	242.5	0.0132	0.80
21391	-1	41	274.4	0.0156	0.79
21401	-1	40	309.2	0.0175	0.79
21411	-1	40	334.3	0.0188	0.79
21421	-1	40	366.5	0.0205	0.79
21431	-1	40	398.8	0.0225	0.79
21441	-1	40	434.3	0.0242	0.80
21731	-1	40	181.6	0.0074	1.06
21741	-1	40	211.3	0.0086	1.05
21751	-1	40	242.7	0.0098	1.04
21761	-1	40	272.2	0.0110	1.04
21771	-1	40	304.5	0.0123	1.03
21781	-1	40	335.3	0.0134	1.04
21791	-1	40	368.7	0.0151	1.01
21801	-1	40	399.5	0.0162	1.02
21811	-1	40	432.2	0.0177	1.00
21821	-1	40	469.9	0.0192	1.00
21831	-1	40	498.8	0.0204	1.00
21841	-1	40	529.4	0.0215	1.00
*821991	-1	40	181.4	0.0092	0.88
*822001	-1	40	213.0	0.0108	0.88
*822011	-1	40	241.7	0.0123	0.87
*822021	-1	40	271.4	0.0138	0.87
*822031	-1	40	306.8	0.0155	0.87
*822041	-1	40	336.7	0.0170	0.87
*822051	-1	40	368.1	0.0186	0.86
*822061	-1	40	399.1	0.0201	0.86
*822071	-1	40	436.1	0.0221	0.86
*822081	-1	40	474.0	0.0239	0.86
*822091	-1	40	500.6	0.0253	0.85
*822101	-1	40	534.8	0.0271	0.85
*822231	-1	41	181.2	0.0075	1.10
*822241	-1	41	211.3	0.0087	1.09
*822251	-1	41	241.7	0.0099	1.09
*822261	-1	41	272.1	0.0111	1.08
*822271	-1	41	272.1	0.0111	1.08
*822281	-1	41	335.2	0.0138	1.05
*822291	-1	41	368.2	0.0150	1.05
*822301	-1	41	398.9	0.0163	1.04
*822311	-1	41	433.0	0.0176	1.04
*822321	-1	41	470.6	0.0190	1.05
*822331	-1	41	496.6	0.0202	1.03
*822341	-1	41	530.4	0.0215	1.04

*experiments with roughness transition strips

TABLE 13.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 13.4.1 : SUMMARY OF RAMPS FROM 40° TO -1° AT A REYNOLDS NUMBER OF 0.8x10^6 (nominal)

Starting Incidence	40°											
Finishing Incidence	-1°											
Pitch Rate	-2	-4	-8	-12	-16	-20	-40	-80	-120	-160	-200	-230
($^\circ s^{-1}$)		-260	-290	-320	-360	-400	-440	-470	-500	-500		
Reynolds Number	0.8x10^6											

(all permutations, without roughness transition strips)

TABLE 13.4.2 : SUMMARY OF RAMPS FROM 40° TO -1° AT A REDUCED PITCH RATE OF -0.02 (nominal)

Starting Incidence	40°					
Finishing Incidence	-1°					
Reduced Pitch Rate	-0.02					
Reynolds Number	0.6x10^6	0.7x10^6	0.8x10^6	0.9x10^6	1.0x10^6	1.1x10^6

(all permutations, without roughness transition strips)

TABLE 13.4.3 : SUMMARY OF RAMPS TO -10° (nominal)

Starting Incidence	40°	35°	30°	28°	26°	24°	22°	20°	18°	16°	14°	12°
Finishing Incidence	-10°											
Pitch Rate	-450°s^{-1}											
Reynolds Number	0.8x10^6											

(all permutations, without roughness transition strips)

TABLE 13.4.4 : SUMMARY OF RAMPS FROM 40° TO -10° (nominal)

Starting Incidence	40°											
Finishing Incidence	-10°											
Pitch Rate ($^\circ s^{-1}$)	-230	-270	-310	-340	-380	-410	-440	-470	-500	-550	-600	-650
Reynolds Number	0.8x10^6						1.0x10^6					

(all permutations, with and without roughness transition strips)

TABLE 13.4.5 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($°s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
30223	40	-41	-1.8	-0.0001	0.76
30233	40	-41	-4.0	-0.0002	0.76
30243	40	-41	-7.3	-0.0004	0.76
30253	40	-41	-11.5	-0.0006	0.76
30263	40	-41	-15.6	-0.0009	0.76
30273	40	-41	-19.5	-0.0011	0.76
30283	40	-41	-39.1	-0.0022	0.75
30293	40	-41	-76.6	-0.0043	0.75
30303	40	-41	-120.2	-0.0067	0.78
30313	40	-41	-159.0	-0.0089	0.78
30323	40	-41	-200.2	-0.0112	0.78
30333	40	-41	-230.6	-0.0129	0.77
30343	40	-41	-255.9	-0.0143	0.77
30353	40	-41	-288.6	-0.0161	0.77
30363	40	-41	-326.8	-0.0183	0.77
30373	40	-41	-367.8	-0.0205	0.77
30383	40	-41	-404.4	-0.0230	0.75
30394	40	-41	-438.1	-0.0249	0.75
30501	40	-41	-545.0	-0.0224	1.05
30521	40	-41	-490.3	-0.0218	0.95
30541	40	-41	-445.0	-0.0220	0.85
30561	40	-41	-382.8	-0.0219	0.76
30581	40	-41	-323.6	-0.0213	0.65
30601	40	-41	-262.0	-0.0207	0.55
30621	40	-50	-541.3	-0.0288	0.82
30631	35	-45	-408.6	-0.0217	0.82
30641	30	-40	-430.3	-0.0228	0.81
30651	28	-38	-425.3	-0.0225	0.81
30661	26	-36	-433.3	-0.0231	0.81
30671	24	-34	-448.3	-0.0239	0.81
30681	22	-32	-445.2	-0.0237	0.80
30691	20	-30	-453.7	-0.0241	0.80
30791	18	-28	-445.5	-0.0238	0.82
30801	16	-26	-430.9	-0.0230	0.82
30811	14	-24	-426.3	-0.0228	0.82
30821	12	-22	-410.6	-0.0219	0.82
31451	40	-50	-21.7	-0.0014	0.71
31461	40	-50	-26.7	-0.0017	0.72
31471	40	-50	-38.0	-0.0024	0.71
31481	40	-50	-53.0	-0.0034	0.70
31491	40	-50	-75.6	-0.0047	0.72
31501	40	-50	-103.7	-0.0065	0.70
31511	40	-50	-123.9	-0.0077	0.71
31521	40	-50	-153.7	-0.0095	0.71
31531	40	-50	-186.1	-0.0116	0.70
31541	40	-50	-230.4	-0.0140	0.72
31551	40	-50	-276.5	-0.0174	0.69
31561	40	-50	-302.1	-0.0189	0.70
31571	40	-50	-342.5	-0.0214	0.70
31581	40	-50	-379.5	-0.0260	0.67
31591	40	-50	-409.7	-0.0278	0.67

TABLE 13.4.5 : LIST OF RAMP DOWN EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
31601	40	-50	-447.9	-0.0306	0.66
31611	40	-50	-476.8	-0.0322	0.67
31621	40	-50	-507.6	-0.0341	0.67
31631	40	-50	-549.5	-0.0367	0.67
31641	40	-50	-595.0	-0.0394	0.67
31651	40	-50	-645.4	-0.0432	0.67
31851	40	-50	-231.4	-0.0108	0.91
31861	40	-50	-272.2	-0.0126	0.91
31871	40	-50	-311.4	-0.0146	0.90
31881	40	-50	-344.6	-0.0162	0.88
31891	40	-50	-379.2	-0.0180	0.87
31901	40	-50	-411.3	-0.0192	0.88
31911	40	-50	-420.0	-0.0199	0.86
31921	40	-50	-478.1	-0.0225	0.88
31931	40	-50	-510.5	-0.0235	0.89
31941	40	-50	-558.8	-0.0262	0.87
31951	40	-50	-607.7	-0.0281	0.88
31961	40	-50	-654.9	-0.0306	0.87
*832111	40	50	-232.8	-0.0134	0.75
*832121	40	50	-273.4	-0.0154	0.77
*832131	40	50	-309.1	-0.0176	0.76
*832141	40	50	-341.9	-0.0197	0.74
*832151	40	50	-377.2	-0.0215	0.75
*832161	40	50	-412.4	-0.0240	0.74
*832171	40	50	-440.5	-0.0252	0.75
*832181	40	50	-473.2	-0.0272	0.74
*832191	40	50	-506.7	-0.0284	0.76
*832201	40	50	-559.2	-0.0321	0.74
*832211	40	50	-606.4	-0.0351	0.73
*832221	40	50	-658.9	-0.0377	0.74
*832351	40	50	-229.9	-0.0108	0.90
*832361	40	50	-273.3	-0.0128	0.89
*832371	41	50	-312.8	-0.0149	0.87
*832381	40	50	-345.1	-0.0161	0.89
*832391	40	50	-346.2	-0.0162	0.88
*832401	40	50	-394.8	-0.0184	0.88
*832411	40	50	-445.0	-0.0208	0.88
*832421	40	50	-477.9	-0.0223	0.88
*832431	40	50	-509.3	-0.0240	0.86
*832441	40	50	-562.2	-0.0257	0.89
*832451	40	50	-614.0	-0.0286	0.87
*832461	40	50	-661.9	-0.0308	0.87

(*experiments with roughness transition strips)

TABLE 13.5 : DETAILS OF SINUSOIDAL EXPERIMENTS

TABLE 13.5.1 : SUMMARY OF SINUSOIDAL EXPERIMENTS (nominal)

Mean Incidence	4°	6°	8°	15°	16°	17°	18°	20°
Amplitude	10°							
Reduced Frequency	0.175							
Reynolds Number	0.8×10^6							

(all permutations, without roughness transition strips)

TABLE 13.5.2 : LIST OF SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
10702	4	10	0.168	0.83
10712	6	10	0.167	0.83
10722	8	10	0.167	0.82
10732	15	10	0.167	0.82
10742	16	10	0.167	0.82
10752	17	10	0.167	0.82
10762	18	10	0.167	0.82
10772	20	10	0.167	0.82

TABLE 13.6 : DETAILS OF SINGLE STREAMTUBE VAWT EXPERIMENTS

TABLE 13.6.1 : SUMMARY OF SINGLE STREAMTUBE VAWT EXPERIMENTS (nominal)

Mean Incidence	0^{o}				
Tip Speed Ratio	1.75				
Reduced Frequency	0.040	0.080	0.100	0.125	0.150
Reynolds Number	1.5×10^{6}				

(all permutations, without roughness transition strips)

TABLE 13.6.2 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{6}
51671	0	1.75	0.145	1.58
51681	0	1.75	0.118	1.57
51691	0	1.75	0.097	1.57
51701	0	1.75	0.076	1.58
51711	0	1.75	0.037	1.58

TABLE 14 : EXPERIMENTS ON AHAVAW (MODEL 13)

TABLE 14.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 14.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Reynolds Number	1.0×10^6	1.5×10^6	2.0×10^6
Angle of Attack	-2° to 30°		

(all permutations)

TABLE 14.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^{-6}
00011	-2	32	1.60
00491	-2	32	1.54
00751	-2	32	1.04
00801	-2	32	2.06
01681	-2	32	1.53
03541	-2	32	1.10
03711	-2	32	1.59
03961	-2	32	2.02
04131	-2	32	0.87
04211	-2	32	1.21
04291	-2	32	1.63
04371	-2	32	2.08
04801	-2	32	0.86
04881	-2	32	1.20
05031	-2	32	2.09
05181	-2	32	1.66
*805541	-2	32	1.57
*805741	-2	32	1.53

(*experiments with roughness transition strips)

TABLE 14.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 14.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Angle of Attack	-4°	-2°	0°	2°	4°	6°	8°	10°	11°	12°	13°
Reynolds Number	1.5×10^6										
Sampling Frequency	100Hz					500Hz					

(all permutations)

Angle of Attack	14°	15°	16°	18°	20°	22°	24°	26°	28°	30°
Reynolds Number	1.5×10^6									
Sampling Frequency	100Hz					500Hz				

(all permutations)

TABLE 14.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40021	-4	100	1.57
40031	-2	100	1.57
40041	0	100	1.57
40051	2	100	1.57
40061	4	100	1.56
40071	6	100	1.56
40081	8	100	1.56
40091	10	100	1.56
40101	11	100	1.56
40111	12	100	1.56
40121	13	100	1.56
40131	14	100	1.49
40141	15	100	1.48
40151	16	100	1.48
40161	18	100	1.48
40171	20	100	1.48
40181	22	100	1.48
40191	24	100	1.47
40201	26	100	1.47
40211	28	100	1.47
40221	30	100	1.47

TABLE 14.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (concluded)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40231	-4	500	1.47
40241	-2	500	1.47
40251	0	500	1.47
40261	2	500	1.47
40271	4	500	1.47
40281	6	500	1.47
40291	8	500	1.47
40301	10	500	1.47
40311	11	500	1.47
40321	12	500	1.46
40331	13	500	1.46
40341	14	500	1.47
40351	15	500	1.47
40361	16	500	1.47
40371	18	500	1.47
40381	20	500	1.46
40391	22	500	1.46
40401	24	500	1.46
40411	26	500	1.46
40421	28	500	1.46
40431	30	500	1.26

TABLE 14.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 14.3.1 : SUMMARY OF RAMPS FROM -1° TO 40° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
0.75	1.5	75.0	1.5	215.0	1.5
1.5	1.5	90.0	1.5	230.0	1.5
3.0	1.5	100.0	1.0 1.5 2.0	245.0	1.5
4.5	1.5	115.0	1.5	260.0	1.5
6.0	1.5	130.0	1.5	275.0	1.5
7.5	1.5	145.0	1.5	290.0	1.5
15.0	1.5	160.0	1.5	300.0	1.0 1.5 2.0
30.0	1.0 1.5 2.0	175.0	1.5	315.0	1.5
45.0	1.5	190.0	1.5	330.0	1.5
60.0	1.5	200.0	1.0 1.5 2.0	345.0	1.5

(all permutations; experiments at a Reynolds number of 1.5x10^6 repeated with roughness transition strips)

TABLE 14.3.2 : SUMMARY OF SHORT RAMPS (nominal)

Starting Incidence	0°								
Finishing Incidence	4°			8°			12°		
Pitch Rate (°s^{-1})	50	100	200	300	350	400	450	500	550
Reynolds Number	1.5x10^6								

(all permutations, without roughness transition strips)

TABLE 14.3.3 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (^{o})	Arc (^{o})	Pitch Rate ($^o s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
20441	-1	41	0.8	0.0001	1.47
20451	-1	41	1.5	0.0002	1.46
20461	-1	41	2.9	0.0003	1.45
20471	-1	41	4.4	0.0005	1.45
20481	-1	41	6.0	0.0007	1.44
20501	-1	41	7.3	0.0008	1.52
20511	-1	41	14.6	0.0017	1.51
20521	-1	41	29.2	0.0034	1.51
20531	-1	41	43.9	0.0051	1.51
20541	-1	41	57.2	0.0066	1.50
20551	-1	41	72.9	0.0085	1.50
20561	-1	41	87.5	0.0102	1.49
20571	-1	41	98.4	0.0115	1.49
20581	-1	41	116.1	0.0135	1.48
20591	-1	41	129.4	0.0150	1.48
20601	-1	41	144.7	0.0169	1.48
20611	-1	41	159.2	0.0185	1.47
20621	-1	41	177.6	0.0206	1.47
20631	-1	41	196.4	0.0228	1.47
20641	-1	41	206.3	0.0239	1.47
20651	-1	41	224.3	0.0261	1.47
20661	-1	41	244.0	0.0283	1.47
20671	-1	41	260.1	0.0302	1.46
20681	-1	41	282.7	0.0328	1.46
20691	-1	41	290.2	0.0337	1.46
20701	-1	41	310.9	0.0361	1.47
20711	-1	41	319.4	0.0370	1.46
20721	-1	41	330.9	0.0383	1.46
20731	-1	41	342.3	0.0396	1.46
20741	-1	41	351.6	0.0407	1.46
20761	-1	41	29.4	0.0052	1.04
20771	-1	41	99.5	0.0176	1.04
20781	-1	41	204.4	0.0362	1.03
20791	-1	41	320.2	0.0566	1.03
20811	-1	41	29.2	0.0026	2.02
20821	-1	41	97.5	0.0085	2.01
20831	-1	41	204.3	0.0178	2.00
20841	-1	41	312.5	0.0272	1.99
20851	0	4	48.2	0.0056	1.50
20861	0	4	93.0	0.0108	1.50
20871	0	4	117.0	0.0136	1.50
20881	0	4	111.6	0.0130	1.50
20891	0	4	120.3	0.0140	1.50
20901	0	4	141.6	0.0169	1.46
20911	0	4	130.8	0.0156	1.46
20921	0	4	128.0	0.0151	1.44
20931	0	4	132.8	0.0158	1.46
20941	0	8	47.0	0.0055	1.49
20951	0	8	114.9	0.0134	1.49
20961	0	8	171.1	0.0199	1.49
20971	0	8	178.0	0.0207	1.48
20981	0	8	180.1	0.0209	1.48
20991	0	8	205.2	0.0244	1.45

TABLE 14.3.3 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
21001	0	8	210.1	0.0249	1.45
21011	0	8	203.0	0.0241	1.45
21021	0	8	203.1	0.0241	1.45
21031	0	12	53.3	0.0063	1.45
21041	0	12	102.2	0.0121	1.45
21051	0	12	198.5	0.0236	1.44
21061	0	12	218.0	0.0259	1.44
21071	0	12	235.5	0.0279	1.44
21081	0	12	255.5	0.0304	1.44
21091	0	12	243.5	0.0289	1.44
21101	0	12	249.4	0.0296	1.44
21111	0	12	255.5	0.0303	1.44
*825751	-1	41	0.7	0.0001	1.52
*825761	-1	41	1.5	0.0002	1.50
*825771	-1	41	3.0	0.0004	1.49
*825781	-1	41	4.4	0.0005	1.48
*825791	-1	41	5.9	0.0007	1.47
*825801	-1	41	7.4	0.0009	1.47
*825811	-1	41	14.7	0.0018	1.46
*825821	-1	41	29.2	0.0035	1.46
*825831	-1	41	43.4	0.0052	1.45
*825841	-1	41	58.0	0.0069	1.45
*825851	-1	41	72.7	0.0088	1.45
*825861	-1	41	87.4	0.0105	1.44
*825871	-1	41	98.4	0.0119	1.44
*825881	-1	41	115.3	0.0139	1.44
*825891	-1	41	132.4	0.0159	1.44
*825901	-1	41	145.4	0.0173	1.46
*825911	-1	41	160.5	0.0191	1.46
*825921	-1	41	176.9	0.0210	1.45
*825931	-1	41	190.8	0.0226	1.45
*825942	-1	41	200.1	0.0237	1.45
*825952	-1	41	215.5	0.0256	1.49
*825962	-1	41	233.9	0.0278	1.48
*825972	-1	41	247.2	0.0293	1.48
*825982	-1	41	263.5	0.0312	1.48
*825992	-1	41	279.4	0.0331	1.47
*826002	-1	41	294.9	0.0352	1.46
*826012	-1	41	306.5	0.0365	1.46
*826022	-1	41	321.4	0.0383	1.45
*826032	-1	41	336.8	0.0401	1.45
*826042	-1	41	346.6	0.0413	1.45

(*experiments with roughness transition strips)

TABLE 14.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 14.4.1 : SUMMARY OF RAMPS FROM 40° TO -1° (nominal)

Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$
-0.75	1.5	-75.0	1.5	-215.0	1.5
-1.5	1.5	-90.0	1.5	-230.0	1.5
-3.0	1.5	-100.0	1.0 1.5 2.0	-245.0	1.5
-4.5	1.5	-115.0	1.5	-260.0	1.5
-6.0	1.5	-130.0	1.5	-275.0	1.5
-7.5	1.5	-145.0	1.5	-290.0	1.5
-15.0	1.5	-160.0	1.5	-300.0	1.0 1.5 2.0
-30.0	1.0 1.5 2.0	-175.0	1.5	-315.0	1.5
-45.0	1.5	-190.0	1.5	-330.0	1.5
-60.0	1.5	-200.0	1.0 1.5 2.0	-345.0	1.5

(all permutations; experiments at a Reynolds number of $1.5x10^6$ repeated with roughness transition strips)

TABLE 14.4.2 : SUMMARY OF RAMPS FROM 30° TO -10° (nominal)

Starting Incidence	30°						
Finishing Incidence	-10°						
Pitch Rate ($^o s^{-1}$)	-1	-45	-100	-145	-200	-260	-330
Reynolds Number	$1.5x10^6$						

(all permutations, both with and without roughness transition strips)

TABLE 14.4.3 : SUMMARY OF RAMPS TO -10° AT $330^o s^{-1}$ (nominal)

Starting Incidence	24°	22°	20°	18°	16°	14°	12°	10°	8°	6°	4°
Finishing Incidence	-10°										
Pitch Rate	$-330^o s^{-1}$										
Reynolds Number	$1.5x10^6$										

(all permutations, both with and without roughness transition strips)

TABLE 14.4.4 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($°s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
31121	40	-41	-0.7	-0.0001	1.44
31131	40	-41	-1.5	-0.0002	1.43
31141	40	-41	-2.9	-0.0003	1.43
31151	40	-41	-4.3	-0.0005	1.42
31161	40	-41	-5.7	-0.0007	1.46
31171	40	-41	-7.2	-0.0009	1.45
31181	40	-41	-14.1	-0.0017	1.44
31191	40	-41	-28.4	-0.0034	1.44
31201	40	-41	-41.7	-0.0049	1.44
31211	40	-41	-55.0	-0.0065	1.43
31221	40	-41	-70.1	-0.0083	1.43
31231	40	-41	-81.8	-0.0097	1.42
31241	40	-41	-93.5	-0.0111	1.42
31251	40	-41	-111.2	-0.0132	1.42
31261	40	-41	-123.7	-0.0146	1.42
31271	40	-41	-137.1	-0.0163	1.42
31281	40	-41	-147.1	-0.0175	1.41
31291	40	-41	-155.8	-0.0185	1.41
31301	40	-41	-167.9	-0.0200	1.41
31311	40	-41	-178.9	-0.0213	1.41
31321	40	-41	-195.3	-0.0229	1.43
31331	40	-41	-218.6	-0.0255	1.43
31341	40	-41	-244.6	-0.0286	1.43
31351	40	-41	-268.0	-0.0313	1.43
31361	40	-41	-283.4	-0.0331	1.42
31371	40	-41	-300.4	-0.0352	1.42
31381	40	-41	-318.7	-0.0373	1.42
31391	40	-41	-333.2	-0.0390	1.42
31401	40	-41	-354.2	-0.0415	1.42
31411	40	-41	-360.2	-0.0422	1.41
31421	40	-41	-28.2	-0.0048	0.99
31431	40	-41	-95.2	-0.0161	0.99
31441	40	-41	-183.6	-0.0310	0.99
31451	40	-41	-328.4	-0.0554	0.99
31461	40	-41	-28.3	-0.0025	1.86
31471	40	-41	-91.0	-0.0081	1.85
31481	40	-41	-174.9	-0.0156	1.84
31491	40	-41	-306.2	-0.0273	1.84
31501	30	-40	-1.0	-0.0001	1.42
31511	30	-40	-42.8	-0.0049	1.42
31521	30	-40	-97.0	-0.0114	1.40
31531	30	-40	-141.7	-0.0167	1.39
31541	30	-40	-189.2	-0.0223	1.39
31551	30	-40	-273.8	-0.0322	1.39
31561	30	-40	-347.3	-0.0409	1.39

TABLE 14.4.4 : LIST OF RAMP DOWN EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
31571	24	-34	-331.8	-0.0389	1.45
31581	22	-32	-327.2	-0.0383	1.45
31591	20	-30	-321.3	-0.0376	1.44
31601	18	-28	-322.2	-0.0377	1.44
31611	16	-26	-321.8	-0.0377	1.44
31621	14	-24	-297.4	-0.0348	1.44
31631	12	-22	-287.4	-0.0339	1.43
31641	10	-20	-298.1	-0.0351	1.43
31651	8	-18	-275.8	-0.0325	1.43
31661	6	-16	-274.6	-0.0323	1.43
31671	4	-14	-244.8	-0.0288	1.43
*836051	40	-41	-0.8	-0.0001	1.40
*836061	40	-41	-3.0	-0.0004	1.44
*836071	40	-41	-5.9	-0.0007	1.43
*836081	40	-41	-14.4	-0.0017	1.44
*836091	40	-41	-42.2	-0.0050	1.43
*836101	40	-41	-70.2	-0.0083	1.44
*836111	40	-41	-94.7	-0.0112	1.44
*836121	40	-41	-124.9	-0.0148	1.44
*836131	40	-41	-151.2	-0.0179	1.44
*836141	40	-41	-170.8	-0.0202	1.44
*836151	40	-41	-177.7	-0.0208	1.45
*836161	40	-41	-191.8	-0.0230	1.46
*836171	40	-41	-206.5	-0.0247	1.45
*836181	40	-41	-223.1	-0.0267	1.45
*836191	40	-41	-250.8	-0.0300	1.45
*836701	40	-41	-267.6	-0.0319	1.44
*836711	40	-41	-289.9	-0.0346	1.45
*836721	40	-41	-291.3	-0.0347	1.44
*836731	40	-41	-322.2	-0.0383	1.44
*836741	40	-41	-339.2	-0.0403	1.44
*836751	40	-41	-355.5	-0.0422	1.44
*836761	30	-40	-43.3	-0.0052	1.43
*836771	30	-40	-142.1	-0.0171	1.43
*836781	30	-40	-250.2	-0.0300	1.43
*836791	30	-40	-338.0	-0.0405	1.43
*836801	24	-34	-334.0	-0.0398	1.44
*836811	22	-32	-325.9	-0.0388	1.43
*836821	20	-30	-316.9	-0.0377	1.43
*836831	18	-28	-311.2	-0.0370	1.43
*836841	16	-26	-319.7	-0.0380	1.43
*836851	14	-24	-307.9	-0.0366	1.43
*836861	12	-22	-296.9	-0.0356	1.42
*836871	10	-20	-301.9	-0.0362	1.41
*836881	8	-18	-294.3	-0.0353	1.41
*836891	6	-16	-278.1	-0.0333	1.41
*836901	4	-14	-262.2	-0.0314	1.41

(*experiments with roughness transition strips)

TABLE 14.5 : DETAILS OF GENERAL SINUSOIDAL EXPERIMENTS

TABLE 14.5.1 : SUMMARY OF OSCILLATIONS ABOUT 10° (nominal)

Mean Incidence	10°							
Amplitude	4°		6°		8°		10°	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations; tests at reduced frequencies of 0.025, 0.100 and 0.175 repeated with roughness transition strips)

TABLE 14.5.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10° (nominal)

Mean Incidence	4°		6°		8°		15°	20°
Amplitude	10°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 14.5.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REYNOLDS NUMBER FIXED (nominal)

Mean Incidence	3°	4°	5°	6°	7°	8°	9°	10°
Amplitude	8°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

Mean Incidence	11°	12°	13°	14°	15°	16°	17°	20°
Amplitude	8°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 14.5.4 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REDUCED FREQUENCY FIXED (nominal)

Mean Incidence	3°	4°	5°	6°	7°	8°	9°	10°
Amplitude	8°							
Reduced Frequency	0.100							
Reynolds Number	1.0×10^6			1.5×10^6			2.0×10^6	

(all permutations)

Mean Incidence	11°	12°	13°	14°	15°	16°	17°	20°
Amplitude	8°							
Reduced Frequency	0.100							
Reynolds Number	1.0×10^6			1.5×10^6			2.0×10^6	

(all permutations)

TABLE 14.5.5 : SUMMARY OF FAST OSCILLATIONS (nominal)

Mean Incidence	0°			4°		
Amplitude	2°			4°		
Frequency (Hz)	1.0	2.5	5.0	7.5	10.0	12.5
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 14.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11691	10	4	0.010	1.51
11701	10	6	0.010	1.50
11711	10	8	0.010	1.50
11721	10	10	0.010	1.50
11731	10	4	0.025	1.47
11741	10	6	0.025	1.47
11751	10	8	0.025	1.46
11761	10	10	0.025	1.46
11771	10	4	0.049	1.46
11781	10	6	0.049	1.46
11791	10	8	0.049	1.45
11801	10	10	0.049	1.45
11811	10	4	0.075	1.45
11821	10	6	0.075	1.45
11831	10	8	0.074	1.45
11841	10	10	0.074	1.45
11851	10	4	0.097	1.48
11861	10	6	0.097	1.48
11871	10	8	0.097	1.47
11881	10	10	0.097	1.47
11891	10	4	0.122	1.47
11901	10	6	0.122	1.47
11911	10	8	0.122	1.47
11921	10	10	0.122	1.47
11931	10	4	0.145	1.47
11941	10	6	0.145	1.47
11951	10	8	0.145	1.47
11961	10	10	0.145	1.47
11971	10	4	0.170	1.47
11981	10	6	0.170	1.47
11991	10	8	0.170	1.47
12001	10	10	0.170	1.47
12011	3	8	0.010	1.40
12021	4	8	0.010	1.40
12031	5	8	0.010	1.40
12041	6	8	0.010	1.40
12051	7	8	0.010	1.40
12061	8	8	0.010	1.42
12071	9	8	0.010	1.41
12081	11	8	0.010	1.41
12091	12	8	0.010	1.41
12101	13	8	0.010	1.41
12111	14	8	0.010	1.40

TABLE 14.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12121	15	8	0.010	1.40
12131	17	8	0.010	1.40
12141	20	8	0.010	1.40
12151	3	8	0.025	1.41
12161	4	8	0.025	1.41
12171	5	8	0.025	1.40
12181	6	8	0.025	1.40
12191	7	8	0.025	1.40
12201	8	8	0.025	1.41
12211	9	8	0.025	1.40
12221	11	8	0.025	1.40
12231	12	8	0.025	1.40
12241	13	8	0.025	1.40
12251	14	8	0.025	1.40
12261	15	8	0.025	1.40
12271	17	8	0.025	1.40
12281	20	8	0.025	1.40
12291	3	8	0.050	1.40
12301	4	8	0.050	1.40
12311	5	8	0.050	1.40
12321	6	8	0.050	1.40
12331	7	8	0.050	1.40
12341	8	8	0.049	1.41
12351	9	8	0.049	1.41
12361	11	8	0.049	1.40
12371	12	8	0.050	1.42
12381	13	8	0.050	1.42
12391	14	8	0.050	1.43
12401	15	8	0.050	1.42
12411	17	8	0.050	1.42
12421	20	8	0.050	1.42
12431	3	8	0.075	1.43
12441	4	8	0.075	1.42
12451	5	8	0.075	1.42
12461	6	8	0.075	1.42
12471	7	8	0.075	1.42
12481	8	8	0.075	1.42
12491	9	8	0.075	1.42
12501	11	8	0.075	1.42
12511	12	8	0.075	1.42
12521	13	8	0.075	1.41
12531	14	8	0.075	1.42
12541	15	8	0.075	1.42
12551	17	8	0.075	1.41

TABLE 14.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12561	20	8	0.075	1.41
12571	3	8	0.100	1.41
12581	4	8	0.100	1.41
12591	5	8	0.100	1.41
12601	6	8	0.100	1.41
12611	7	8	0.100	1.41
12621	8	8	0.100	1.42
12631	9	8	0.100	1.42
12641	11	8	0.100	1.41
12651	12	8	0.100	1.41
12661	13	8	0.100	1.41
12671	14	8	0.101	1.41
12681	15	8	0.101	1.41
12691	17	8	0.100	1.41
12701	20	8	0.100	1.41
12711	3	8	0.124	1.43
12721	4	8	0.124	1.43
12731	5	8	0.124	1.43
12741	6	8	0.124	1.43
12751	7	8	0.124	1.43
12761	8	8	0.124	1.43
12771	9	8	0.124	1.43
13141	4	10	0.010	1.51
13151	6	10	0.010	1.50
13161	8	10	0.010	1.50
13171	15	10	0.010	1.50
13181	20	10	0.010	1.49
13191	4	10	0.025	1.46
13201	6	10	0.025	1.46
13211	8	10	0.025	1.45
13221	15	10	0.025	1.45
13231	20	10	0.025	1.45
13241	4	10	0.049	1.45
13251	6	10	0.049	1.45
13261	8	10	0.049	1.45
13271	15	10	0.049	1.45
13281	20	10	0.049	1.45
13291	4	10	0.099	1.44
13301	6	10	0.099	1.44
13311	8	10	0.099	1.44
13321	15	10	0.099	1.44
13331	20	10	0.099	1.45
13341	4	10	0.124	1.45
13351	6	10	0.124	1.44

TABLE 14.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13361	8	10	0.124	1.44
13371	15	10	0.124	1.44
13381	20	10	0.124	1.44
13391	4	10	0.149	1.44
13401	6	10	0.149	1.44
13411	8	10	0.149	1.44
13421	15	10	0.149	1.44
13431	20	10	0.149	1.44
13441	4	10	0.173	1.44
13451	6	10	0.173	1.44
13461	8	10	0.173	1.44
13471	15	10	0.173	1.44
13481	20	10	0.173	1.44
13491	4	10	0.074	1.56
13501	6	10	0.074	1.56
13511	8	10	0.074	1.56
13521	15	10	0.074	1.56
13531	20	10	0.074	1.55
13551	3	8	0.095	1.10
13561	4	8	0.095	1.10
13571	5	8	0.095	1.10
13581	6	8	0.095	1.10
13591	7	8	0.095	1.10
13601	8	8	0.095	1.10
13611	9	8	0.095	1.10
13621	10	8	0.095	1.10
13631	11	8	0.096	1.08
13641	12	8	0.096	1.08
13651	13	8	0.096	1.08
13661	14	8	0.096	1.08
13671	15	8	0.096	1.08
13681	16	8	0.096	1.08
13691	17	8	0.096	1.08
13701	20	8	0.096	1.08
13721	0	2	0.042	1.56
13731	0	2	0.106	1.56
13742	0	2	0.204	1.48
13752	0	2	0.306	1.47
13762	0	2	0.408	1.47
13772	0	2	0.510	1.47
13781	2	2	0.042	1.55
13791	2	2	0.106	1.55
13802	2	2	0.204	1.47
13812	2	2	0.306	1.47

TABLE 14.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13822	2	2	0.408	1.47
13832	2	2	0.510	1.47
13841	2	4	0.042	1.54
13851	2	4	0.106	1.54
13862	2	4	0.203	1.47
13872	2	4	0.305	1.47
13882	2	4	0.406	1.47
13892	2	4	0.508	1.47
13901	0	4	0.042	1.53
13911	0	4	0.106	1.53
13922	0	4	0.206	1.48
13932	0	4	0.309	1.47
13942	0	4	0.412	1.47
13952	0	4	0.515	1.47
13971	3	8	0.098	1.99
13981	4	8	0.098	1.99
13991	5	8	0.098	1.97
14001	6	8	0.098	1.97
14011	7	8	0.098	1.97
14021	8	8	0.098	1.97
14031	9	8	0.098	1.96
14041	10	8	0.098	1.96
14051	11	8	0.100	1.93
14061	12	8	0.100	1.92
14071	13	8	0.100	1.92
14081	14	8	0.100	1.91
14091	15	8	0.100	1.91
14101	16	8	0.100	1.91
14111	17	8	0.100	1.91
14121	20	8	0.100	1.90
*815551	10	4	0.025	1.50
*815561	10	6	0.025	1.50
*815571	10	8	0.025	1.50
*815581	10	10	0.025	1.49
*815591	10	4	0.100	1.48
*815601	10	6	0.100	1.48
*815611	10	8	0.100	1.48
*815621	10	10	0.100	1.48
*815631	10	4	0.176	1.48
*815641	10	6	0.176	1.47
*815651	10	8	0.175	1.47
*815661	10	10	0.175	1.47

*experiments with roughness transition strips

TABLE 14.6 : DETAILS OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS

TABLE 14.6.1 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.05						
Reynolds Number	0.8×10^6		1.1×10^6		1.5×10^6		2.0×10^6

(all permutations)

TABLE 14.6.2 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.02		0.04	0.05		0.06	0.075
Reynolds Number	1.5×10^6						

(all permutations; experiments at reduced frequency of 0.075 were repeated with roughness transition strips)

TABLE 14.6.3 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
14141	0	5.4	0.047	0.87
14151	0	10.0	0.047	0.87
14161	0	12.2	0.047	0.87
14171	0	13.8	0.047	0.87
14181	0	17.4	0.047	0.87
14191	0	22.6	0.047	0.87
14201	0	32.8	0.047	0.87
14221	0	5.4	0.047	1.20
14231	0	10.0	0.047	1.20
14241	0	12.2	0.047	1.20
14251	0	13.8	0.047	1.20
14261	0	17.4	0.047	1.20
14271	0	22.6	0.047	1.20
14281	0	32.8	0.047	1.20
14301	0	5.4	0.047	1.60
14311	0	10.0	0.047	1.60
14321	0	12.2	0.047	1.60
14331	0	13.8	0.047	1.60
14341	0	17.4	0.047	1.59
14351	0	22.6	0.047	1.59
14361	0	32.8	0.047	1.59
14381	0	5.4	0.049	2.07
14391	0	10.0	0.049	2.06
14401	0	12.2	0.049	2.05
14411	0	13.8	0.049	2.05
14421	0	17.4	0.049	2.04
14431	0	22.6	0.049	2.04
14442	0	32.8	0.049	1.98
14451	0	5.4	0.019	1.58
14461	0	10.0	0.019	1.58
14471	0	12.2	0.019	1.57
14481	0	13.8	0.019	1.57
14491	0	17.4	0.019	1.57
14501	0	22.6	0.019	1.57
14511	0	32.8	0.019	1.56
14521	0	5.4	0.038	1.56
14531	0	10.0	0.038	1.56
14541	0	12.2	0.038	1.56
14551	0	13.8	0.038	1.56
14561	0	17.4	0.038	1.56

TABLE 14.6.3 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
14571	0	22.6	0.038	1.55
14581	0	32.8	0.038	1.55
14591	0	5.4	0.047	1.56
14601	0	10.0	0.047	1.56
14611	0	12.2	0.047	1.55
14621	0	13.8	0.047	1.55
14631	0	17.4	0.047	1.55
14641	0	22.6	0.047	1.55
14651	0	32.8	0.047	1.55
14661	0	5.4	0.057	1.55
14671	0	10.0	0.057	1.55
14681	0	12.2	0.057	1.55
14691	0	13.8	0.057	1.55
14701	0	17.4	0.057	1.55
14711	0	22.6	0.057	1.55
14721	0	32.8	0.057	1.55
14731	0	5.4	0.071	1.55
14741	0	10.0	0.071	1.55
14751	0	12.2	0.071	1.54
14761	0	13.8	0.071	1.54
14771	0	17.4	0.071	1.54
14781	0	22.6	0.071	1.54
14791	0	32.8	0.071	1.54
*815671	0	5.4	0.078	1.49
*815681	0	10.0	0.078	1.48
*815691	0	12.2	0.078	1.48
*815701	0	13.8	0.078	1.48
*815711	0	17.4	0.078	1.48
*815721	0	22.6	0.078	1.48
*815731	0	32.8	0.078	1.48

*experiments with roughness transition strips

TABLE 14.7 : DETAILS OF SINGLE STREAMTUBE VAWT EXPERIMENTS

TABLE 14.7.1 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.05						
Reynolds Number	$0.8x10^6$		$1.1x10^6$		$1.5x10^6$		$2.0x10^6$

(all permutations)

TABLE 14.7.2 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.02		0.04	0.05		0.06	0.075
Reynolds Number	$1.5x10^6$						

(all permutations)

TABLE 14.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
54811	0	6.00	0.047	0.86
54821	0	4.00	0.047	0.86
54831	0	3.50	0.047	0.86
54841	0	3.25	0.047	0.86
54851	0	2.85	0.047	0.86
54861	0	2.33	0.047	0.86
54871	0	1.75	0.047	0.86
54891	0	6.00	0.046	1.20
54901	0	4.00	0.046	1.20
54911	0	3.50	0.046	1.19
54921	0	3.25	0.046	1.19
54931	0	2.85	0.046	1.19
54941	0	2.33	0.046	1.19
54951	0	1.75	0.046	1.19

TABLE 14.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (concluded)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
54961	0	6.00	0.046	1.60
54971	0	4.00	0.046	1.60
54981	0	3.50	0.046	1.60
54991	0	3.25	0.046	1.59
55001	0	2.85	0.046	1.59
55011	0	2.33	0.046	1.59
55021	0	1.75	0.046	1.58
55041	0	6.00	0.046	2.07
55051	0	4.00	0.046	2.07
55061	0	3.50	0.046	2.06
55071	0	3.25	0.045	2.05
55081	0	2.85	0.045	2.05
55091	0	2.33	0.045	2.04
55102	0	1.75	0.049	1.97
55111	0	6.00	0.018	1.57
55121	0	4.00	0.018	1.57
55131	0	3.50	0.018	1.56
55141	0	3.25	0.018	1.56
55151	0	2.85	0.018	1.56
55161	0	2.33	0.018	1.56
55171	0	1.75	0.018	1.56
55191	0	6.00	0.037	1.64
55201	0	4.00	0.037	1.64
55211	0	3.50	0.037	1.64
55221	0	3.25	0.037	1.64
55231	0	2.85	0.037	1.64
55241	0	2.33	0.037	1.63
55251	0	1.75	0.037	1.63
55261	0	6.00	0.046	1.64
55271	0	4.00	0.046	1.64
55281	0	3.50	0.046	1.63
55291	0	3.25	0.046	1.63
55301	0	2.85	0.046	1.63
55311	0	2.33	0.046	1.62
55321	0	1.75	0.046	1.62
55331	0	6.00	0.055	1.61
55341	0	4.00	0.055	1.61
55351	0	3.50	0.055	1.61
55361	0	3.25	0.055	1.60
55371	0	2.85	0.055	1.60
55381	0	2.33	0.055	1.60
55391	0	1.75	0.055	1.60
55401	0	6.00	0.069	1.61
55411	0	4.00	0.069	1.61
55421	0	3.50	0.069	1.60
55431	0	3.25	0.069	1.60
55441	0	2.85	0.069	1.60
55451	0	2.33	0.069	1.60
55461	0	1.75	0.069	1.60

TABLE 14.8 : LIST OF NON-STANDARD VAWT EXPERIMENTS

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
[a]55482	0	12	0.045	2.00
[b]55492	0	12	0.045	1.99
[c]55502	0	20	0.045	1.98
[d]55512	0	20	0.045	1.97
[e]55521	0	30	0.046	1.96
[f]55531	0	30	0.046	1.94

[a]angle of attack trace from simulation of the VAWT 260 at a wind speed of 7.89 ms^{-1} (structural dynamic effects not included)

[b]angle of attack trace from simulation of the VAWT 260 at a wind speed of 7.89 ms^{-1} (structural dynamic effects included)

[c]angle of attack trace from simulation of the VAWT 260 at a wind speed of 10.57 ms^{-1} (structural dynamic effects not included)

[d]angle of attack trace from simulation of the VAWT 260 at a wind speed of 10.57 ms^{-1} (structural dynamic effects included)

[e]angle of attack trace from VAWT 260

[f]equivalent angle of attack trace for wind tunnel to reproduce airloads from VAWT 260

TABLE 15 : EXPERIMENTS ON GUVA10 (MODEL 14)

TABLE 15.1 : DETAILS OF STATIC EXPERIMENTS

TABLE 15.1.1 : SUMMARY OF STATIC EXPERIMENTS (nominal)

Reynolds Number	1.0×10^6	1.5×10^6	2.0×10^6
Angle of Attack	-2° to 30°		

(all permutations)

TABLE 15.1.2 : LIST OF STATIC EXPERIMENTS (actual)

Run Number	Start (°)	Sweep (°)	Reynolds No. x 10^{-6}
00011	-2	32	1.51
00741	-2	32	1.04
00831	-2	32	2.07
00921	-2	32	1.43
01681	-2	32	1.54
02311	-2	32	1.56
03471	-2	32	1.56
03871	-2	32	0.99
04041	-2	32	1.93
04211	-2	32	1.99
04361	-2	32	1.08
04511	-2	32	0.78
04661	-2	32	1.52
*805371	-2	32	1.53
*805571	-2	32	1.55
*806131	-2	32	1.54

(*experiments with roughness transition strips)

TABLE 15.2 : DETAILS OF UNSTEADY STATIC EXPERIMENTS

TABLE 15.2.1 : SUMMARY OF UNSTEADY STATIC EXPERIMENTS (nominal)

Angle of Attack	-4°	-2°	0°	2°	4°	6°	8°	10°	11°	12°	13°
Reynolds Number	1.5×10^6										
Sampling Frequency	100Hz					500Hz					

(all permutations)

Angle of Attack	14°	15°	16°	18°	20°	22°	24°	26°	28°	30°
Reynolds Number	1.5×10^6									
Sampling Frequency	100Hz					500Hz				

(all permutations)

TABLE 15.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (actual)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40021	-4	100	1.50
40031	-2	100	1.50
40041	0	100	1.50
40051	2	100	1.50
40061	4	100	1.50
40071	6	100	1.50
40081	8	100	1.50
40091	10	100	1.49
40101	11	100	1.49
40111	12	100	1.49
40121	13	100	1.49
40131	14	100	1.49
40141	15	100	1.49
40151	16	100	1.49
40161	18	100	1.48
40171	20	100	1.48
40181	22	100	1.48
40191	24	100	1.48
40201	26	100	1.48
40211	28	100	1.48
40221	30	100	1.47

TABLE 15.2.2 : LIST OF UNSTEADY STATIC EXPERIMENTS (concluded)

Run Number	Angle of Attack (°)	Sampling Frequency (Hz)	Reynolds Number x 10^{-6}
40231	-4	500	1.48
40241	-2	500	1.48
40251	0	500	1.48
40261	2	500	1.48
40271	4	500	1.47
40281	6	500	1.47
40291	8	500	1.47
40301	10	500	1.47
40311	11	500	1.47
40321	12	500	1.47
40331	13	500	1.47
40341	14	500	1.47
40351	15	500	1.47
40361	16	500	1.47
40371	18	500	1.47
40381	20	500	1.47
40391	22	500	1.46
40401	24	500	1.46
40411	26	500	1.46
40421	28	500	1.46
40431	30	500	1.46

TABLE 15.3 : DETAILS OF RAMP UP EXPERIMENTS

TABLE 15.3.1 : SUMMARY OF RAMPS FROM -1° TO 40° (nominal)

Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}	Pitch Rate	Reynolds Number x10^{-6}
0.75	1.5	75.0	1.5	215.0	1.5
1.5	1.5	90.0	1.5	230.0	1.5
3.0	1.5	100.0	1.0 1.5 2.0	245.0	1.5
4.5	1.5	115.0	1.5	260.0	1.5
6.0	1.5	130.0	1.5	275.0	1.5
7.5	1.5	145.0	1.5	290.0	1.5
15.0	1.5	160.0	1.5	300.0	1.0 1.5 2.0
30.0	1.0 1.5 2.0	175.0	1.5	315.0	1.5
45.0	1.5	190.0	1.5	330.0	1.5
60.0	1.5	200.0	1.0 1.5 2.0	345.0	1.5

(all permutations; experiments at a Reynolds number of 1.5x10^6 repeated with roughness transition strips)

TABLE 15.3.2 : SUMMARY OF SHORT RAMPS (nominal)

Starting Incidence	0°								
Finishing Incidence	4°			8°			12°		
Pitch Rate ($^\circ s^{-1}$)	50	100	200	300	350	400	450	500	550
Reynolds Number	1.5x10^6								

(all permutations, without roughness transition strips)

TABLE 15.3.3 : LIST OF RAMP UP EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
20441	-1	41	0.7	0.0001	1.46
20451	-1	41	1.5	0.0002	1.47
20461	-1	41	3.0	0.0004	1.46
20471	-1	41	4.5	0.0005	1.46
20481	-1	41	5.9	0.0007	1.45
20491	-1	41	7.4	0.0009	1.44
20501	-1	41	14.9	0.0018	1.44
20511	-1	41	29.4	0.0035	1.43
20521	-1	41	44.2	0.0053	1.43
20531	-1	41	57.6	0.0069	1.43
20541	-1	41	73.4	0.0086	1.47
20551	-1	41	90.2	0.0106	1.46
20561	-1	41	101.7	0.0120	1.46
20571	-1	41	114.9	0.0135	1.46
20581	-1	41	132.2	0.0155	1.45
20591	-1	41	150.4	0.0180	1.44
20601	-1	41	163.9	0.0195	1.43
20611	-1	41	181.2	0.0216	1.43
20621	-1	41	192.9	0.0230	1.43
20631	-1	41	203.1	0.0242	1.43
20641	-1	41	221.7	0.0264	1.44
20651	-1	41	237.3	0.0282	1.43
20661	-1	41	247.0	0.0294	1.43
20671	-1	41	262.6	0.0312	1.43
20681	-1	41	278.5	0.0331	1.43
20691	-1	41	294.4	0.0352	1.43
20701	-1	41	298.9	0.0357	1.43
20711	-1	41	312.5	0.0372	1.42
20721	-1	41	327.4	0.0390	1.42
20731	-1	41	340.2	0.0405	1.42
20751	-1	41	29.1	0.0051	1.04
20761	-1	41	100.0	0.0175	1.04
20771	-1	41	206.3	0.0362	1.04
20781	-1	41	284.6	0.0499	1.04
20881	-1	41	29.7	0.0026	1.95
20891	-1	41	100.0	0.0088	1.94
20901	-1	41	206.8	0.0182	1.93
20911	-1	41	290.1	0.0255	1.92
20931	0	4	55.4	0.0066	1.43
20941	0	4	99.2	0.0119	1.43
20951	0	4	108.0	0.0129	1.43
20961	0	4	124.7	0.0149	1.42
20971	0	4	121.8	0.0146	1.42
20981	0	4	122.3	0.0147	1.42
20991	0	4	116.3	0.0140	1.42
21001	0	4	113.6	0.0137	1.42
21011	0	4	110.8	0.0133	1.42
21021	0	8	53.7	0.0064	1.43
21031	0	8	96.3	0.0115	1.43
21041	0	8	178.9	0.0214	1.43

TABLE 15.3.3 : LIST OF RAMP UP EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{\circ}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
21051	0	8	174.0	0.0208	1.43
21061	0	8	192.6	0.0230	1.43
21071	0	8	192.4	0.0229	1.43
21081	0	8	190.2	0.0226	1.43
21091	0	8	206.6	0.0245	1.43
21101	0	8	185.5	0.0220	1.43
21111	0	12	52.8	0.0063	1.43
21121	0	12	93.4	0.0111	1.43
21131	0	12	185.8	0.0221	1.43
21141	0	12	230.5	0.0274	1.43
21151	0	12	243.6	0.0288	1.48
21161	0	12	227.5	0.0270	1.47
21171	0	12	237.4	0.0282	1.46
21181	0	12	249.5	0.0296	1.46
21191	0	12	237.4	0.0281	1.46
*825581	-1	41	0.8	0.0001	1.53
*825601	-1	41	1.5	0.0002	1.52
*825611	-1	41	4.6	0.0006	1.50
*825621	-1	41	5.8	0.0007	1.49
*825631	-1	41	7.5	0.0009	1.50
*825641	-1	41	14.9	0.0018	1.49
*825651	-1	41	29.5	0.0035	1.49
*825661	-1	41	44.4	0.0053	1.49
*825671	-1	41	59.8	0.0071	1.49
*825681	-1	41	75.2	0.0090	1.49
*825691	-1	41	93.1	0.0111	1.48
*825701	-1	41	103.7	0.0124	1.48
*825711	-1	41	118.1	0.0140	1.48
*825721	-1	41	135.5	0.0161	1.48
*825731	-1	41	150.8	0.0180	1.48
*825741	-1	41	166.5	0.0198	1.47
*825751	-1	41	181.1	0.0216	1.47
*825761	-1	41	197.4	0.0235	1.47
*825771	-1	41	207.5	0.0247	1.47
*825791	-1	41	238.4	0.0282	1.49
*825801	-1	41	252.6	0.0299	1.48
*825811	-1	41	266.4	0.0315	1.48
*825821	-1	41	279.7	0.0330	1.48
*825831	-1	41	288.4	0.0344	1.47
*825841	-1	41	303.4	0.0361	1.47
*825851	-1	41	322.7	0.0384	1.46
*825861	-1	41	334.1	0.0397	1.46
*825871	-1	41	348.3	0.0414	1.46

(*experiments with roughness transition strips)

TABLE 15.4 : DETAILS OF RAMP DOWN EXPERIMENTS

TABLE 15.4.1 : SUMMARY OF RAMPS FROM 40° TO -1° (nominal)

Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$	Pitch Rate	Reynolds Number $x10^{-6}$
-0.75	1.5	-75.0	1.5	-215.0	1.5
-1.5	1.5	-90.0	1.5	-230.0	1.5
-3.0	1.5	-100.0	1.0 1.5 2.0	-245.0	1.5
-4.5	1.5	-115.0	1.5	-260.0	1.5
-6.0	1.5	-130.0	1.5	-275.0	1.5
-7.5	1.5	-145.0	1.5	-290.0	1.5
-15.0	1.5	-160.0	1.5	-300.0	1.0 1.5 2.0
-30.0	1.0 1.5 2.0	-175.0	1.5	-315.0	1.5
-45.0	1.5	-190.0	1.5	-330.0	1.5
-60.0	1.5	-200.0	1.0 1.5 2.0	-345.0	1.5

(all permutations; experiments at a Reynolds number of $1.5x10^6$ repeated with roughness transition strips)

TABLE 15.4.2 : SUMMARY OF RAMPS FROM 30° TO -10° (nominal)

Starting Incidence	30°						
Finishing Incidence	-10°						
Pitch Rate ($^os^{-1}$)	-1	-45	-100	-145	-200	-260	-330
Reynolds Number	$1.5x10^6$						

(all permutations, both with and without roughness transition strips)

TABLE 15.4.3 : SUMMARY OF RAMPS TO -10° AT 330^os^{-1} (nominal)

Starting Incidence	24°	22°	20°	18°	16°	14°	12°	10°	8°	6°	4°
Finishing Incidence	-10°										
Pitch Rate	-330^os^{-1}										
Reynolds Number	$1.5x10^6$										

(all permutations, both with and without roughness transition strips)

TABLE 15.4.4 : LIST OF RAMP DOWN EXPERIMENTS (actual)

Run Number	Start (°)	Arc (°)	Pitch Rate ($°s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
30791	40	-41	-28.0	-0.0051	1.00
30801	40	-41	-91.7	-0.0166	1.00
30811	40	-41	-178.6	-0.0323	1.00
30821	40	-41	-275.5	-0.0498	1.00
30841	40	-41	-27.8	-0.0024	2.03
30851	40	-41	-92.4	-0.0080	2.01
30861	40	-41	-179.8	-0.0155	2.00
30871	40	-41	-259.1	-0.0223	1.99
31201	40	-41	-0.7	-0.0001	1.45
31211	40	-41	-1.4	-0.0002	1.43
31221	40	-41	-2.9	-0.0003	1.42
31231	40	-41	-4.4	-0.0005	1.42
31241	40	-41	-5.8	-0.0007	1.41
31251	40	-41	-7.1	-0.0009	1.43
31261	40	-41	-14.0	-0.0017	1.42
31271	40	-41	-28.4	-0.0034	1.42
31281	40	-41	-41.7	-0.0050	1.42
31291	40	-41	-54.6	-0.0065	1.41
31301	40	-41	-68.3	-0.0081	1.43
31311	40	-41	-83.1	-0.0098	1.43
31321	40	-41	-92.8	-0.0110	1.42
31331	40	-41	-102.9	-0.0122	1.42
31341	40	-41	-120.9	-0.0143	1.42
31351	40	-41	-136.0	-0.0164	1.40
31361	40	-41	-148.5	-0.0179	1.40
31371	40	-41	-157.6	-0.0190	1.40
31381	40	-41	-171.1	-0.0206	1.39
31391	40	-41	-183.1	-0.0220	1.39
31401	40	-41	-187.0	-0.0221	1.45
31411	40	-41	-201.3	-0.0237	1.45
31421	40	-41	-213.7	-0.0252	1.44
31431	40	-41	-223.1	-0.0263	1.44
31441	40	-41	-236.0	-0.0278	1.44
31451	40	-41	-256.5	-0.0307	1.42
31461	40	-41	-258.5	-0.0309	1.42
31471	40	-41	-277.9	-0.0332	1.41
31481	40	-41	-295.1	-0.0352	1.41
31491	40	-41	-313.4	-0.0374	1.41
31501	30	-40	-1.0	-0.0001	1.51
31511	30	-40	-43.3	-0.0051	1.50
31521	30	-40	-96.7	-0.0115	1.49
31531	30	-40	-144.1	-0.0171	1.49
31541	30	-40	-190.0	-0.0226	1.49
31551	30	-40	-237.8	-0.0282	1.48
31561	30	-40	-303.4	-0.0360	1.48
31571	24	-34	-305.5	-0.0366	1.48
31581	22	-32	-305.3	-0.0365	1.47
31591	20	-30	-294.8	-0.0352	1.47
31601	18	-28	-298.7	-0.0357	1.47
31611	16	-26	-292.8	-0.0349	1.47
31621	14	-24	-286.3	-0.0341	1.47

TABLE 15.4.4 : LIST OF RAMP DOWN EXPERIMENTS (concluded)

Run Number	Start (°)	Arc (°)	Pitch Rate ($^{o}s^{-1}$)	Reduced Pitch Rate	Reynolds No. x 10^{-6}
31631	12	-22	-295.1	-0.0353	1.46
31641	10	-20	-285.4	-0.0341	1.46
31651	8	-18	-289.5	-0.0346	1.46
31661	6	-16	-263.9	-0.0315	1.46
31671	4	-14	-255.7	-0.0305	1.45
*835881	40	-41	-0.8	-0.0001	1.47
*835891	40	-41	-3.0	-0.0004	1.46
*835901	40	-41	-5.8	-0.0007	1.46
*835911	40	-41	-14.4	-0.0017	1.45
*835921	40	-41	-43.0	-0.0051	1.44
*835931	40	-41	-71.7	-0.0085	1.44
*835941	40	-41	-94.1	-0.0112	1.44
*835951	40	-41	-130.0	-0.0155	1.44
*835961	40	-41	-152.7	-0.0184	1.43
*835971	40	-41	-171.9	-0.0206	1.43
*835981	40	-41	-178.8	-0.0214	1.43
*835991	40	-41	-191.6	-0.0228	1.45
*836001	40	-41	-205.9	-0.0244	1.44
*836011	40	-41	-219.5	-0.0260	1.44
*836021	40	-41	-235.4	-0.0279	1.44
*836031	40	-41	-256.5	-0.0304	1.44
*836041	40	-41	-270.0	-0.0323	1.43
*836051	40	-41	-283.3	-0.0339	1.42
*836061	40	-41	-311.7	-0.0373	1.42
*836071	40	-41	-322.0	-0.0385	1.42
*836081	40	-41	-349.7	-0.0418	1.42
*836091	30	-40	-44.5	-0.0053	1.43
*836101	30	-40	-145.5	-0.0175	1.42
*836111	30	-40	-247.9	-0.0297	1.42
*836121	30	-40	-329.7	-0.0395	1.42
*836141	24	-34	-318.8	-0.0380	1.51
*836151	22	-32	-307.6	-0.0367	1.51
*836161	20	-30	-308.5	-0.0367	1.51
*836171	18	-28	-301.4	-0.0359	1.50
*836181	16	-26	-307.1	-0.0365	1.50
*836191	14	-24	-299.5	-0.0356	1.50
*836201	12	-22	-302.5	-0.0361	1.49
*836211	10	-20	-296.5	-0.0354	1.49
*836221	8	-18	-289.2	-0.0345	1.49
*836231	6	-16	-290.9	-0.0347	1.49
*836241	4	-14	-272.4	-0.0324	1.49

(*experiments with roughness transition strips)

TABLE 15.5 : DETAILS OF GENERAL SINUSOIDAL EXPERIMENTS

TABLE 15.5.1 : SUMMARY OF OSCILLATIONS ABOUT 10° (nominal)

Mean Incidence	10°							
Amplitude	4°		6°		8°		10°	
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 15.5.2 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 10° (nominal)

Mean Incidence	4°		6°		8°		15°	20°
Amplitude	10°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 15.5.3 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REYNOLDS NUMBER FIXED (nominal)

Mean Incidence	3°	4°	5°	6°	7°	8°	9°	10°
Amplitude	8°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

Mean Incidence	11°	12°	13°	14°	15°	16°	17°	20°
Amplitude	8°							
Reduced Frequency	0.010	0.025	0.050	0.075	0.100	0.125	0.150	0.175
Reynolds Number	1.5×10^6							

(all permutations)

TABLE 15.5.4 : SUMMARY OF OSCILLATIONS OF AMPLITUDE 8°, WITH REDUCED FREQUENCY FIXED (nominal)

Mean Incidence	3°	4°	5°	6°	7°	8°	9°	10°
Amplitude	8°							
Reduced Frequency	0.100							
Reynolds Number	1.0×10^6			1.5×10^6			2.0×10^6	

(all permutations)

Mean Incidence	11°	12°	13°	14°	15°	16°	17°	20°
Amplitude	8°							
Reduced Frequency	0.100							
Reynolds Number	1.0×10^6			1.5×10^6			2.0×10^6	

(all permutations)

TABLE 15.5.5 : SUMMARY OF FAST OSCILLATIONS (nominal)

Mean Incidence	0°			4°		
Amplitude	2°			4°		
Frequency (Hz)	1.0	2.5	5.0	7.5	10.0	12.5
Reynolds Number	1.5×10^6					

(all permutations)

TABLE 15.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
11691	10	4	0.010	1.52
11701	10	6	0.010	1.52
11711	10	8	0.010	1.51
11721	10	10	0.010	1.51
11731	10	4	0.025	1.50
11741	10	6	0.025	1.50
11751	10	8	0.025	1.50
11761	10	10	0.025	1.50
11771	10	4	0.050	1.51
11781	10	6	0.050	1.51
11791	10	8	0.050	1.51
11801	10	10	0.050	1.50
11811	10	4	0.075	1.50
11821	10	6	0.075	1.50
11831	10	8	0.075	1.50
11841	10	10	0.075	1.50
11851	10	4	0.100	1.50
11861	10	6	0.100	1.50
11871	10	8	0.100	1.50
11881	10	10	0.100	1.49
11891	10	4	0.125	1.51
11901	10	6	0.124	1.51
11911	10	8	0.124	1.51
11921	10	10	0.124	1.51
11931	10	4	0.151	1.50
11941	10	6	0.150	1.49
11951	10	8	0.150	1.49
11961	10	10	0.150	1.49
11971	10	4	0.177	1.48
11981	10	6	0.176	1.48
11991	10	8	0.176	1.48
12001	10	10	0.176	1.48
12011	3	8	0.010	1.48
12021	4	8	0.010	1.47
12031	5	8	0.010	1.47
12041	6	8	0.010	1.47
12051	7	8	0.010	1.47
12061	8	8	0.010	1.47
12071	9	8	0.010	1.47
12081	11	8	0.010	1.47
12091	12	8	0.010	1.47
12101	13	8	0.010	1.46
12111	14	8	0.010	1.47
12121	15	8	0.010	1.46
12131	16	8	0.010	1.46
12141	17	8	0.010	1.46
12151	20	8	0.010	1.46
12161	3	8	0.025	1.45
12171	4	8	0.025	1.45
12181	5	8	0.025	1.45
12191	6	8	0.025	1.45
12201	7	8	0.025	1.45
12211	8	8	0.025	1.47

TABLE 15.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12221	9	8	0.025	1.46
12231	11	8	0.025	1.46
12241	12	8	0.025	1.46
12251	13	8	0.025	1.46
12261	14	8	0.025	1.48
12271	15	8	0.025	1.48
12281	16	8	0.025	1.48
12291	17	8	0.025	1.47
12301	20	8	0.025	1.47
12321	3	8	0.050	1.56
12331	4	8	0.050	1.56
12341	5	8	0.050	1.55
12351	6	8	0.050	1.55
12361	7	8	0.050	1.55
12371	8	8	0.050	1.54
12381	9	8	0.050	1.54
12391	11	8	0.050	1.54
12401	12	8	0.050	1.54
12411	13	8	0.050	1.54
12421	14	8	0.050	1.53
12431	15	8	0.050	1.52
12441	16	8	0.050	1.52
12451	17	8	0.050	1.52
12461	20	8	0.050	1.52
12471	3	8	0.076	1.52
12481	4	8	0.075	1.51
12491	5	8	0.075	1.51
12501	6	8	0.075	1.51
12511	7	8	0.075	1.51
12521	8	8	0.075	1.52
12531	9	8	0.075	1.51
12541	11	8	0.075	1.51
12551	12	8	0.075	1.51
12561	13	8	0.075	1.51
12571	14	8	0.075	1.51
12581	15	8	0.075	1.51
12591	16	8	0.075	1.51
12601	17	8	0.075	1.50
12611	20	8	0.075	1.50
12621	3	8	0.101	1.50
12631	4	8	0.101	1.50
12641	5	8	0.101	1.50
12651	6	8	0.101	1.50
12661	7	8	0.101	1.49
12671	8	8	0.100	1.51
12681	9	8	0.100	1.50
12691	11	8	0.100	1.50
12701	12	8	0.100	1.50
12711	13	8	0.100	1.50
12721	14	8	0.101	1.49
12731	15	8	0.100	1.49
12741	16	8	0.100	1.49

TABLE 15.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
12751	17	8	0.100	1.49
12761	20	8	0.100	1.49
12771	3	8	0.125	1.50
12781	4	8	0.125	1.50
12791	5	8	0.125	1.49
12801	6	8	0.125	1.49
12811	7	8	0.125	1.49
12821	8	8	0.125	1.49
12831	9	8	0.125	1.49
12841	11	8	0.125	1.49
12851	12	8	0.125	1.49
12861	13	8	0.125	1.49
12871	14	8	0.125	1.49
12881	15	8	0.125	1.48
12891	16	8	0.125	1.48
12901	17	8	0.125	1.48
12911	20	8	0.125	1.48
12921	3	8	0.151	1.48
12931	4	8	0.151	1.48
12941	5	8	0.151	1.48
12951	6	8	0.151	1.47
12961	7	8	0.151	1.47
12971	8	8	0.151	1.47
12981	9	8	0.151	1.47
12991	11	8	0.150	1.48
13001	12	8	0.150	1.48
13011	13	8	0.150	1.48
13021	14	8	0.149	1.48
13031	15	8	0.149	1.47
13041	16	8	0.149	1.47
13051	17	8	0.149	1.47
13061	20	8	0.149	1.47
13071	3	8	0.175	1.49
13081	4	8	0.175	1.49
13091	5	8	0.175	1.49
13101	6	8	0.175	1.49
13111	7	8	0.175	1.49
13121	8	8	0.175	1.48
13131	9	8	0.175	1.48
13141	11	8	0.175	1.48
13151	12	8	0.175	1.48
13161	13	8	0.175	1.48
13171	14	8	0.175	1.48
13181	15	8	0.175	1.48
13191	16	8	0.175	1.48
13201	17	8	0.175	1.48
13211	20	8	0.175	1.48
13221	4	10	0.010	1.48
13231	6	10	0.010	1.47
13241	8	10	0.010	1.61
13251	15	10	0.010	1.47
13261	20	10	0.010	1.47
13271	4	10	0.025	1.46
13281	6	10	0.025	1.46
13291	8	10	0.025	1.46

TABLE 15.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (continued)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13301	15	10	0.025	1.46
13311	20	10	0.025	1.46
13321	4	10	0.050	1.45
13331	6	10	0.050	1.45
13341	8	10	0.050	1.45
13351	15	10	0.050	1.45
13361	20	10	0.050	1.45
13371	4	10	0.076	1.45
13381	6	10	0.076	1.44
13391	8	10	0.076	1.44
13401	15	10	0.076	1.44
13411	20	10	0.076	1.44
13421	4	10	0.100	1.46
13431	6	10	0.100	1.46
13441	8	10	0.100	1.45
13451	15	10	0.100	1.45
13461	20	10	0.100	1.45
13481	4	10	0.125	1.53
13491	6	10	0.125	1.53
13501	8	10	0.125	1.52
13511	15	10	0.125	1.52
13521	20	10	0.125	1.52
13531	4	10	0.152	1.50
13541	6	10	0.151	1.50
13551	8	10	0.151	1.50
13561	15	10	0.151	1.50
13571	20	10	0.151	1.50
13581	4	10	0.175	1.51
13591	6	10	0.175	1.51
13601	8	10	0.175	1.51
13611	15	10	0.175	1.51
13621	20	10	0.175	1.51
13631	0	2	0.043	1.50
13641	0	2	0.107	1.50
13651	0	2	0.108	1.48
13661	0	2	0.162	1.48
13671	0	2	0.216	1.47
13681	0	2	0.271	1.47
13691	2	2	0.043	1.49
13701	2	2	0.108	1.49
13711	2	2	0.108	1.47
13721	2	2	0.162	1.47
13731	2	2	0.216	1.47
13741	2	2	0.270	1.47
13751	0	4	0.043	1.46
13761	0	4	0.108	1.46
13771	0	4	0.108	1.47
13781	0	4	0.162	1.47
13791	0	4	0.216	1.46
13801	0	4	0.270	1.46
13811	2	4	0.043	1.46
13821	2	4	0.108	1.47

TABLE 15.5.6 : LIST OF GENERAL SINUSOIDAL EXPERIMENTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
13831	2	4	0.109	1.47
13841	2	4	0.163	1.47
13851	2	4	0.217	1.46
13861	2	4	0.271	1.46
13881	3	8	0.099	1.01
13891	4	8	0.099	1.01
13901	5	8	0.098	1.01
13911	6	8	0.098	1.01
13921	7	8	0.098	1.01
13931	8	8	0.098	1.01
13941	9	8	0.098	1.01
13951	10	8	0.098	1.01
13961	11	8	0.101	0.99
13971	12	8	0.101	0.99
13981	13	8	0.101	0.99
13991	14	8	0.100	0.99
14001	15	8	0.100	0.99
14011	16	8	0.100	0.99
14021	17	8	0.100	0.99
14031	20	8	0.100	0.99
14051	3	8	0.099	1.93
14061	4	8	0.099	1.93
14071	5	8	0.099	1.93
14081	6	8	0.099	1.92
14091	7	8	0.099	1.92
14101	8	8	0.099	1.92
14111	9	8	0.099	1.92
14121	10	8	0.099	1.92
14131	11	8	0.099	1.92
14141	12	8	0.099	1.92
14151	13	8	0.099	1.91
14161	14	8	0.099	1.91
14171	15	8	0.099	1.91
14181	16	8	0.099	1.91
14191	17	8	0.099	1.90
14201	20	8	0.099	1.90
*815381	10	4	0.025	1.51
*815391	10	6	0.025	1.51
*815401	10	8	0.025	1.50
*815411	10	10	0.025	1.50
*815421	10	4	0.099	1.52
*815431	10	6	0.099	1.52
*815441	10	8	0.099	1.52
*815451	10	10	0.099	1.52
*815461	10	4	0.175	1.51
*815471	10	6	0.175	1.50
*815481	10	8	0.175	1.50
*815491	10	10	0.175	1.50

(*experiments with roughness transition strips)

TABLE 15.6 : DETAILS OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS

TABLE 15.6.1 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.05						
Reynolds Number	0.8×10^6		1.1×10^6		1.5×10^6		2.0×10^6

(all permutations)

TABLE 15.6.2 : SUMMARY OF SINUSOIDAL EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Amplitude	5.4^o	10.0^o	12.2^o	13.8^o	17.4^o	22.6^o	32.8^o
Reduced Frequency	0.02		0.04	0.05		0.06	0.075
Reynolds Number	1.5×10^6						

(all permutations; experiments at reduced frequency of 0.075 were repeated with roughness transition strips)

TABLE 15.6.3 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (actual)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
14221	0	5.4	0.052	1.91
14231	0	10.0	0.052	1.90
14241	0	12.2	0.052	1.90
14251	0	13.8	0.052	1.90
14261	0	17.4	0.052	1.89
14271	0	22.6	0.052	1.89
14281	0	32.8	0.052	1.89
14441	0	5.4	0.052	1.08
14451	0	10.0	0.052	1.08
14461	0	12.2	0.052	1.08
14471	0	13.8	0.052	1.08
14481	0	17.4	0.052	1.08
14491	0	22.6	0.052	1.08
14501	0	32.8	0.052	1.08
14521	0	5.4	0.053	0.78
14531	0	10.0	0.053	0.78
14541	0	12.2	0.053	0.78
14551	0	13.8	0.053	0.78
14561	0	17.4	0.053	0.78
14571	0	22.6	0.053	0.78
14581	0	32.8	0.053	0.78
14671	0	5.4	0.053	1.51
14681	0	10.0	0.053	1.50
14691	0	12.2	0.053	1.50
14701	0	13.8	0.053	1.50
14711	0	17.4	0.053	1.50
14721	0	22.6	0.053	1.50
14731	0	32.8	0.053	1.49
14881	0	5.4	0.021	1.48
14891	0	10.0	0.021	1.48
14901	0	12.2	0.021	1.48
14911	0	13.8	0.021	1.48
14921	0	17.4	0.021	1.48
14931	0	22.6	0.021	1.48
14941	0	32.8	0.021	1.47

TABLE 15.6.3 : LIST OF SINUSOIDAL EXPERIMENTS RELEVANT TO THE STUDY OF VAWTS (concluded)

Run Number	Mean (°)	Amp'ude (°)	Reduced Frequency	Reynolds No. x 10^{-6}
14951	0	5.4	0.042	1.48
14961	0	10.0	0.042	1.47
14971	0	12.2	0.042	1.47
14981	0	13.8	0.042	1.47
14991	0	17.4	0.042	1.47
15001	0	22.6	0.042	1.47
15011	0	32.8	0.042	1.46
15161	0	5.4	0.063	1.47
15171	0	10.0	0.063	1.47
15181	0	12.2	0.063	1.47
15191	0	13.8	0.063	1.47
15201	0	17.4	0.063	1.47
15211	0	22.6	0.063	1.47
15221	0	32.8	0.063	1.47
15231	0	5.4	0.080	1.46
15241	0	10.0	0.080	1.46
15251	0	12.2	0.080	1.46
15261	0	13.8	0.080	1.46
15271	0	17.4	0.080	1.46
15281	0	22.6	0.080	1.46
15291	0	32.8	0.080	1.46
*815501	0	5.4	0.081	1.51
*815511	0	10.0	0.081	1.50
*815521	0	12.2	0.081	1.50
*815531	0	13.8	0.081	1.50
*815541	0	17.4	0.081	1.50
*815551	0	22.6	0.081	1.50
*815561	0	32.8	0.080	1.50

(*experiments with roughness transition strips)

TABLE 15.7 : DETAILS OF SINGLE STREAMTUBE VAWT EXPERIMENTS

TABLE 15.7.1 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REDUCED FREQUENCY (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.05						
Reynolds Number	$0.8x10^6$		$1.1x10^6$		$1.5x10^6$		$2.0x10^6$

(all permutations)

TABLE 15.7.2 : SUMMARY OF VAWT EXPERIMENTS AT FIXED REYNOLDS NUMBER (nominal)

Mean Incidence	0^o						
Tip Speed Ratio	1.75	2.33	2.80	3.25	3.50	4.00	6.00
Reduced Frequency	0.02		0.04	0.05		0.06	0.075
Reynolds Number	$1.5x10^6$						

(all permutations)

TABLE 15.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (actual)

Run Number	Mean (^{o})	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
54291	0	6.00	0.052	1.97
54301	0	4.00	0.052	1.96
54311	0	3.50	0.052	1.96
54321	0	3.25	0.052	1.95
54331	0	2.80	0.052	1.95
54341	0	2.33	0.051	1.94
54351	0	1.75	0.051	1.94
54371	0	6.00	0.052	1.08
54381	0	4.00	0.052	1.08
54391	0	3.50	0.052	1.08
54401	0	3.25	0.052	1.08
54411	0	2.80	0.052	1.08
54421	0	2.33	0.052	1.08
54431	0	1.75	0.050	1.09

TABLE 15.7.3 : LIST OF SINGLE STREAMTUBE VAWT EXPERIMENTS (concluded)

Run Number	Mean (°)	TSR	Reduced Frequency	Reynolds No. x 10^{-6}
54591	0	6.00	0.053	0.79
54601	0	4.00	0.053	0.79
54611	0	3.50	0.053	0.79
54621	0	3.25	0.053	0.79
54631	0	2.80	0.052	0.82
54641	0	2.33	0.052	0.82
54651	0	1.75	0.052	0.82
54741	0	6.00	0.052	1.51
54751	0	4.00	0.052	1.51
54761	0	3.50	0.052	1.51
54771	0	3.25	0.052	1.51
54781	0	2.80	0.052	1.51
54791	0	2.33	0.052	1.50
54801	0	1.75	0.052	1.50
54811	0	6.00	0.021	1.50
54821	0	4.00	0.021	1.50
54831	0	3.50	0.021	1.50
54841	0	3.25	0.021	1.49
54851	0	2.80	0.021	1.49
54861	0	2.33	0.021	1.49
54871	0	1.75	0.021	1.49
55021	0	6.00	0.042	1.49
55031	0	4.00	0.042	1.49
55041	0	3.50	0.042	1.49
55051	0	3.25	0.042	1.49
55061	0	2.80	0.042	1.49
55071	0	2.33	0.042	1.49
55081	0	1.75	0.042	1.48
55091	0	6.00	0.063	1.46
55101	0	4.00	0.063	1.46
55111	0	3.50	0.063	1.46
55121	0	3.25	0.063	1.46
55131	0	2.80	0.063	1.46
55141	0	2.33	0.063	1.45
55151	0	1.75	0.063	1.45
55301	0	6.00	0.081	1.45
55311	0	4.00	0.081	1.44
55321	0	3.50	0.081	1.44
55331	0	3.25	0.081	1.44
55341	0	2.80	0.081	1.44
55351	0	2.33	0.081	1.44
55361	0	1.75	0.081	1.44

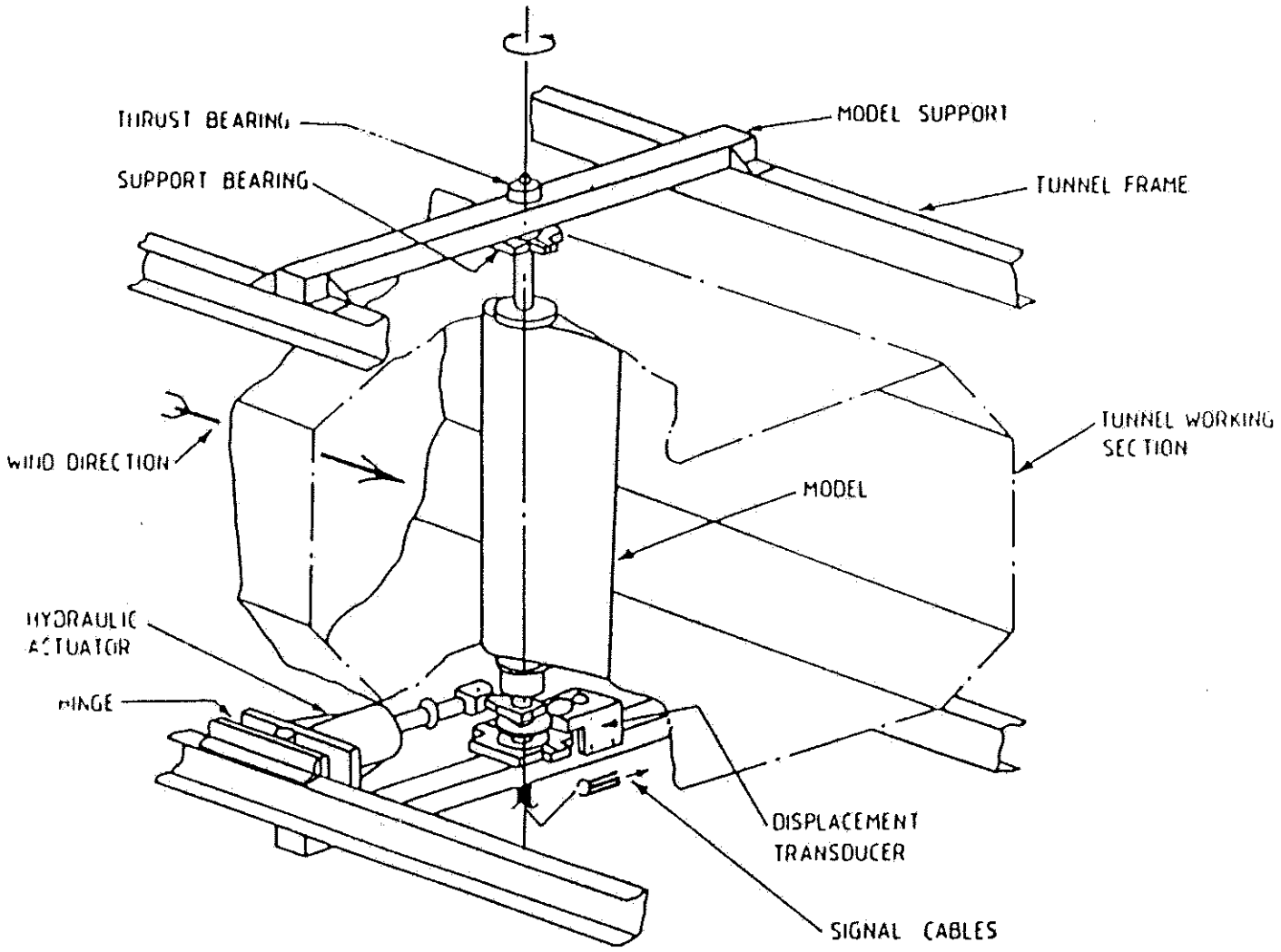


FIGURE 1 : GLASGOW UNIVERSITY'S DYNAMIC STALL RIG

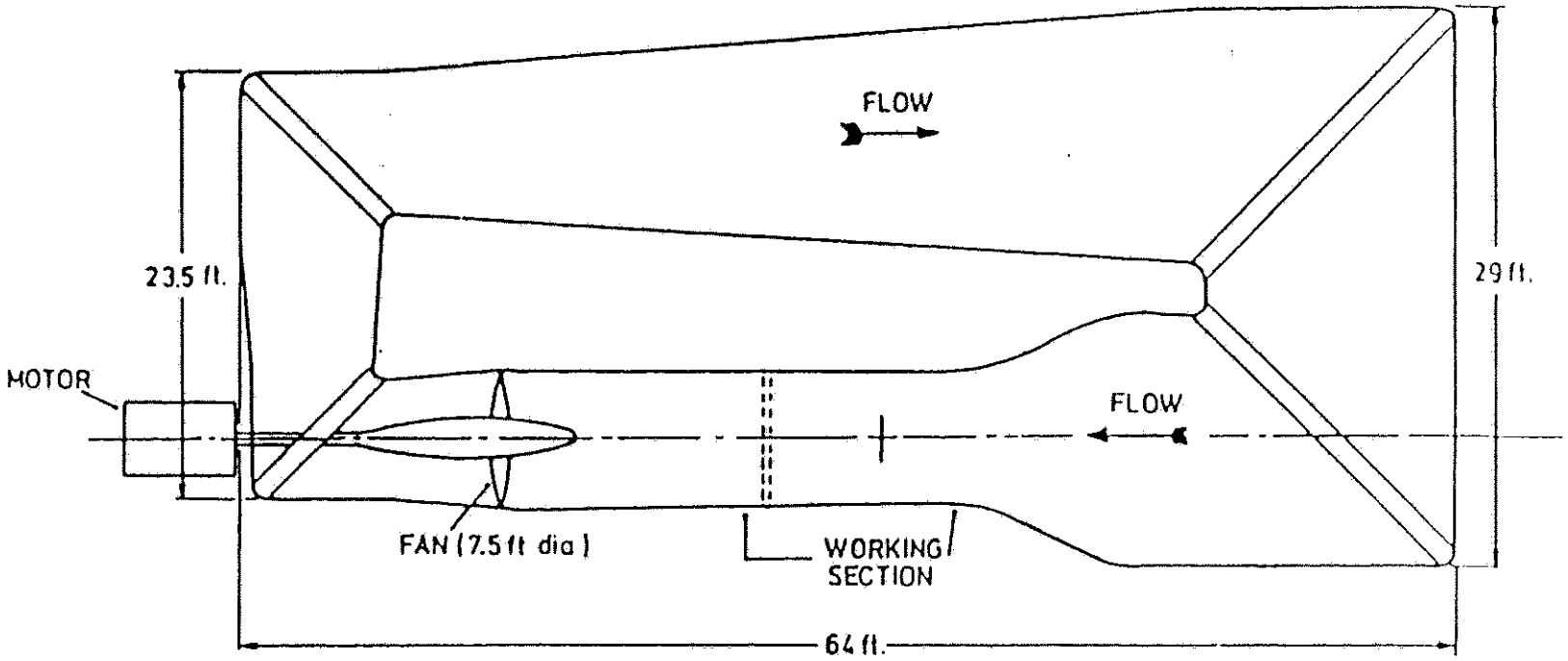
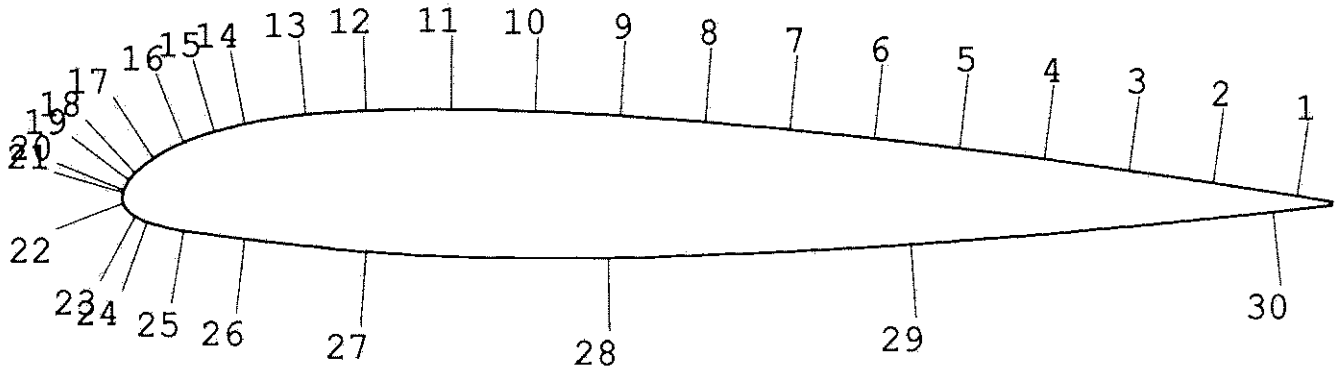
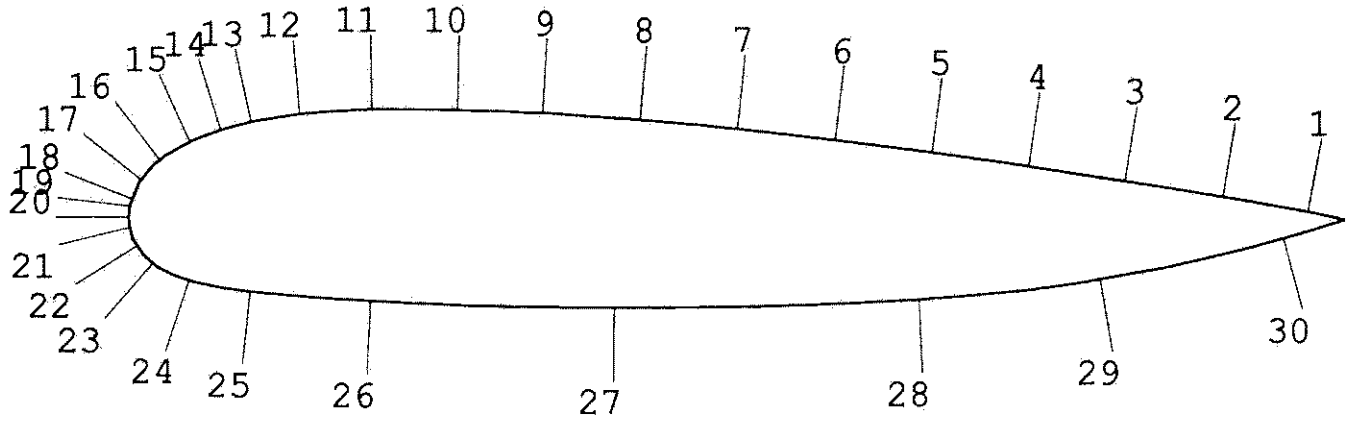


FIGURE 2 : PLAN VIEW OF THE GLASGOW UNIVERSITY "HANDLEY PAGE"
7ft X 5ft 3in WIND TUNNEL



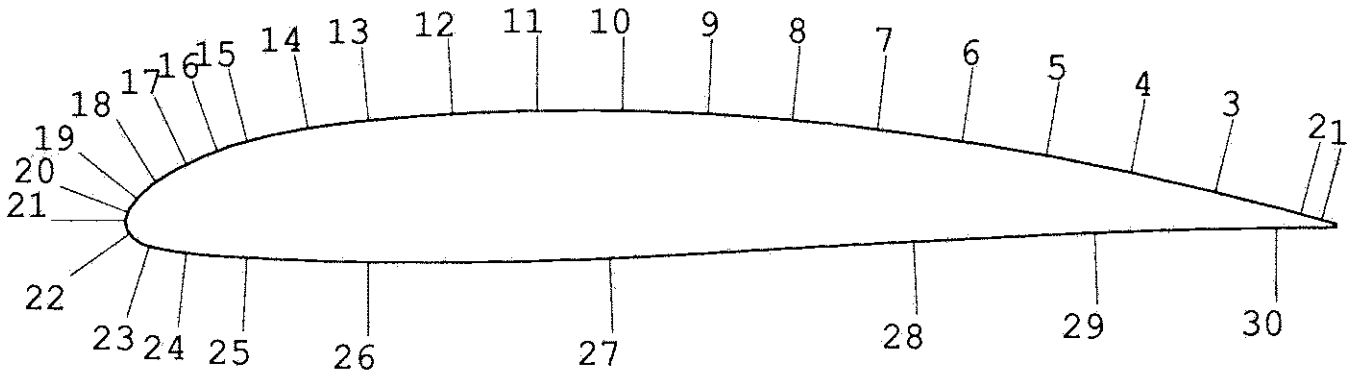
X(1)/C = 0.9700	X(11)/C = 0.2700	X(21)/C = 0.0000
X(2)/C = 0.9000	X(12)/C = 0.2000	X(22)/C = 0.0000
X(3)/C = 0.8300	X(13)/C = 0.1500	X(23)/C = 0.0100
X(4)/C = 0.7600	X(14)/C = 0.1000	X(24)/C = 0.0200
X(5)/C = 0.6900	X(15)/C = 0.0750	X(25)/C = 0.0500
X(6)/C = 0.6200	X(16)/C = 0.0500	X(26)/C = 0.1000
X(7)/C = 0.5500	X(17)/C = 0.0250	X(27)/C = 0.2000
X(8)/C = 0.4800	X(18)/C = 0.0100	X(28)/C = 0.4000
X(9)/C = 0.4100	X(19)/C = 0.0050	X(29)/C = 0.6500
X(10)/C = 0.3400	X(20)/C = 0.0005	X(30)/C = 0.9500

Figure 3.1 : PRESSURE TRANSDUCER LOCATIONS FOR MODELS 1 AND 2.



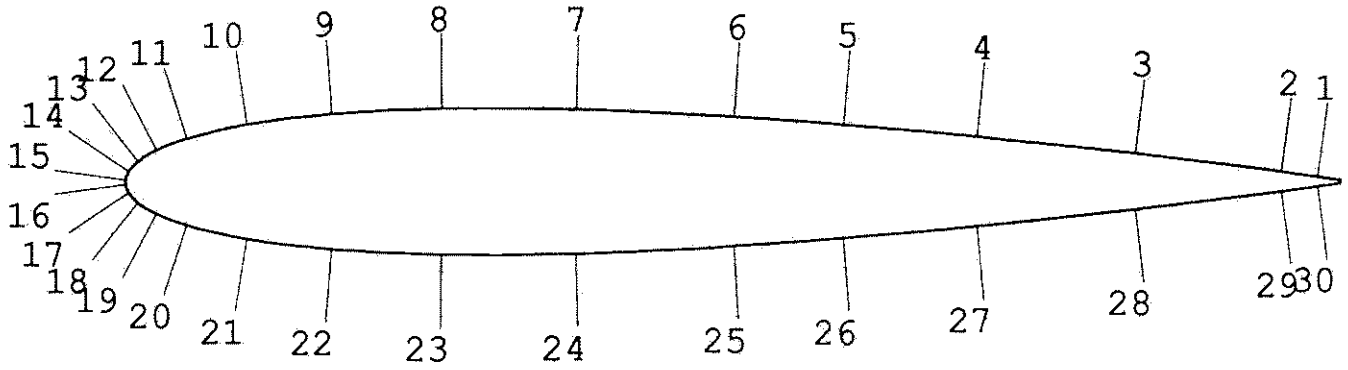
X(1)/C = 0.9700	X(11)/C = 0.2000	X(21)/C = 0.0010
X(2)/C = 0.9000	X(12)/C = 0.1400	X(22)/C = 0.0070
X(3)/C = 0.8200	X(13)/C = 0.1000	X(23)/C = 0.0200
X(4)/C = 0.7400	X(14)/C = 0.0750	X(24)/C = 0.0500
X(5)/C = 0.6600	X(15)/C = 0.0500	X(25)/C = 0.1000
X(6)/C = 0.5800	X(16)/C = 0.0250	X(26)/C = 0.2000
X(7)/C = 0.5000	X(17)/C = 0.0100	X(27)/C = 0.4000
X(8)/C = 0.4200	X(18)/C = 0.0030	X(28)/C = 0.6500
X(9)/C = 0.3400	X(19)/C = 0.0010	X(29)/C = 0.8000
X(10)/C = 0.2700	X(20)/C = 0.0000	X(30)/C = 0.9500

Figure 3.2 : PRESSURE TRANSDUCER LOCATIONS FOR MODEL 3.



X(1)/C = 0.9875	X(11)/C = 0.3400	X(21)/C = 0.0000
X(2)/C = 0.9700	X(12)/C = 0.2700	X(22)/C = 0.0040
X(3)/C = 0.9000	X(13)/C = 0.2000	X(23)/C = 0.0200
X(4)/C = 0.8300	X(14)/C = 0.1500	X(24)/C = 0.0500
X(5)/C = 0.7600	X(15)/C = 0.1000	X(25)/C = 0.1000
X(6)/C = 0.6900	X(16)/C = 0.0750	X(26)/C = 0.2000
X(7)/C = 0.6200	X(17)/C = 0.0500	X(27)/C = 0.4000
X(8)/C = 0.5500	X(18)/C = 0.0250	X(28)/C = 0.6500
X(9)/C = 0.4800	X(19)/C = 0.0100	X(29)/C = 0.8000
X(10)/C = 0.4100	X(20)/C = 0.0025	X(30)/C = 0.9500

Figure 3.3 : PRESSURE TRANSDUCER LOCATIONS FOR MODEL 4.



X(1)/C = 0.98000	X(11)/C = 0.05000	X(21)/C = 0.10000
X(2)/C = 0.95000	X(12)/C = 0.02500	X(22)/C = 0.17000
X(3)/C = 0.83000	X(13)/C = 0.01000	X(23)/C = 0.26000
X(4)/C = 0.70000	X(14)/C = 0.00250	X(24)/C = 0.37000
X(5)/C = 0.59000	X(15)/C = 0.00025	X(25)/C = 0.50000
X(6)/C = 0.50000	X(16)/C = 0.00025	X(26)/C = 0.59000
X(7)/C = 0.37000	X(17)/C = 0.00250	X(27)/C = 0.70000
X(8)/C = 0.26000	X(18)/C = 0.01000	X(28)/C = 0.83000
X(9)/C = 0.17000	X(19)/C = 0.02500	X(29)/C = 0.95000
X(10)/C = 0.10000	X(20)/C = 0.05000	X(30)/C = 0.98000

Figure 3.4 : PRESSURE TRANSDUCER LOCATIONS FOR MODELS 5 TO 14.

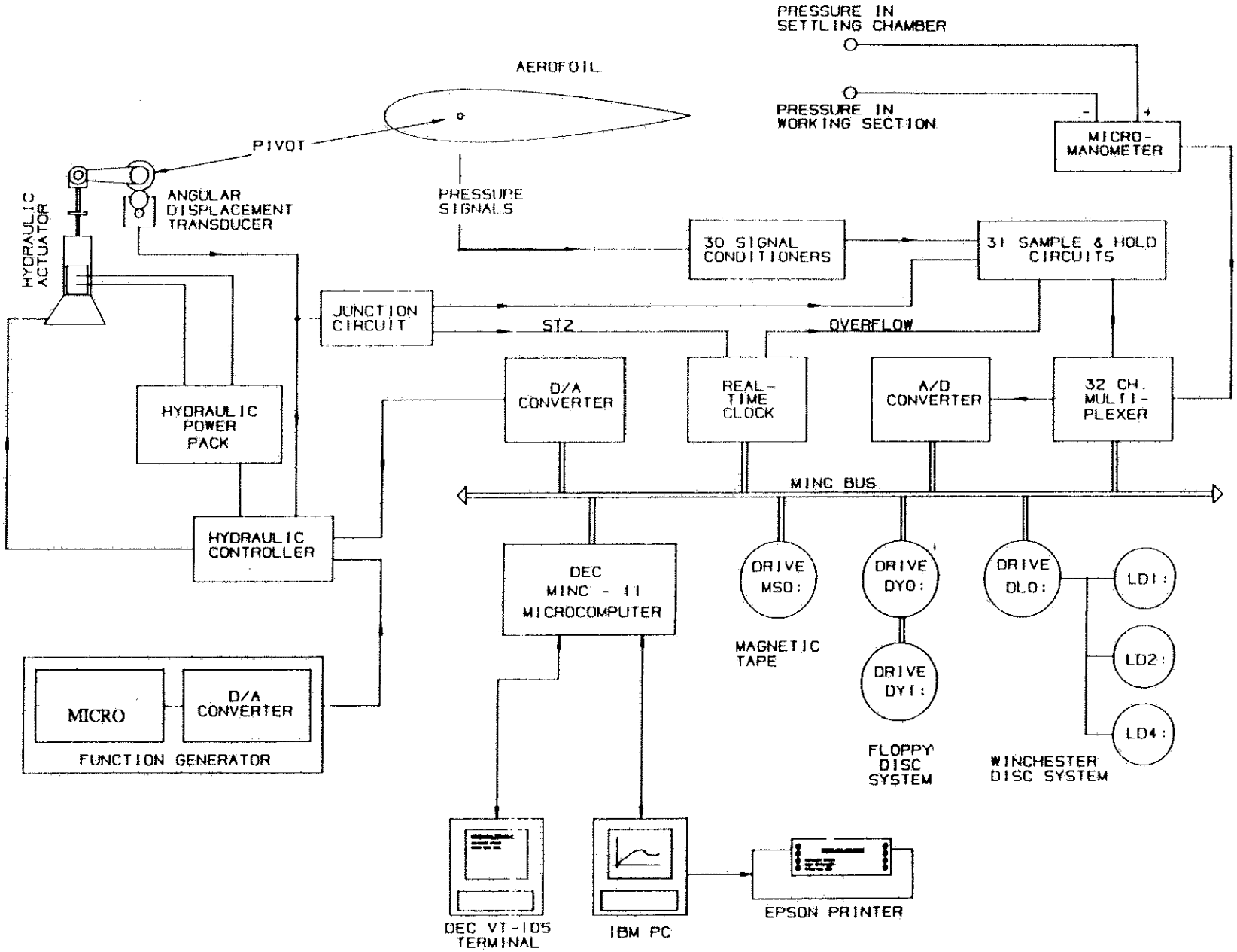


FIGURE 4: SYSTEMATIC ARRANGEMENT OF DATA ACQUISITION AND CONTROL SYSTEM

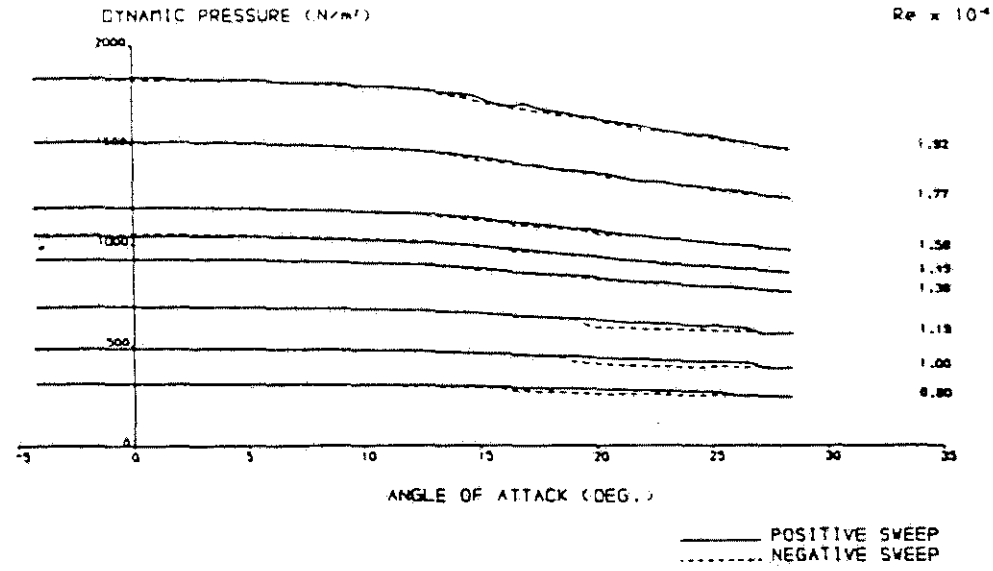


FIGURE 5 : REDUCTION OF DYNAMIC PRESSURE WITH INCREASING ANGLE OF ATTACK.

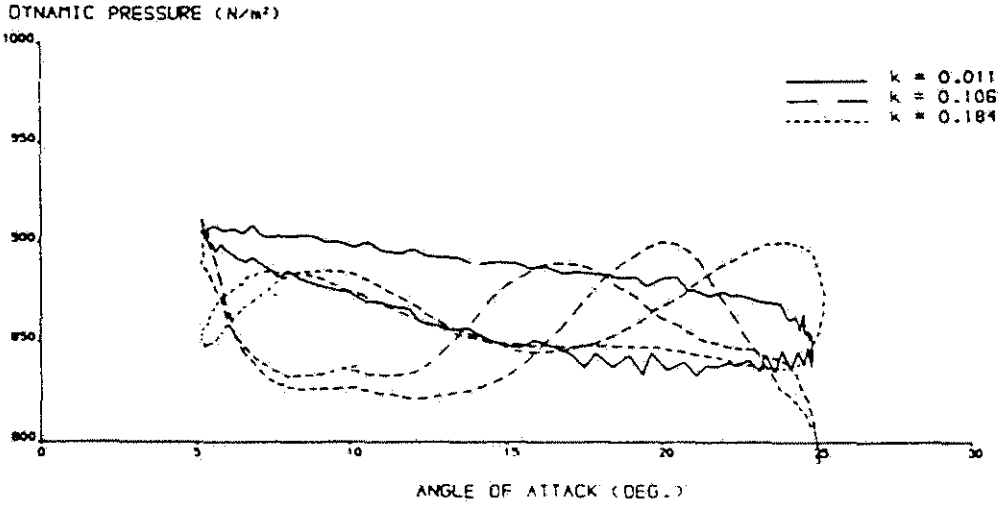


FIGURE 6 : VARIATION OF DYNAMIC PRESSURE DURING OSCILLATORY TESTS.

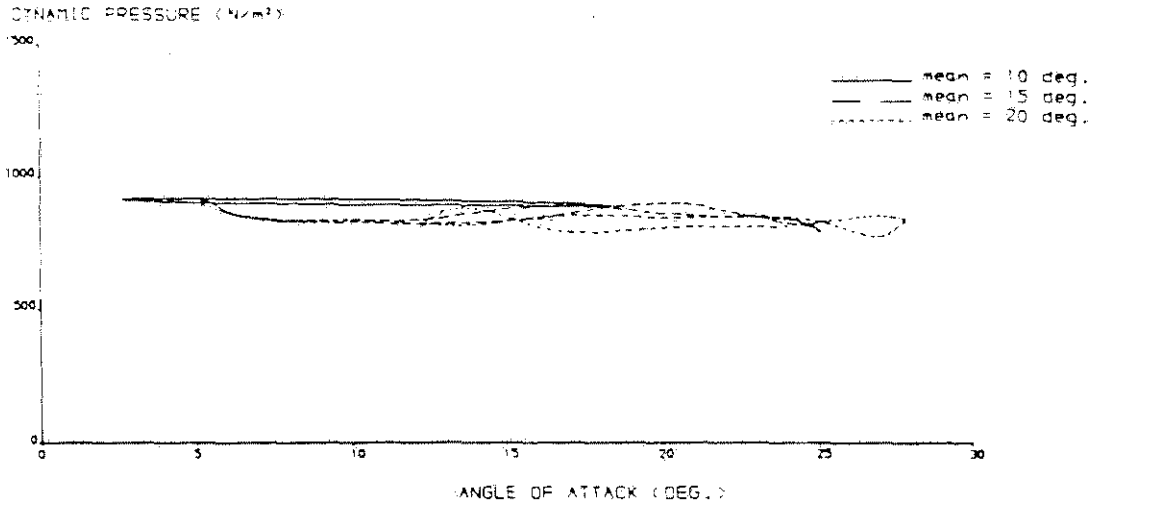


FIGURE 7 : VARIATION OF DYNAMIC PRESSURE FOR VARIOUS MEAN ANGLES OF ATTACK AT A REDUCED FREQUENCY OF 0.10.

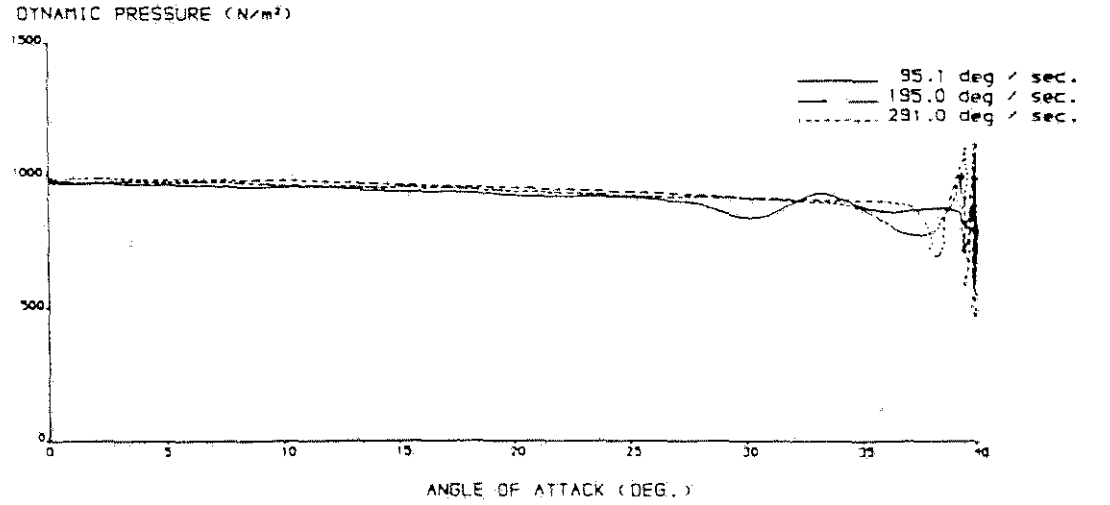


FIGURE 8 : VARIATION OF DYNAMIC PRESSURE FOR VARIOUS PITCH RATES DURING RAMP TESTS.

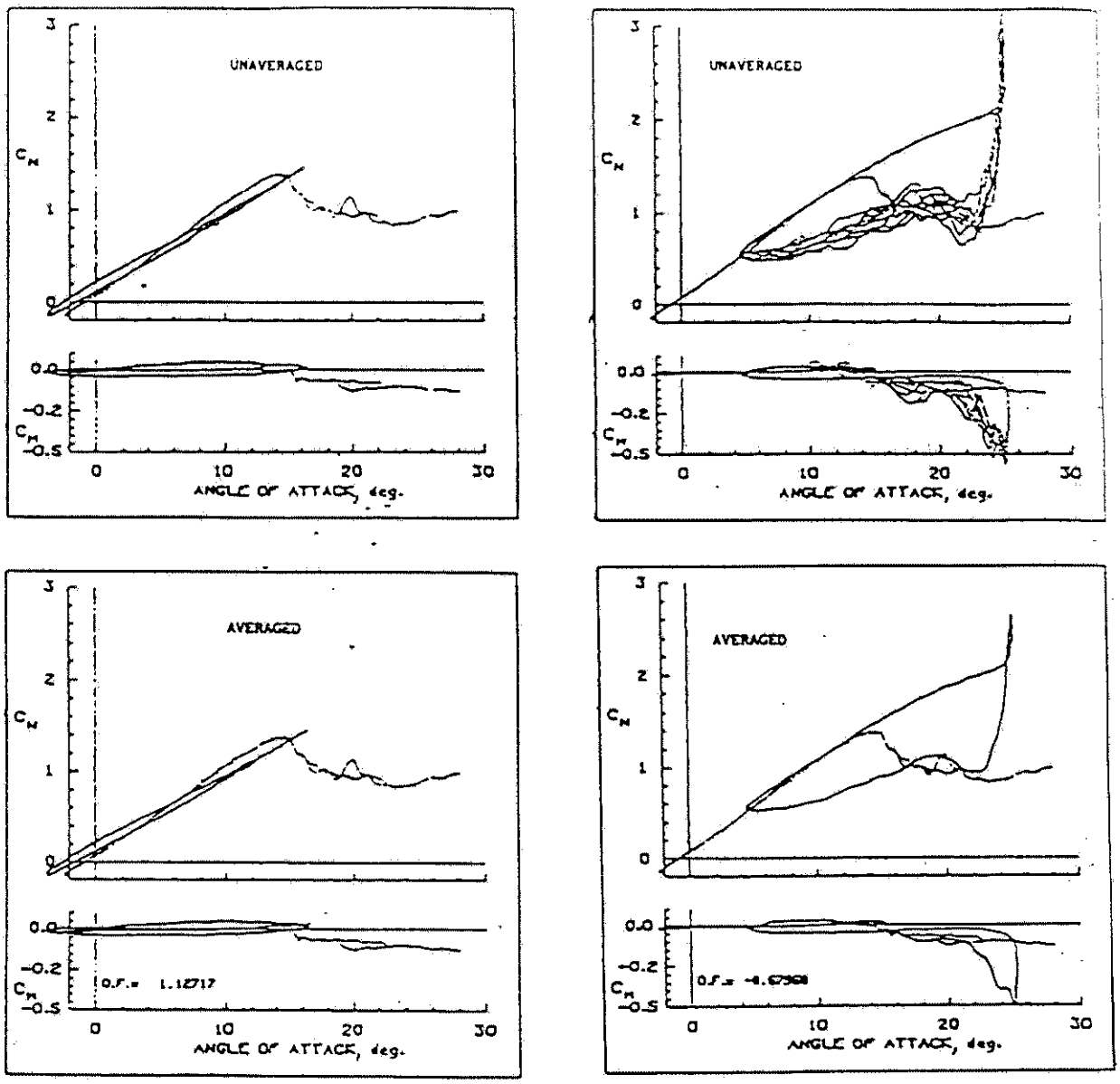


FIGURE 9: EFFECT OF AVERAGING ON THE NORMAL FORCE AND PITCHING MOMENT FOR OSCILLATORY TESTS.

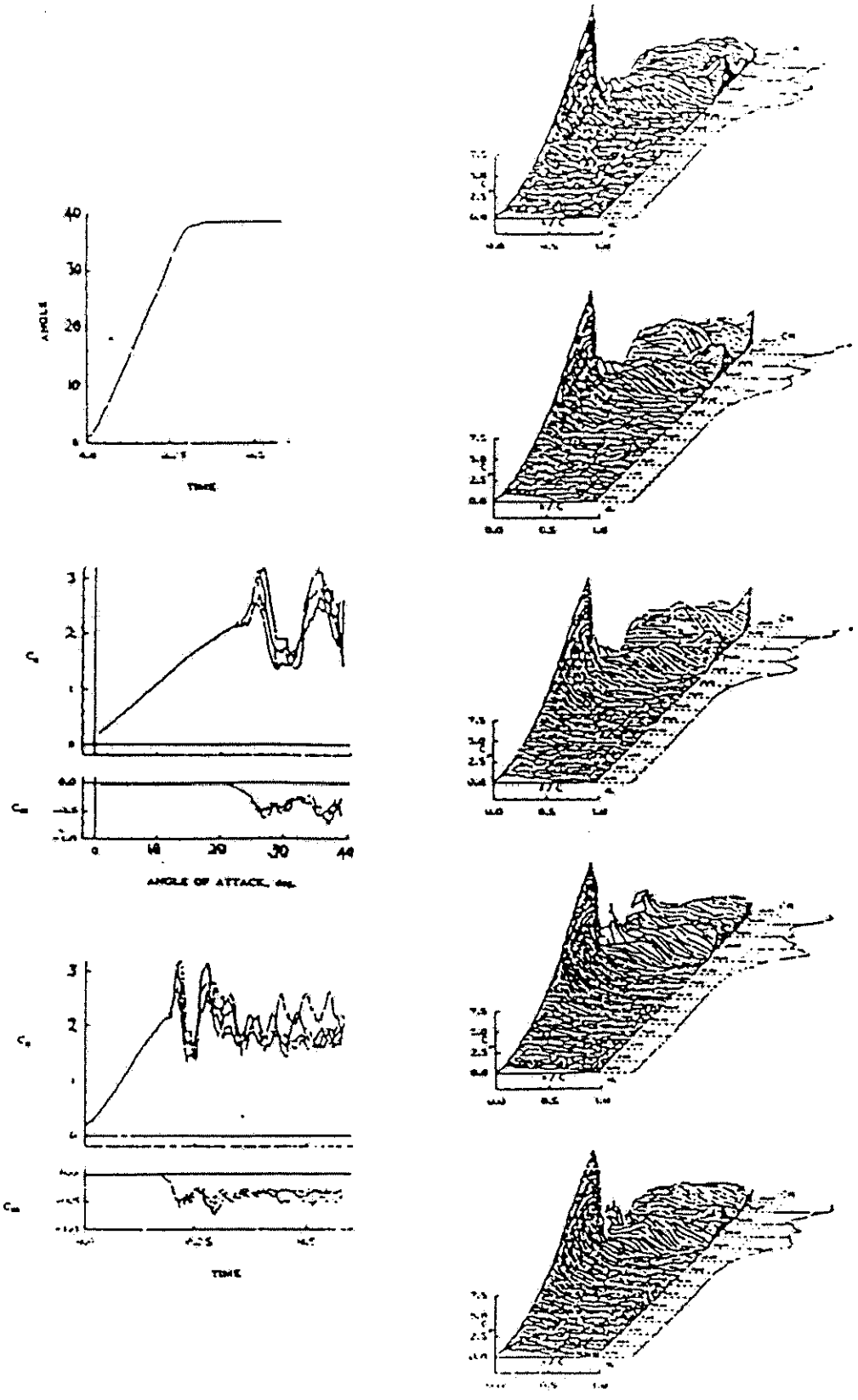


FIGURE 10: TYPICAL UNAVERAGED DATA FOR RAMP TESTS.

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PRESSURE DATA FOR THE

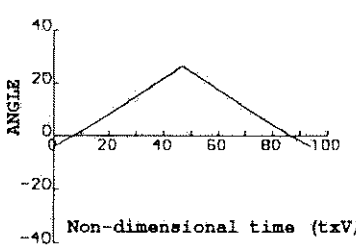
NACA 23012 AEROFOIL

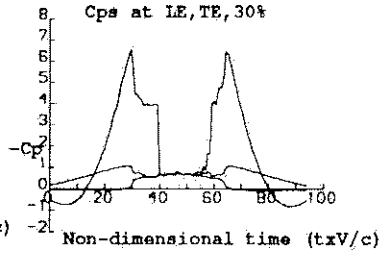
(MODEL 1)

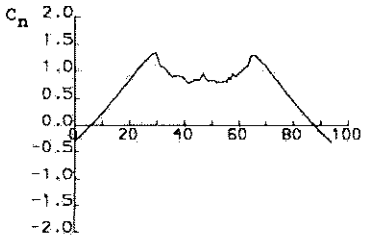
DYNAMIC CHARACTERISTICS FOR THE NACA 23012

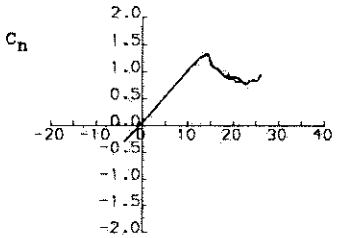
RUN REFERENCE NUMBER: 121
REYNOLDS NUMBER = 1495173.
DYNAMIC PRESSURE = 997.73 Nm^{-2}
NUMBER OF CYCLES = 1
MOTION TYPE: STATIC

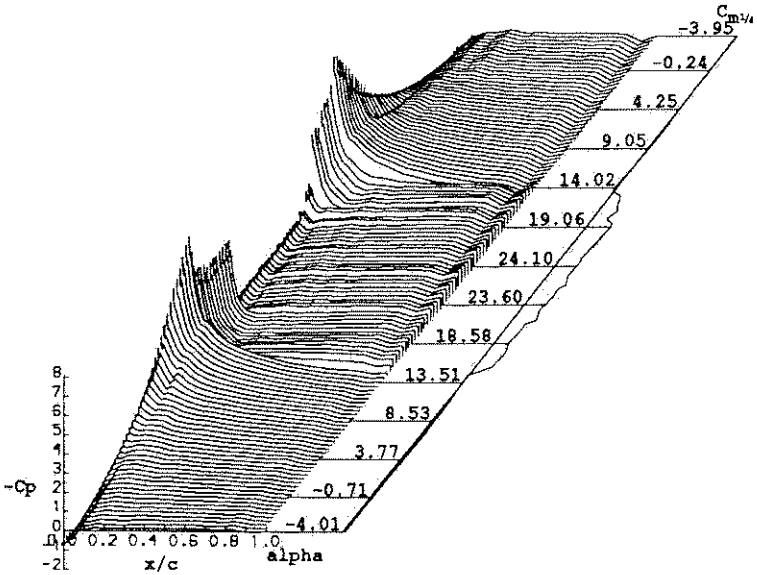
DATE OF TEST: 20/6/83
MACH NUMBER = 0.118
AIR TEMPERATURE = 24.5°C
SAMPLING FREQUENCY = 100.00 Hz.
AVERAGED DATA OF 1 CYCLES

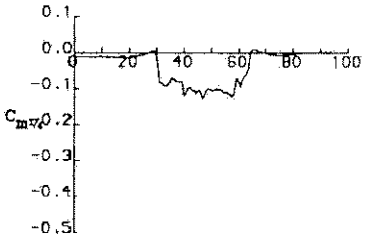


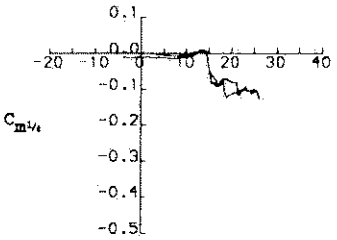


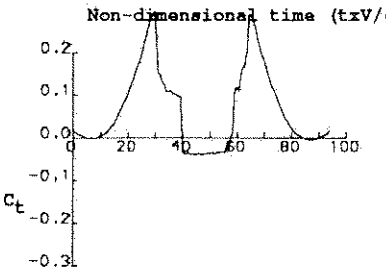


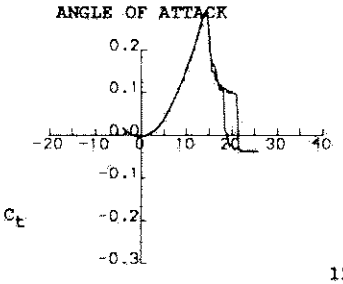








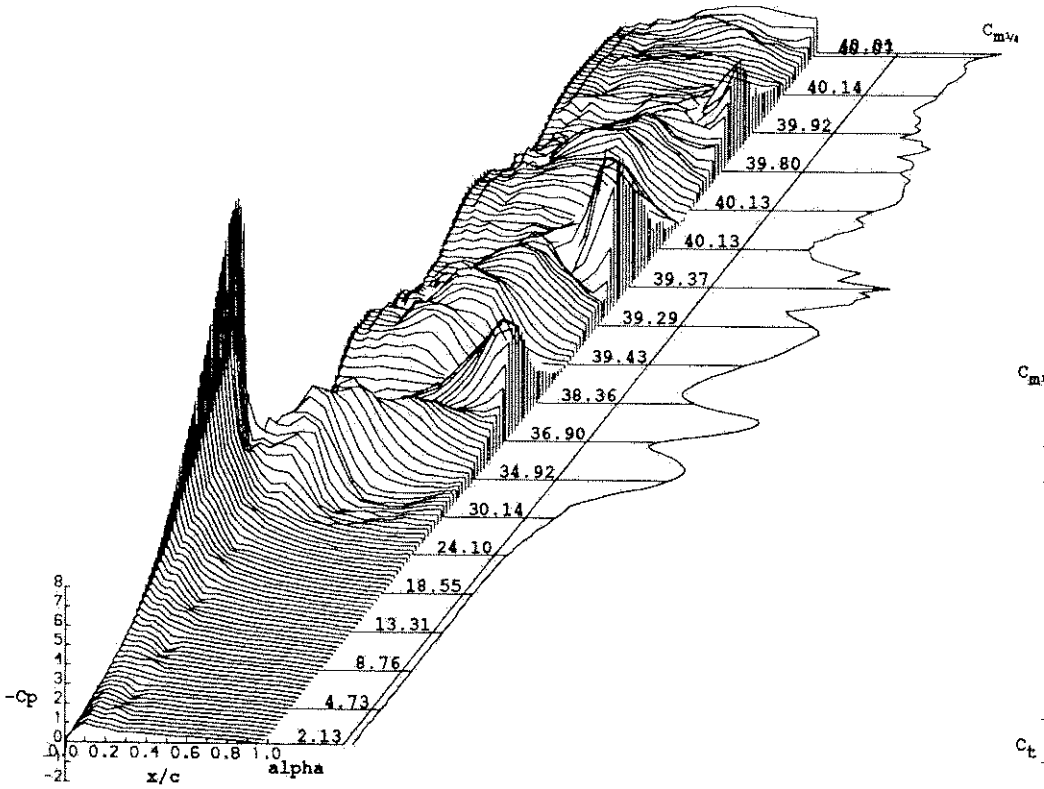


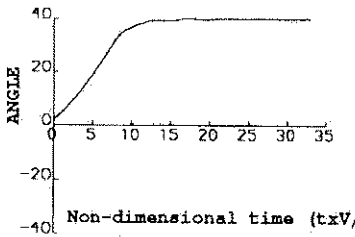


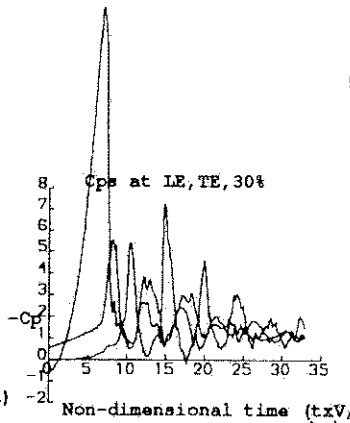
DYNAMIC CHARACTERISTICS FOR THE NACA 23012

RUN REFERENCE NUMBER: 20982
REYNOLDS NUMBER = 1503734.
DYNAMIC PRESSURE = 977.11 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 40.000°
AVERAGED DATA OF 5 CYCLES

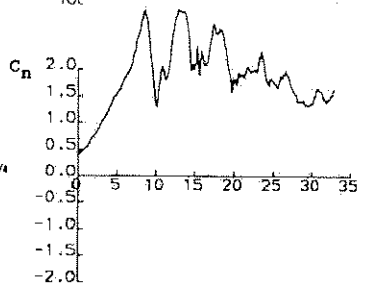
DATE OF TEST: 4/11/84
MACH NUMBER = 0.113
AIR TEMPERATURE = 28.0°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03713
LINEAR PITCH RATE = 303.99°s^{-1}



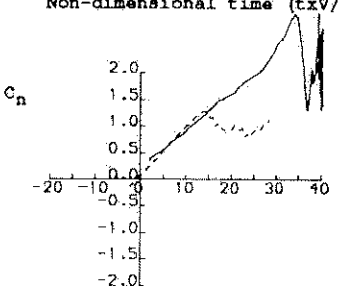




Non-dimensional time (txV/c)

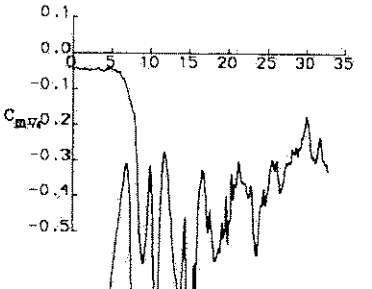


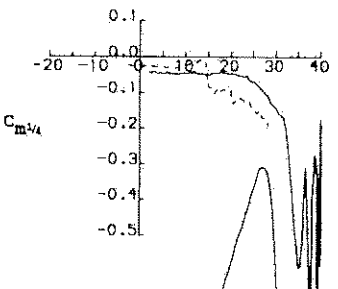
Non-dimensional time (txV/c)



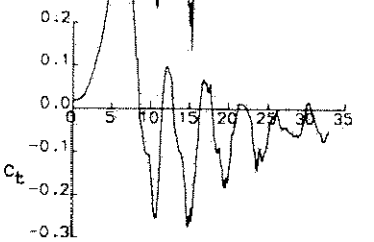
Non-dimensional time (txV/c)

ANGLE OF ATTACK (alpha)

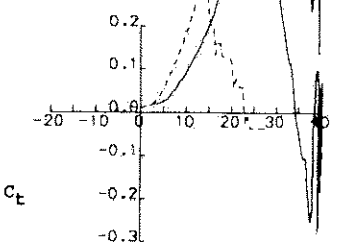




Non-dimensional time (txV/c)



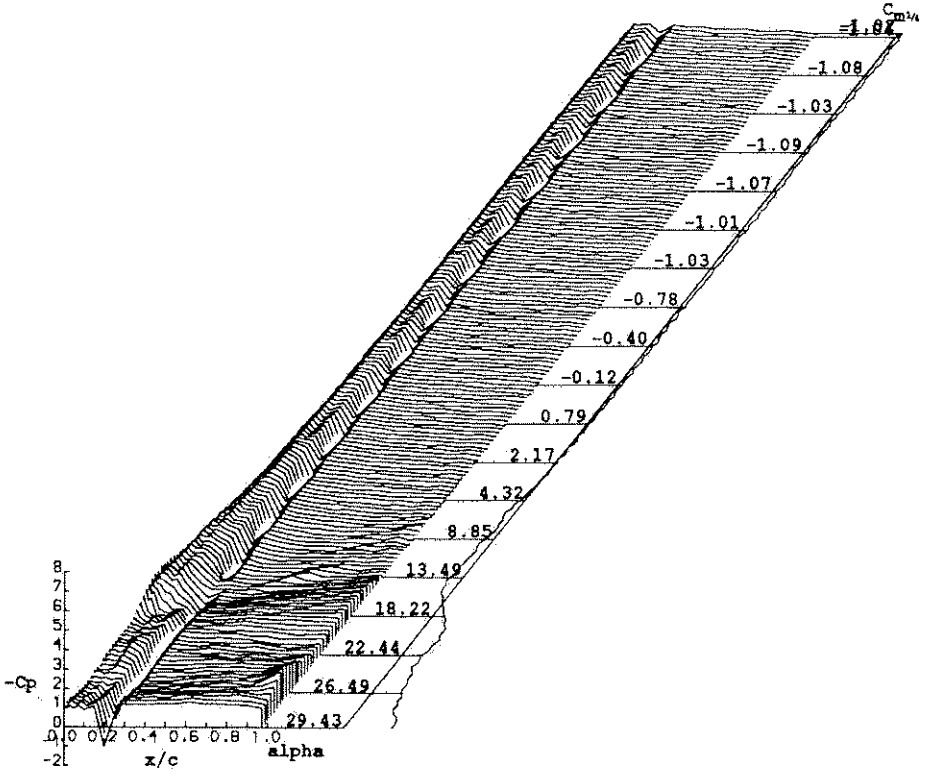
ANGLE OF ATTACK (alpha)

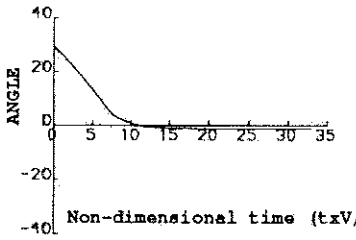


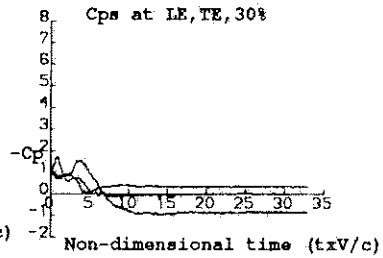
DYNAMIC CHARACTERISTICS FOR THE NACA 23012

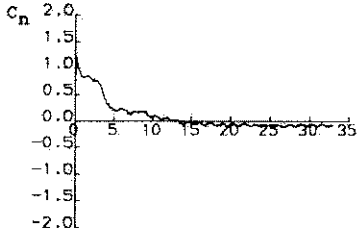
RUN REFERENCE NUMBER: 31111
REYNOLDS NUMBER = 1518183.
DYNAMIC PRESSURE = 985.56 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 30.00°
RAMP ARC = -31.000°
AVERAGED DATA OF 5 CYCLES

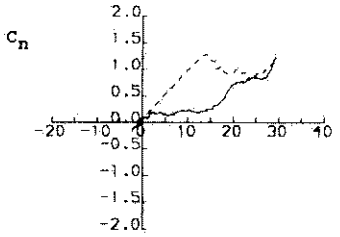
DATE OF TEST: 30/5/84
MACH NUMBER = 0.113
AIR TEMPERATURE = 27.5°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.02792
LINEAR PITCH RATE = -228.67°S^{-1}

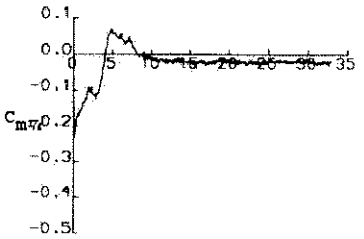


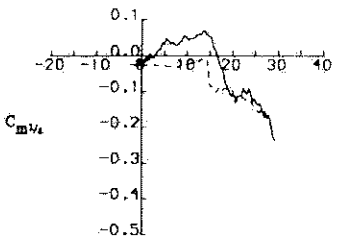


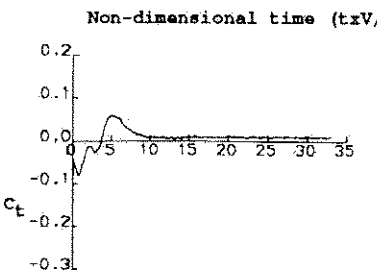


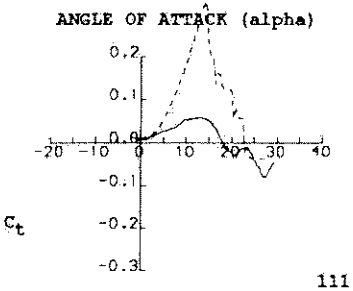








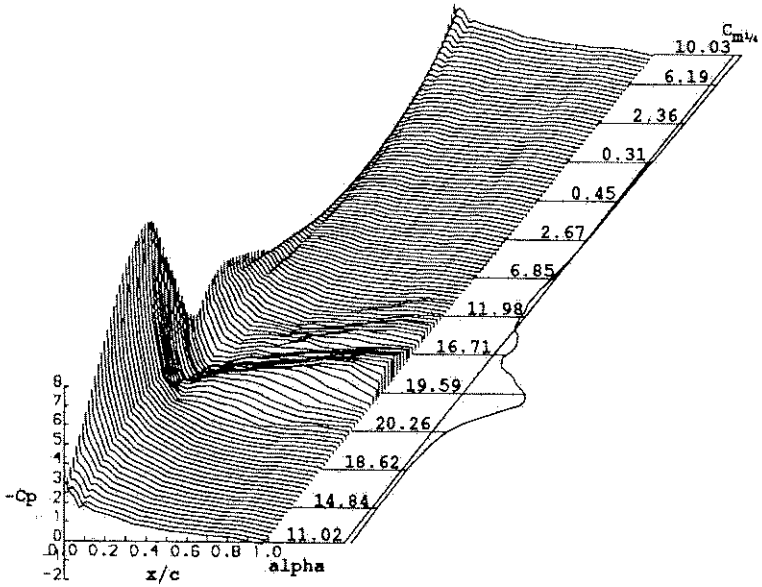


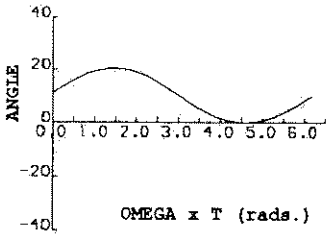


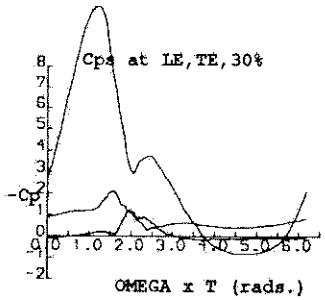
DYNAMIC CHARACTERISTICS FOR THE NACA 23012

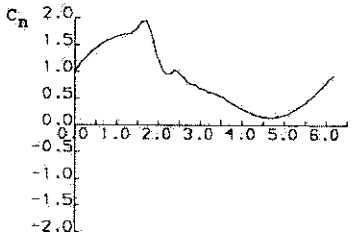
RUN REFERENCE NUMBER: 13651
REYNOLDS NUMBER = 1514791.
DYNAMIC PRESSURE = 999.61 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.330 Hz.
AVERAGED DATA OF 10 CYCLES

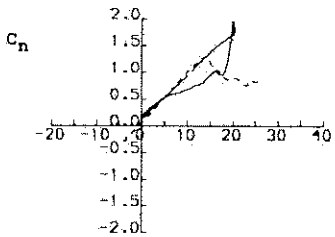
DATE OF TEST: 16/6/83
MACH NUMBER = 0.112
AIR TEMPERATURE = 34.0°C
SAMPLING FREQUENCY = 298.24 Hz.
REDUCED FREQUENCY = 0.102
AMPLITUDE = 10.00°

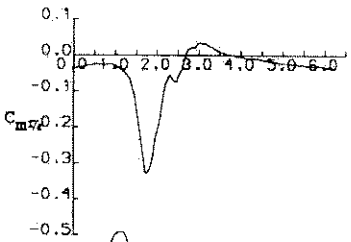


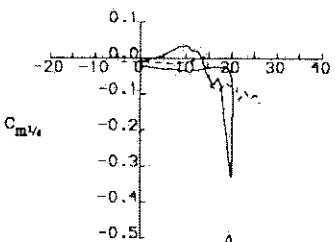


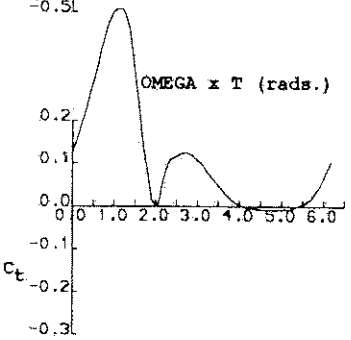


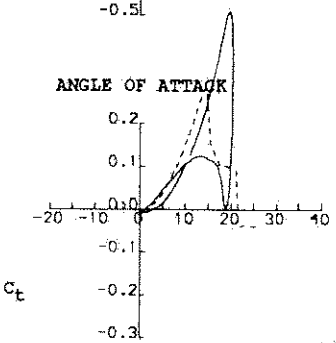












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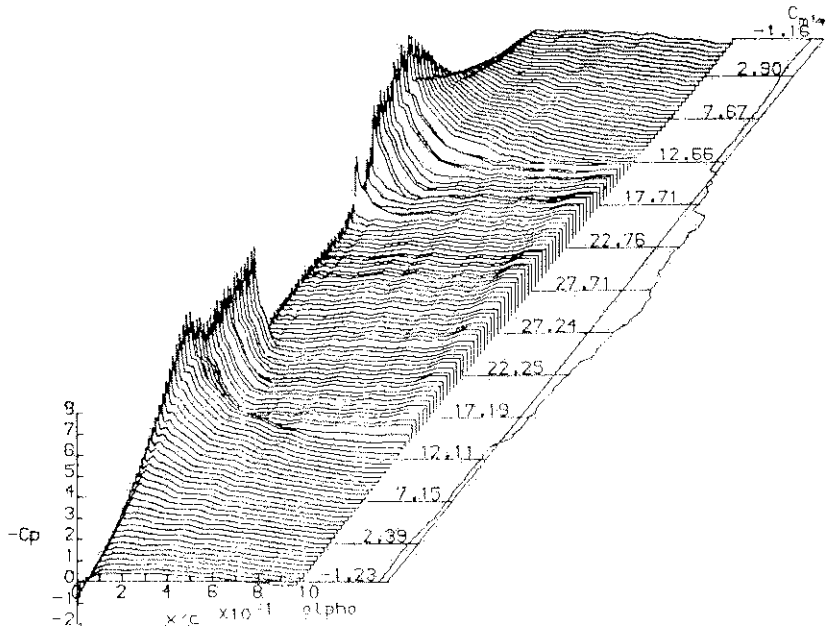
PRESSURE DATA FOR THE NACA 23012A AEROFOIL

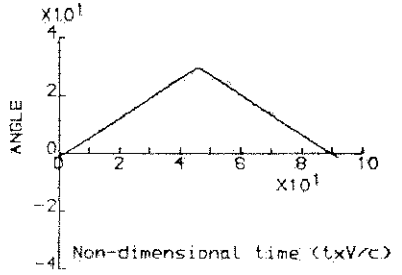
(MODEL 2)

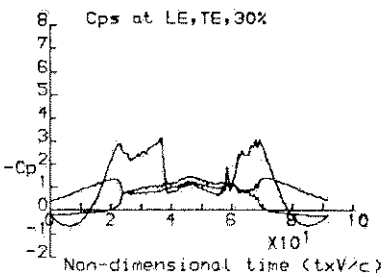
DYNAMIC CHARACTERISTICS FOR THE NACA23012A MODEL02

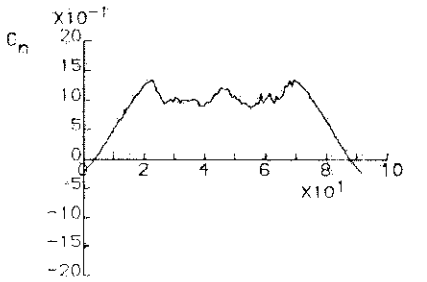
RUN REFERENCE NUMBER: 101
REYNOLDS NUMBER = 1511935.
DYNAMIC PRESSURE = 996.12 Nm^{-2}
NUMBER OF CYCLES = 1
MOTION TYPE: STATIC

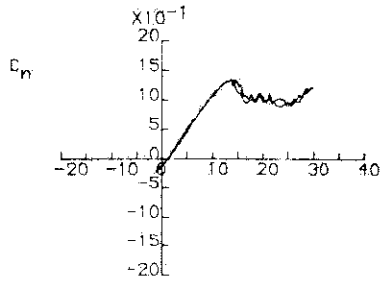
DATE OF TEST: 4/3/86
MACH NUMBER = 0.114
AIR TEMPERATURE = 29.0℃
SAMPLING FREQUENCY = 100.00 Hz.
AVERAGED DATA OF 1 CYCLES

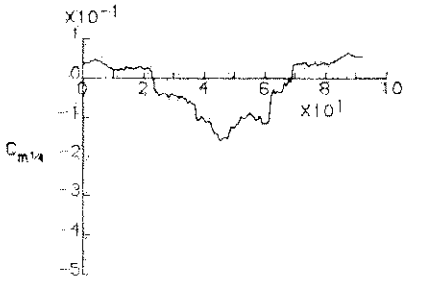


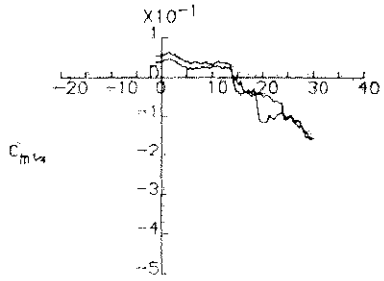


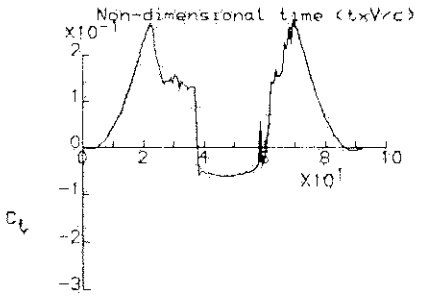


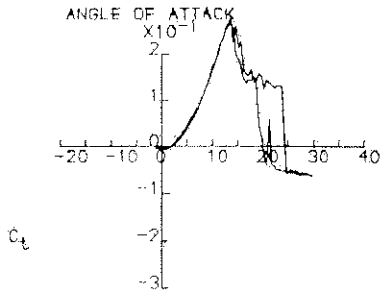








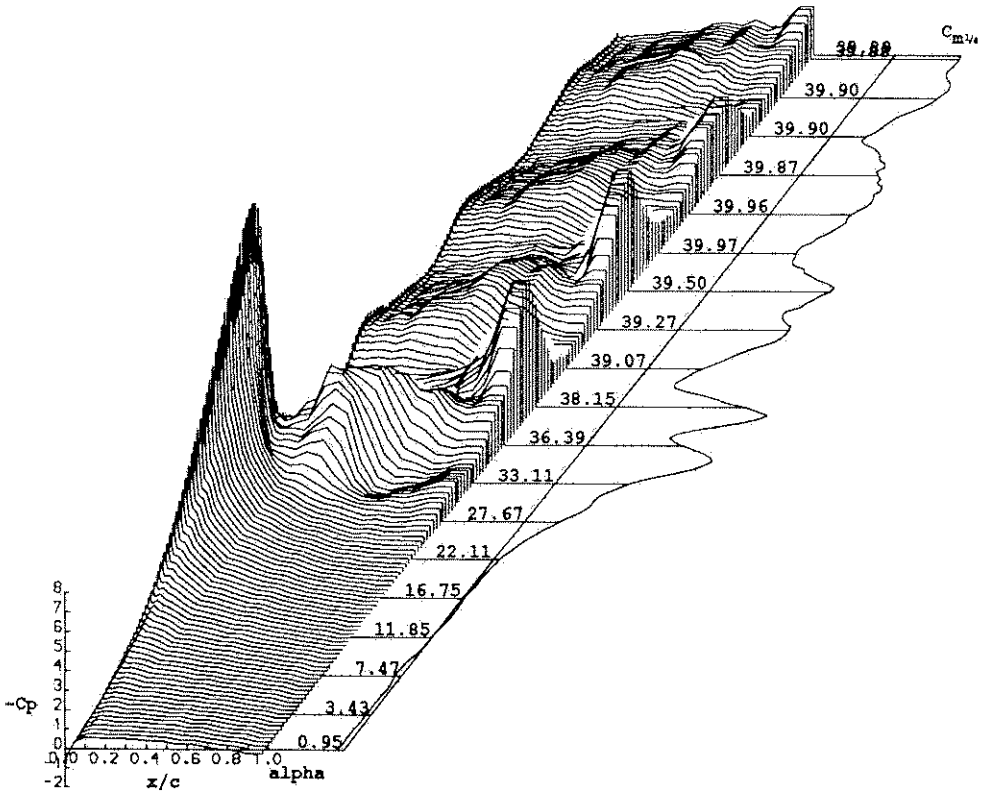


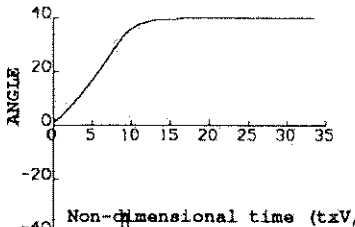


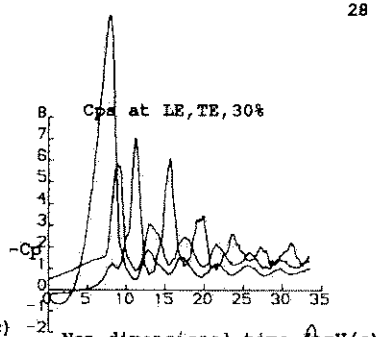
DYNAMIC CHARACTERISTICS FOR THE NACA23012A MODEL02

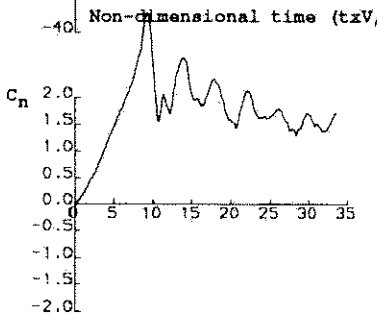
RUN REFERENCE NUMBER: 20281
REYNOLDS NUMBER = 1486762.
DYNAMIC PRESSURE = 988.32 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

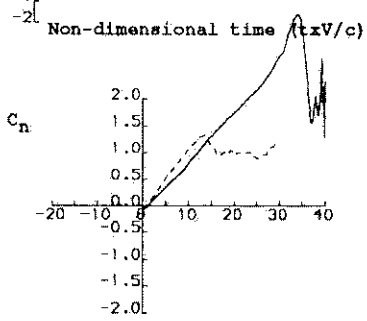
DATE OF TEST: 4/3/86
MACH NUMBER = 0.114
AIR TEMPERATURE = 30.0°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03580
LINEAR PITCH RATE = 298.51°S^{-1}

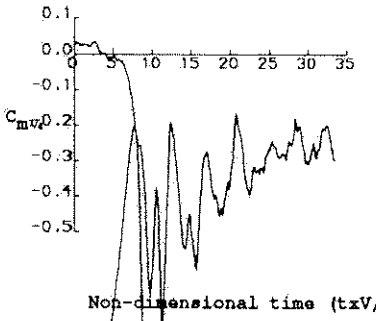


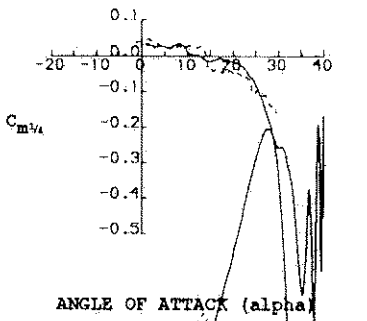


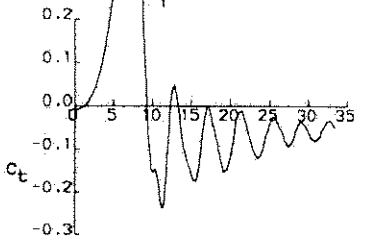


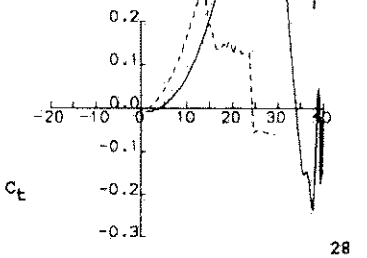








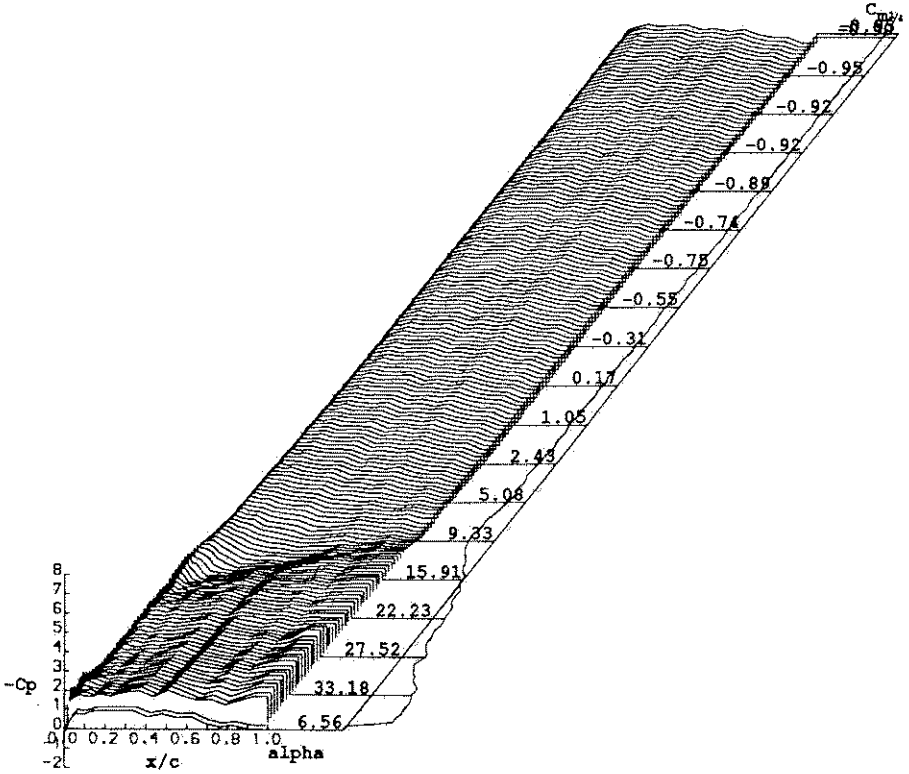


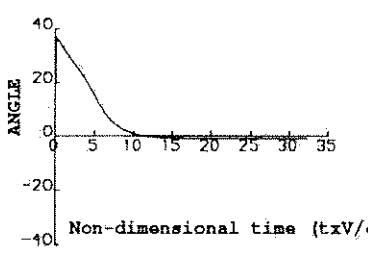


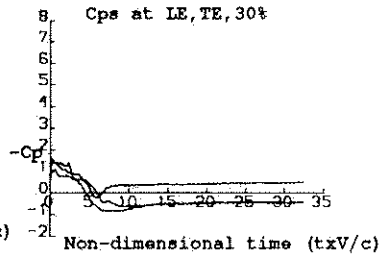
DYNAMIC CHARACTERISTICS FOR THE NACA23012A MODEL02

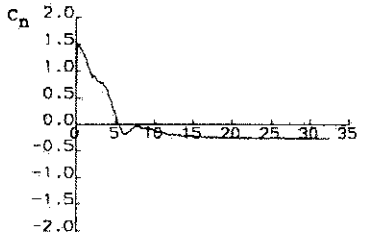
RUN REFERENCE NUMBER: 30321
REYNOLDS NUMBER = 1468062.
DYNAMIC PRESSURE = 944.34 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 40.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

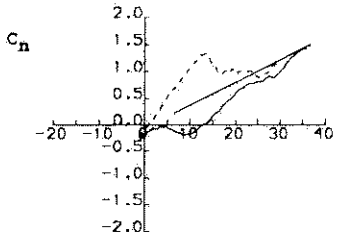
DATE OF TEST: 17/3/86
MACH NUMBER = 0.111
AIR TEMPERATURE = 30.0°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.04033
LINEAR PITCH RATE = $-325.18°S^{-1}$

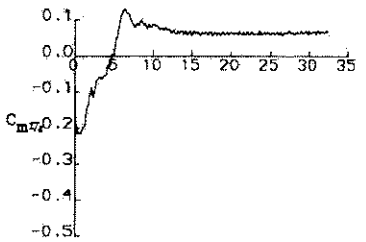


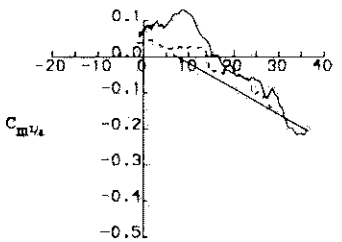


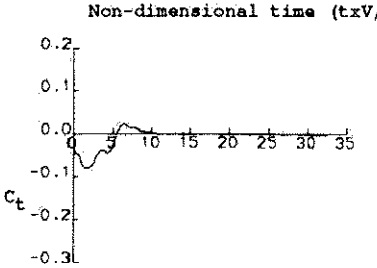


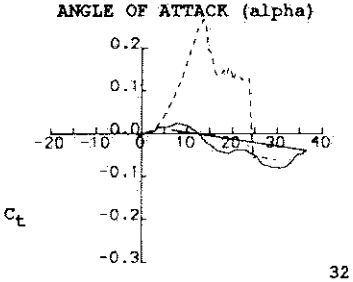








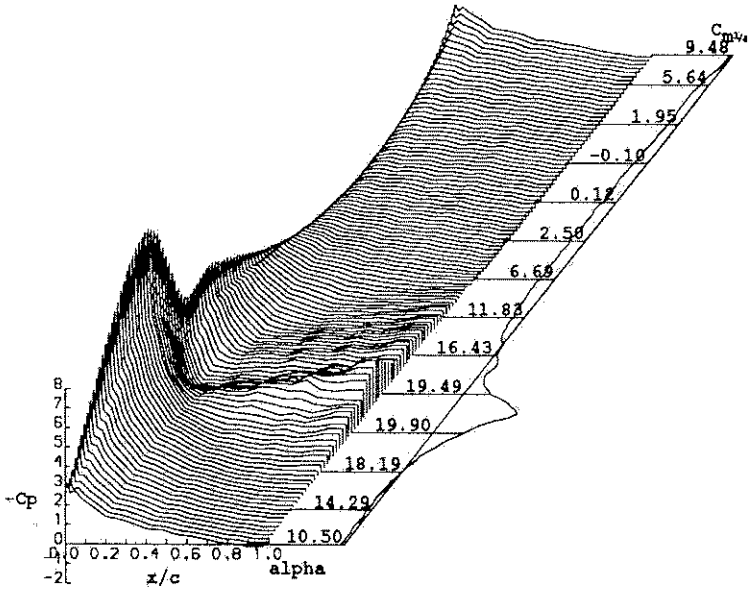


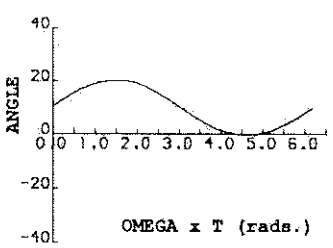


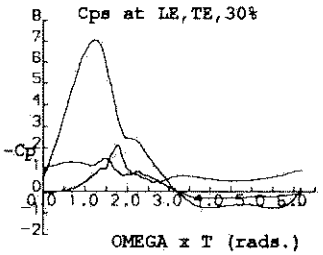
DYNAMIC CHARACTERISTICS FOR THE NACA23012A MODEL02

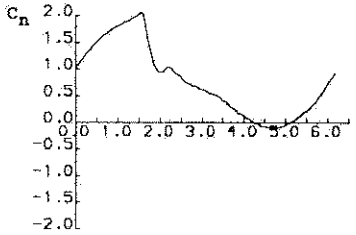
RUN REFERENCE NUMBER: 10801
REYNOLDS NUMBER = 1486036.
DYNAMIC PRESSURE = 954.88 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.330 Hz.
AVERAGED DATA OF 10 CYCLES

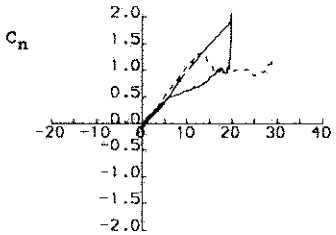
DATE OF TEST: 17/3/86
MACH NUMBER = 0.111
AIR TEMPERATURE = 30.0°C
SAMPLING FREQUENCY = 298.24 Hz.
REDUCED FREQUENCY = 0.104
AMPLITUDE = 10.00°

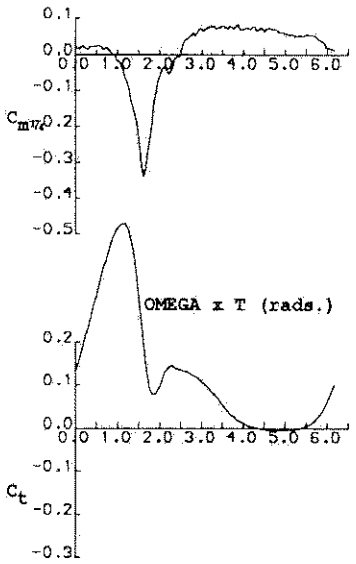


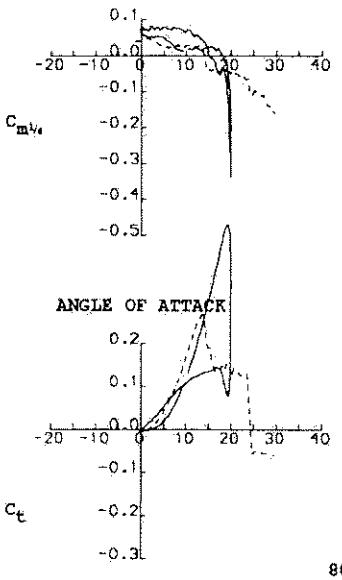












G.U. Aero Report 9221

UNIVERSITY OF GLASGOW

DEPARTMENT OF AEROSPACE ENGINEERING

PRESSURE DATA FOR THE

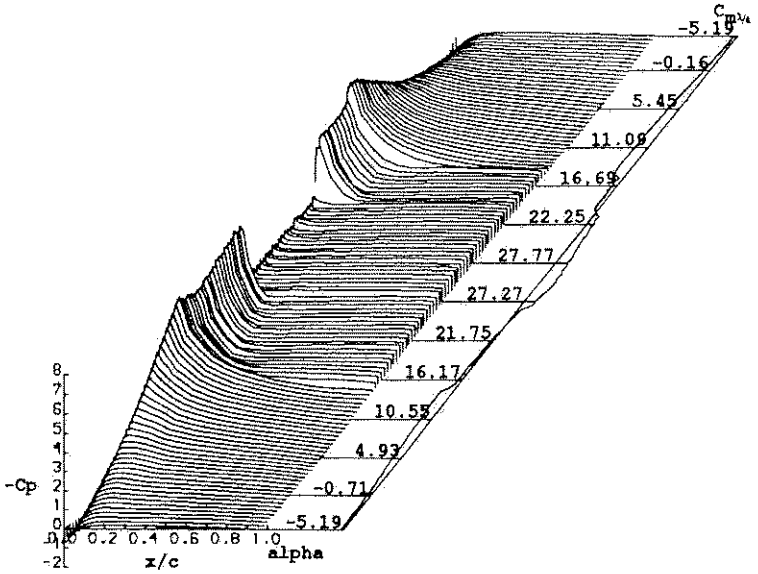
NACA 23012B AEROFOIL

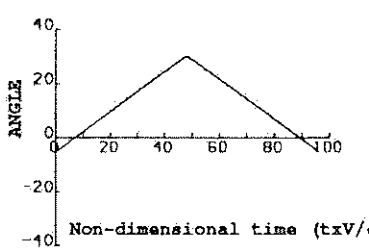
(MODEL 3)

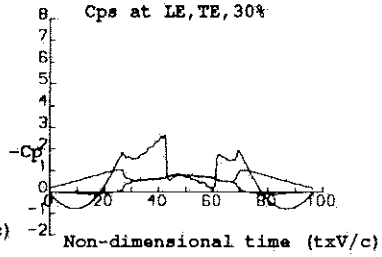
DYNAMIC CHARACTERISTICS FOR THE NACA23012B MODEL03

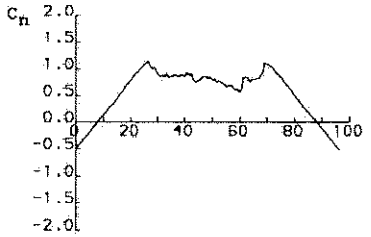
RUN REFERENCE NUMBER: 3341
REYNOLDS NUMBER = 1486835.
DYNAMIC PRESSURE = 1031.71 Nm^{-2}
NUMBER OF CYCLES = 1
MOTION TYPE: STATIC

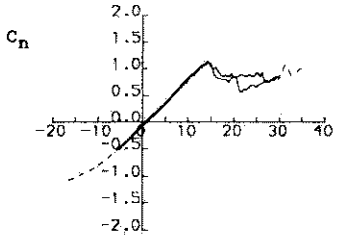
DATE OF TEST: 6/12/87
MACH NUMBER = 0.120
AIR TEMPERATURE = 29.4°C
SAMPLING FREQUENCY = 100.00 Hz.
AVERAGED DATA OF 1 CYCLES

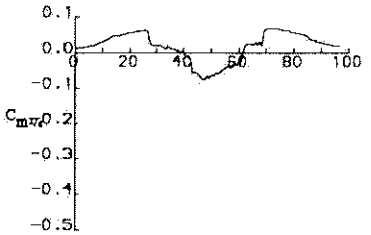


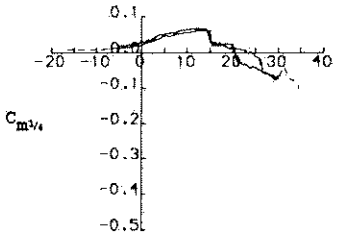


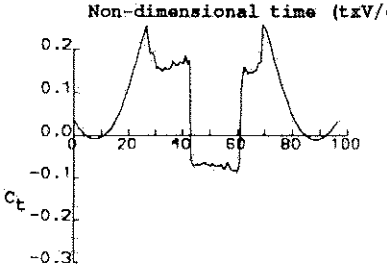


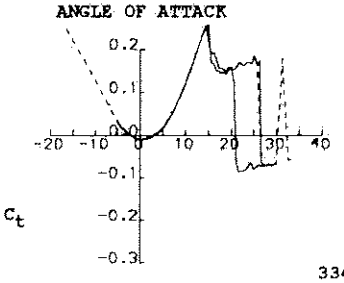








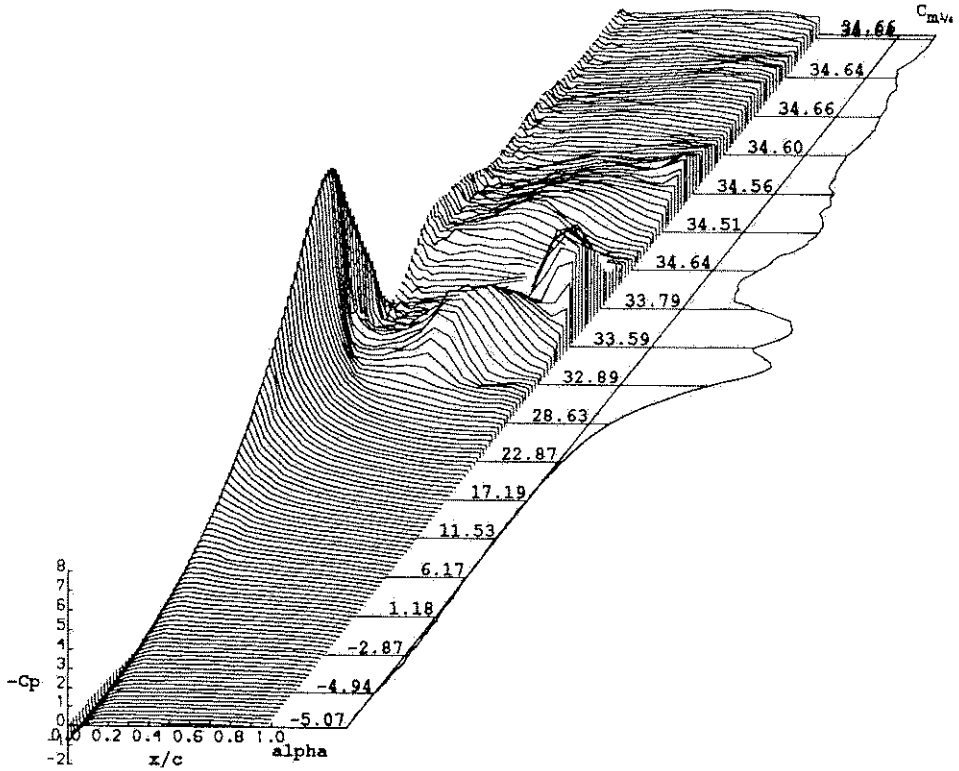


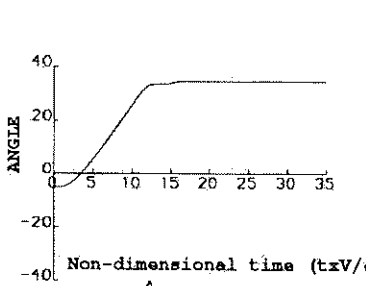


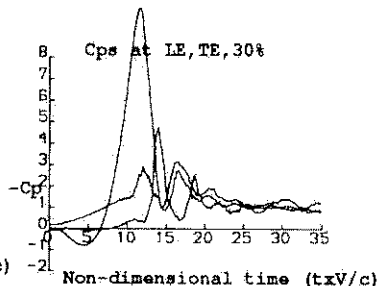
DYNAMIC CHARACTERISTICS FOR THE NACA23012B MODEL03

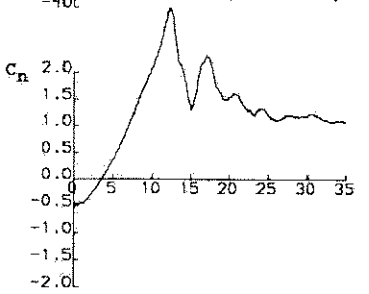
RUN REFERENCE NUMBER: 23271
REYNOLDS NUMBER = 1486882.
DYNAMIC PRESSURE = 1014.82 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -6.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

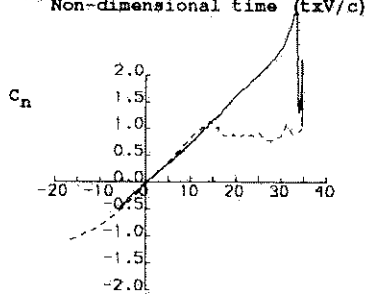
DATE OF TEST: 6/12/87
MACH NUMBER = 0.119
AIR TEMPERATURE = 26.3°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03468
LINEAR PITCH RATE = 299.44°S^{-1}

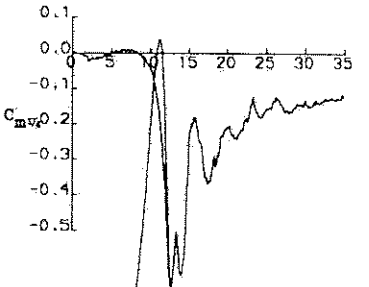


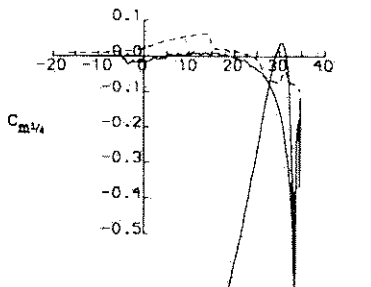


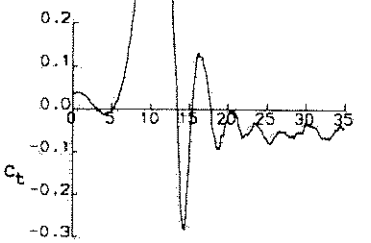


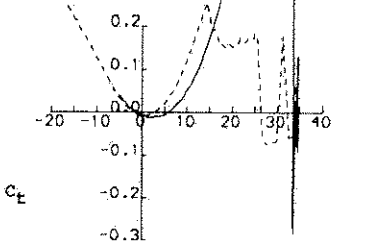








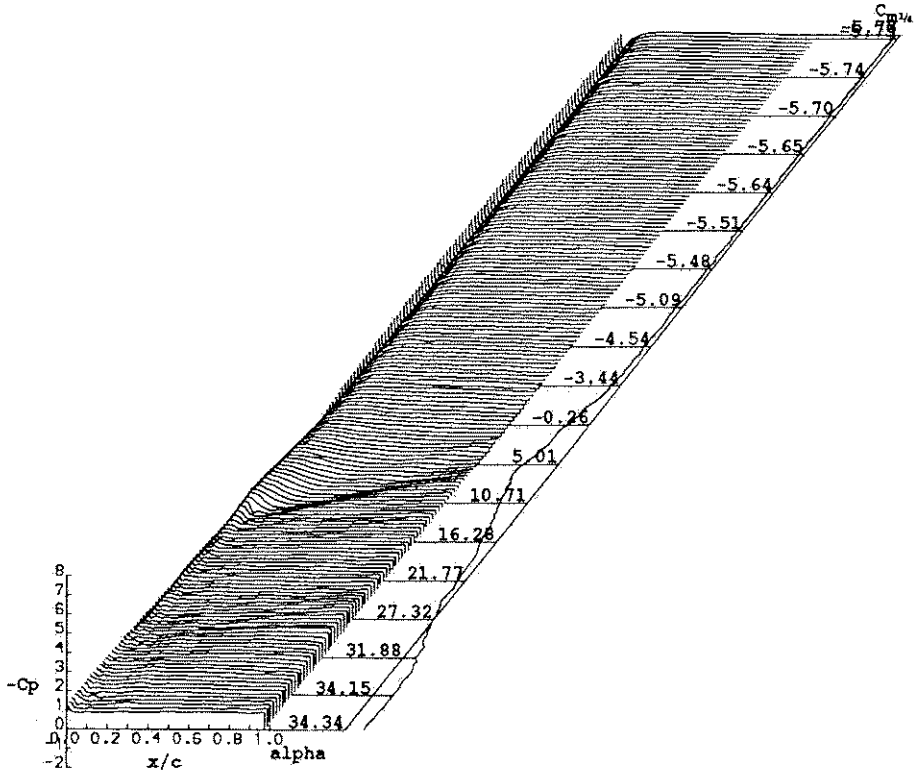


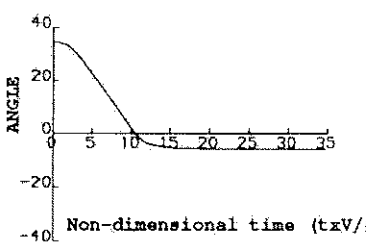


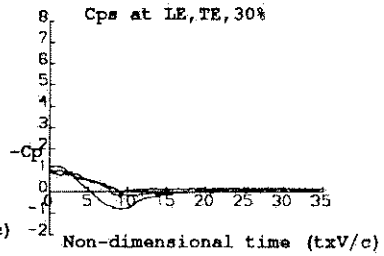
DYNAMIC CHARACTERISTICS FOR THE NACA23012B MODEL03

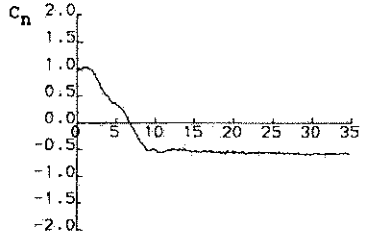
RUN REFERENCE NUMBER: 33691
REYNOLDS NUMBER = 1457566.
DYNAMIC PRESSURE = 1004.76 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 35.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

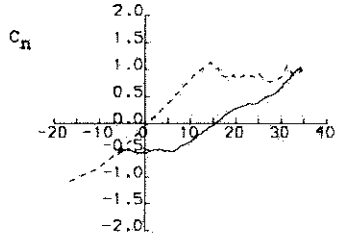
DATE OF TEST: 6/12/87
MACH NUMBER = 0.118
AIR TEMPERATURE = 30.9°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.03512
LINEAR PITCH RATE = -302.67°S^{-1}





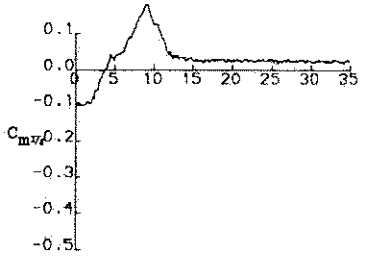


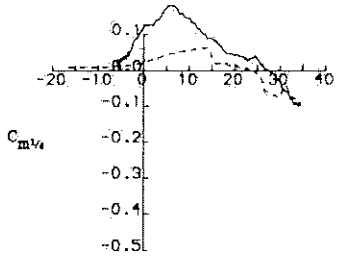




Non-dimensional time (txV/c)

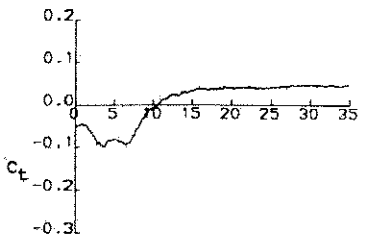
ANGLE OF ATTACK (alpha)

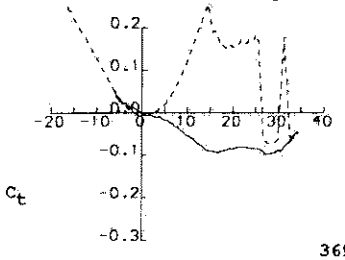




Non-dimensional time (txV/c)

ANGLE OF ATTACK (alpha)

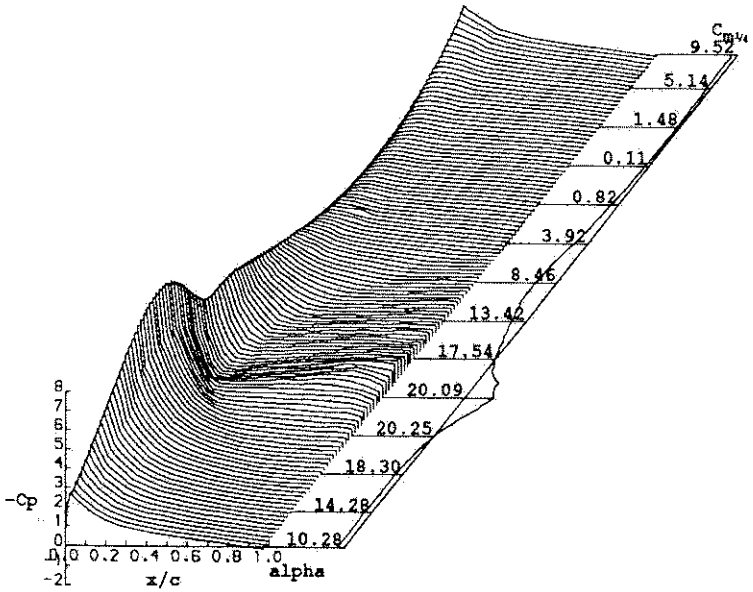


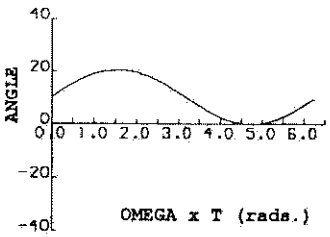


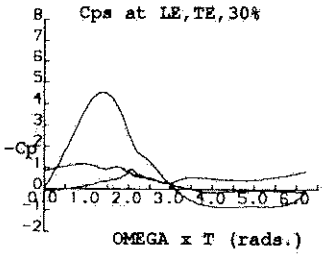
DYNAMIC CHARACTERISTICS FOR THE NACA23012B MODEL03

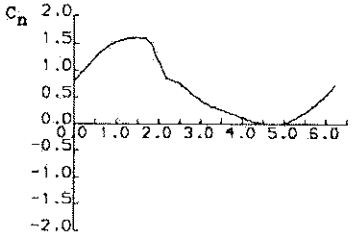
RUN REFERENCE NUMBER: 11052
REYNOLDS NUMBER = 1493082.
DYNAMIC PRESSURE = 1021.06 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.417 Hz.
AVERAGED DATA OF 10 CYCLES

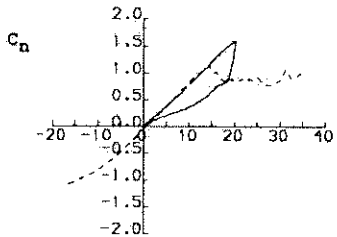
DATE OF TEST: 2/12/87
MACH NUMBER = 0.118
AIR TEMPERATURE = 28.8°C
SAMPLING FREQUENCY = 309.41 Hz.
REDUCED FREQUENCY = 0.101
AMPLITUDE = 10.00°

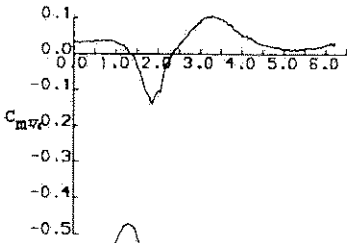


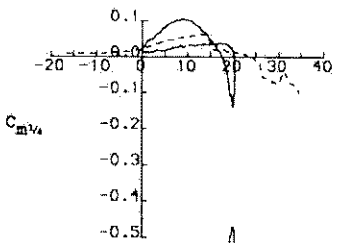


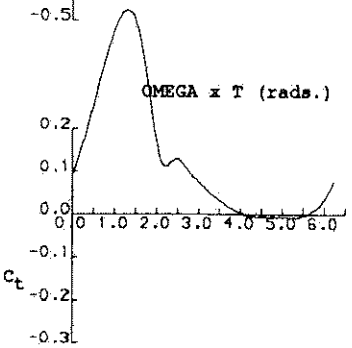


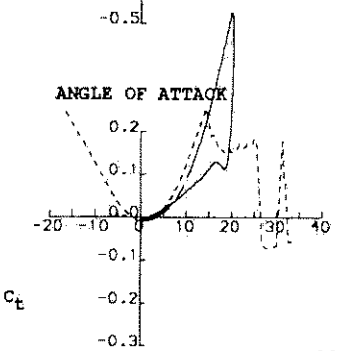








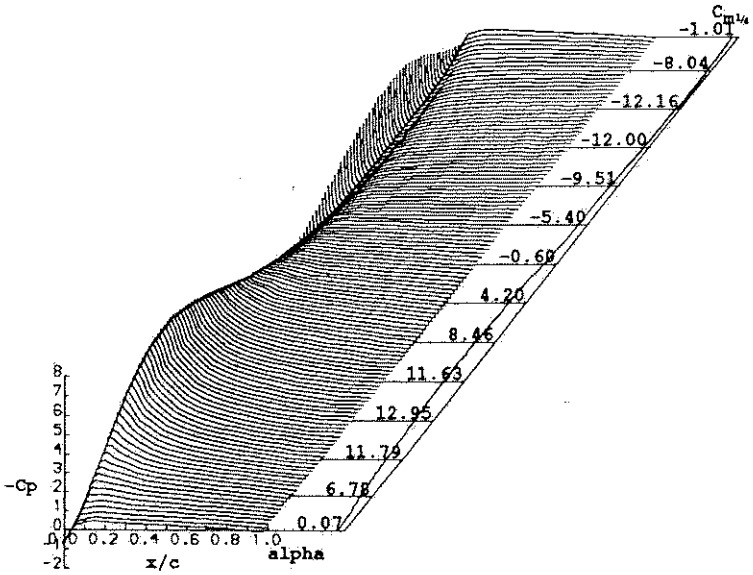


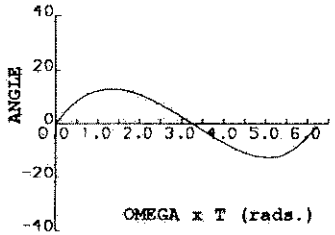


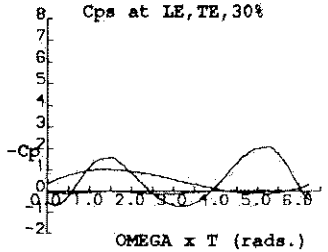
DYNAMIC CHARACTERISTICS FOR THE NACA23012B MODEL03

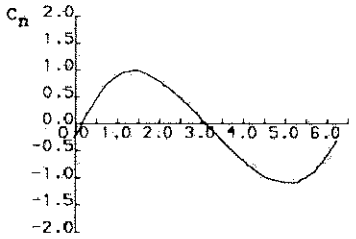
RUN REFERENCE NUMBER: 56911
REYNOLDS NUMBER = 1480614.
DYNAMIC PRESSURE = 1028.02 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: VAWT FUNCTION
MEAN ANGLE = 0.00°
OSCILLATION FREQUENCY = 1.224 Hz.
AVERAGED DATA OF 10 CYCLES

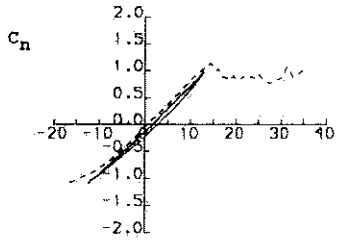
DATE OF TEST: 21/12/87
MACH NUMBER = 0.120
AIR TEMPERATURE = 28.5°C
SAMPLING FREQUENCY = 156.67 Hz.
REDUCED FREQUENCY = 0.050
AMPLITUDE = 13.76°

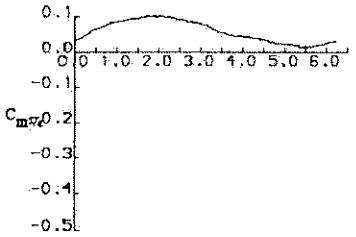


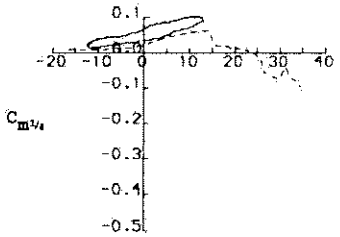


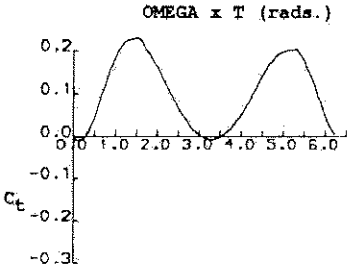


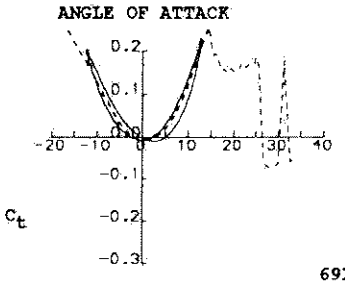












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UNIVERSITY OF GLASGOW

DEPARTMENT OF AEROSPACE ENGINEERING

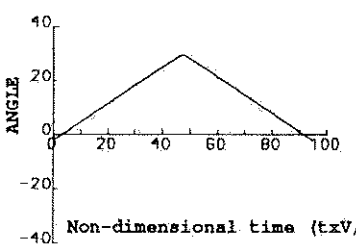
PRESSURE DATA FOR THE

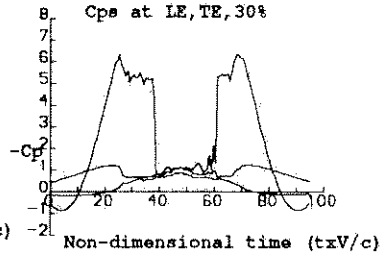
NACA 23012C AEROFOIL

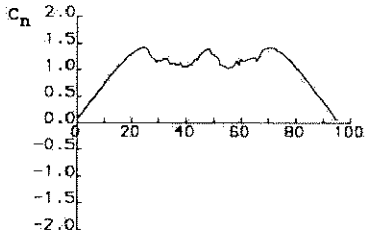
(MODEL 4)

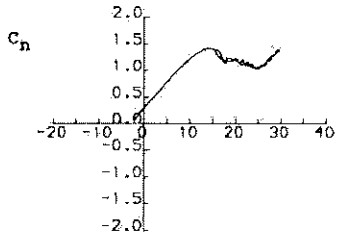
DYNAMIC CHARACTERISTICS FOR THE NACA23012C MODEL04

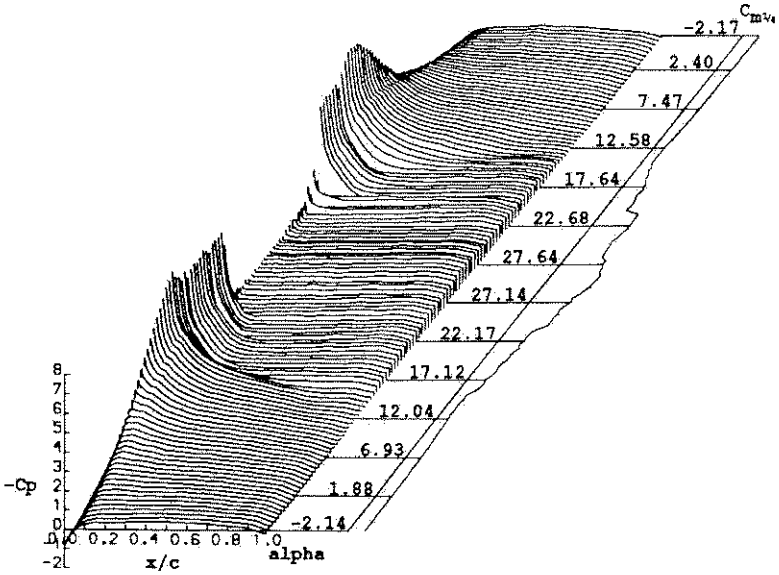
RUN REFERENCE NUMBER: 5341
DATE OF TEST: 12/12/88
REYNOLDS NUMBER = 1494846.
MACH NUMBER = 0.119
DYNAMIC PRESSURE = 1012.22 Nm^{-2}
AIR TEMPERATURE = 26.2°C
NUMBER OF CYCLES = 1
SAMPLING FREQUENCY = 100.00 Hz.
MOTION TYPE: STATIC
AVERAGED DATA OF 1 CYCLES

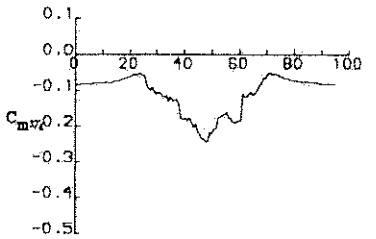


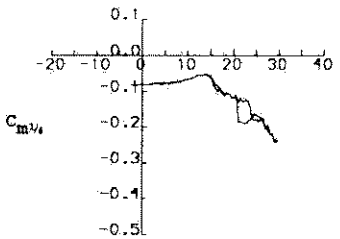


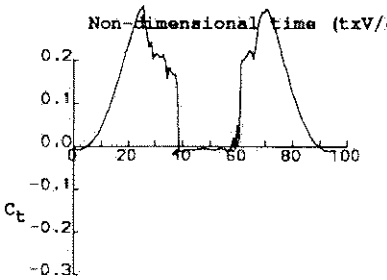


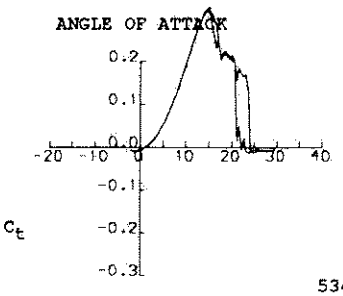








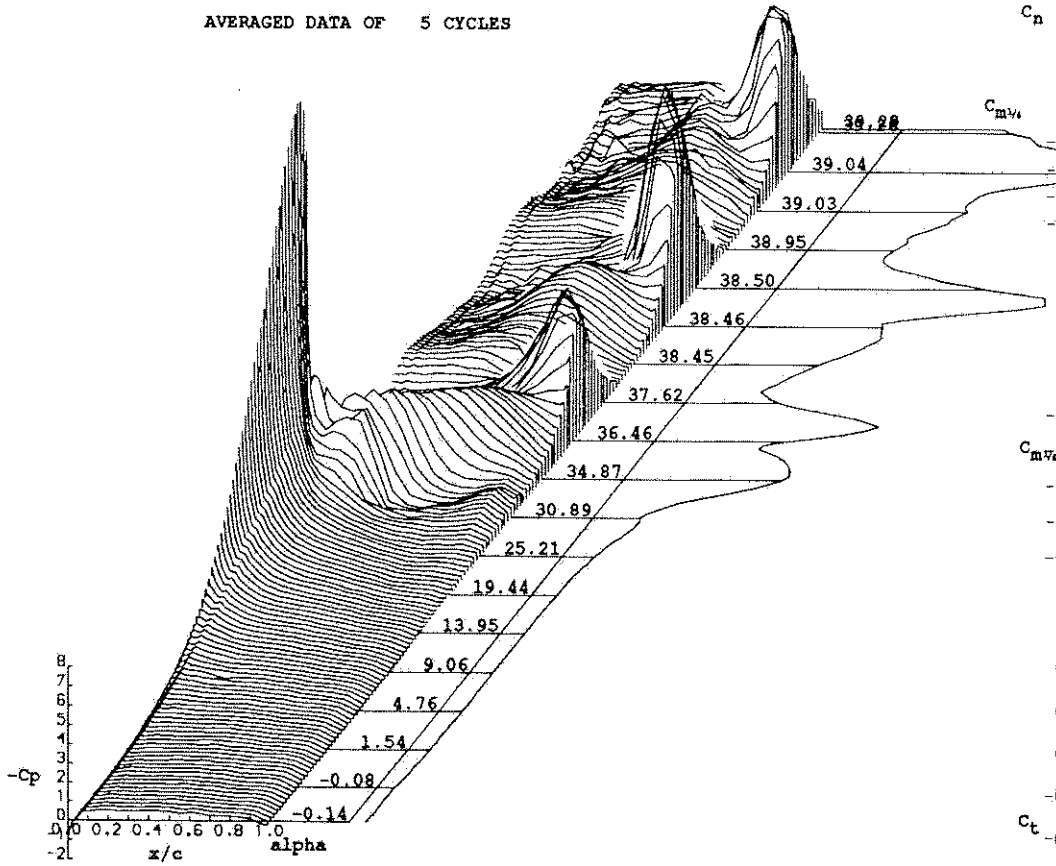


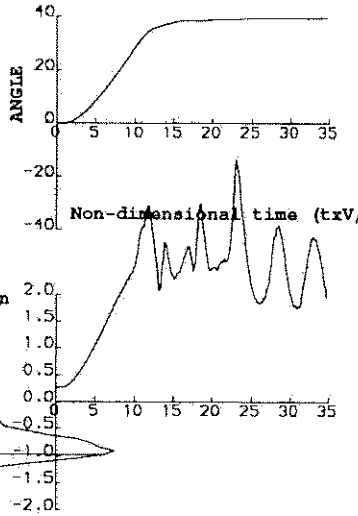


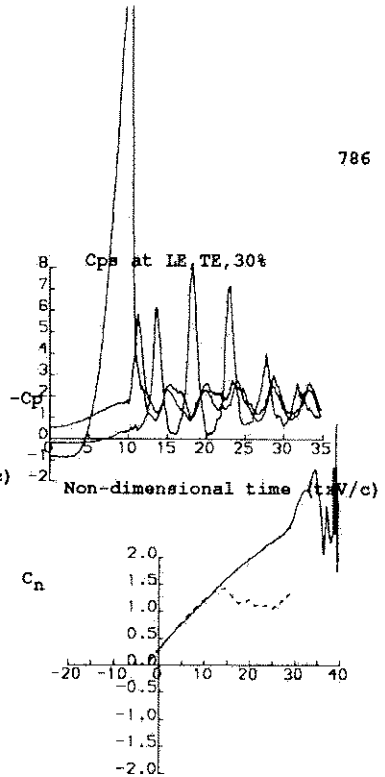
DYNAMIC CHARACTERISTICS FOR THE NACA23012C MODEL04

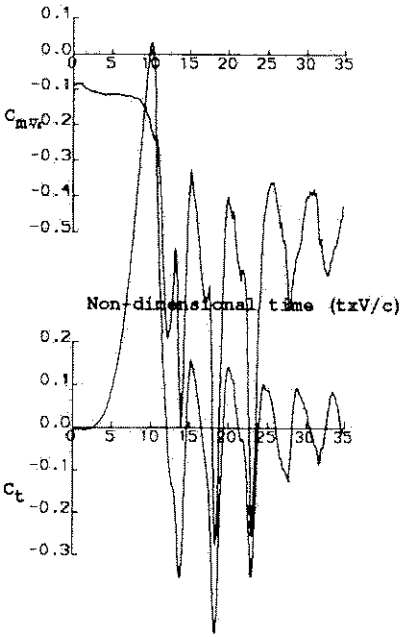
RUN REFERENCE NUMBER: 27861
REYNOLDS NUMBER = 1464408.
DYNAMIC PRESSURE = 1007.27 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

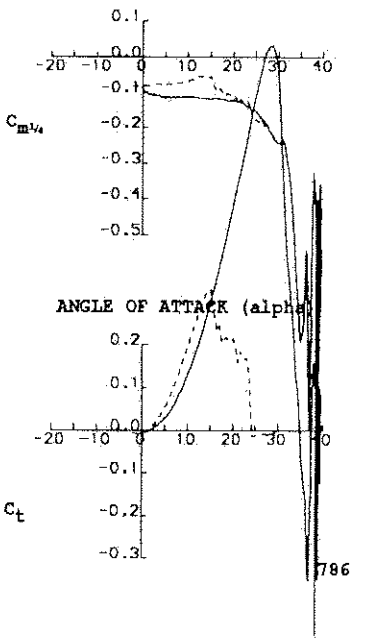
DATE OF TEST: 13/12/88
MACH NUMBER = 0.118
AIR TEMPERATURE = 30.7°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03405
LINEAR PITCH RATE = 292.95°S^{-1}







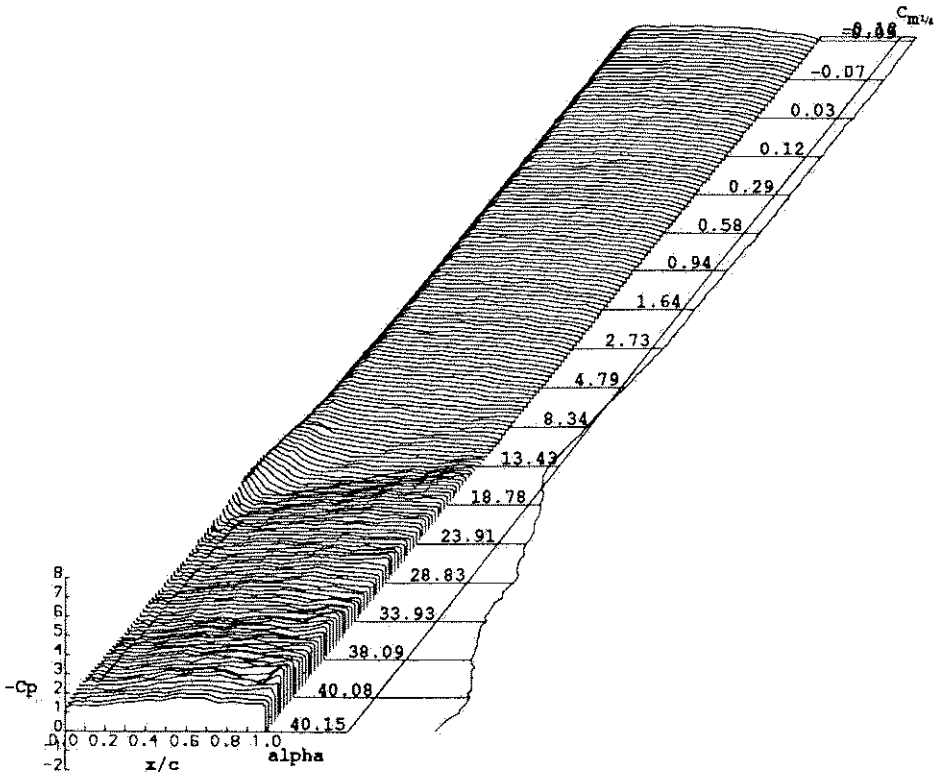


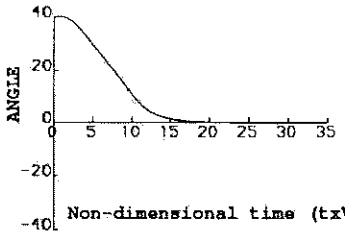


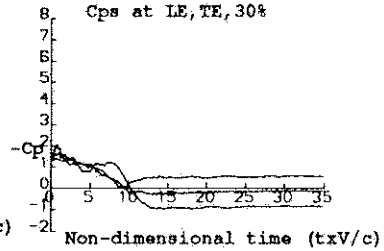
DYNAMIC CHARACTERISTICS FOR THE NACA23012C MODEL04

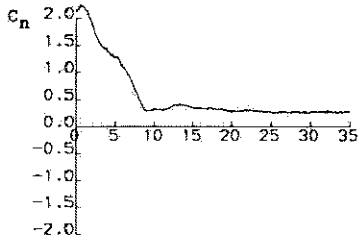
RUN REFERENCE NUMBER: 38211
REYNOLDS NUMBER = 1477136.
DYNAMIC PRESSURE = 1017.26 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 40.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

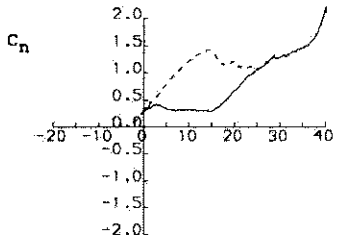
DATE OF TEST: 14/12/88
MACH NUMBER = 0.119
AIR TEMPERATURE = 30.2°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.03139
LINEAR PITCH RATE = -270.69°S^{-1}

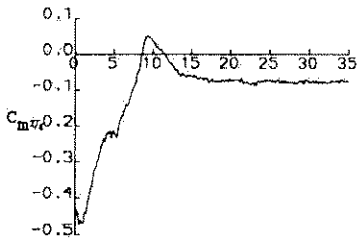


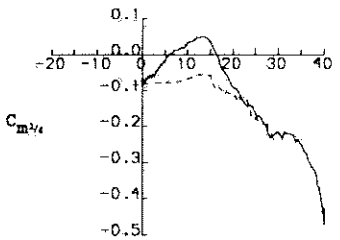


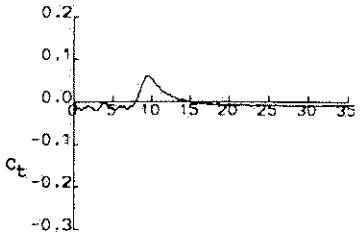


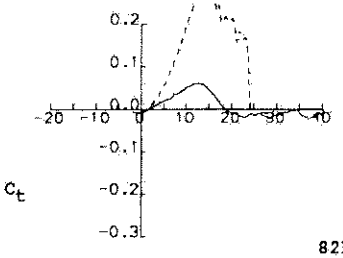








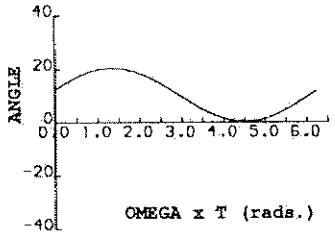


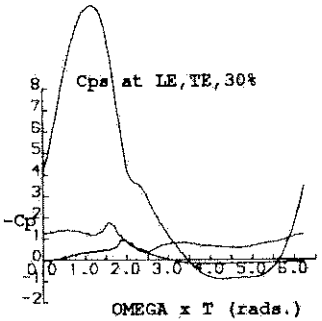


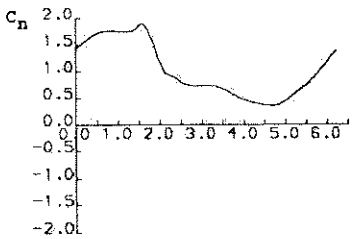
DYNAMIC CHARACTERISTICS FOR THE NACA23012C

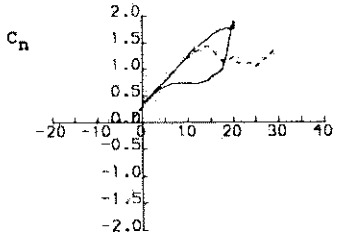
RUN REFERENCE NUMBER: 15211
REYNOLDS NUMBER = 1491670.
DYNAMIC PRESSURE = 1015.71 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.412 Hz.
AVERAGED DATA OF 10 CYCLES

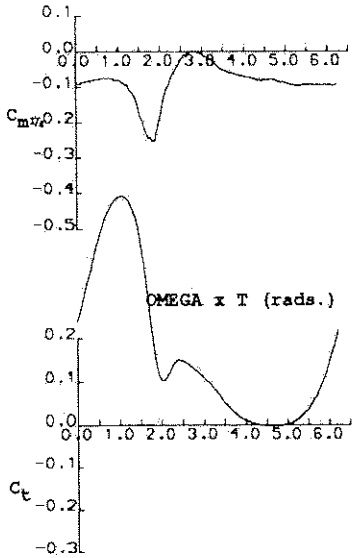
DATE OF TEST: 12/12/88
MACH NUMBER = 0.119
AIR TEMPERATURE = 27.1°C
SAMPLING FREQUENCY = 308.74 Hz.
REDUCED FREQUENCY = 0.101
AMPLITUDE = 10.00°

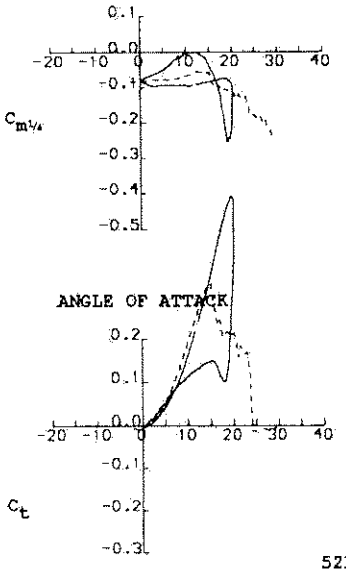


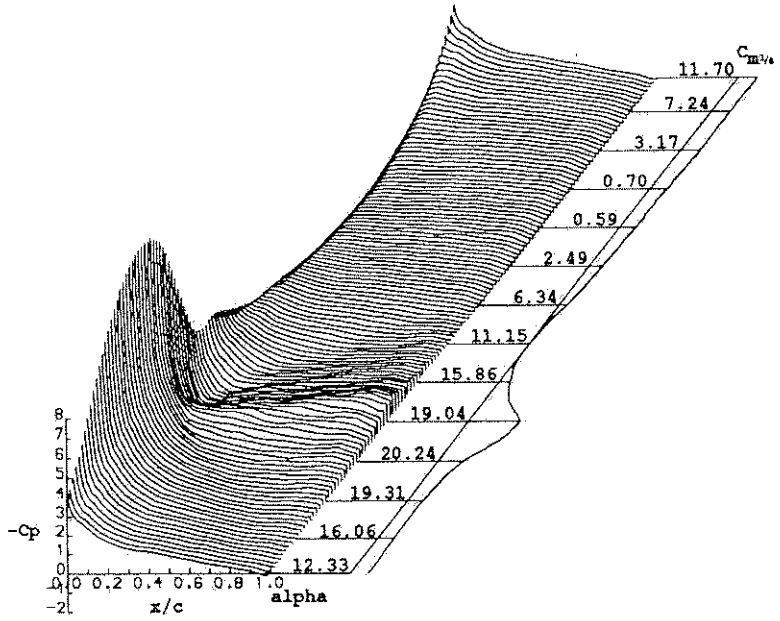












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UNIVERSITY OF GLASGOW

DEPARTMENT OF AEROSPACE ENGINEERING

PRESSURE DATA FOR THE

NACA 0015 AEROFOIL WITH CHORD OF LENGTH 0.55m

(MODEL 5)

DYNAMIC CHARACTERISTICS FOR THE NACA 0015

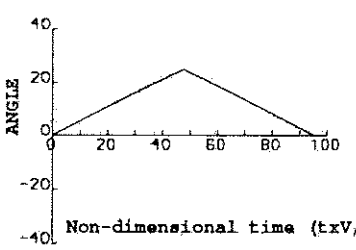
RUN REFERENCE NUMBER: 51 DATE OF TEST: 18/2/88

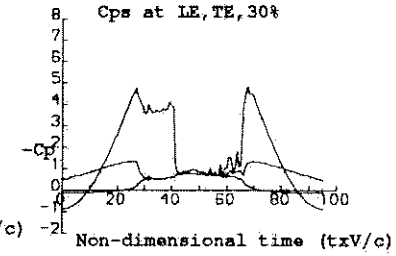
REYNOLDS NUMBER = 1514141. MACH NUMBER = 0.120

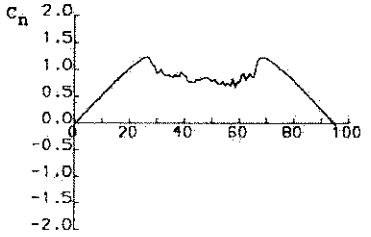
DYNAMIC PRESSURE = 1021.55 Nm^{-2} AIR TEMPERATURE = 23.0°C

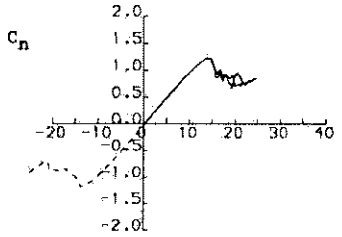
NUMBER OF CYCLES = 1 SAMPLING FREQUENCY = 100.00 Hz.

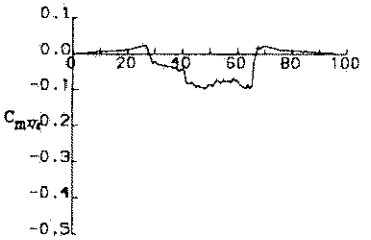
MOTION TYPE: STATIC AVERAGED DATA OF 1 CYCLES

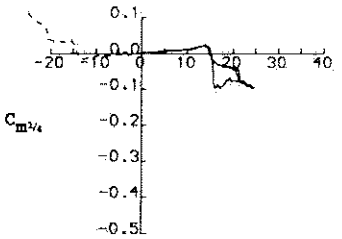


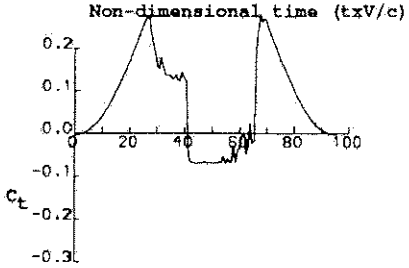


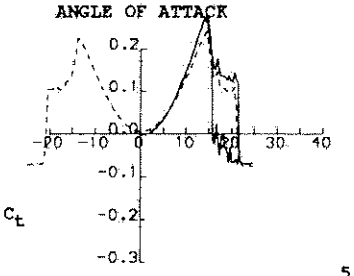


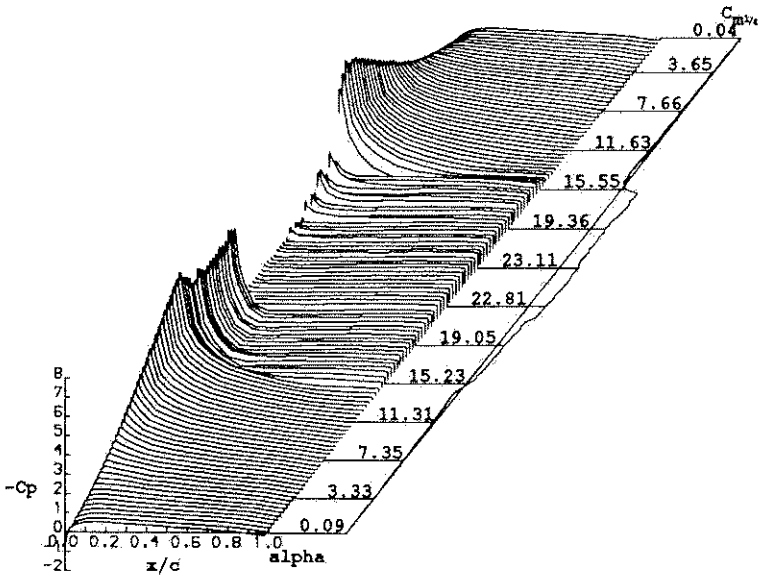








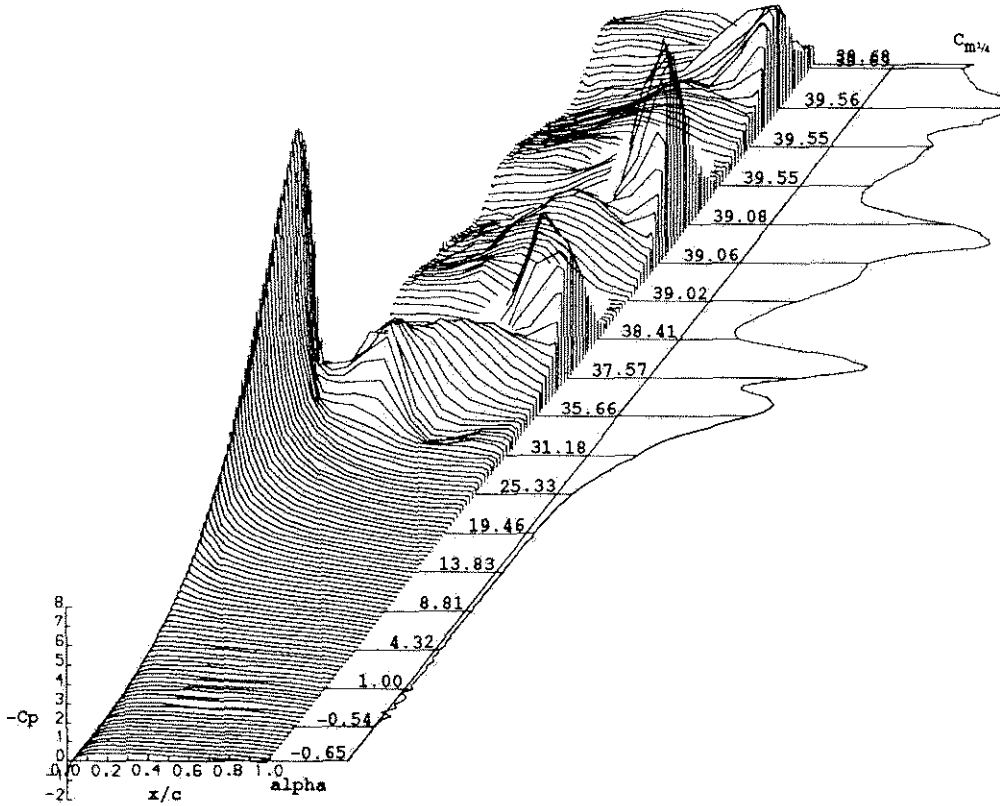


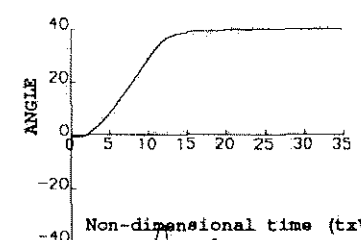


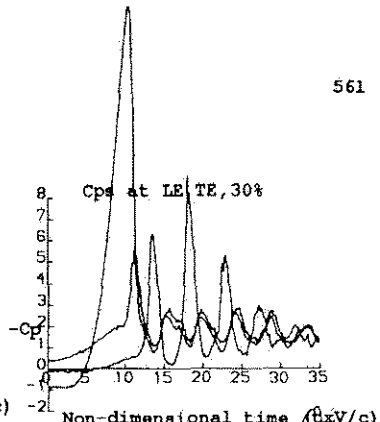
DYNAMIC CHARACTERISTICS FOR THE NACA 0015

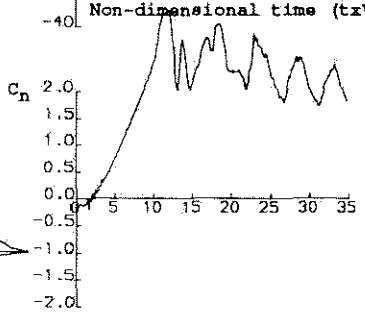
RUN REFERENCE NUMBER: 25611
REYNOLDS NUMBER = 1469028.
DYNAMIC PRESSURE = 1009.77 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

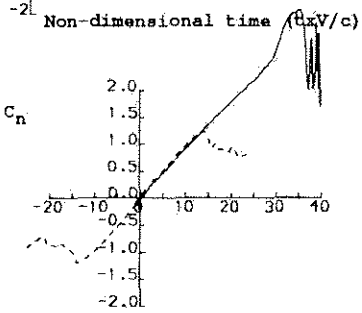
DATE OF TEST: 24/2/88
MACH NUMBER = 0.119
AIR TEMPERATURE = 29.4°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03489
LINEAR PITCH RATE = 300.94°S^{-1}

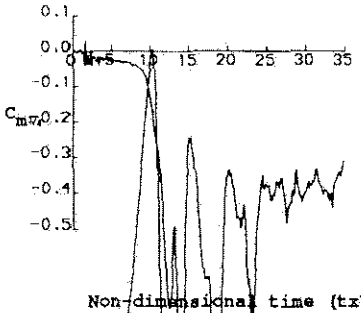


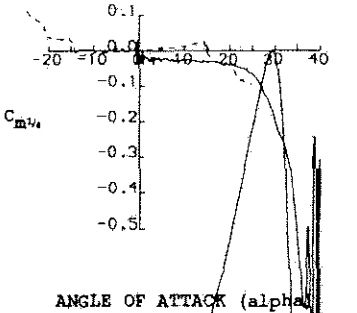


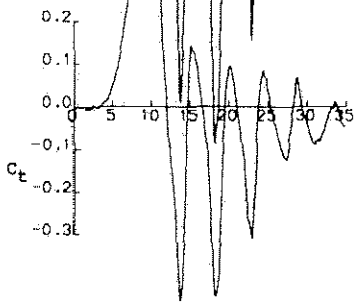


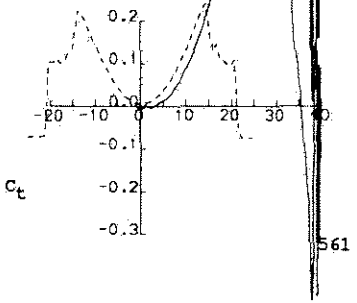








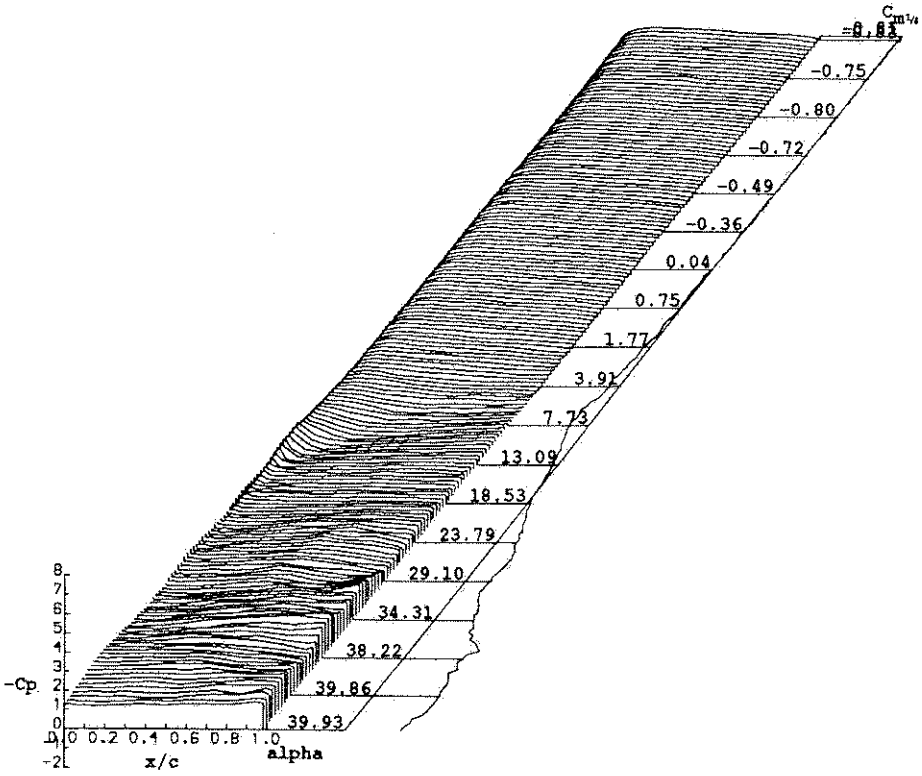


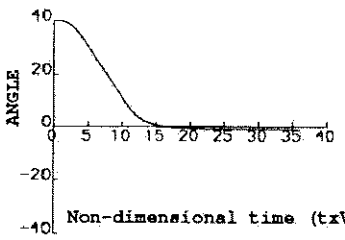


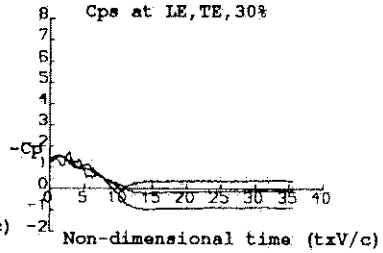
DYNAMIC CHARACTERISTICS FOR THE NACA 0015

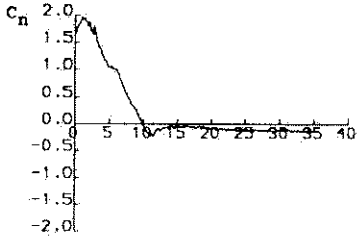
RUN REFERENCE NUMBER: 36621
REYNOLDS NUMBER = 1471553.
DYNAMIC PRESSURE = 1041.73 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 40.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

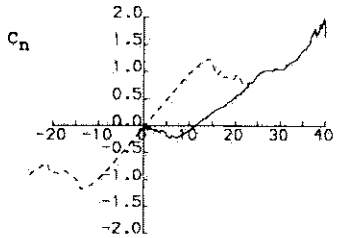
DATE OF TEST: 24/2/88
MACH NUMBER = 0.121
AIR TEMPERATURE = 32.7°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.03284
LINEAR PITCH RATE = $-289.26°S^{-1}$

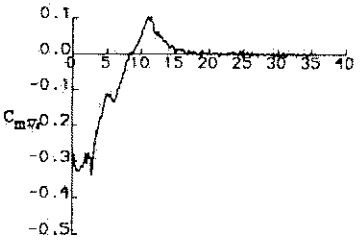


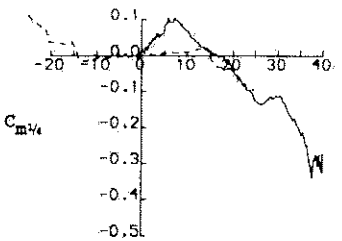


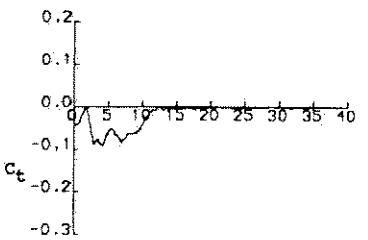


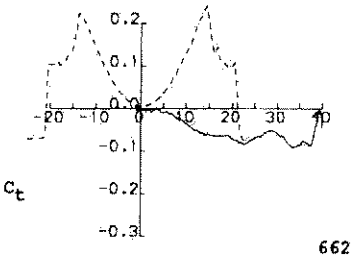








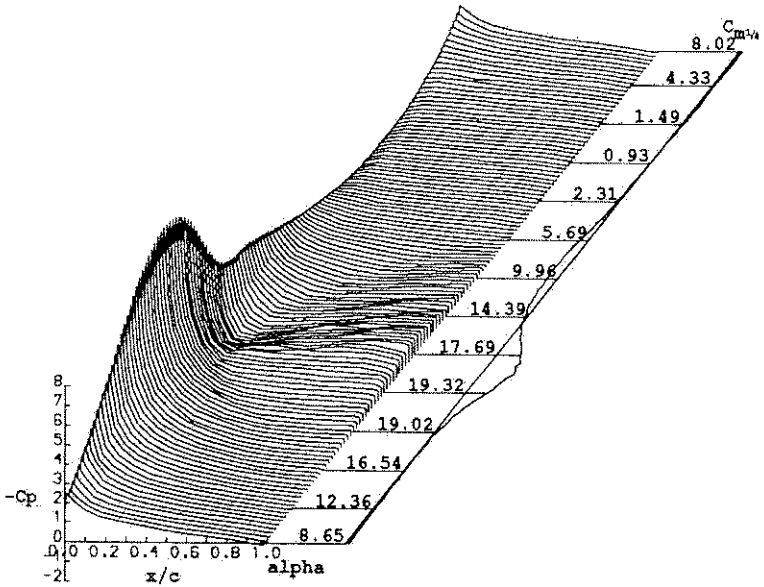


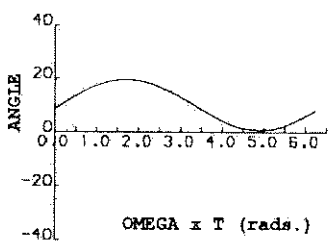


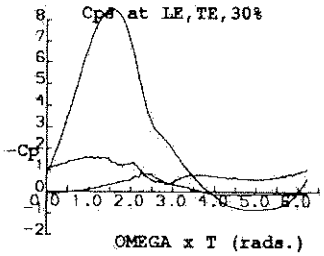
DYNAMIC CHARACTERISTICS FOR THE NACA 0015

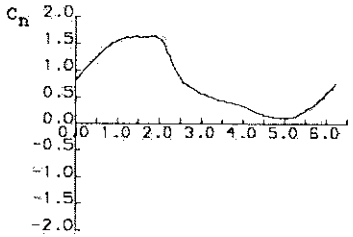
RUN REFERENCE NUMBER: 12191
REYNOLDS NUMBER = 1480535.
DYNAMIC PRESSURE = 987.04 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.448 Hz.
AVERAGED DATA OF 10 CYCLES

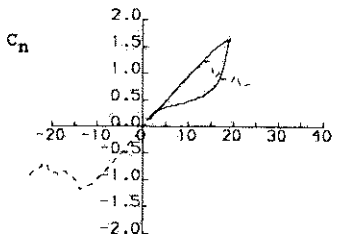
DATE OF TEST: 23/2/88
MACH NUMBER = 0.117
AIR TEMPERATURE = 24.9°C
SAMPLING FREQUENCY = 313.38 Hz.
REDUCED FREQUENCY = 0.104
AMPLITUDE = 10.00°

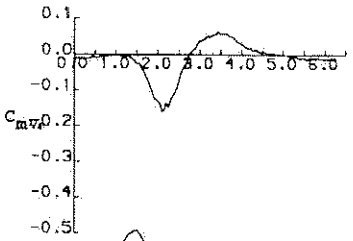


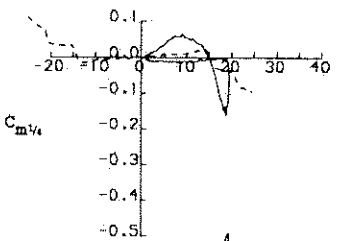


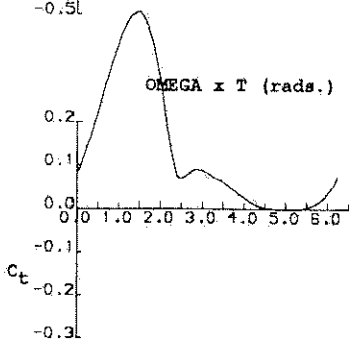


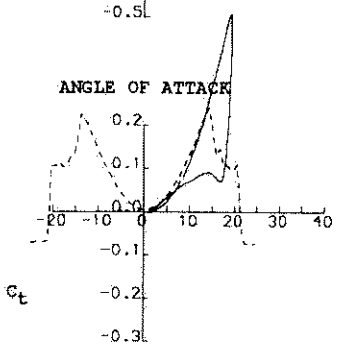








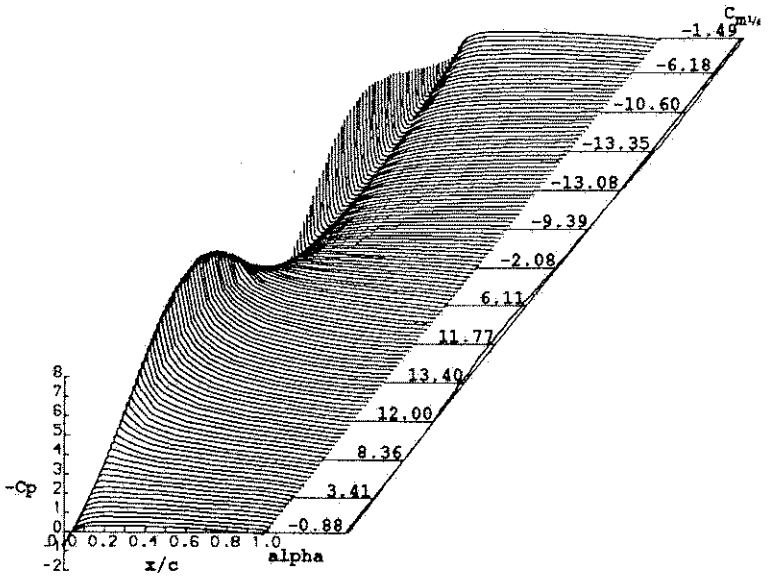


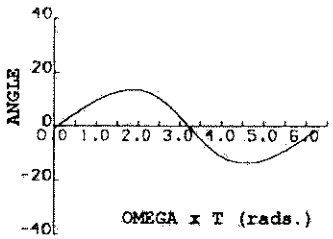


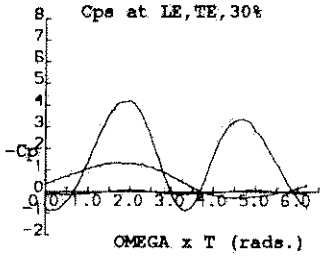
DYNAMIC CHARACTERISTICS FOR THE NACA 0015

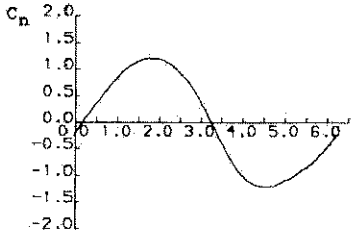
RUN REFERENCE NUMBER: 51371
REYNOLDS NUMBER = 1464710.
DYNAMIC PRESSURE = 1015.95 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: VAWT FUNCTION
MEAN ANGLE = 0.00°
OSCILLATION FREQUENCY = 1.219 Hz.
AVERAGED DATA OF 10 CYCLES

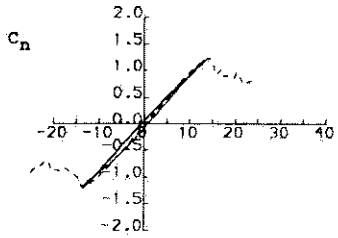
DATE OF TEST: 19/2/88
MACH NUMBER = 0.119
AIR TEMPERATURE = 30.9°C
SAMPLING FREQUENCY = 156.03 Hz.
REDUCED FREQUENCY = 0.051
AMPLITUDE = 13.80°

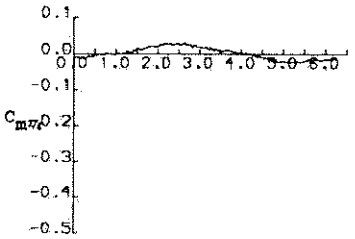


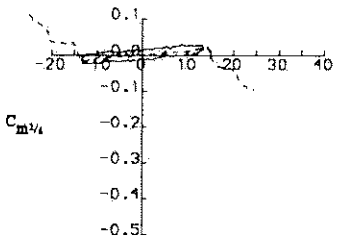


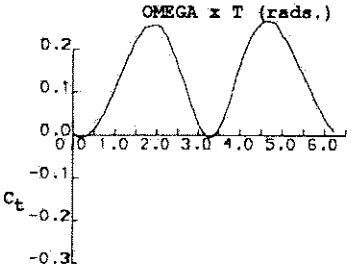


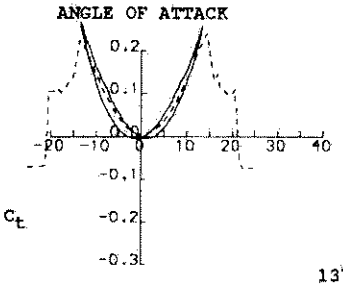












DYNAMIC CHARACTERISTICS FOR THE NACA 0015

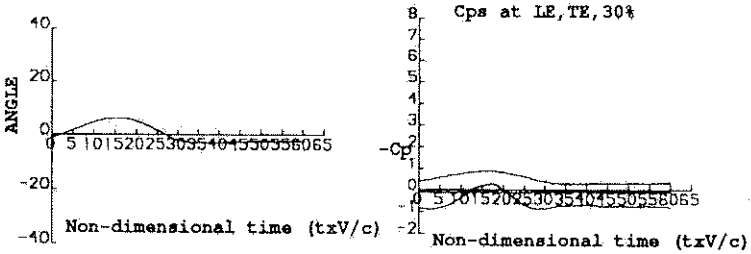
RUN REFERENCE NUMBER: 71851 DATE OF TEST: 23/2/88

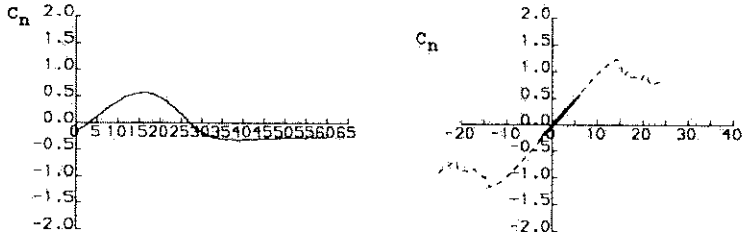
REYNOLDS NUMBER = 1479333. MACH NUMBER = 0.117

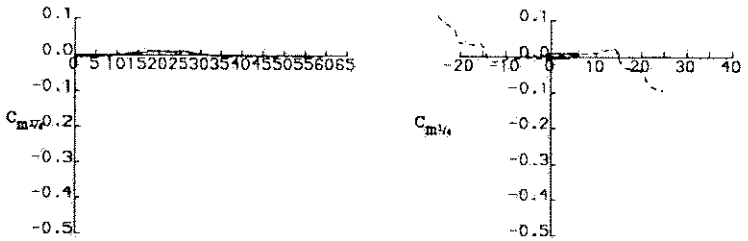
DYNAMIC PRESSURE = 987.98 Nm^{-2} AIR TEMPERATURE = 25.2°C

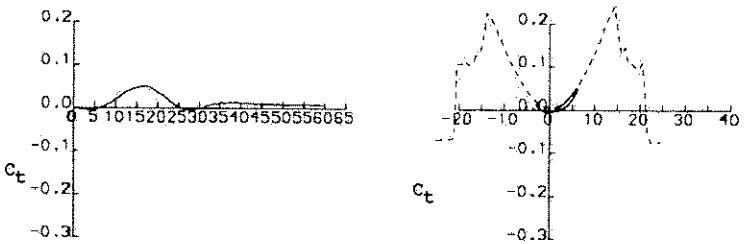
NUMBER OF CYCLES = 10 SAMPLING FREQUENCY = 155.91 Hz.

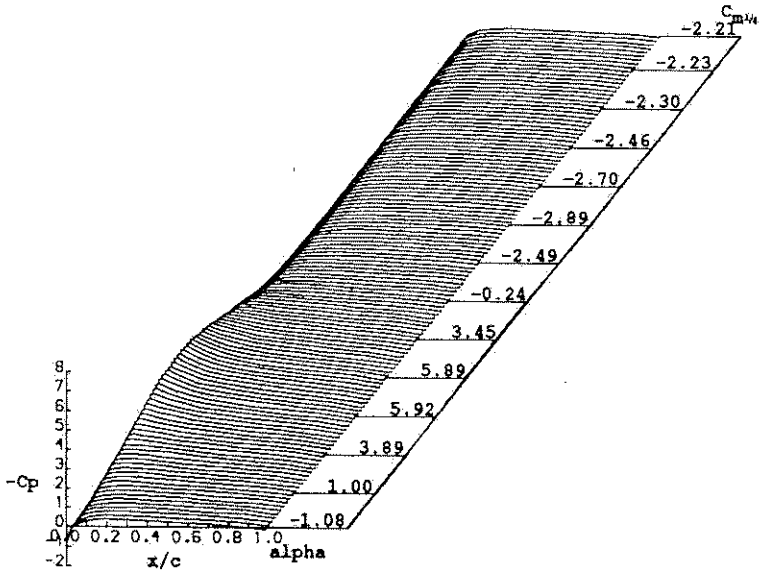
MOTION TYPE: VAWT FUNCTION (MSDD) AVERAGED DATA OF 10 CYCLES











G.U. Aero Report 9221

UNIVERSITY OF GLASGOW

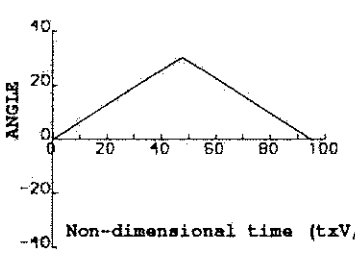
DEPARTMENT OF AEROSPACE ENGINEERING

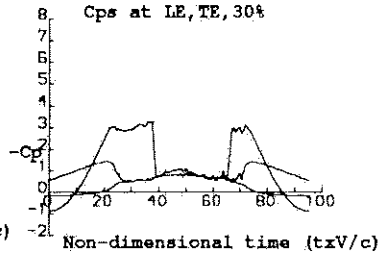
PRESSURE DATA FOR THE NACA 0018 AEROFOIL

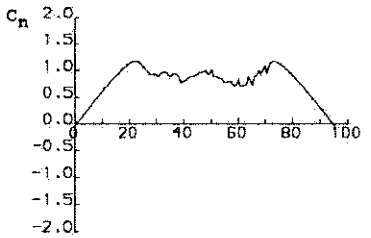
(MODEL 6)

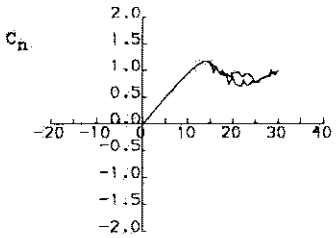
DYNAMIC CHARACTERISTICS FOR THE NACA 0018

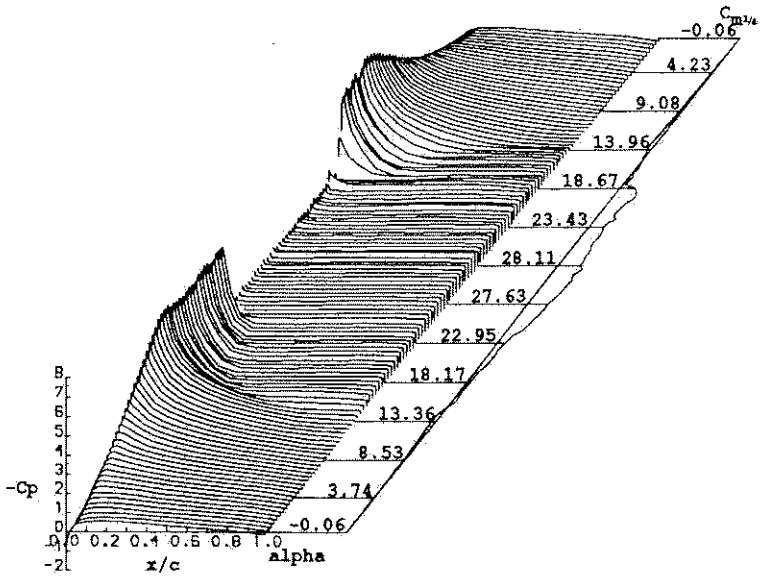
RUN REFERENCE NUMBER: 51
DATE OF TEST: 13/5/88
REYNOLDS NUMBER = 1528734.
MACH NUMBER = 0.121
DYNAMIC PRESSURE = 1018.51 Nm^{-2}
AIR TEMPERATURE = 18.5°C
NUMBER OF CYCLES = 1
SAMPLING FREQUENCY = 100.00 Hz.
MOTION TYPE: STATIC
AVERAGED DATA OF 1 CYCLES

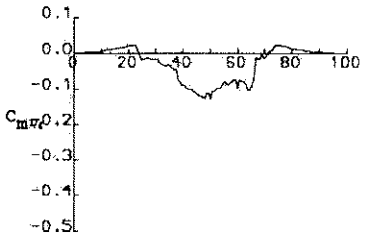


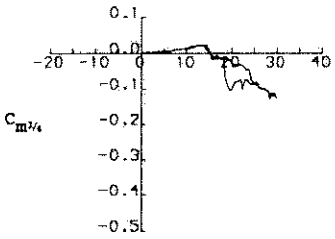


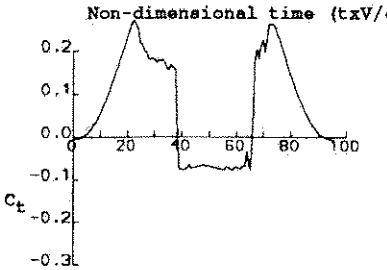


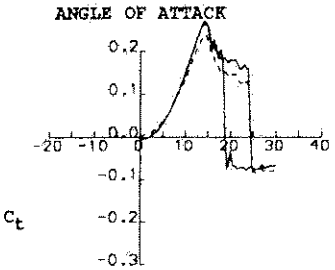








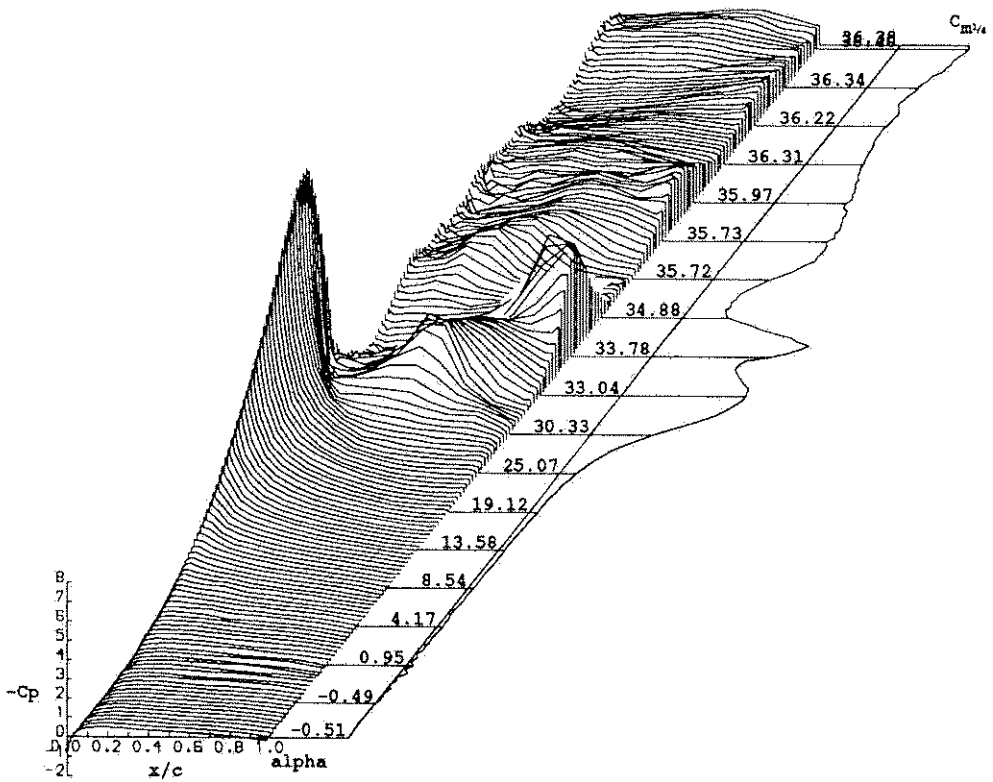


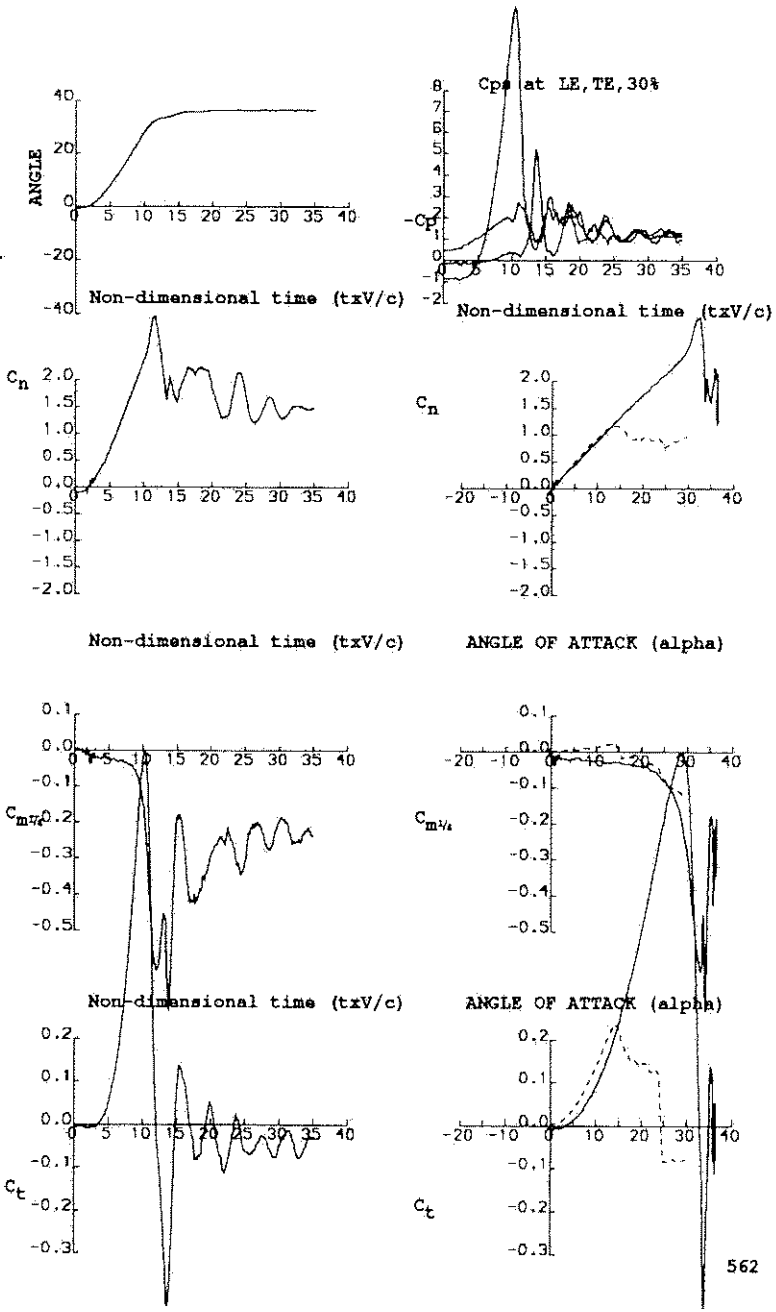


DYNAMIC CHARACTERISTICS FOR THE NACA 0018

RUN REFERENCE NUMBER: 25621
REYNOLDS NUMBER = 1437624.
DYNAMIC PRESSURE = 992.13 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

DATE OF TEST: 11/7/88
MACH NUMBER = 0.119
AIR TEMPERATURE = 29.7°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03407
LINEAR PITCH RATE = 294.84°S^{-1}

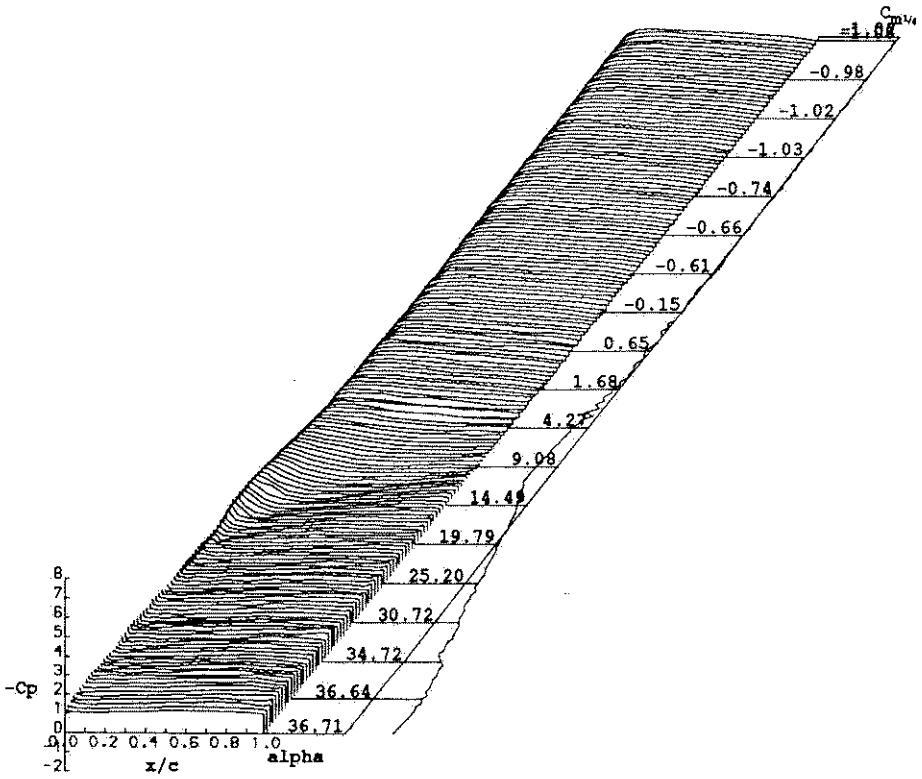


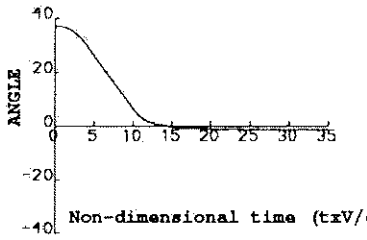


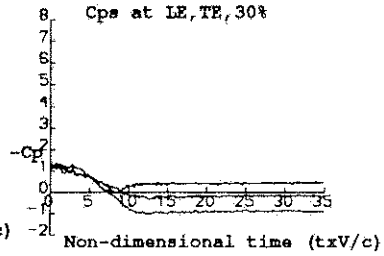
DYNAMIC CHARACTERISTICS FOR THE NACA 0018

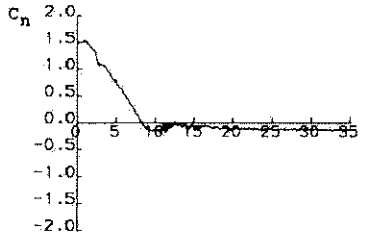
RUN REFERENCE NUMBER: 36621
REYNOLDS NUMBER = 1451250.
DYNAMIC PRESSURE = 1000.84 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 40.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

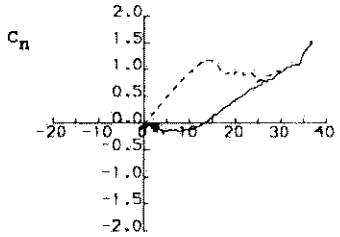
DATE OF TEST: 11/7/88
MACH NUMBER = 0.119
AIR TEMPERATURE = 29.6°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.03429
LINEAR PITCH RATE = -296.62°S^{-1}

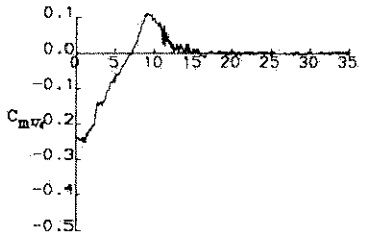


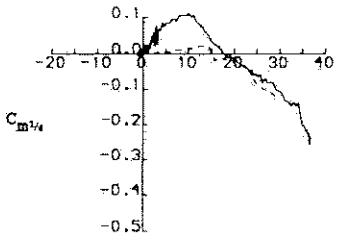


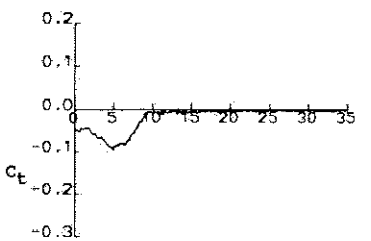


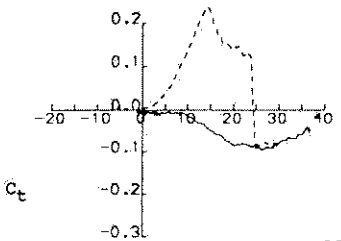








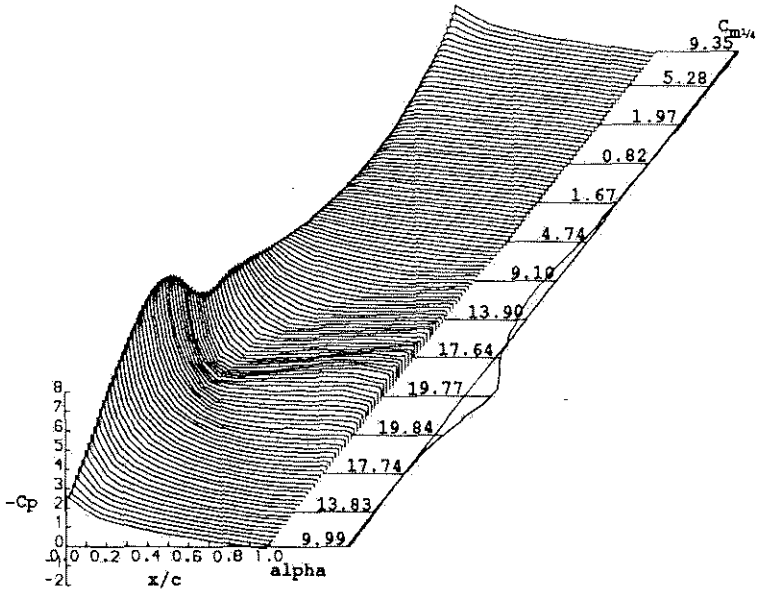


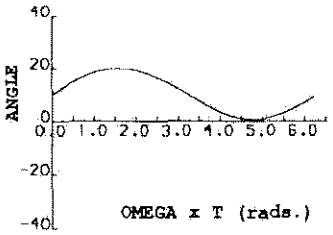


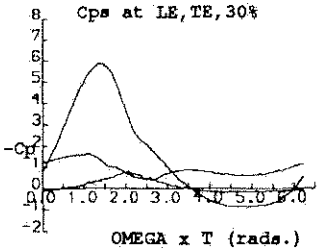
DYNAMIC CHARACTERISTICS FOR THE NACA 0018

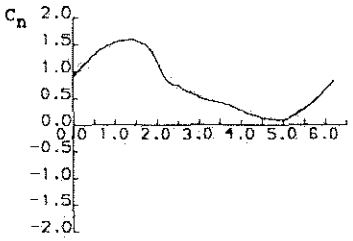
RUN REFERENCE NUMBER: 12191
REYNOLDS NUMBER = 1462973.
DYNAMIC PRESSURE = 1005.08 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.448 Hz.
AVERAGED DATA OF 10 CYCLES

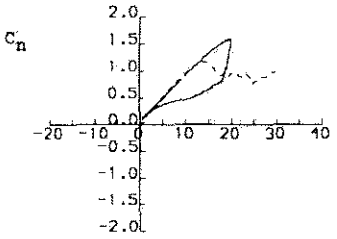
DATE OF TEST: 11/7/88
MACH NUMBER = 0.119
AIR TEMPERATURE = 28.2°C
SAMPLING FREQUENCY = 313.38 Hz.
REDUCED FREQUENCY = 0.102
AMPLITUDE = 10.00°

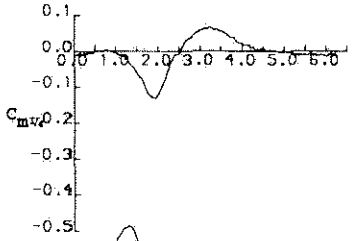


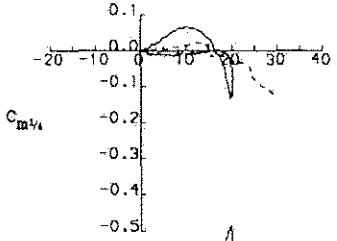


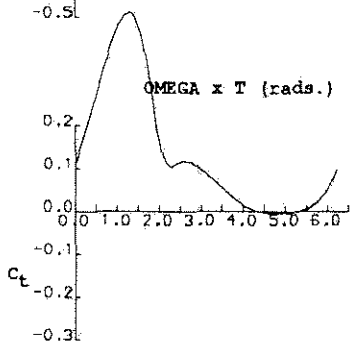


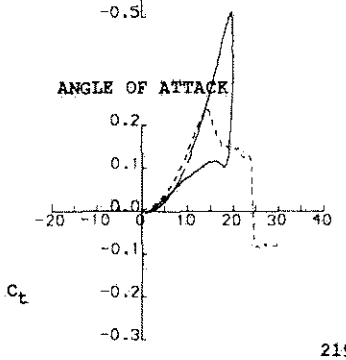






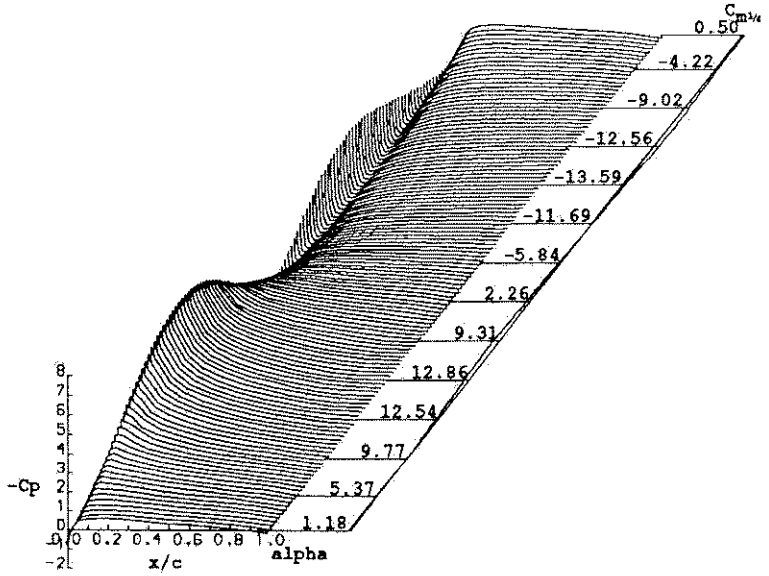


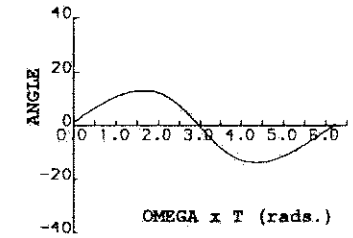


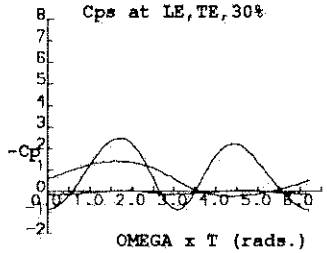


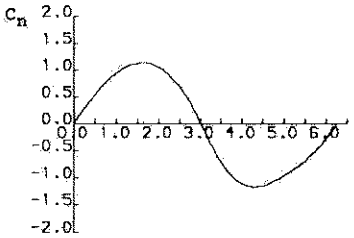
DYNAMIC CHARACTERISTICS FOR THE NACA 0018

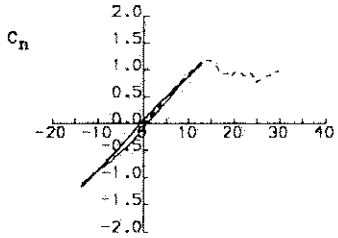
RUN REFERENCE NUMBER: 51371
DATE OF TEST: 14/7/88
REYNOLDS NUMBER = 1450793.
MACH NUMBER = 0.119
DYNAMIC PRESSURE = 996.25 Nm^{-2}
AIR TEMPERATURE = 27.8°C
NUMBER OF CYCLES = 10
SAMPLING FREQUENCY = 159.36 Hz.
MOTION TYPE: VAWT FUNCTION
REDUCED FREQUENCY = 0.052
MEAN ANGLE = 0.00°
AMPLITUDE = 13.80°
OSCILLATION FREQUENCY = 1.245 Hz.
AVERAGED DATA OF 10 CYCLES

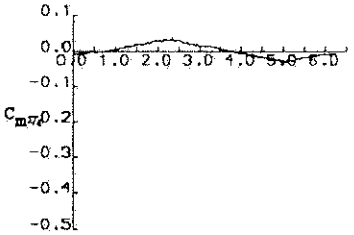


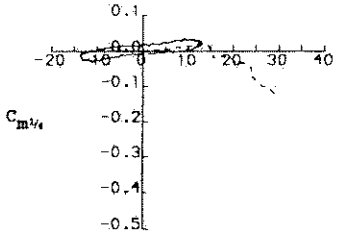


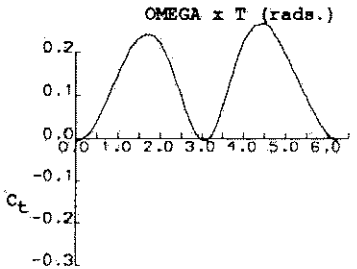


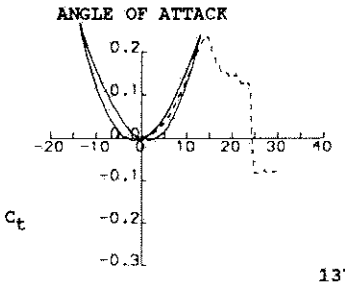












DYNAMIC CHARACTERISTICS FOR THE NACA 0018

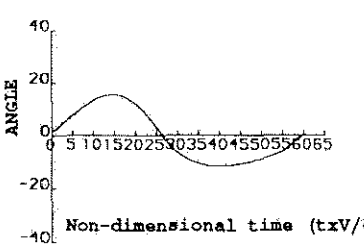
RUN REFERENCE NUMBER: 71851 DATE OF TEST: 14/7/88

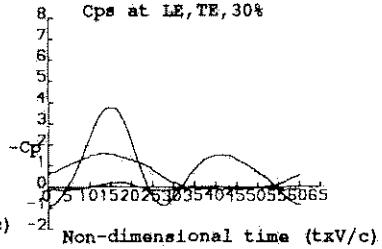
REYNOLDS NUMBER = 1503410. MACH NUMBER = 0.120

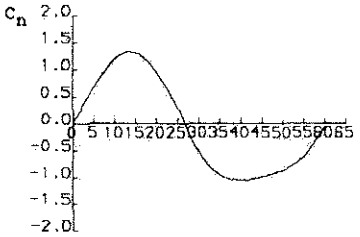
DYNAMIC PRESSURE = 1020.23 Nm^{-2} AIR TEMPERATURE = 23.2°C

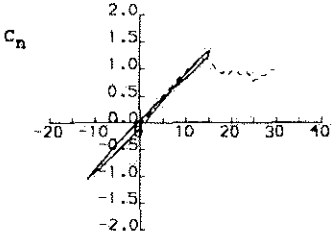
NUMBER OF CYCLES = 10 SAMPLING FREQUENCY = 159.36 Hz.

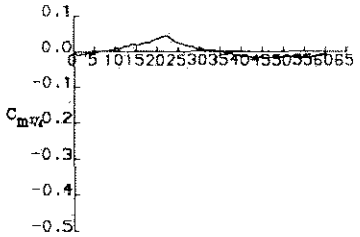
MOTION TYPE: VAWT FUNCTION (MSDD) AVERAGED DATA OF 10 CYCLES

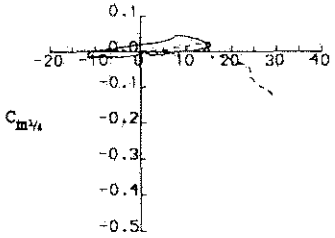


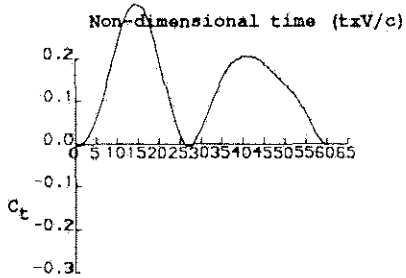


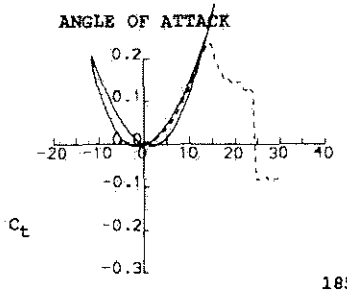


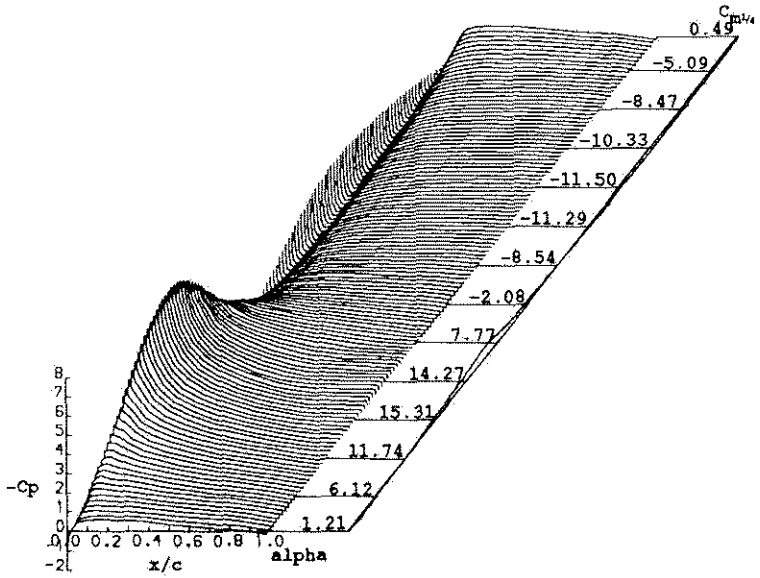












G.U. Aero Report 9221

UNIVERSITY OF GLASGOW

DEPARTMENT OF AEROSPACE ENGINEERING

PRESSURE DATA FOR THE

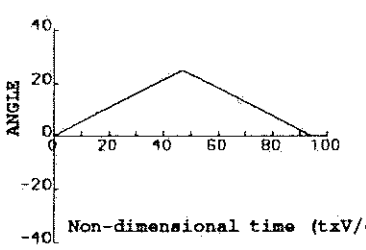
NACA 0021 AEROFOIL

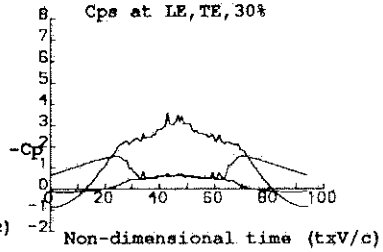
(MODEL 7)

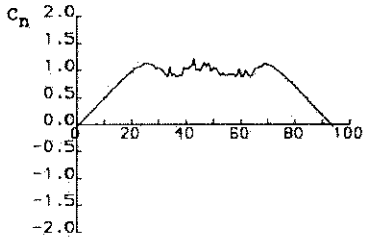
DYNAMIC CHARACTERISTICS FOR THE NACA 0021

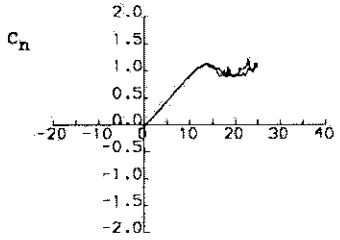
RUN REFERENCE NUMBER: 51
REYNOLDS NUMBER = 1430866.
DYNAMIC PRESSURE = 996.36 Nm^{-2}
NUMBER OF CYCLES = 1
MOTION TYPE: STATIC

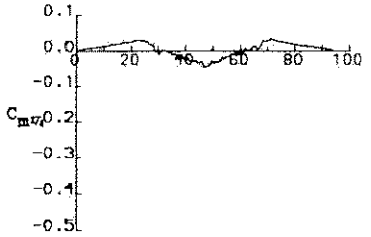
DATE OF TEST: 11/1/88
MACH NUMBER = 0.117
AIR TEMPERATURE = 29.2°C
SAMPLING FREQUENCY = 100.00 Hz.
AVERAGED DATA OF 1 CYCLES

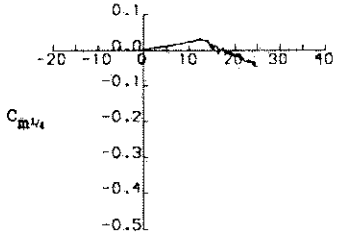


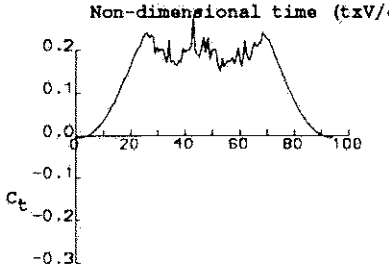


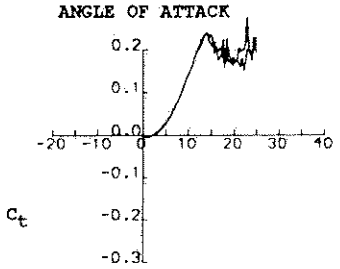


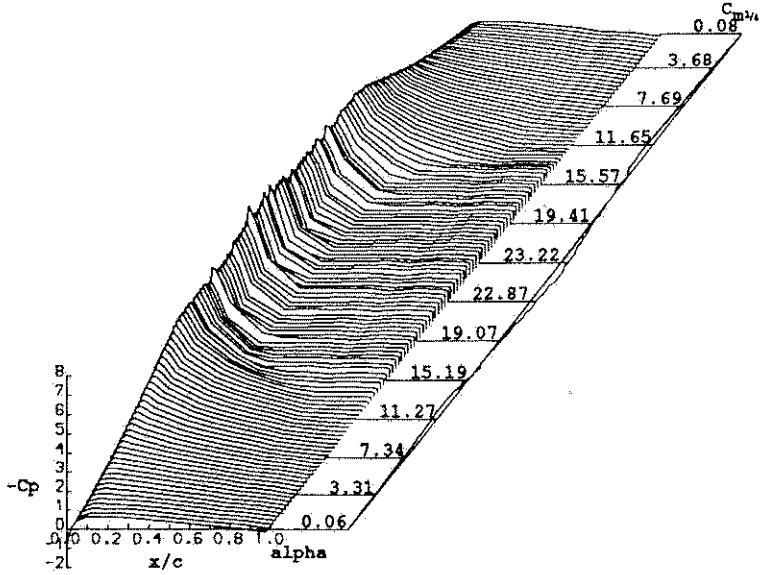








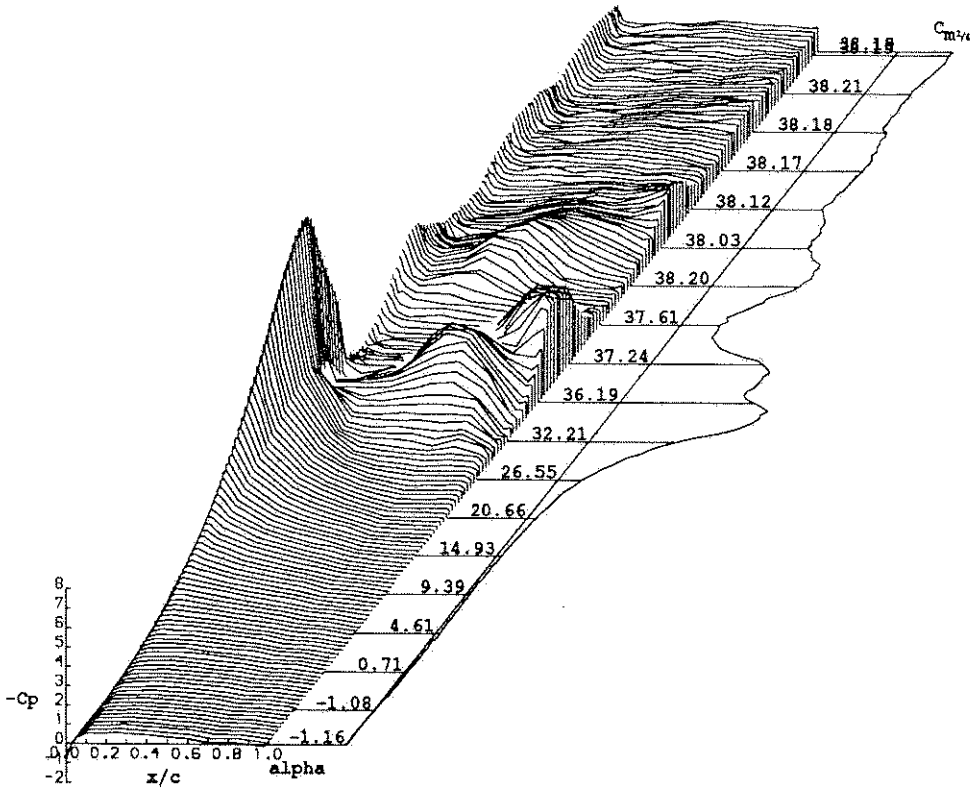


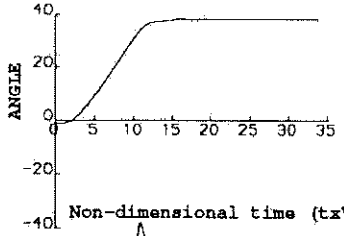


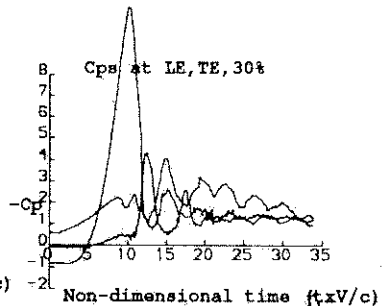
DYNAMIC CHARACTERISTICS FOR THE NACA 0021

RUN REFERENCE NUMBER: 25601
REYNOLDS NUMBER = 1426928.
DYNAMIC PRESSURE = 971.33 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

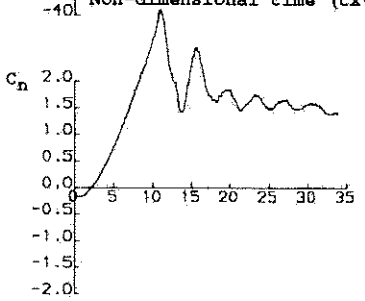
DATE OF TEST: 15/1/88
MACH NUMBER = 0.116
AIR TEMPERATURE = 26.7°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03461
LINEAR PITCH RATE = 305.95°S^{-1}



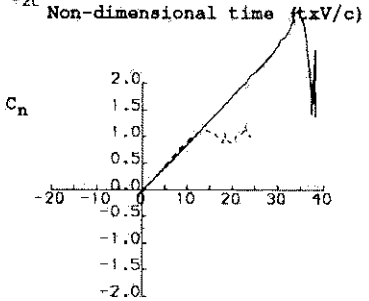




Non-dimensional time (txV/c)

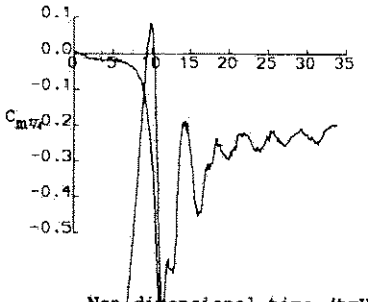


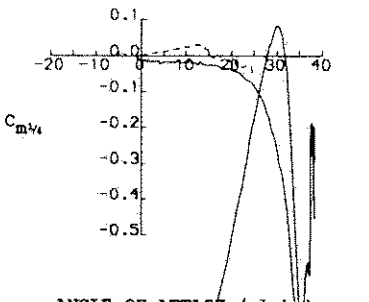
Non-dimensional time (txV/c)



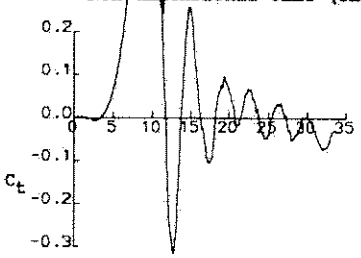
Non-dimensional time (txV/c)

ANGLE OF ATTACK (alpha)

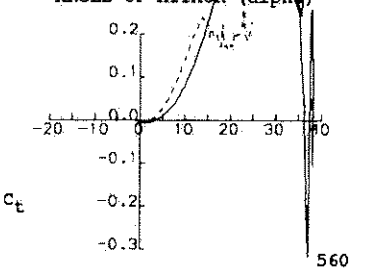




Non-dimensional time (txV/c)



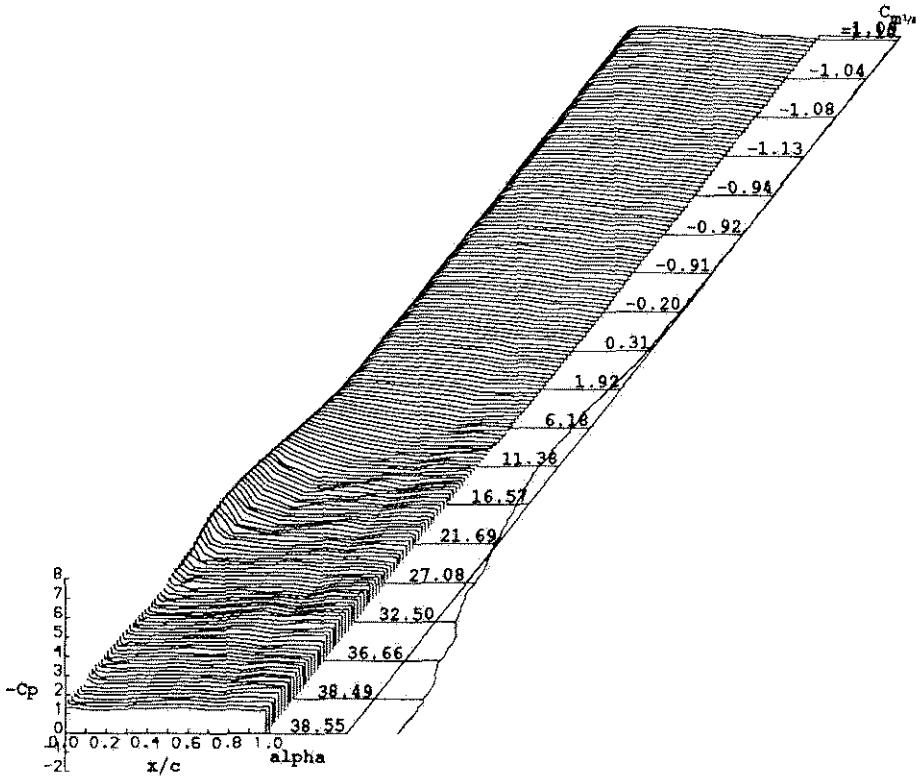
ANGLE OF ATTACK (alpha)

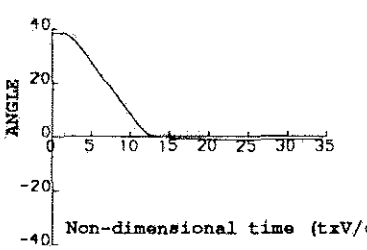


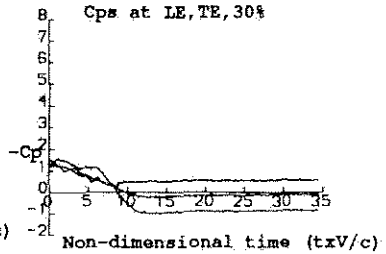
DYNAMIC CHARACTERISTICS FOR THE NACA 0021

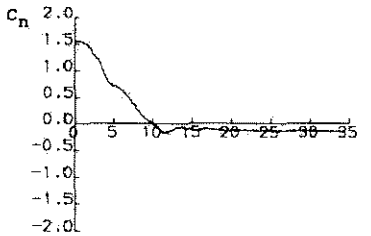
RUN REFERENCE NUMBER: 36601
REYNOLDS NUMBER = 1414574.
DYNAMIC PRESSURE = 994.16 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 40.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

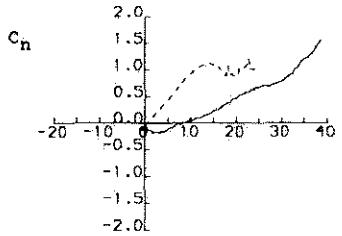
DATE OF TEST: 15/1/88
MACH NUMBER = 0.117
AIR TEMPERATURE = 31.5°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.03287
LINEAR PITCH RATE = -296.25°s^{-1}

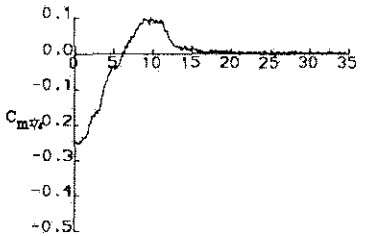


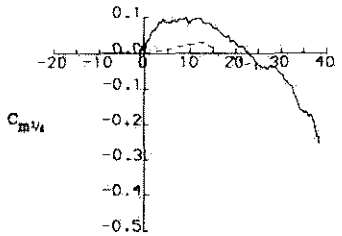


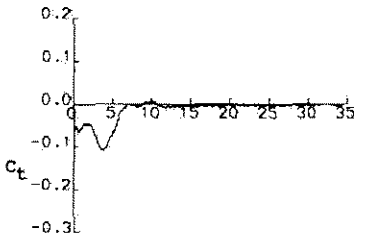


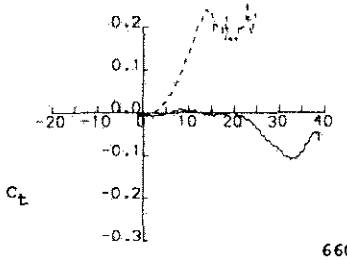








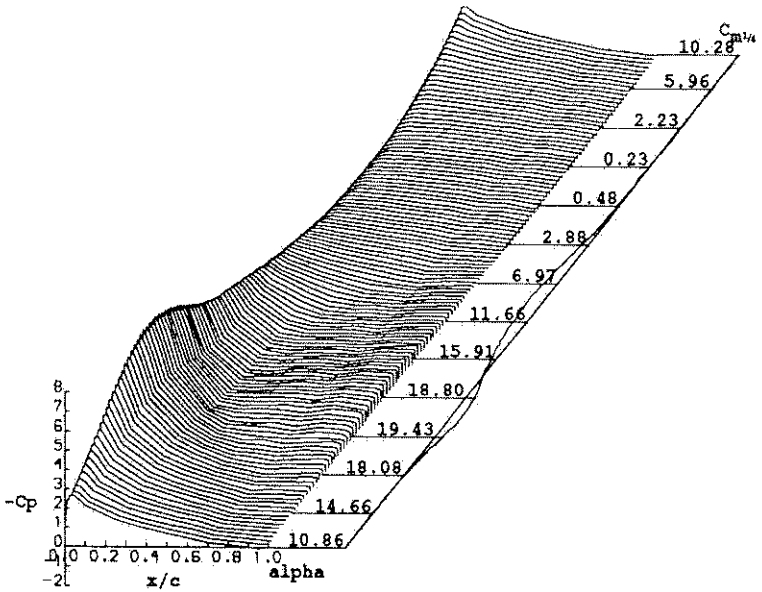


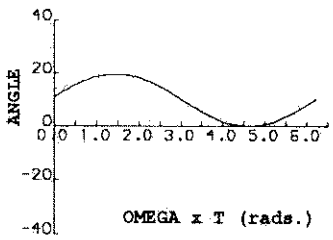


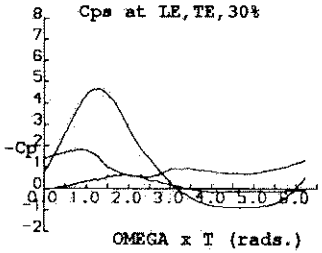
DYNAMIC CHARACTERISTICS FOR THE NACA 0021

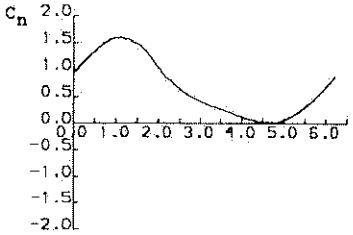
RUN REFERENCE NUMBER: 12191
REYNOLDS NUMBER = 1365537.
DYNAMIC PRESSURE = 929.41 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.448 Hz.
AVERAGED DATA OF 10 CYCLES

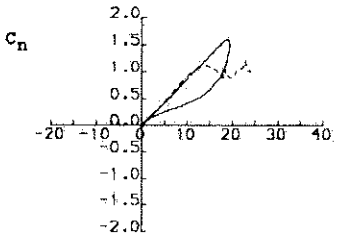
DATE OF TEST: 13/1/88
MACH NUMBER = 0.114
AIR TEMPERATURE = 29.5°C
SAMPLING FREQUENCY = 313.38 Hz.
REDUCED FREQUENCY = 0.100
AMPLITUDE = 10.00°

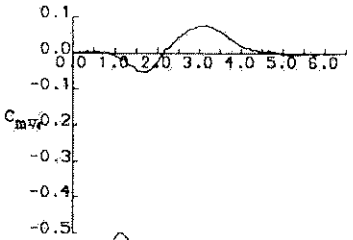


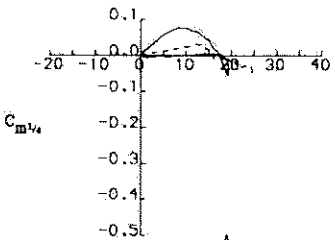


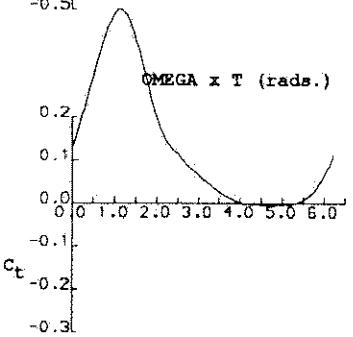


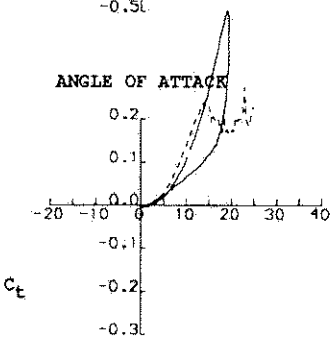








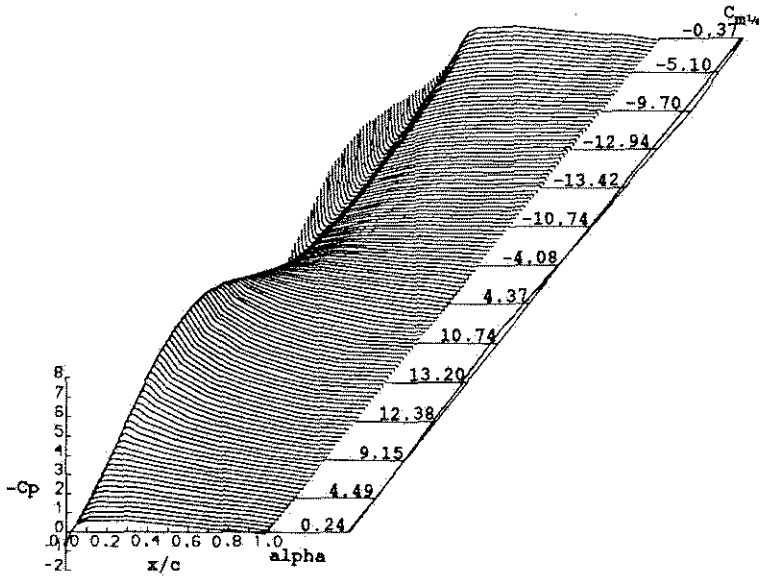


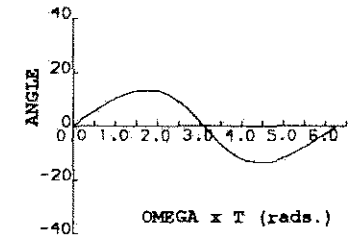


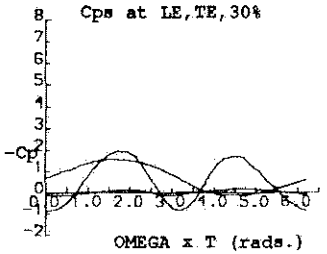
DYNAMIC CHARACTERISTICS FOR THE NACA 0021

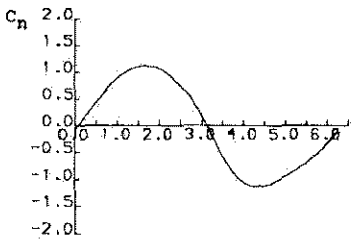
RUN REFERENCE NUMBER: 51372
REYNOLDS NUMBER = 1466071.
DYNAMIC PRESSURE = 1018.65 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: VAWT FUNCTION
MEAN ANGLE = 0.00°
OSCILLATION FREQUENCY = 1.245 Hz.
AVERAGED DATA OF 10 CYCLES

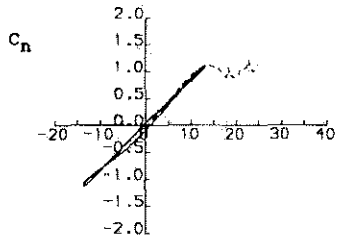
DATE OF TEST: 26/1/88
MACH NUMBER = 0.121
AIR TEMPERATURE = 27.4°C
SAMPLING FREQUENCY = 159.36 Hz.
REDUCED FREQUENCY = 0.051
AMPLITUDE = 13.80°

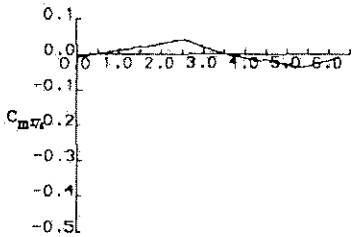


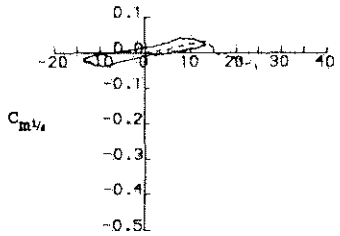


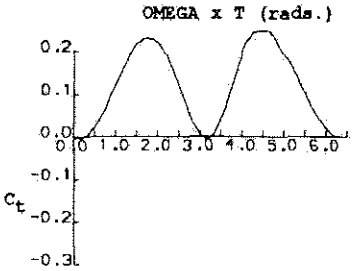


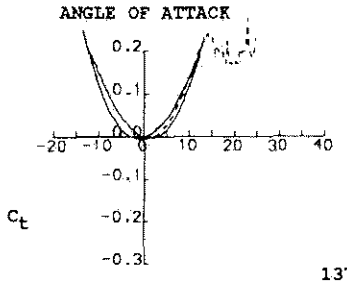












DYNAMIC CHARACTERISTICS FOR THE NACA 0021

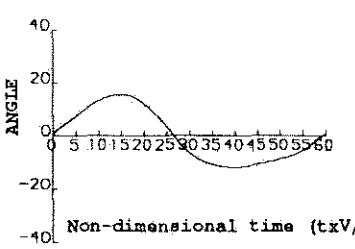
RUN REFERENCE NUMBER: 71851 DATE OF TEST: 12/1/88

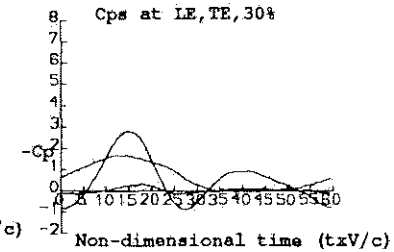
REYNOLDS NUMBER = 1393491. MACH NUMBER = 0.117

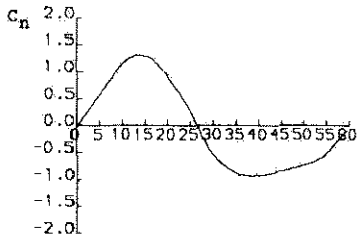
DYNAMIC PRESSURE = 985.41 Nm^{-2} AIR TEMPERATURE = 32.6°C

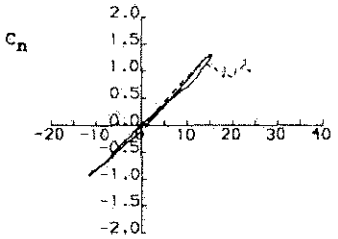
NUMBER OF CYCLES = 10 SAMPLING FREQUENCY = 159.36 Hz.

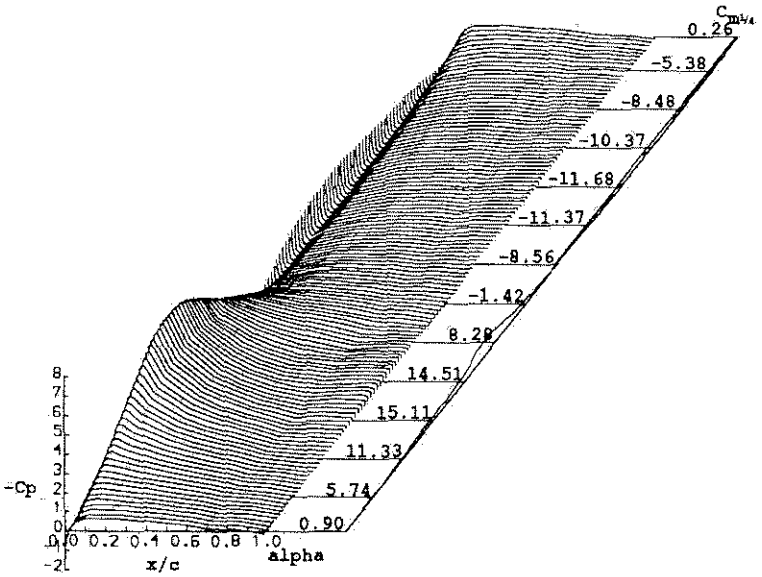
MOTION TYPE: VAWT FUNCTION (MSDD) AVERAGED DATA OF 10 CYCLES

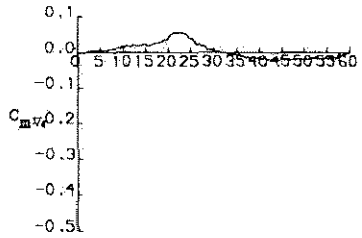


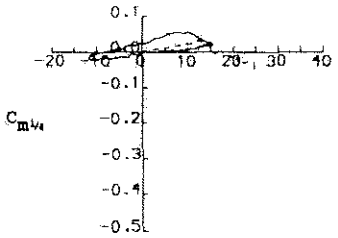


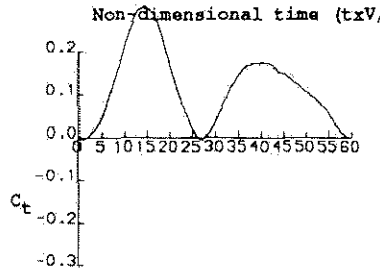


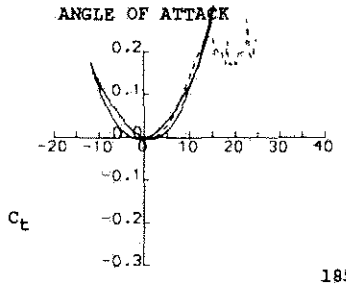












G.U. Aero Report 9221

UNIVERSITY OF GLASGOW

DEPARTMENT OF AEROSPACE ENGINEERING

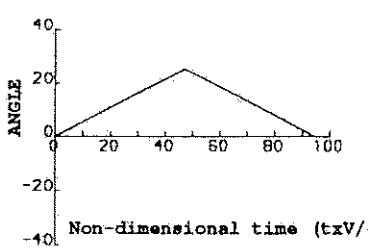
PRESSURE DATA FOR THE

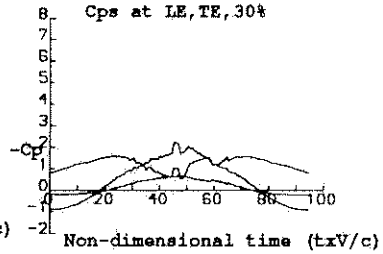
NACA 0025 AEROFOIL

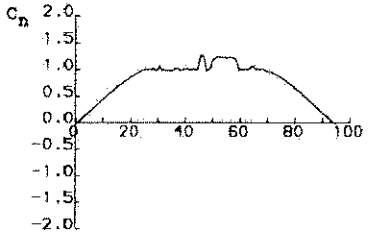
(MODEL 8)

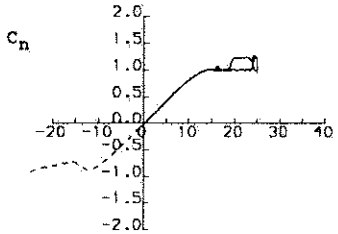
DYNAMIC CHARACTERISTICS FOR THE NACA 0025

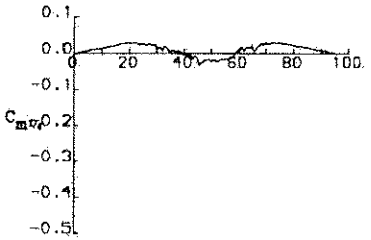
RUN REFERENCE NUMBER: 51
DATE OF TEST: 13/10/88
REYNOLDS NUMBER = 1506609.
MACH NUMBER = 0.120
DYNAMIC PRESSURE = 998.03 Nm^{-2}
AIR TEMPERATURE = 19.2°C
NUMBER OF CYCLES = 1
SAMPLING FREQUENCY = 100.00 Hz.
MOTION TYPE: STATIC
AVERAGED DATA OF 1 CYCLES

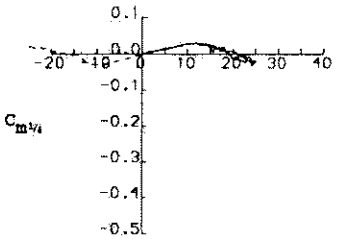


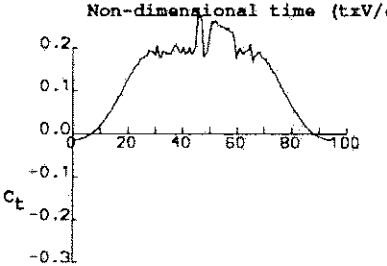


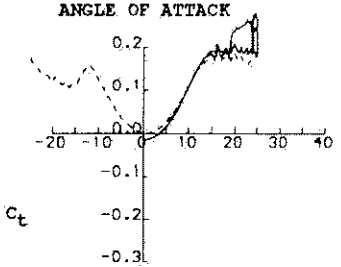


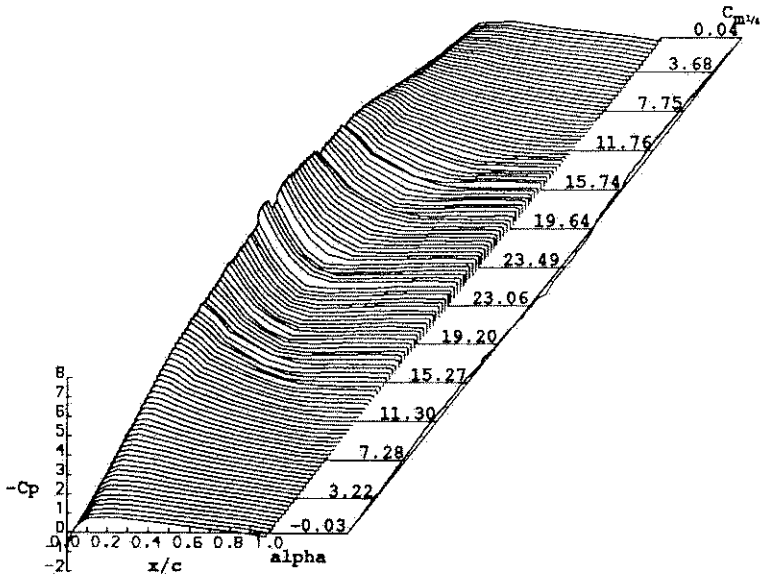






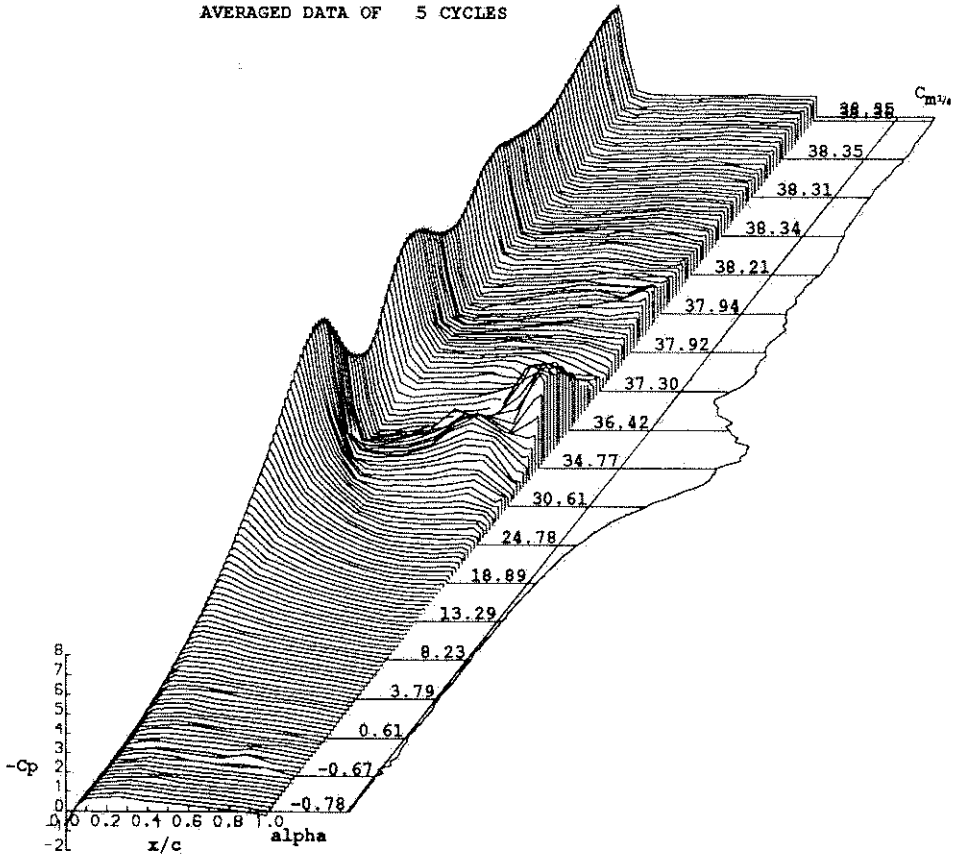


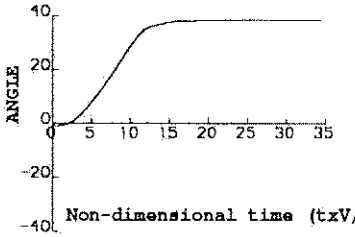


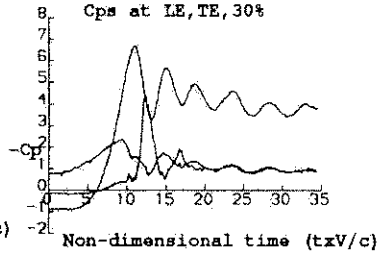


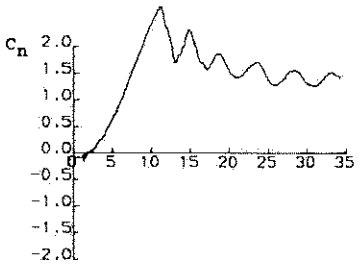
DYNAMIC CHARACTERISTICS FOR THE NACA 0025

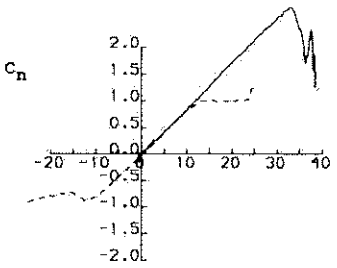
RUN REFERENCE NUMBER: 25611
DATE OF TEST: 27/10/88
REYNOLDS NUMBER = 1559807.
MACH NUMBER = 0.119
DYNAMIC PRESSURE = 1021.84 Nm^{-2}
AIR TEMPERATURE = 17.0°C
NUMBER OF CYCLES = 5
SAMPLING FREQUENCY = 550.05 Hz.
MOTION TYPE: RAMP UP
REDUCED PITCH RATE = 0.03544
START ANGLE = -1.00°
LINEAR PITCH RATE = 301.09°S^{-1}
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

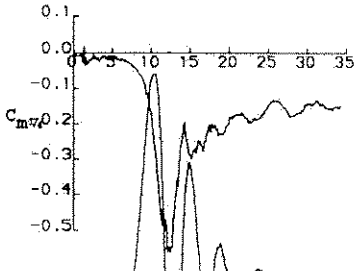


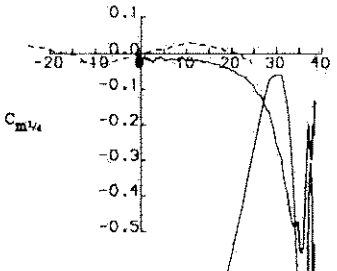


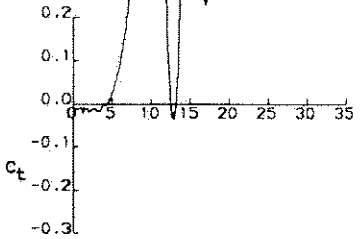


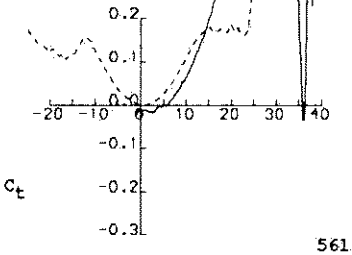








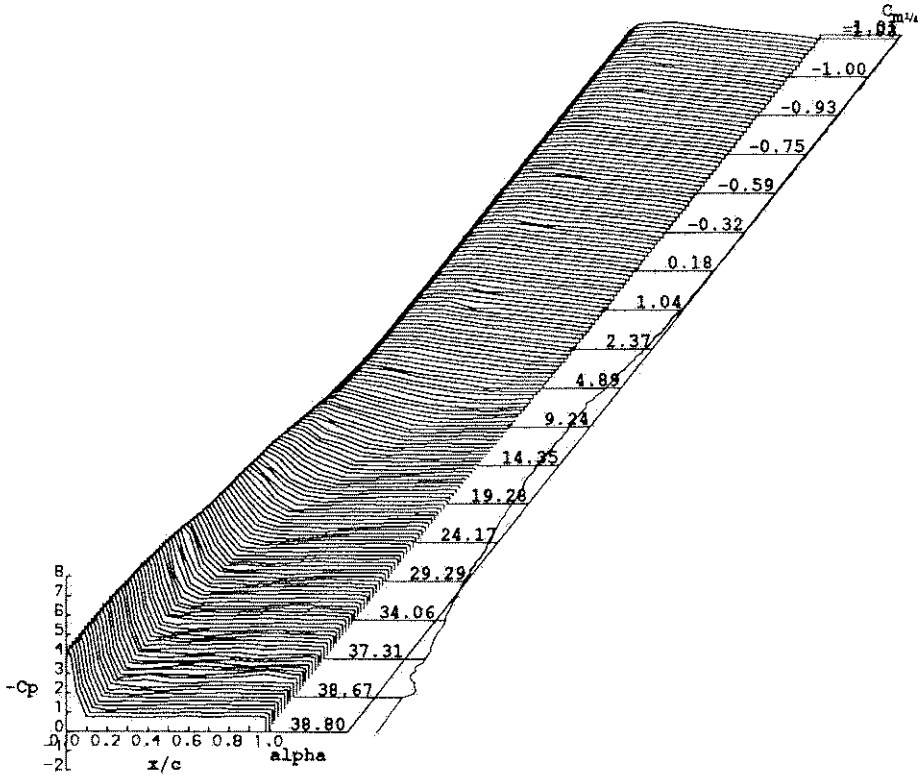


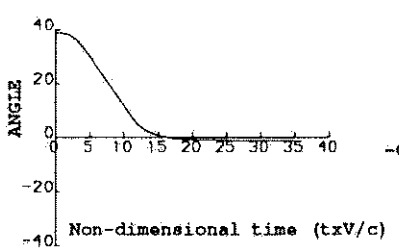


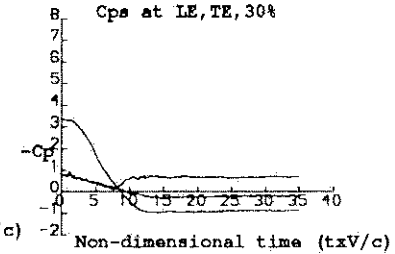
DYNAMIC CHARACTERISTICS FOR THE NACA 0025

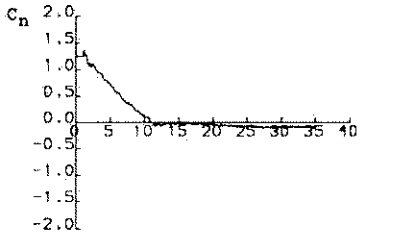
RUN REFERENCE NUMBER: 36601
REYNOLDS NUMBER = 1450602.
DYNAMIC PRESSURE = 1003.58 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 40.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

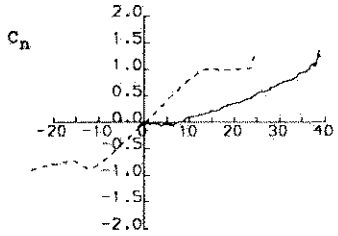
DATE OF TEST: 27/10/88
MACH NUMBER = 0.119
AIR TEMPERATURE = 30.5°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.03162
LINEAR PITCH RATE = -273.71°S^{-1}

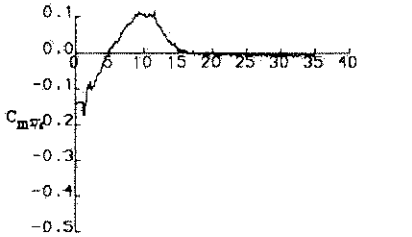


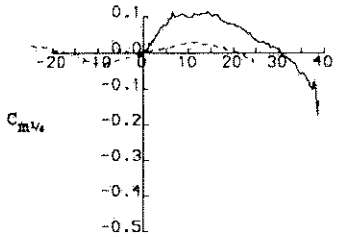


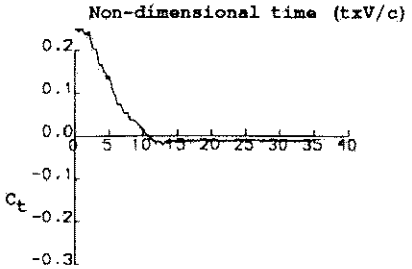


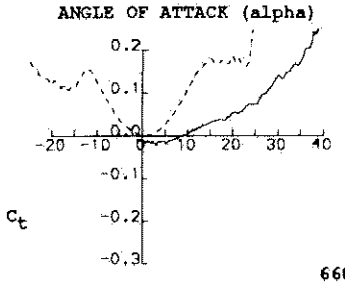








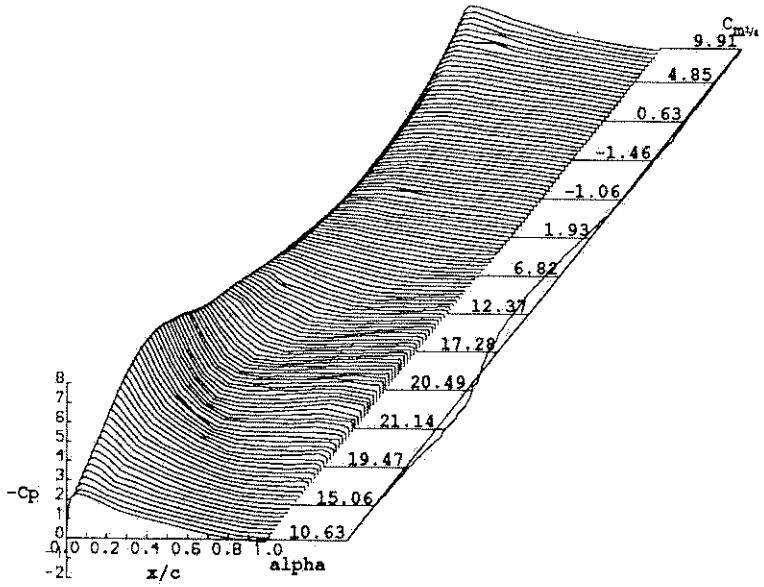


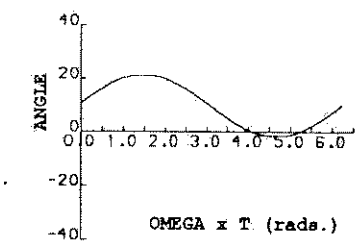


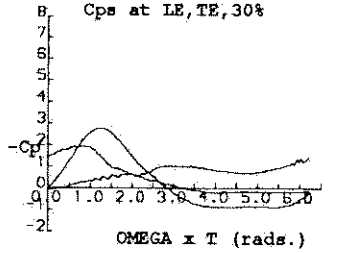
DYNAMIC CHARACTERISTICS FOR THE NACA 0025

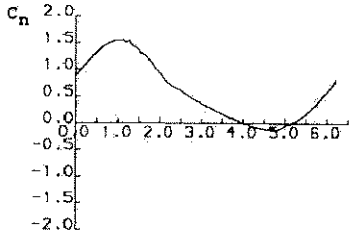
RUN REFERENCE NUMBER: 12191
REYNOLDS NUMBER = 1507520.
DYNAMIC PRESSURE = 1012.15 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.448 Hz.
AVERAGED DATA OF 10 CYCLES

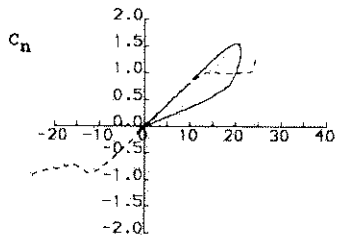
DATE OF TEST: 1/11/88
MACH NUMBER = 0.119
AIR TEMPERATURE = 23.7°C
SAMPLING FREQUENCY = 313.38 Hz.
REDUCED FREQUENCY = 0.103
AMPLITUDE = 10.00°

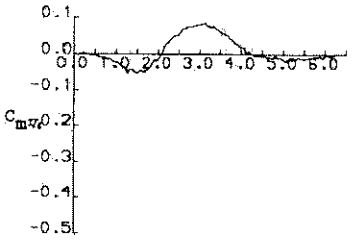


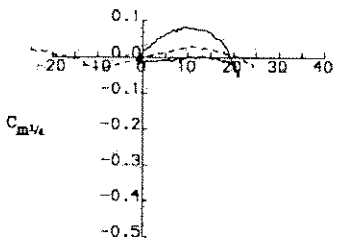


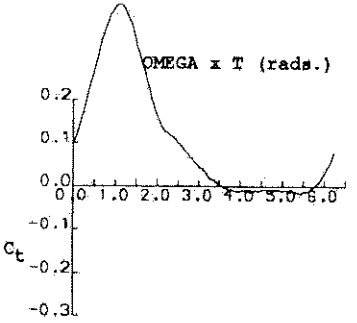


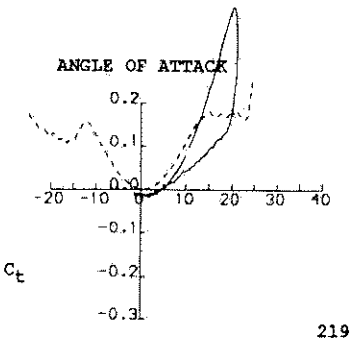








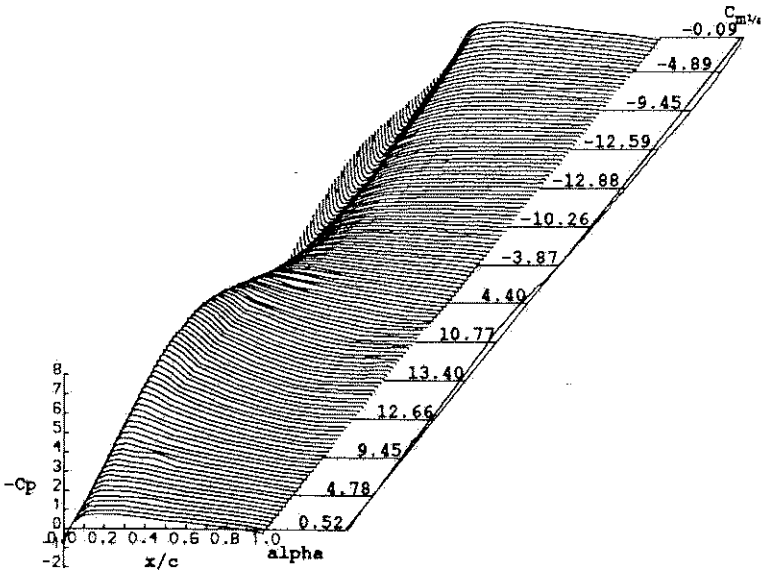


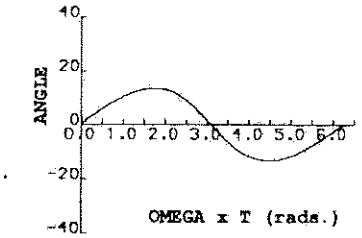


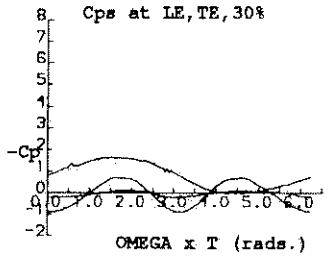
DYNAMIC CHARACTERISTICS FOR THE NACA 0025

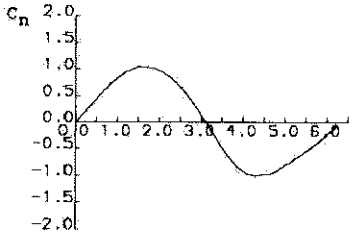
RUN REFERENCE NUMBER: 51371
REYNOLDS NUMBER = 1440617.
DYNAMIC PRESSURE = 1000.62 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: VAWT FUNCTION
MEAN ANGLE = 0.00°
OSCILLATION FREQUENCY = 1.245 Hz.
AVERAGED DATA OF 10 CYCLES

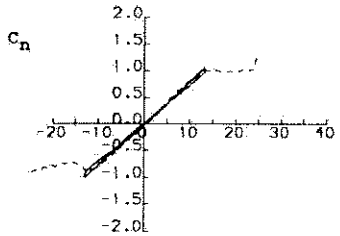
DATE OF TEST: 13/10/88
MACH NUMBER = 0.120
AIR TEMPERATURE = 29.9°C
SAMPLING FREQUENCY = 159.36 Hz.
REDUCED FREQUENCY = 0.051
AMPLITUDE = 13.80°

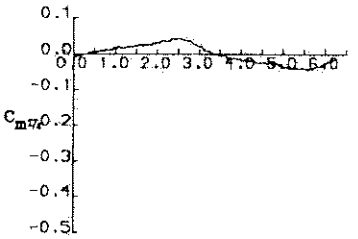


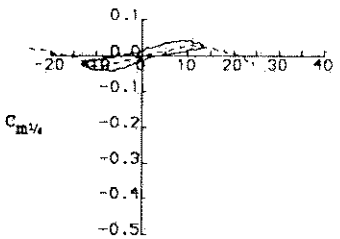


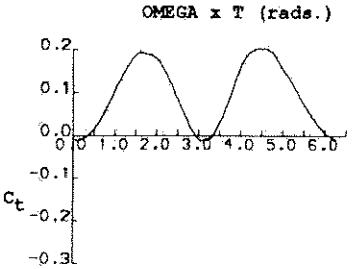


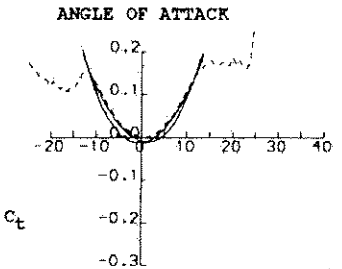








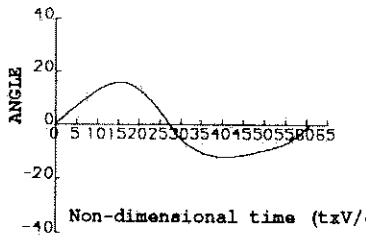


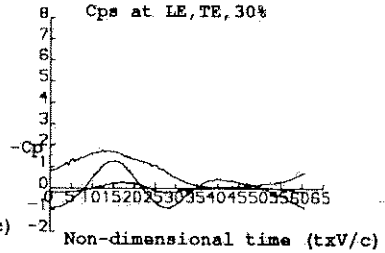


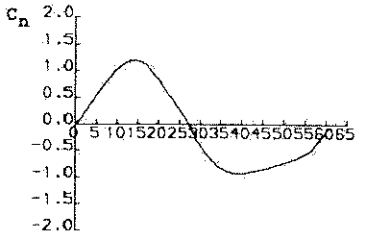
DYNAMIC CHARACTERISTICS FOR THE NACA 0025

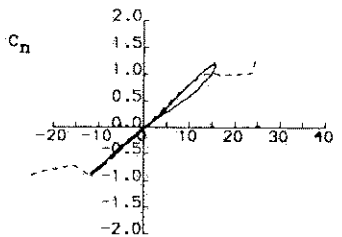
RUN REFERENCE NUMBER: 71851
REYNOLDS NUMBER = 1457941.
DYNAMIC PRESSURE = 1013.76 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: VAWT FUNCTION (MSDD)

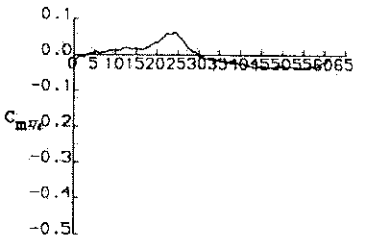
DATE OF TEST: 26/10/88
MACH NUMBER = 0.121
AIR TEMPERATURE = 28.3°C
SAMPLING FREQUENCY = 159.36 Hz.
AVERAGED DATA OF 10 CYCLES

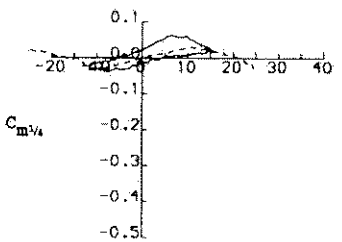


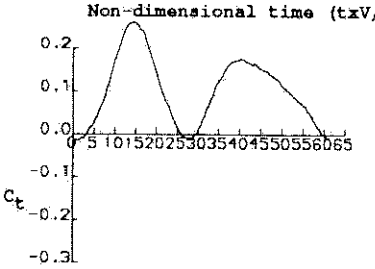


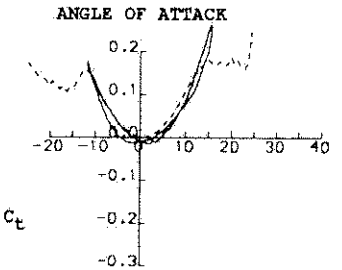


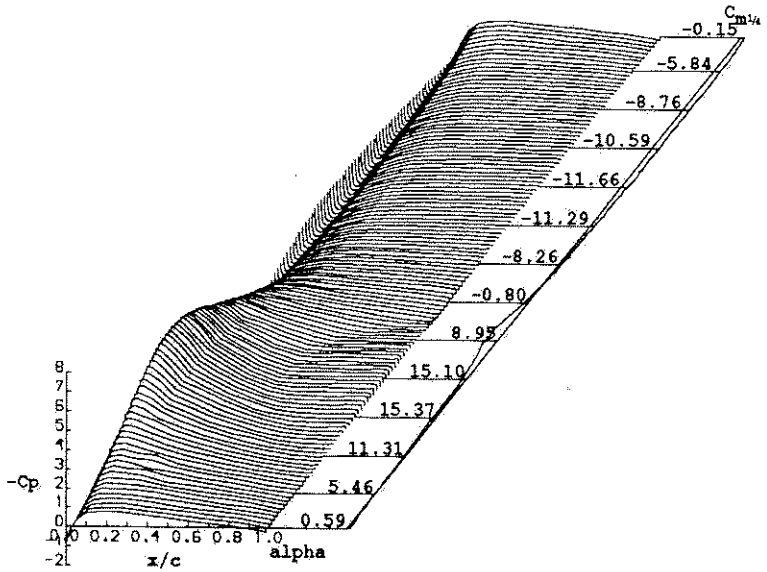












G.U. Aero Report 9221

UNIVERSITY OF GLASGOW

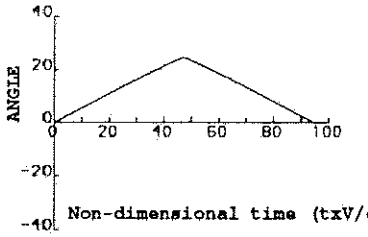
DEPARTMENT OF AEROSPACE ENGINEERING

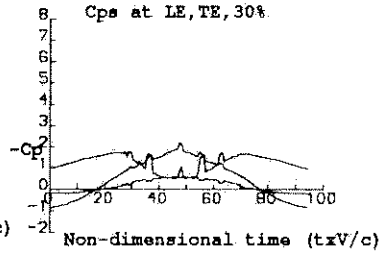
PRESSURE DATA FOR THE NACA 0030 AEROFOIL

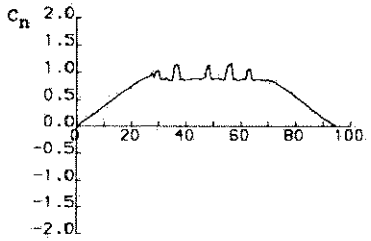
(MODEL 9)

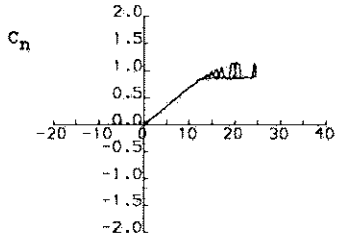
DYNAMIC CHARACTERISTICS FOR THE NACA 0030

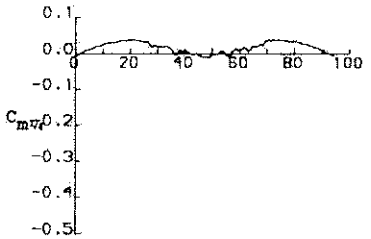
RUN REFERENCE NUMBER: 52
DATE OF TEST: 2/11/88
REYNOLDS NUMBER = 1516593.
MACH NUMBER = 0.120
DYNAMIC PRESSURE = 1001.95 Nm^{-2}
AIR TEMPERATURE = 18.6°C
NUMBER OF CYCLES = 1
SAMPLING FREQUENCY = 100.00 Hz.
MOTION TYPE: STATIC
AVERAGED DATA OF 1 CYCLES

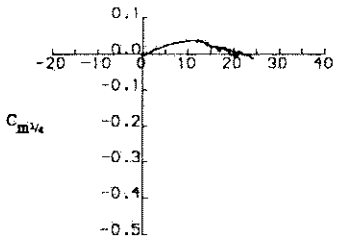


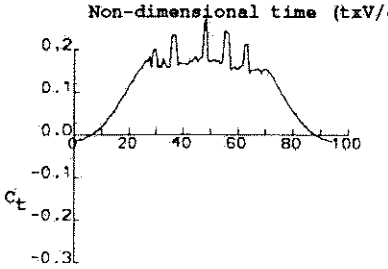


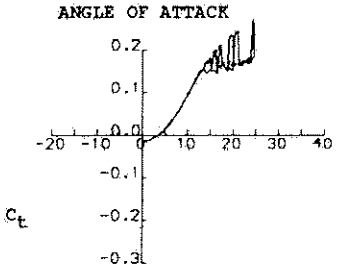


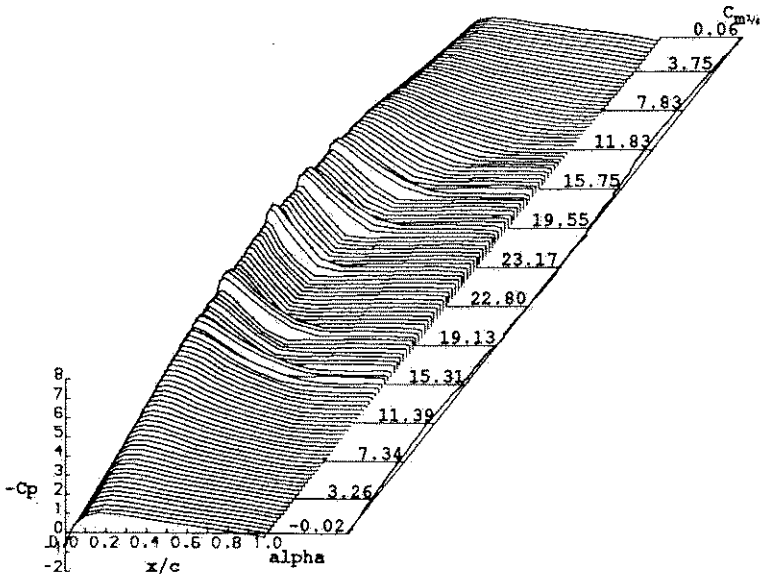








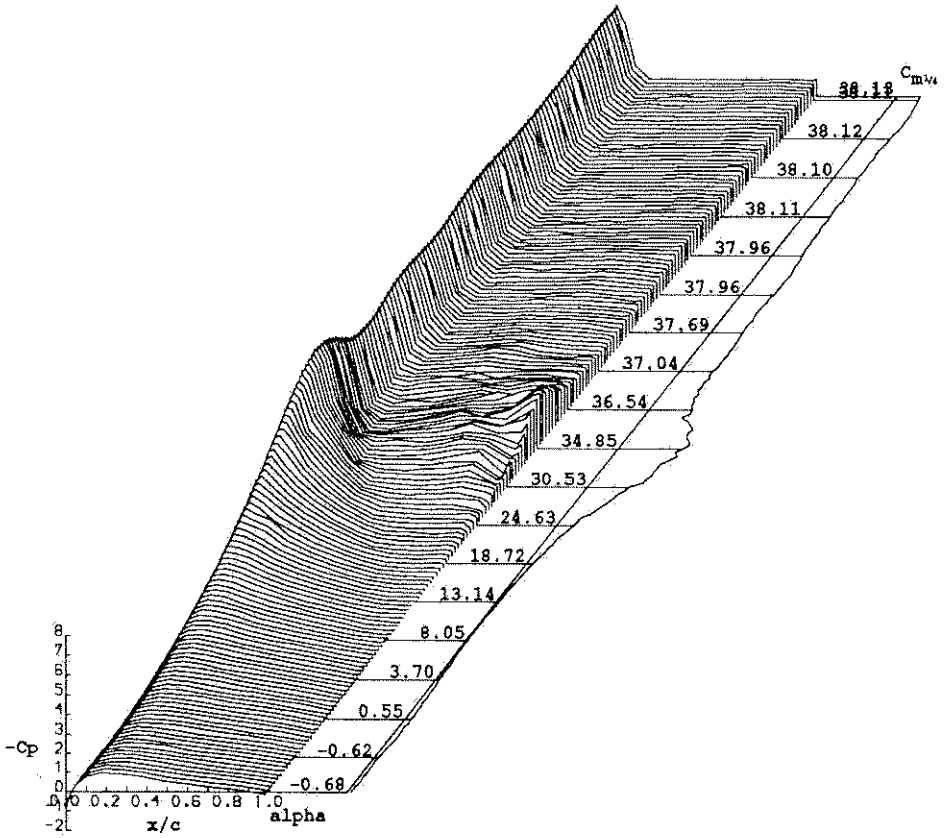


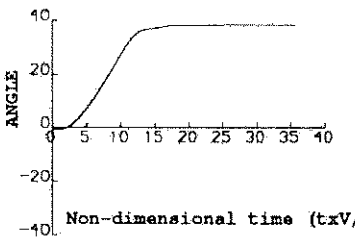


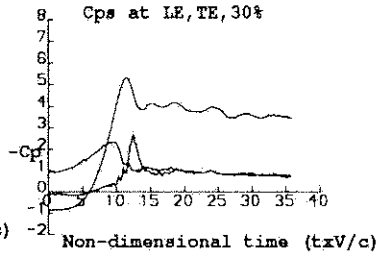
DYNAMIC CHARACTERISTICS FOR THE NACA 0030

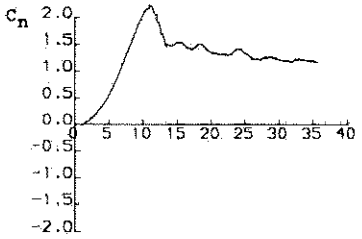
RUN REFERENCE NUMBER: 25611
REYNOLDS NUMBER = 1435494.
DYNAMIC PRESSURE = 1013.42 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

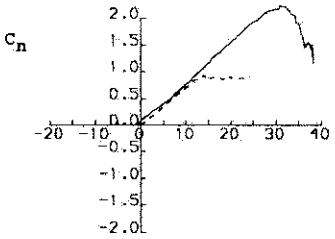
DATE OF TEST: 30/11/88
MACH NUMBER = 0.121
AIR TEMPERATURE = 31.3°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03437
LINEAR PITCH RATE = 303.00°s^{-1}

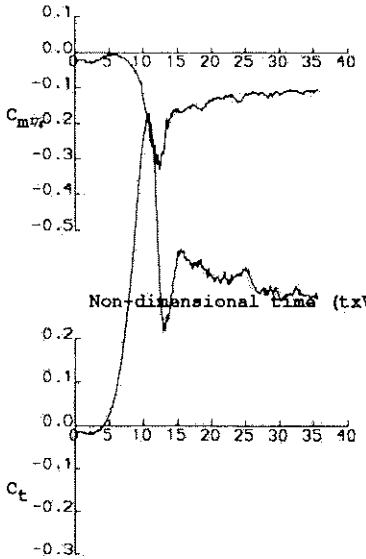


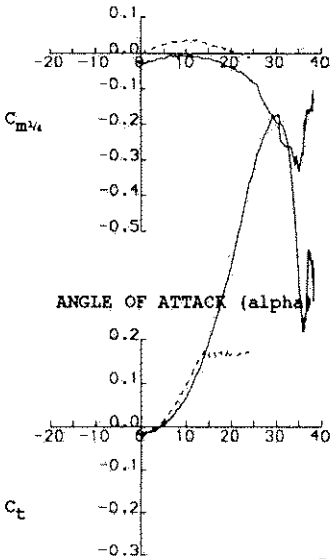






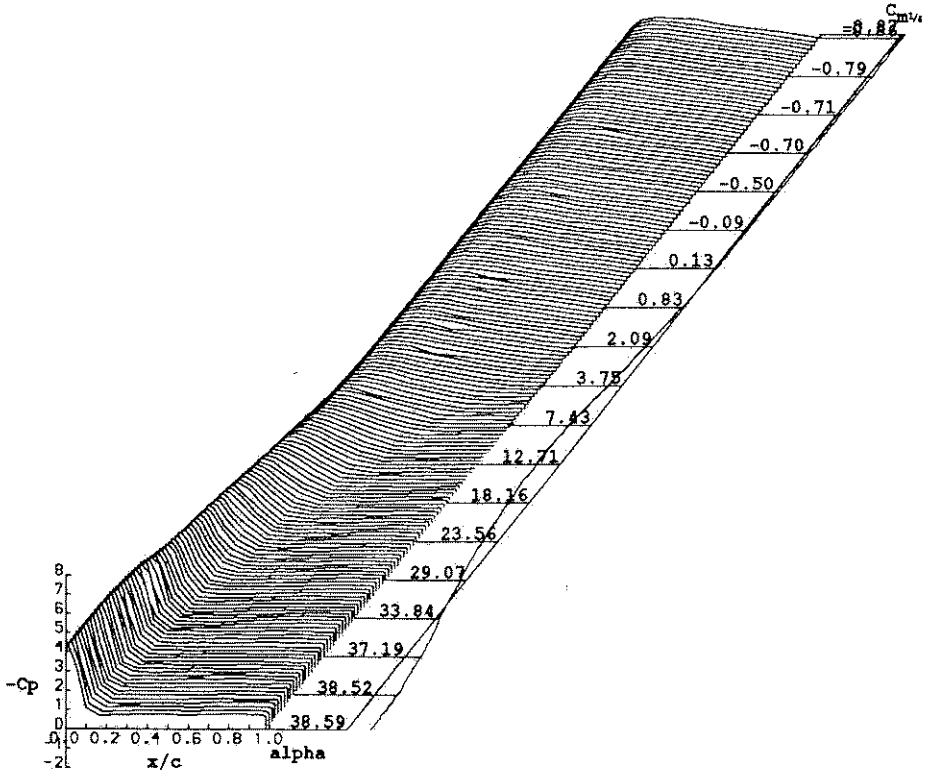


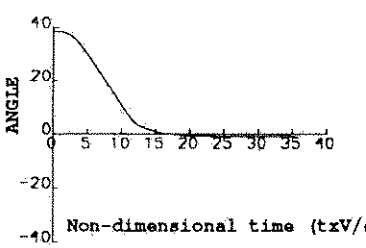


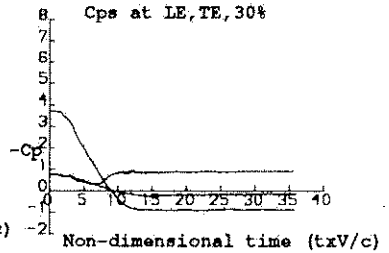


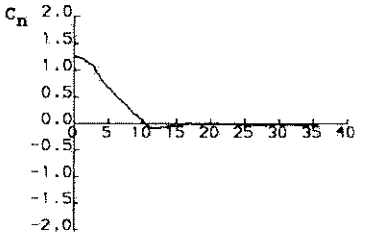
DYNAMIC CHARACTERISTICS FOR THE NACA 0030

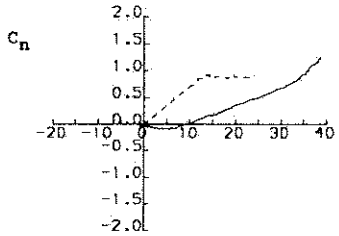
RUN REFERENCE NUMBER: 36621
DATE OF TEST: 30/11/88
REYNOLDS NUMBER = 1450268.
MACH NUMBER = 0.121
DYNAMIC PRESSURE = 1021.41 Nm^{-2}
AIR TEMPERATURE = 29.8°C
NUMBER OF CYCLES = 5
SAMPLING FREQUENCY = 550.05 Hz.
MOTION TYPE: RAMP DOWN
REDUCED PITCH RATE = -0.03380
START ANGLE = 40.00°
LINEAR PITCH RATE = -298.46°S^{-1}
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

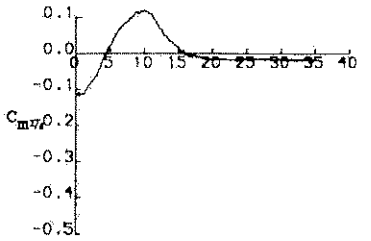


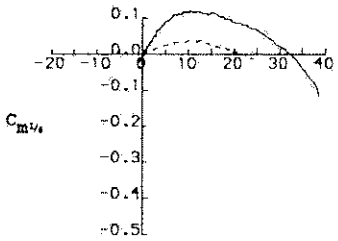


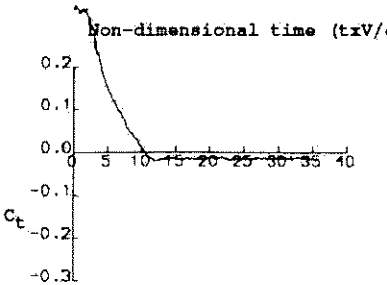


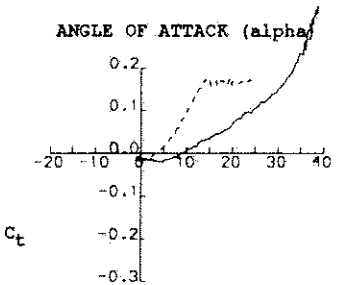








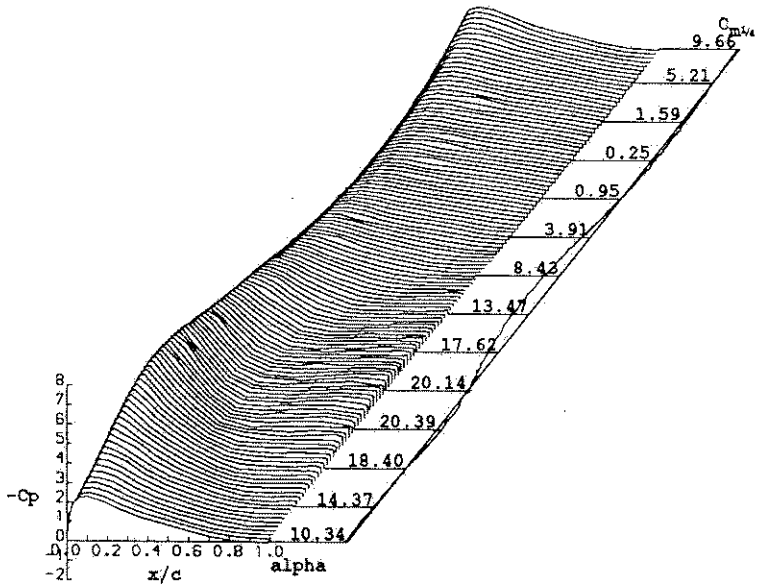


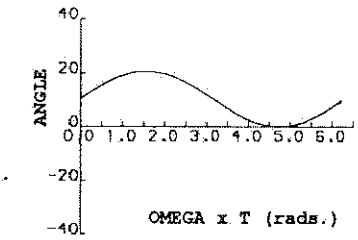


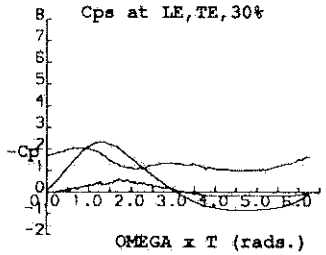
DYNAMIC CHARACTERISTICS FOR THE NACA 0030

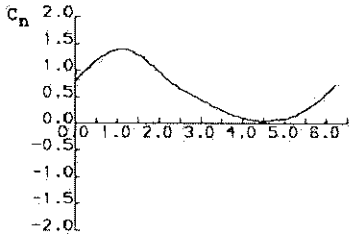
RUN REFERENCE NUMBER: 12191
REYNOLDS NUMBER = 1511944.
DYNAMIC PRESSURE = 1016.05 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.448 Hz.
AVERAGED DATA OF 10 CYCLES

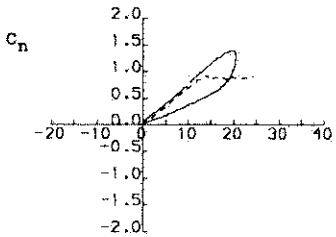
DATE OF TEST: 27/11/88
MACH NUMBER = 0.120
AIR TEMPERATURE = 21.5°C
SAMPLING FREQUENCY = 313.38 Hz.
REDUCED FREQUENCY = 0.102
AMPLITUDE = 10.00°

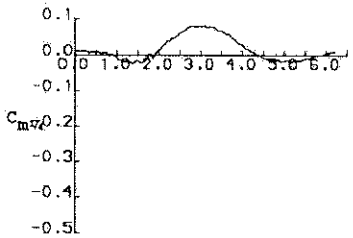


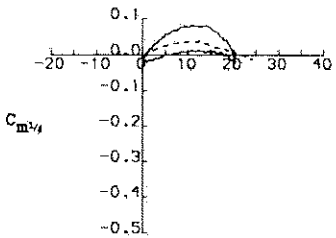


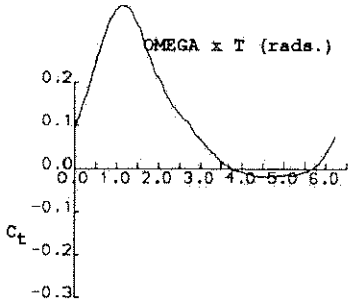


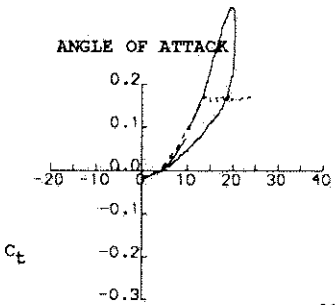






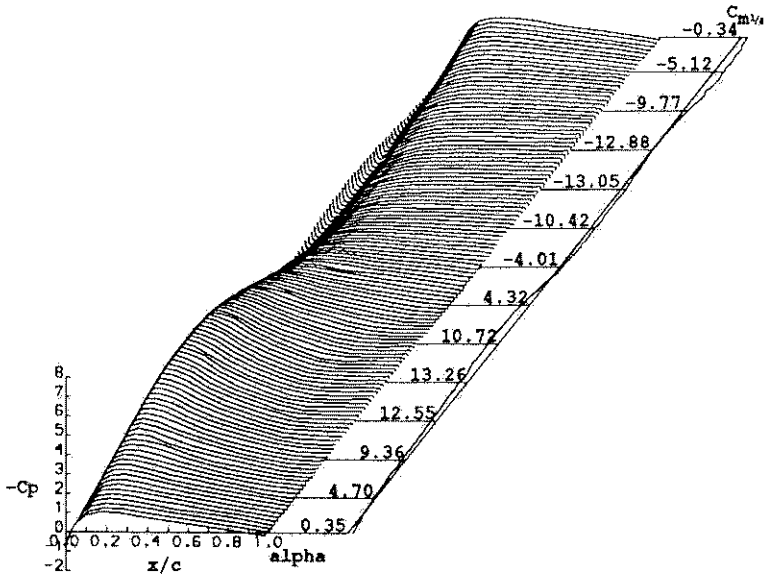


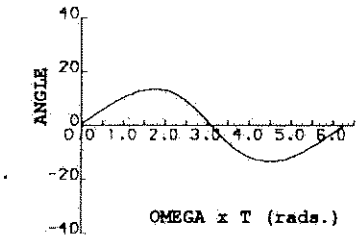


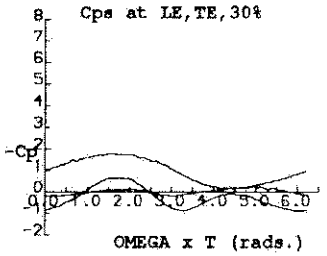


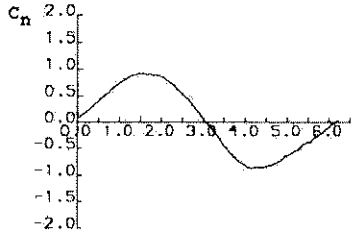
DYNAMIC CHARACTERISTICS FOR THE NACA 0030

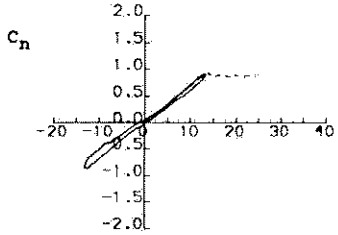
RUN REFERENCE NUMBER: 51371
DATE OF TEST: 2/11/88
REYNOLDS NUMBER = 1466204.
MACH NUMBER = 0.120
DYNAMIC PRESSURE = 1014.14 Nm^{-2}
AIR TEMPERATURE = 27.8°C
NUMBER OF CYCLES = 10
SAMPLING FREQUENCY = 157.31 Hz.
MOTION TYPE: VAWT FUNCTION
REDUCED FREQUENCY = 0.051
MEAN ANGLE = 0.00°
AMPLITUDE = 13.80°
OSCILLATION FREQUENCY = 1.229 Hz.
AVERAGED DATA OF 10 CYCLES

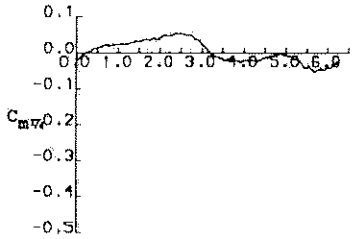


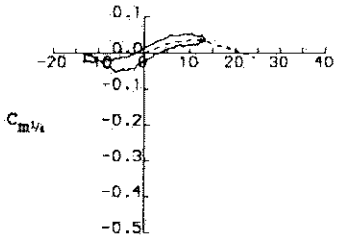


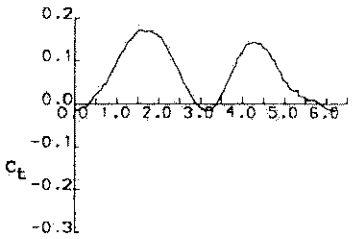


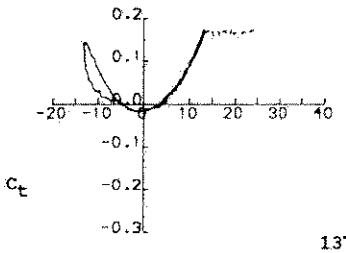








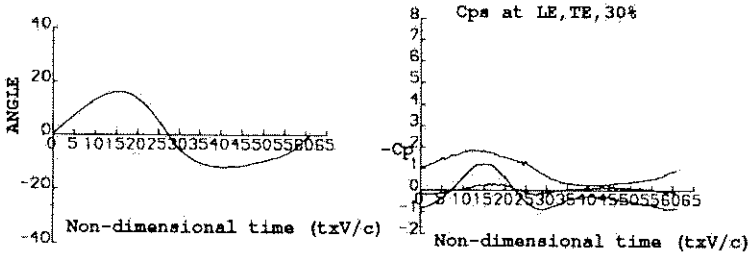


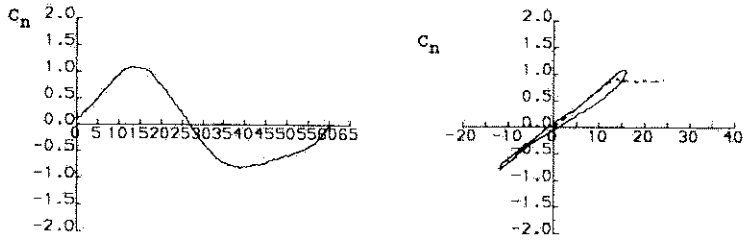


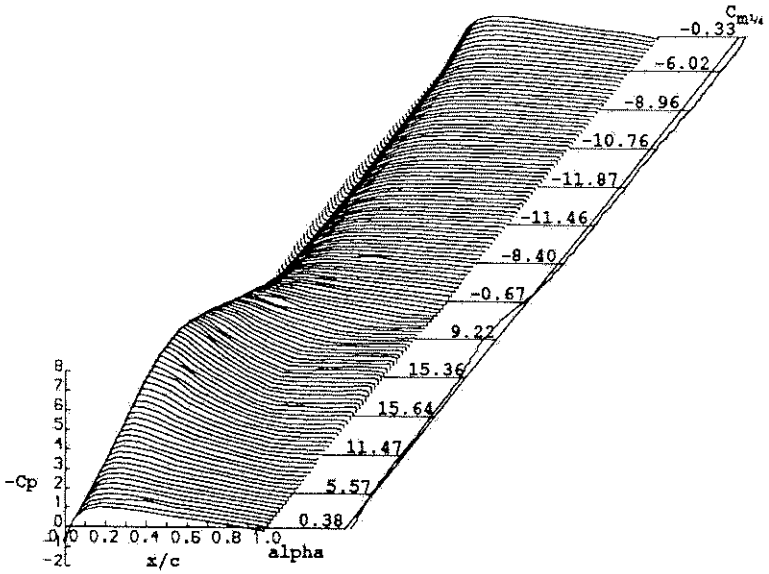
DYNAMIC CHARACTERISTICS FOR THE NACA 0030

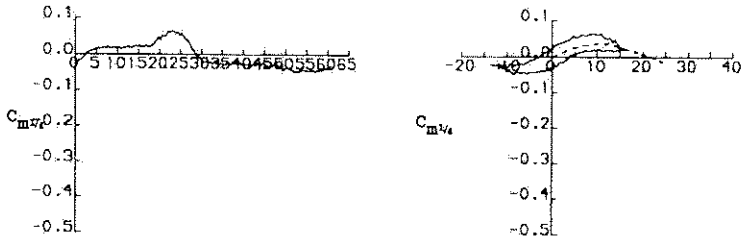
RUN REFERENCE NUMBER: 71851
REYNOLDS NUMBER = 1436653.
DYNAMIC PRESSURE = 1010.48 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: VAWT FUNCTION (MSDD)

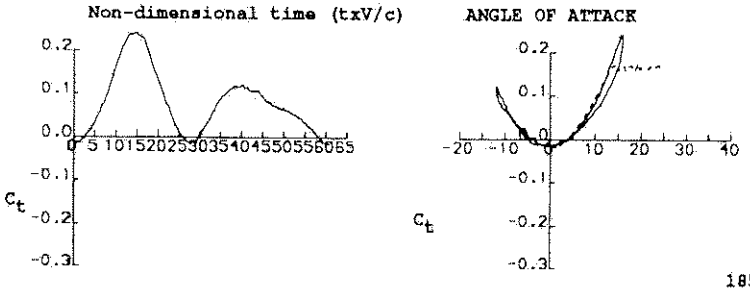
DATE OF TEST: 2/11/88
MACH NUMBER = 0.120
AIR TEMPERATURE = 32.2°C
SAMPLING FREQUENCY = 159.36 Hz.
AVERAGED DATA OF 10 CYCLES











G.U. Aero Report 9221

UNIVERSITY OF GLASGOW

DEPARTMENT OF AEROSPACE ENGINEERING

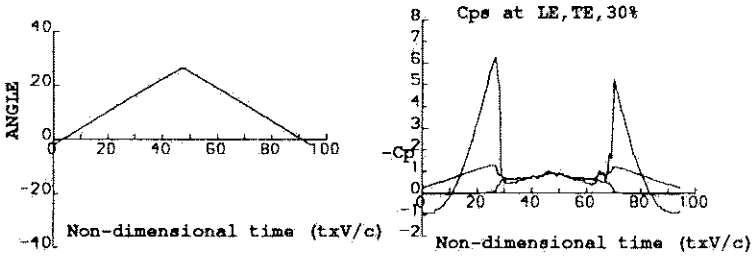
PRESSURE DATA FOR THE

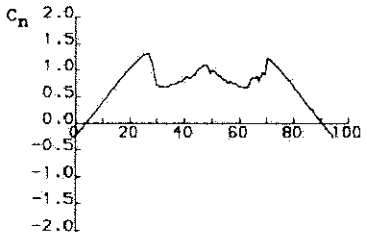
NACA 0012 AEROFOIL

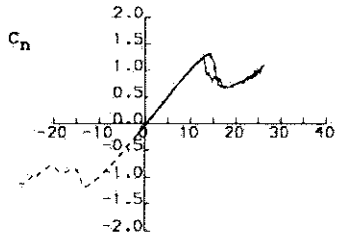
(MODEL 11)

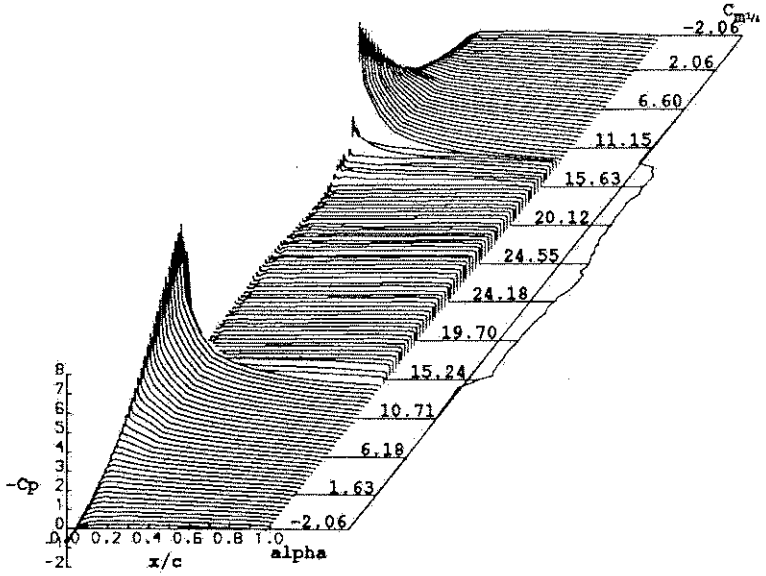
DYNAMIC CHARACTERISTICS FOR THE NACA 0012

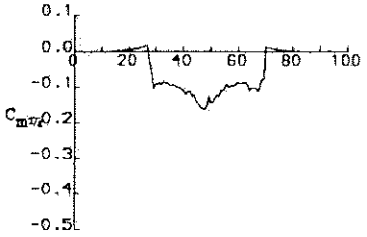
RUN REFERENCE NUMBER: 851
DATE OF TEST: 18/12/90
REYNOLDS NUMBER = 1472072.
MACH NUMBER = 0.118
DYNAMIC PRESSURE = 995.51 Nm^{-2}
AIR TEMPERATURE = 26.9°C
NUMBER OF CYCLES = 1
SAMPLING FREQUENCY = 100.00 Hz.
MOTION TYPE: STATIC
AVERAGED DATA OF 1 CYCLES

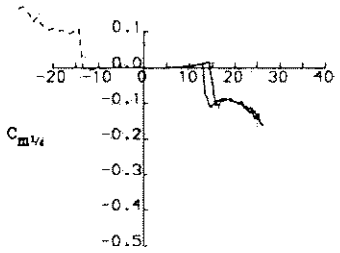


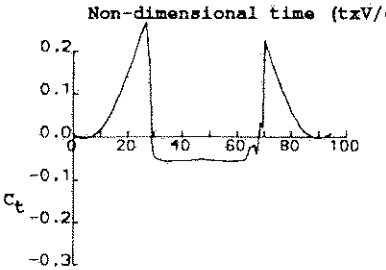


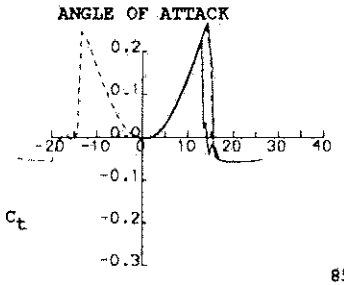






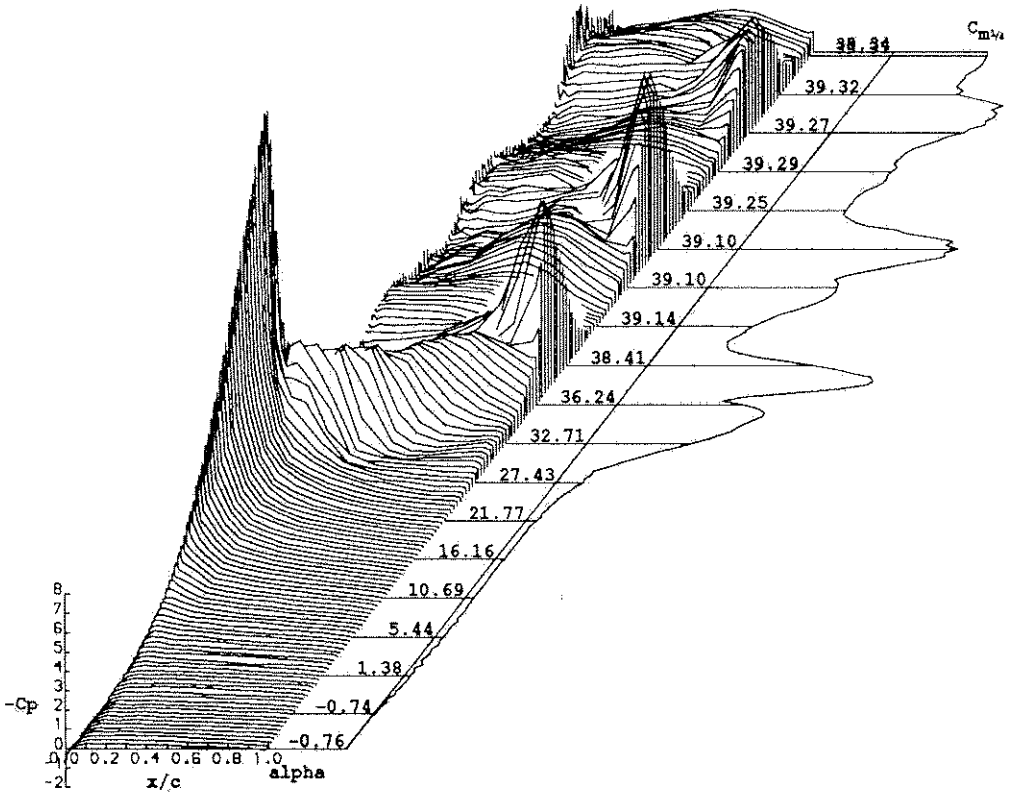


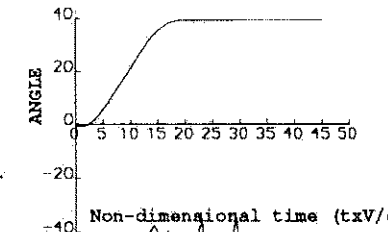


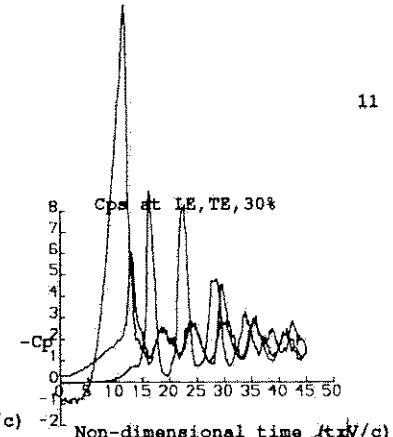


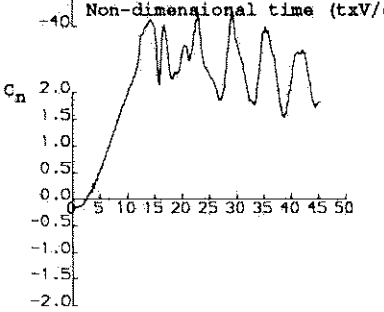
DYNAMIC CHARACTERISTICS FOR THE NACA 0012

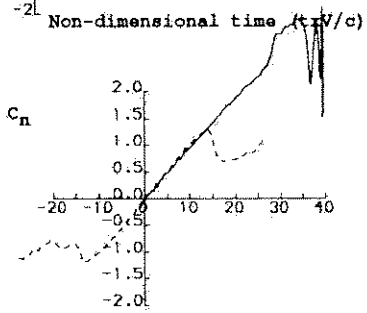
RUN REFERENCE NUMBER: 20112
DATE OF TEST: 17/1/91
REYNOLDS NUMBER = 789772.
MACH NUMBER = 0.120
DYNAMIC PRESSURE = 1011.12 Nm^{-2}
AIR TEMPERATURE = ****°C
NUMBER OF CYCLES = 5
SAMPLING FREQUENCY = 550.05 Hz.
MOTION TYPE: RAMP UP
REDUCED PITCH RATE = 0.02697
START ANGLE = -1.00°
LINEAR PITCH RATE = 301.08°S^{-1}
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

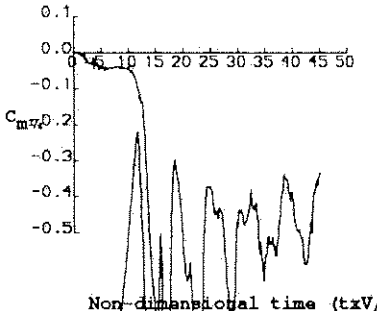


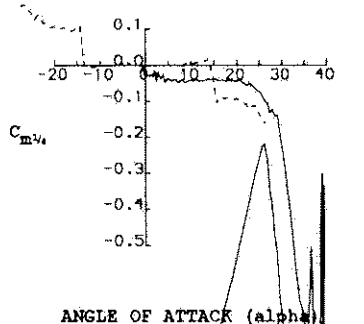


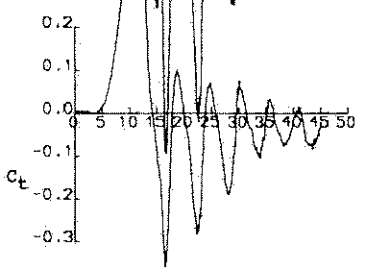


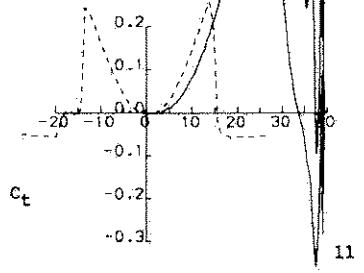








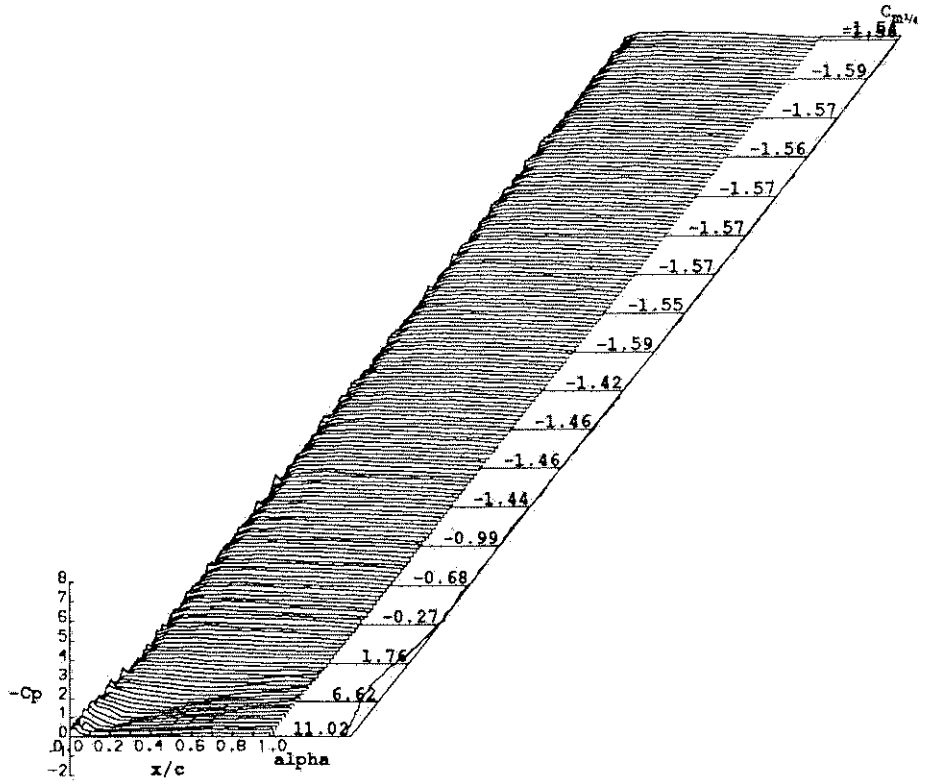


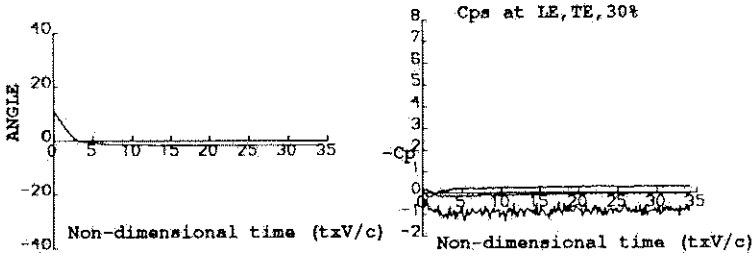


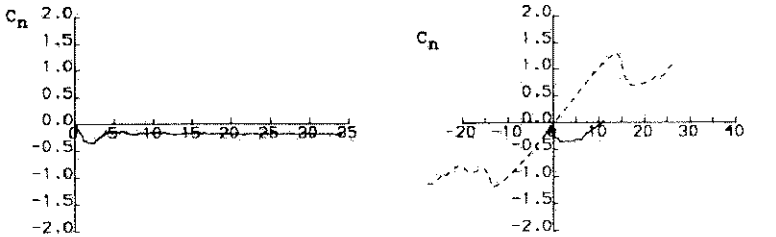
DYNAMIC CHARACTERISTICS FOR THE NACA 0012

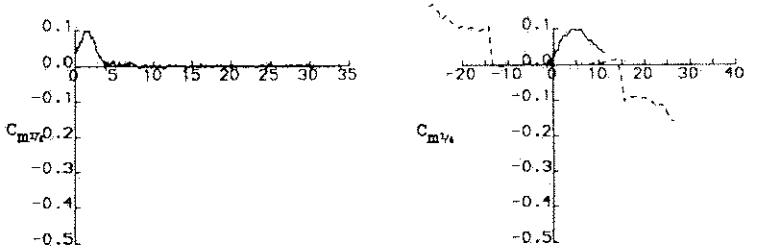
RUN REFERENCE NUMBER: 30401
REYNOLDS NUMBER = 1484219.
DYNAMIC PRESSURE = 986.39 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 40.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

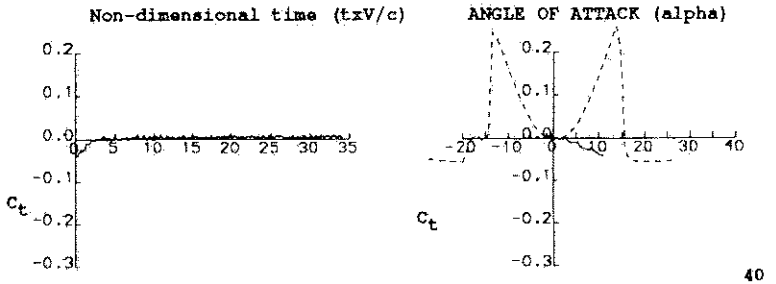
DATE OF TEST: 17/12/90
MACH NUMBER = 0.117
AIR TEMPERATURE = 24.7°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.03627
LINEAR PITCH RATE = $-306.22°s^{-1}$







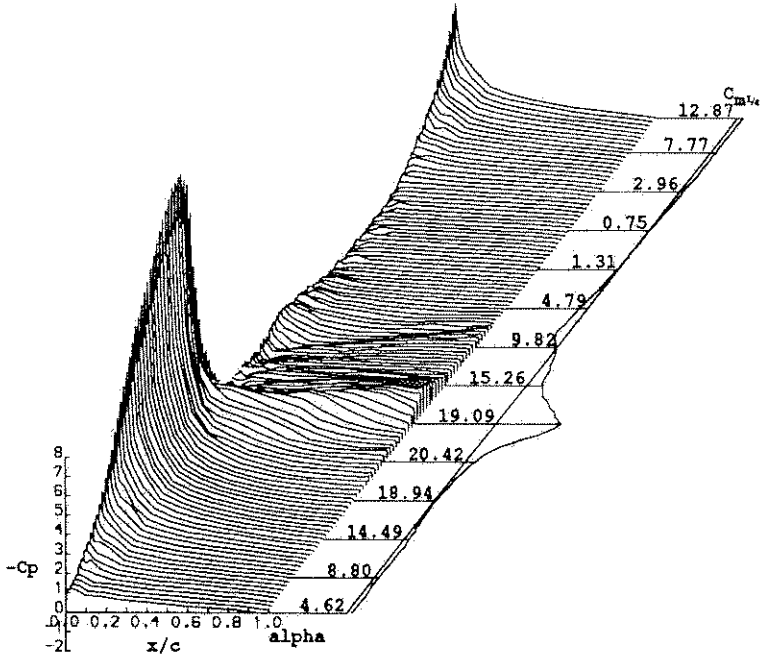


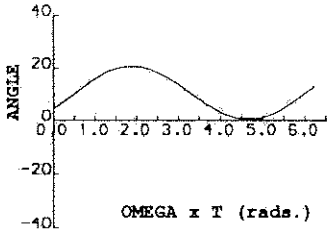


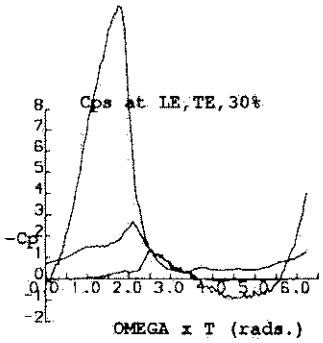
DYNAMIC CHARACTERISTICS FOR THE NACA 0012

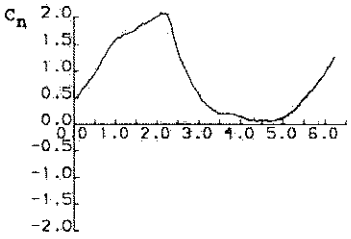
RUN REFERENCE NUMBER: 12161
REYNOLDS NUMBER = 1500675.
DYNAMIC PRESSURE = 992.64 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.330 Hz.
AVERAGED DATA OF 10 CYCLES

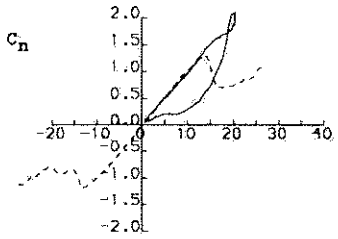
DATE OF TEST: 24/1/91
MACH NUMBER = 0.117
AIR TEMPERATURE = 23.7°C
SAMPLING FREQUENCY = 298.24 Hz.
REDUCED FREQUENCY = 0.100
AMPLITUDE = 10.00°

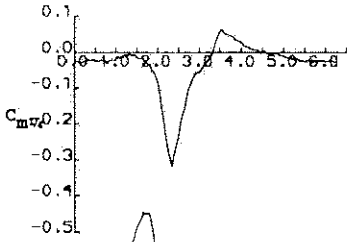


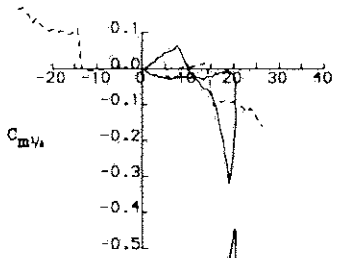


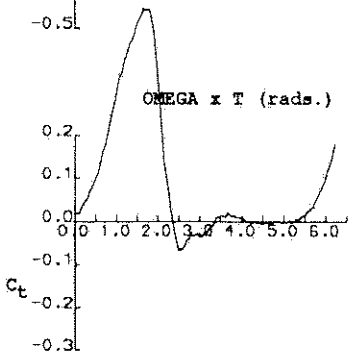


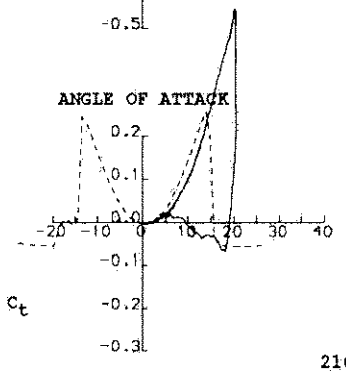












G.U. Aero Report 9221

UNIVERSITY OF GLASGOW

DEPARTMENT OF AEROSPACE ENGINEERING

PRESSURE DATA FOR THE

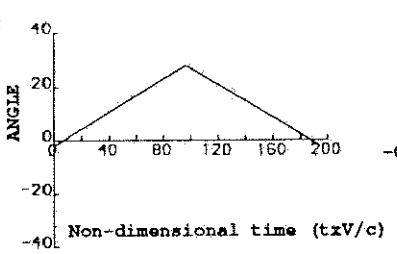
NACA 0015 AEROFOIL WITH CHORD OF LENGTH 0.275m

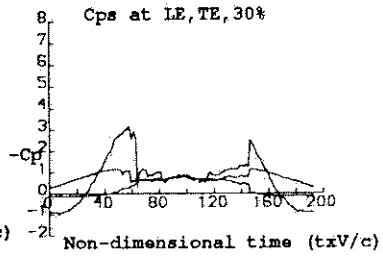
(MODEL 12)

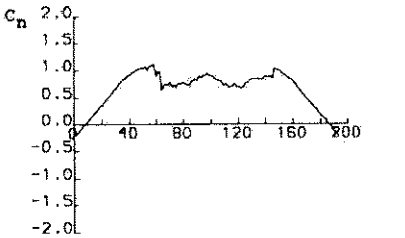
DYNAMIC CHARACTERISTICS FOR THE NACA 0015 - half chord

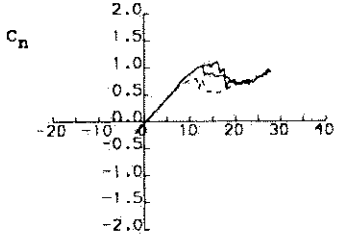
RUN REFERENCE NUMBER: 551
REYNOLDS NUMBER = 763537.
DYNAMIC PRESSURE = 1049.04 Nm^{-2}
NUMBER OF CYCLES = 1
MOTION TYPE: STATIC

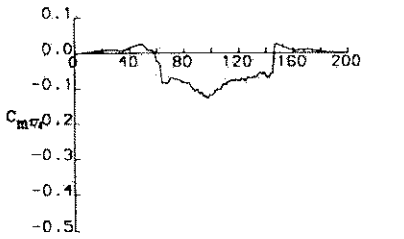
DATE OF TEST: 14/8/91
MACH NUMBER = 0.122
AIR TEMPERATURE = 23.8°C
SAMPLING FREQUENCY = 100.00 Hz.
AVERAGED DATA OF 1 CYCLES

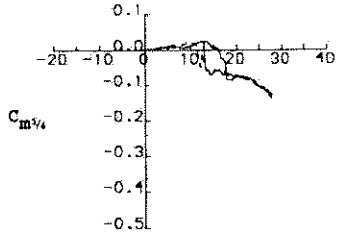


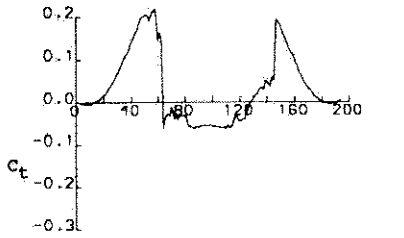


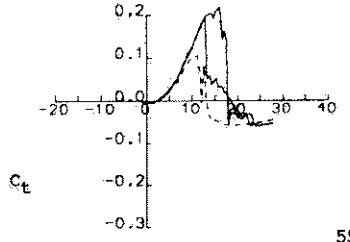


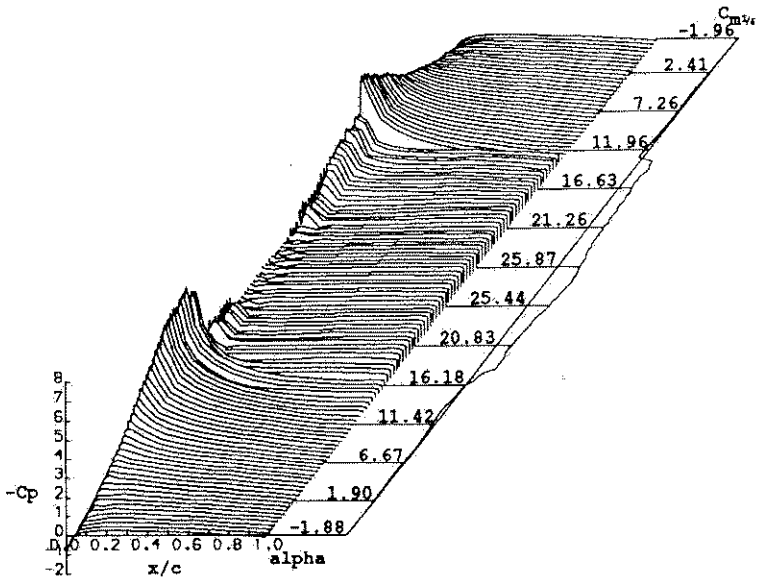








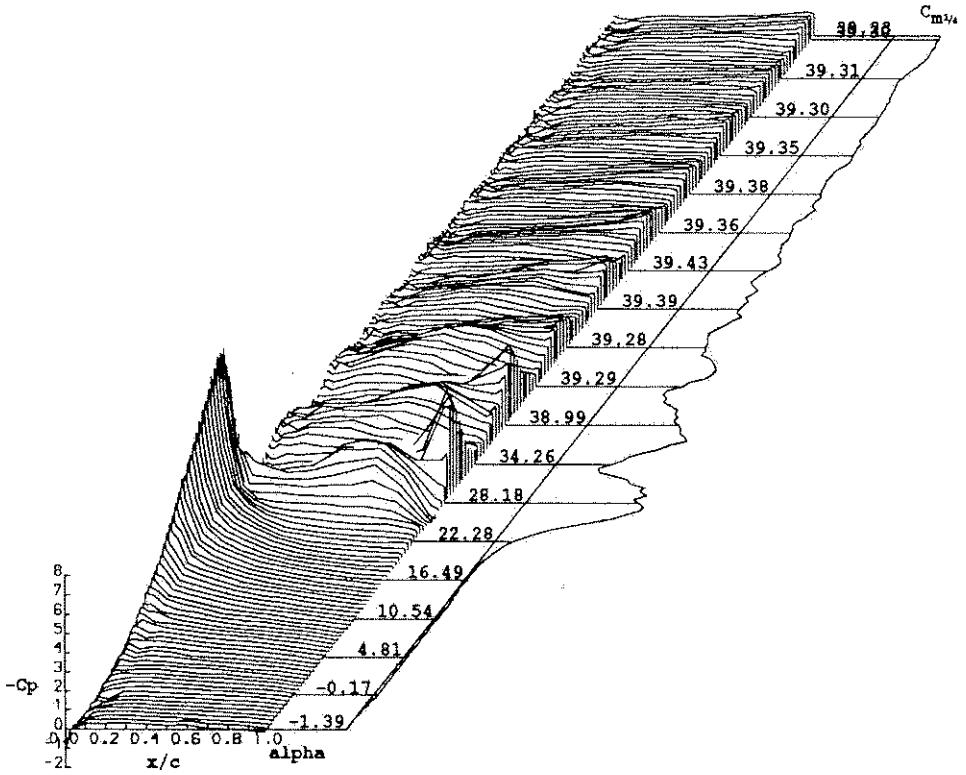


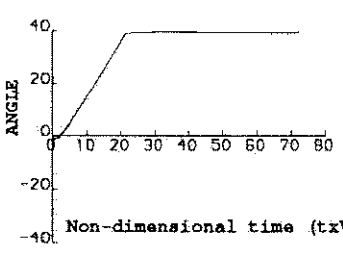


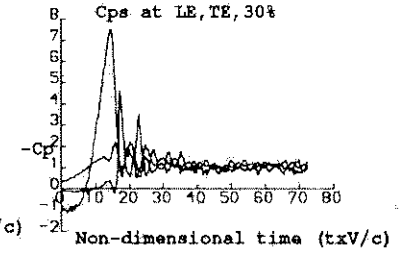
DYNAMIC CHARACTERISTICS FOR THE NACA 0015 - half chord

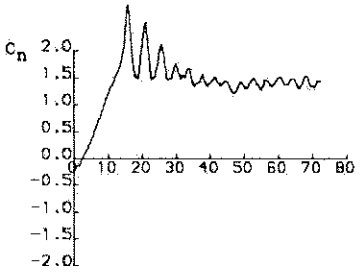
RUN REFERENCE NUMBER: 20153
REYNOLDS NUMBER = 763687.
DYNAMIC PRESSURE = 1086.48 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

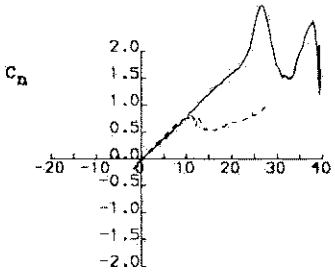
DATE OF TEST: 2/8/91
MACH NUMBER = 0.124
AIR TEMPERATURE = 28.0°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.01786
LINEAR PITCH RATE = 320.08°S^{-1}

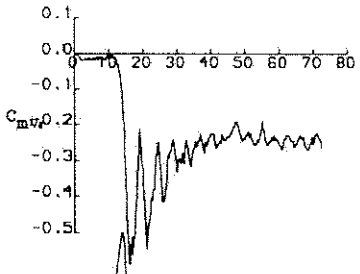


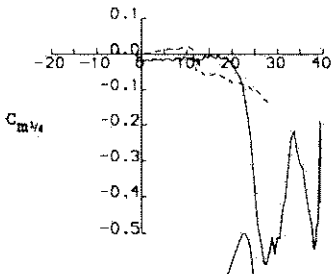


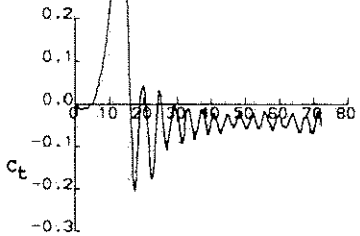


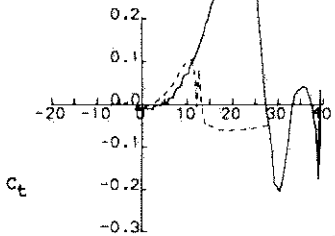








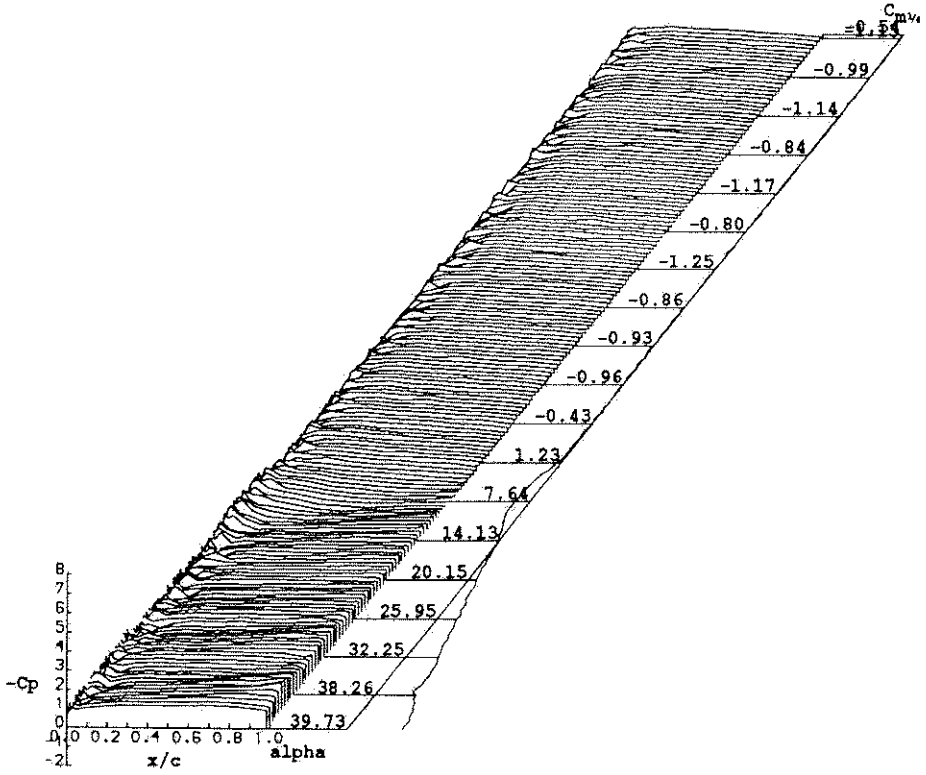


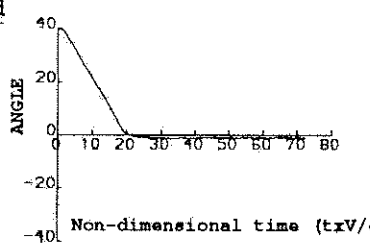


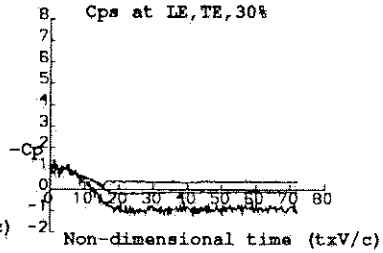
DYNAMIC CHARACTERISTICS FOR THE NACA 0015 - half chord

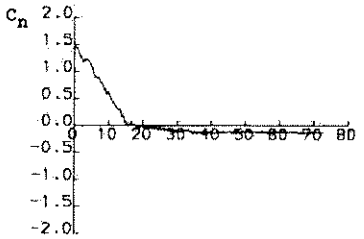
RUN REFERENCE NUMBER: 30363
REYNOLDS NUMBER = 768591.
DYNAMIC PRESSURE = 1084.85 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 40.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

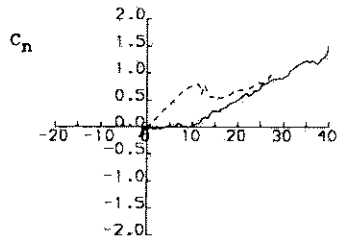
DATE OF TEST: 5/8/91
MACH NUMBER = 0.124
AIR TEMPERATURE = 25.4°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.01826
LINEAR PITCH RATE = -326.85°S^{-1}

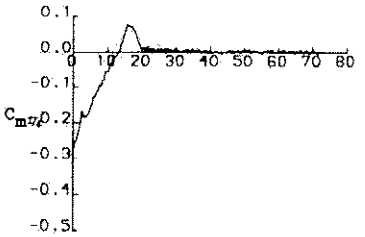


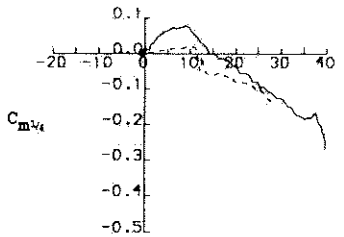






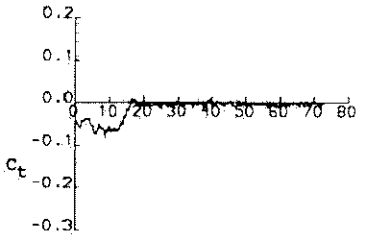


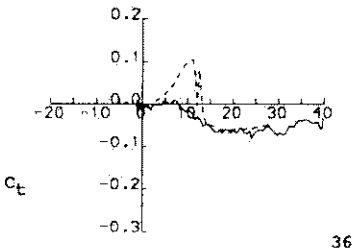




Non-dimensional time (txV/c)

ANGLE OF ATTACK (alpha)

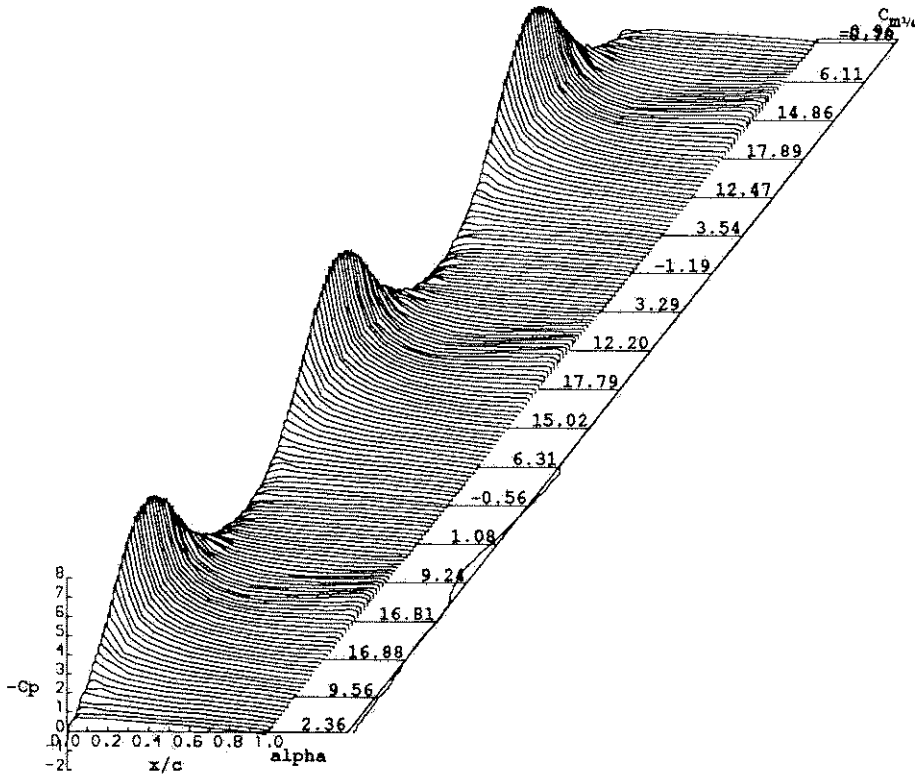


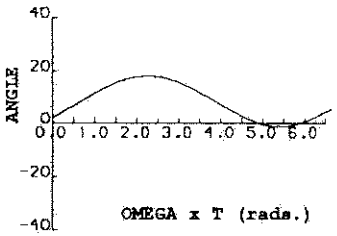


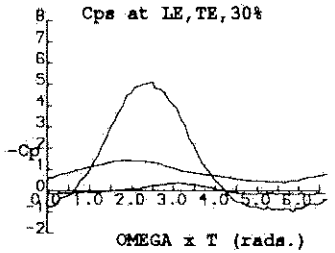
DYNAMIC CHARACTERISTICS FOR THE NACA 0015 - half chord

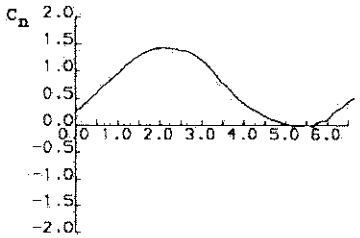
RUN REFERENCE NUMBER: 10722
REYNOLDS NUMBER = 824542.
DYNAMIC PRESSURE = 1209.63 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 8.00°
OSCILLATION FREQUENCY = 8.700 Hz.
AVERAGED DATA OF 10 CYCLES

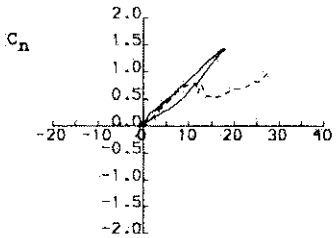
DATE OF TEST: 26/8/91
MACH NUMBER = 0.130
AIR TEMPERATURE = 23.1°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED FREQUENCY = 0.168
AMPLITUDE = 10.00°

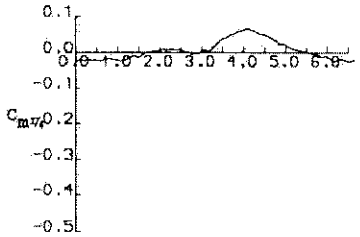


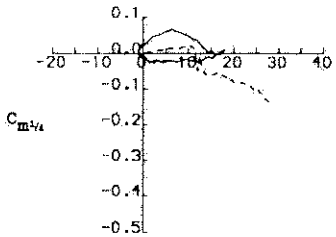


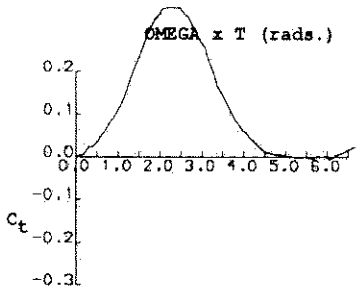


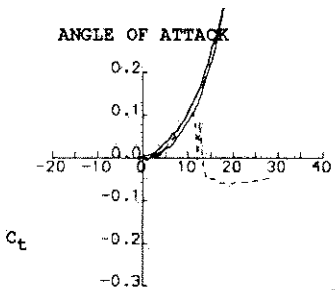








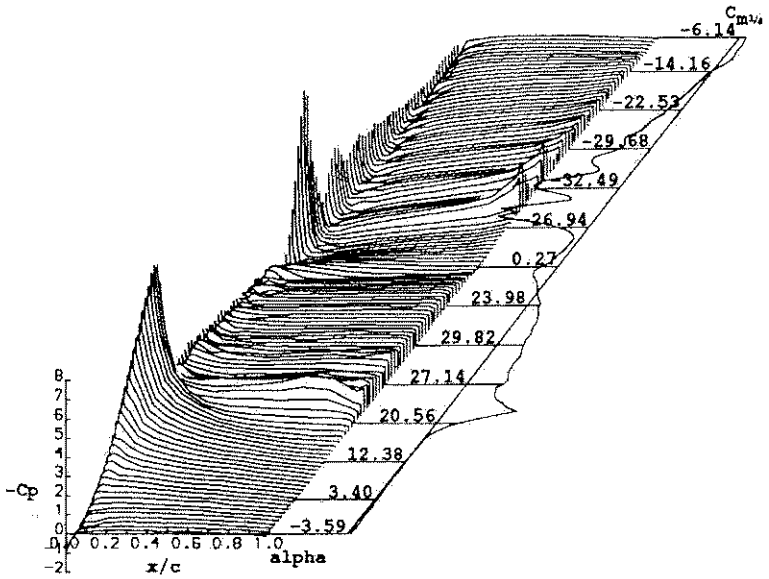


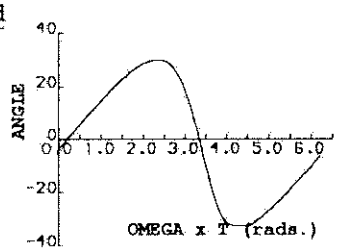


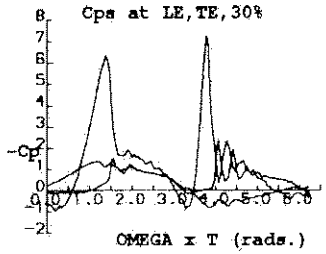
DYNAMIC CHARACTERISTICS FOR THE NACA 0015 - half chord

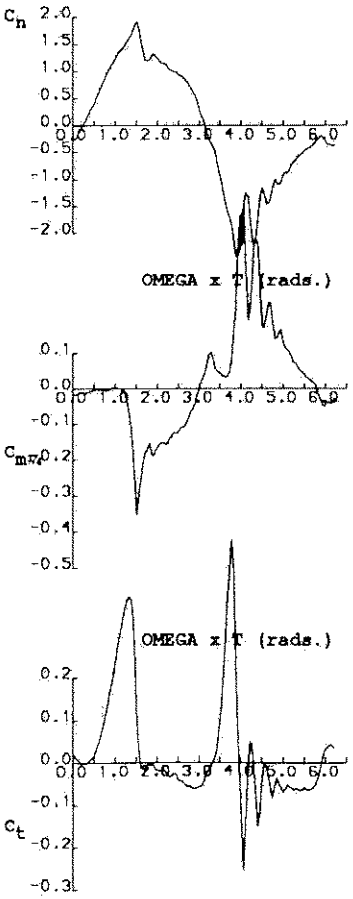
RUN REFERENCE NUMBER: 51701
REYNOLDS NUMBER = 1578187.
DYNAMIC PRESSURE = 1094.48 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: VAWT FUNCTION
MEAN ANGLE = 0.00°
OSCILLATION FREQUENCY = 1.870 Hz.
AVERAGED DATA OF 10 CYCLES

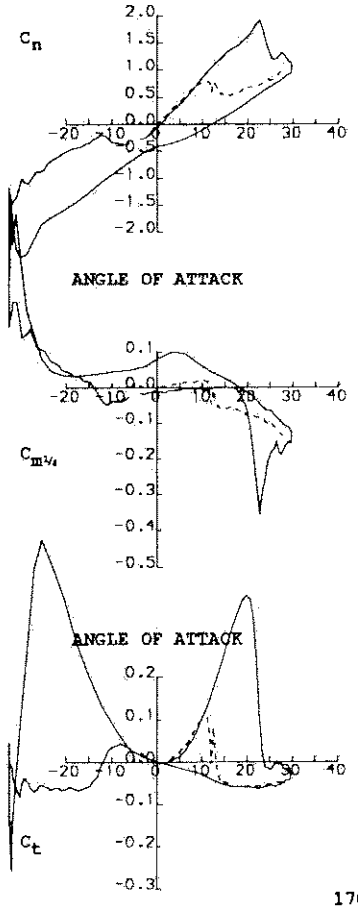
DATE OF TEST: 5/9/91
MACH NUMBER = 0.123
AIR TEMPERATURE = 22.6°C
SAMPLING FREQUENCY = 239.35 Hz.
REDUCED FREQUENCY = 0.076
AMPLITUDE = 1.75°











G.U. Aero Report 9221

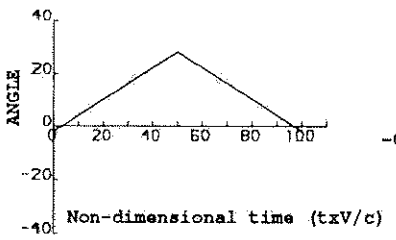
UNIVERSITY OF GLASGOW

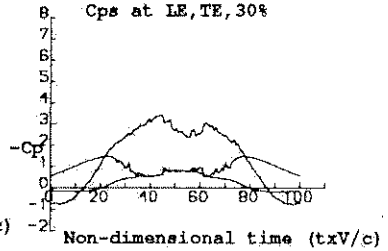
DEPARTMENT OF AEROSPACE ENGINEERING

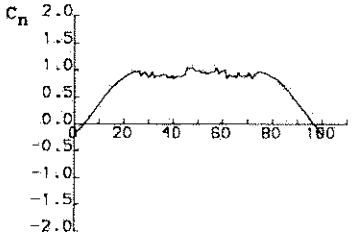
PRESSURE DATA FOR THE AHAVAW AEROFOIL (MODEL 13)

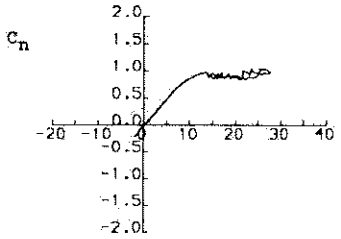
DYNAMIC CHARACTERISTICS FOR THE AHAVAW - VAWT Model

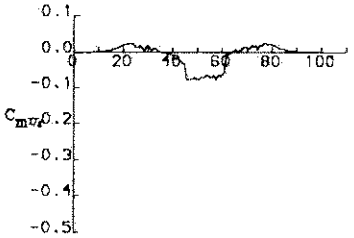
RUN REFERENCE NUMBER: 11
DATE OF TEST: 4/11/91
REYNOLDS NUMBER = 1599672.
MACH NUMBER = 0.127
DYNAMIC PRESSURE = 1121.96 Nm^{-2}
AIR TEMPERATURE = 18.5°C
NUMBER OF CYCLES = 1
SAMPLING FREQUENCY = 100.00 Hz.
MOTION TYPE: STATIC
AVERAGED DATA OF 1 CYCLES

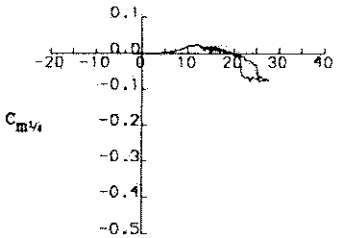


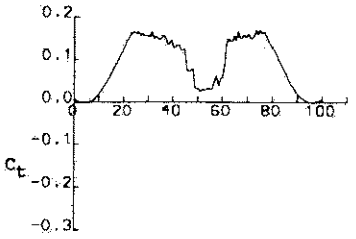


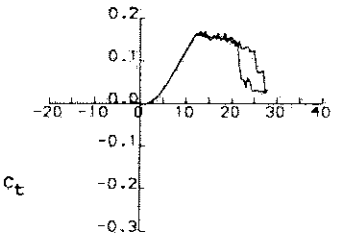


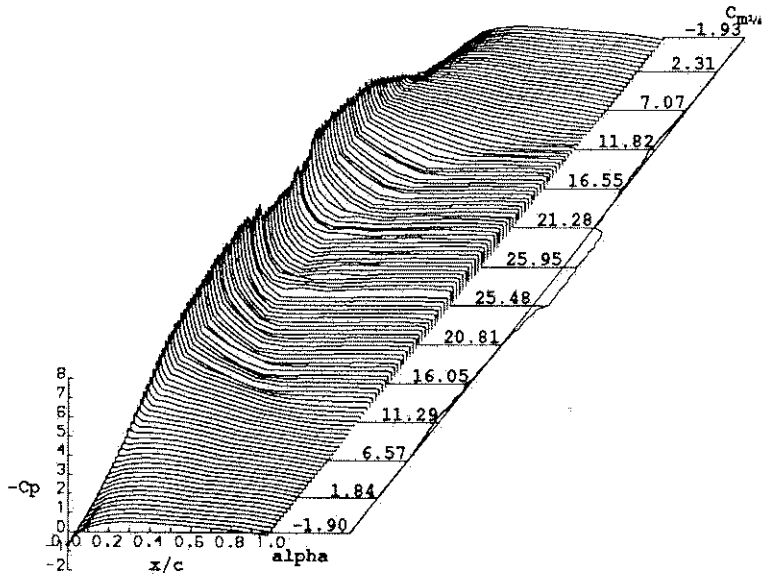








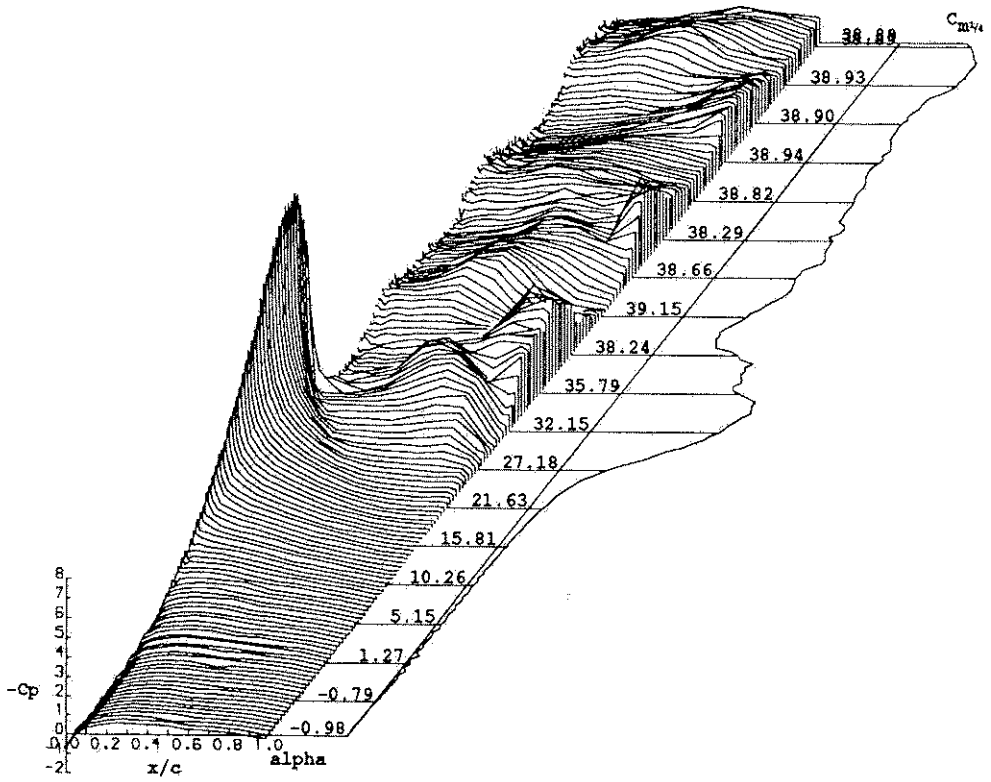


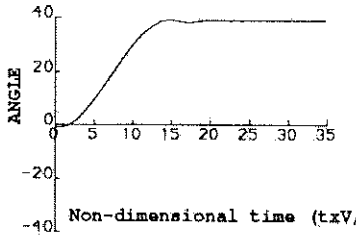


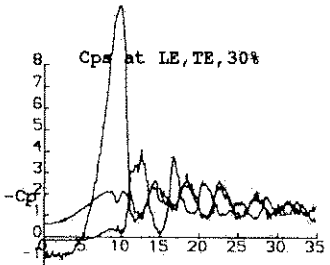
DYNAMIC CHARACTERISTICS FOR THE AHAVAW - VAWT Model

RUN REFERENCE NUMBER: 20701
REYNOLDS NUMBER = 1467846.
DYNAMIC PRESSURE = 1002.41 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

DATE OF TEST: 5/11/91
MACH NUMBER = 0.119
AIR TEMPERATURE = 27.3°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03609
LINEAR PITCH RATE = 310.95°S^{-1}

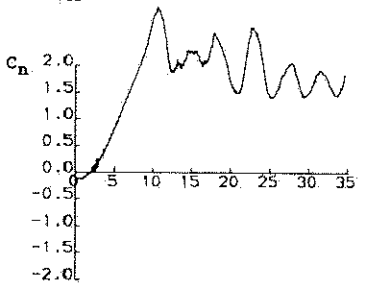


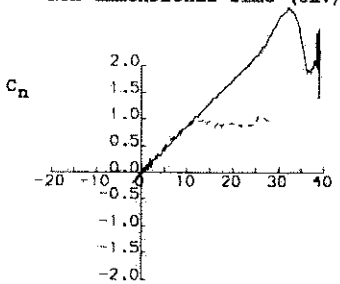




Non-dimensional time (txV/c)

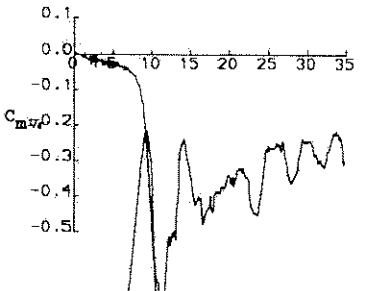
Non-dimensional time (txV/c)

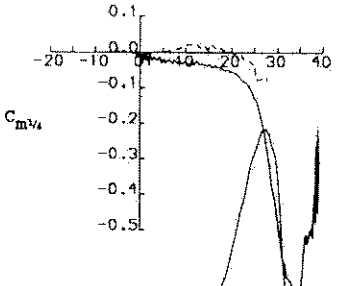




Non-dimensional time (txV/c)

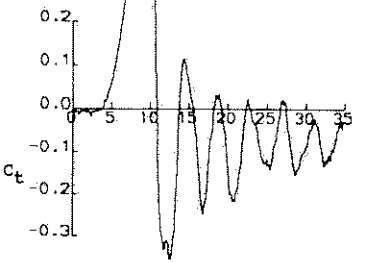
ANGLE OF ATTACK (alpha)

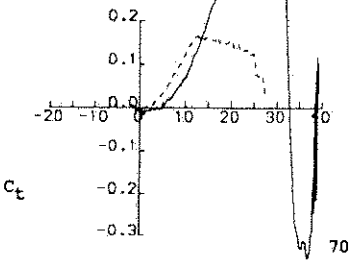




Non-dimensional time (txV/c)

ANGLE OF ATTACK (alpha)

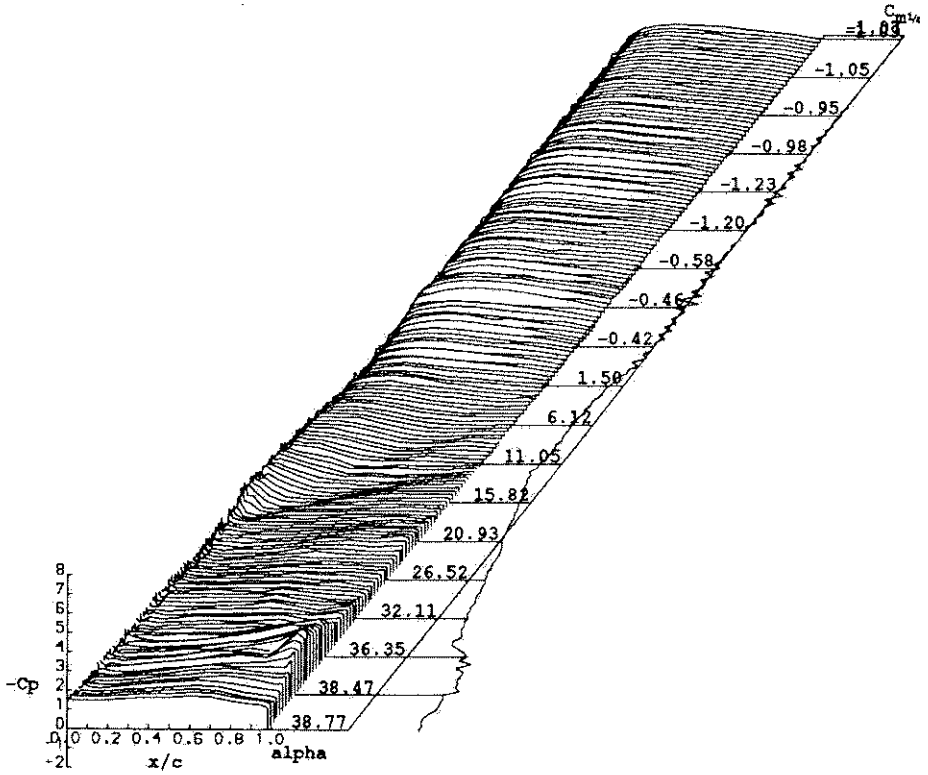


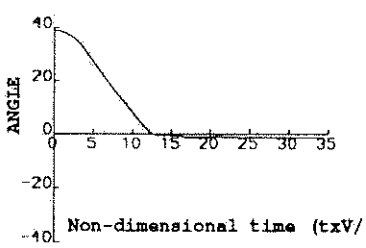


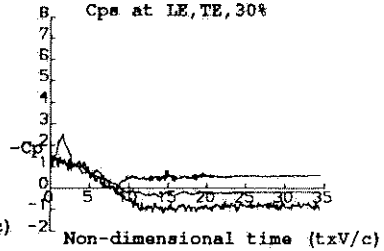
DYNAMIC CHARACTERISTICS FOR THE AHAVAW - VAWT Model

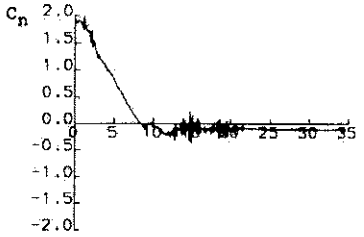
RUN REFERENCE NUMBER: 31371
REYNOLDS NUMBER = 1421955.
DYNAMIC PRESSURE = 965.74 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP DOWN
START ANGLE = 40.00°
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

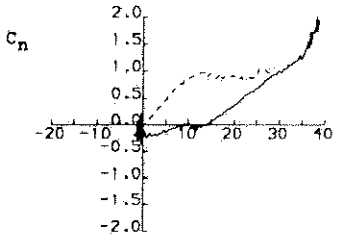
DATE OF TEST: 6/11/91
MACH NUMBER = 0.117
AIR TEMPERATURE = 29.3°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = -0.03524
LINEAR PITCH RATE = -300.44°S^{-1}

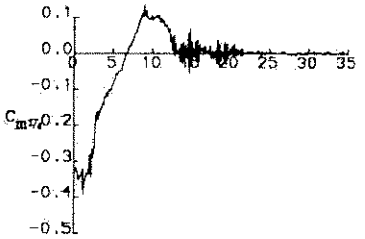


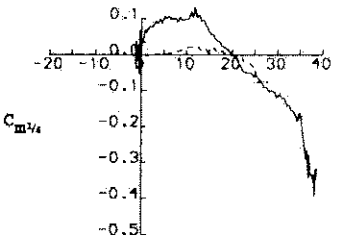


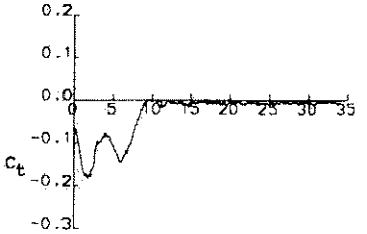


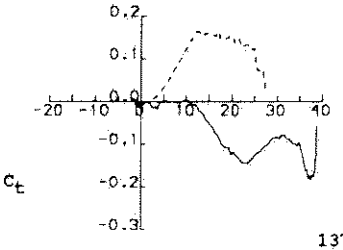








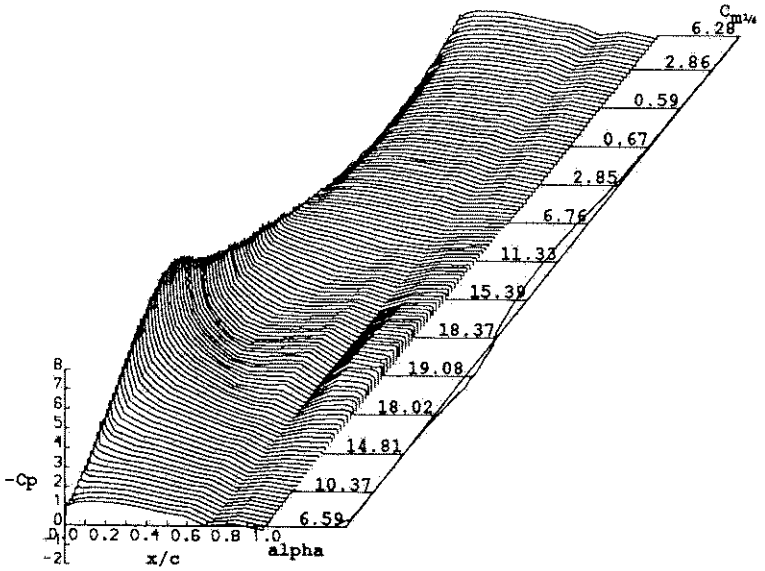


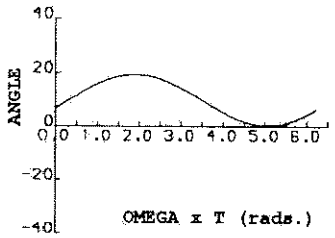


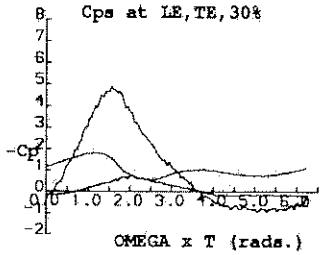
DYNAMIC CHARACTERISTICS FOR THE AHAVAW - VAWT Model

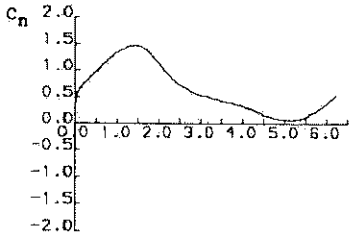
RUN REFERENCE NUMBER: 11881
REYNOLDS NUMBER = 1474032.
DYNAMIC PRESSURE = 1002.94 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.330 Hz.
AVERAGED DATA OF 10 CYCLES

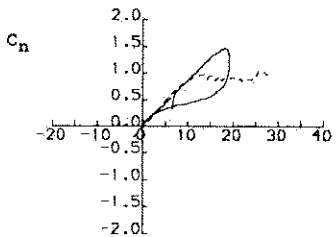
DATE OF TEST: 7/11/91
MACH NUMBER = 0.120
AIR TEMPERATURE = 25.1°C
SAMPLING FREQUENCY = 298.24 Hz.
REDUCED FREQUENCY = 0.097
AMPLITUDE = 10.00°

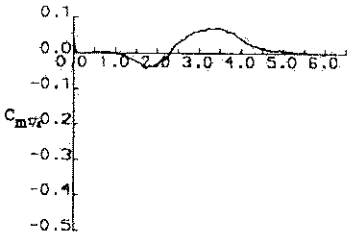


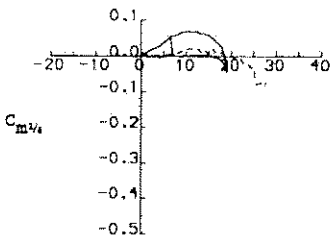


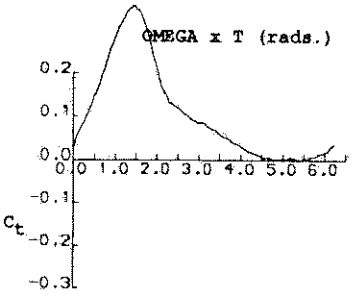


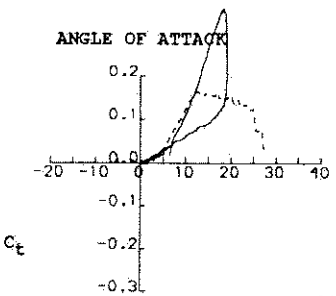






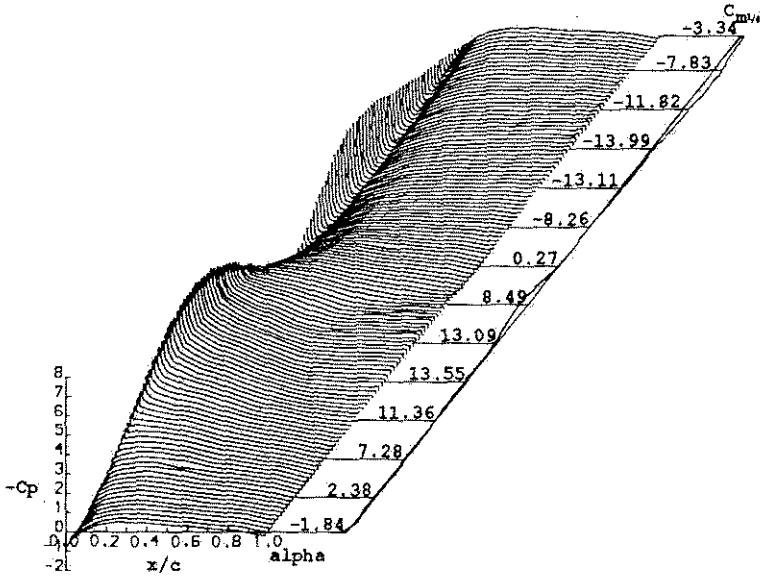


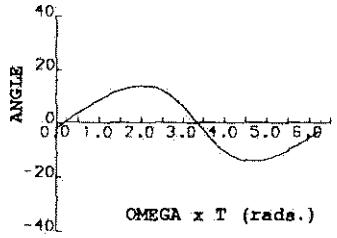


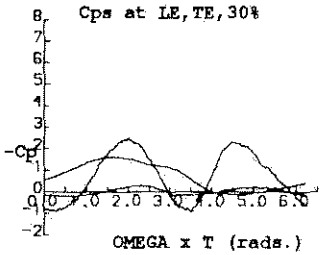


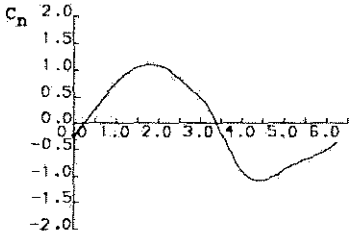
DYNAMIC CHARACTERISTICS FOR THE AHAVAW - VAWT Model

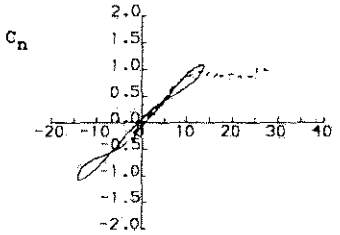
RUN REFERENCE NUMBER: 54991
DATE OF TEST: 13/11/91
REYNOLDS NUMBER = 1589817.
MACH NUMBER = 0.132
DYNAMIC PRESSURE = 1195.20 Nm^{-2}
AIR TEMPERATURE = 25.4°C
NUMBER OF CYCLES = 10
SAMPLING FREQUENCY = 155.91 Hz.
MOTION TYPE: VAWT FUNCTION
REDUCED FREQUENCY = 0.046
MEAN ANGLE = 0.00°
AMPLITUDE = 13.80°
OSCILLATION FREQUENCY = 1.218 Hz.
AVERAGED DATA OF 10 CYCLES

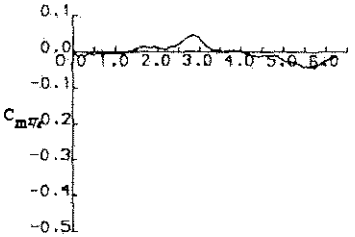


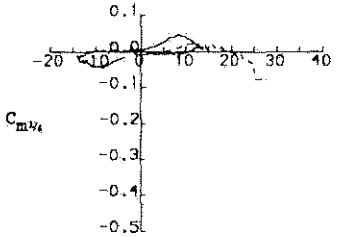


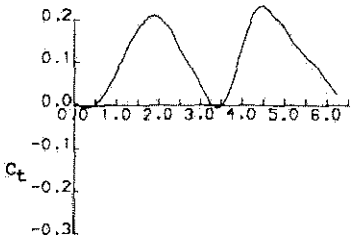


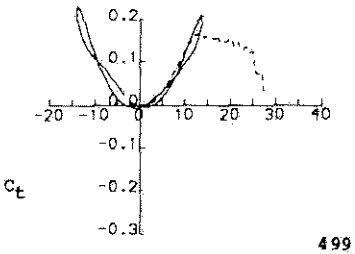












G.U. Aero Report 9221

UNIVERSITY OF GLASGOW

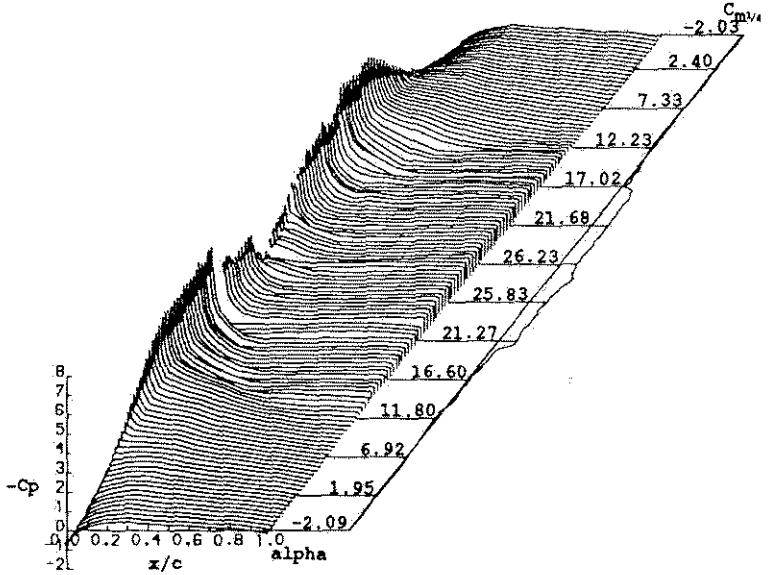
DEPARTMENT OF AEROSPACE ENGINEERING

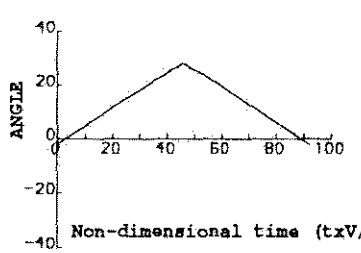
PRESSURE DATA FOR THE GUVA10 AEROFOIL

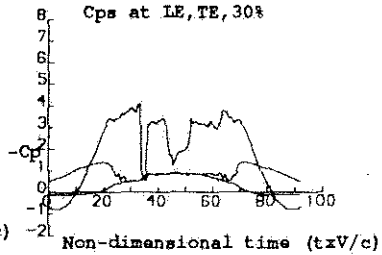
(MODEL 14)

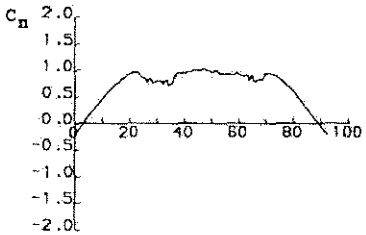
DYNAMIC CHARACTERISTICS FOR THE GUVA10

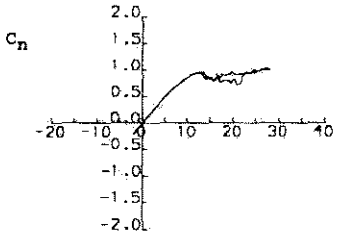
RUN REFERENCE NUMBER: 1681
DATE OF TEST: 28/2/92
REYNOLDS NUMBER = 1536178.
MACH NUMBER = 0.117
DYNAMIC PRESSURE = 983.62 Nm^{-2}
AIR TEMPERATURE = 16.0°C
NUMBER OF CYCLES = 1
SAMPLING FREQUENCY = 100.00 Hz.
MOTION TYPE: STATIC
AVERAGED DATA OF 1 CYCLES

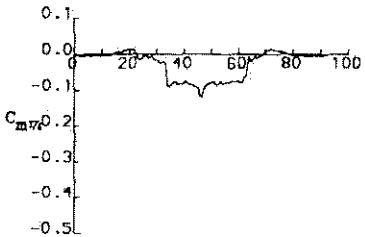


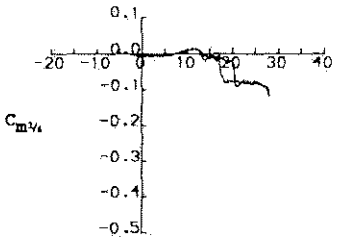


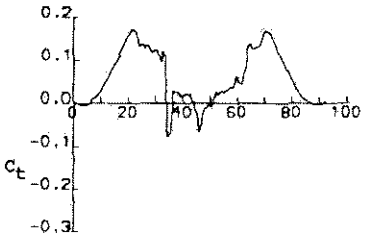


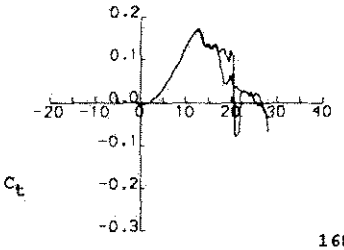








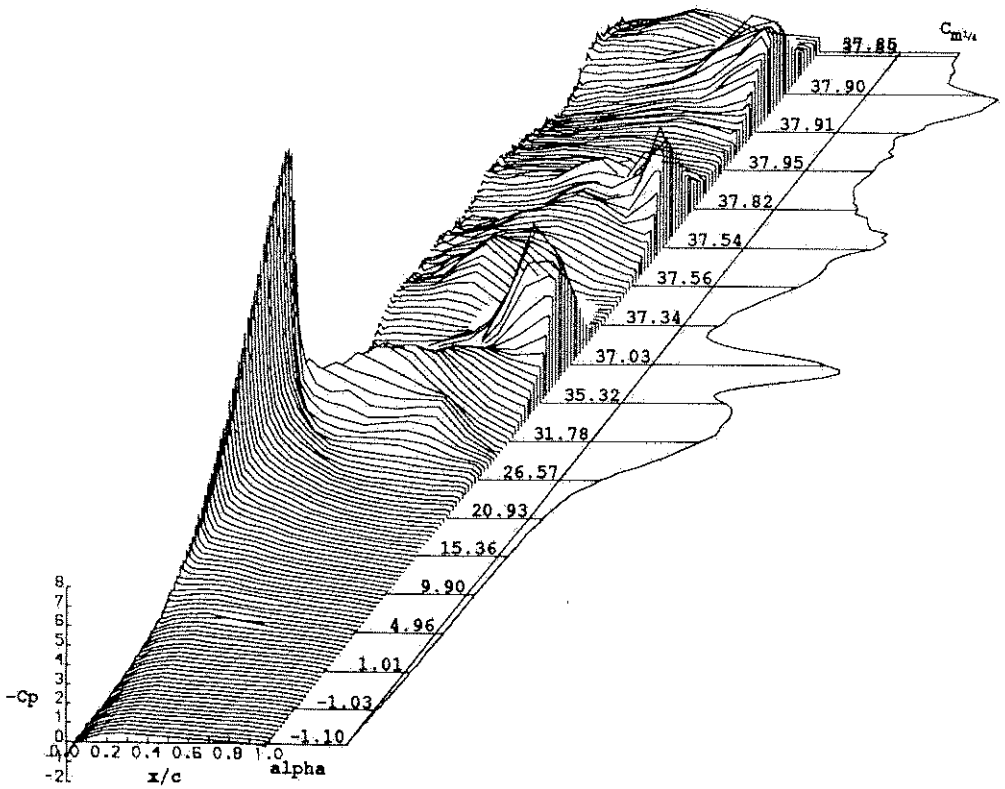


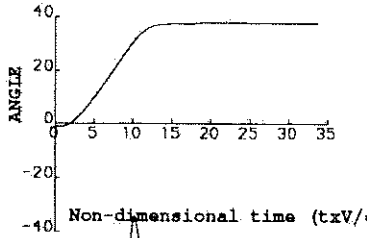


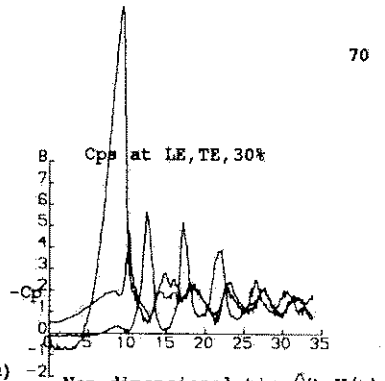
DYNAMIC CHARACTERISTICS FOR THE GUVA10

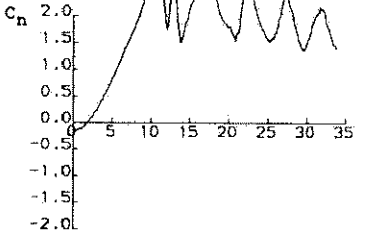
RUN REFERENCE NUMBER: 20701
REYNOLDS NUMBER = 1427995.
DYNAMIC PRESSURE = 949.77 Nm^{-2}
NUMBER OF CYCLES = 5
MOTION TYPE: RAMP UP
START ANGLE = -1.00°
RAMP ARC = 41.000°
AVERAGED DATA OF 5 CYCLES

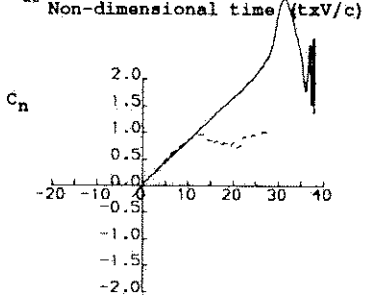
DATE OF TEST: 25/2/92
MACH NUMBER = 0.116
AIR TEMPERATURE = 27.7°C
SAMPLING FREQUENCY = 550.05 Hz.
REDUCED PITCH RATE = 0.03565
LINEAR PITCH RATE = 298.87°S^{-1}

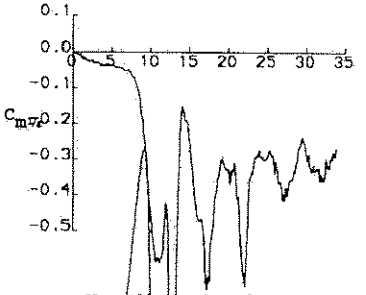


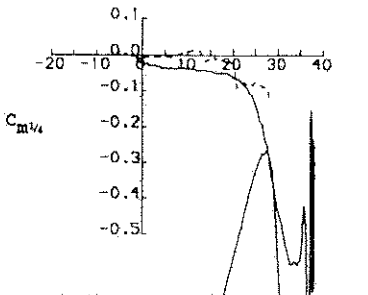


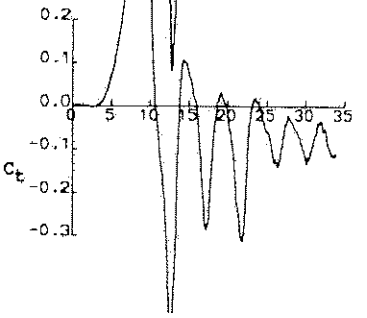


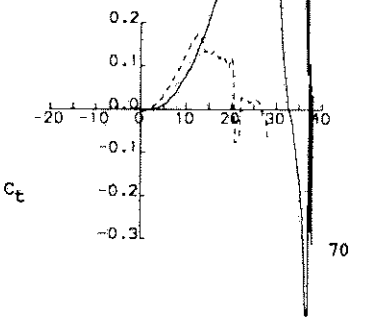






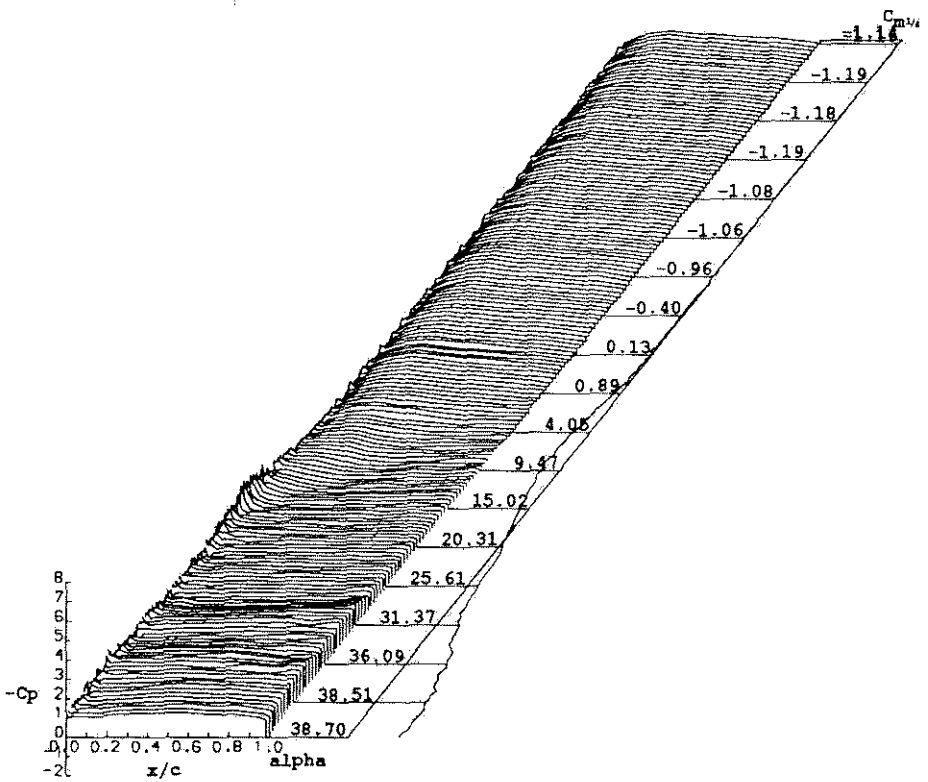


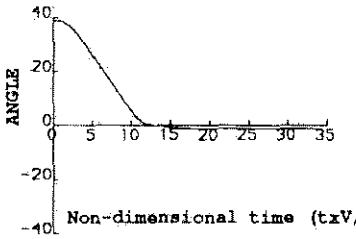


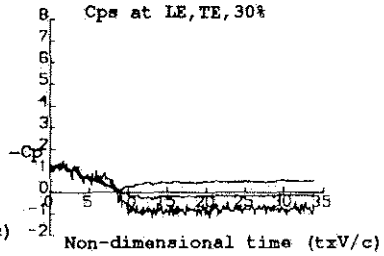


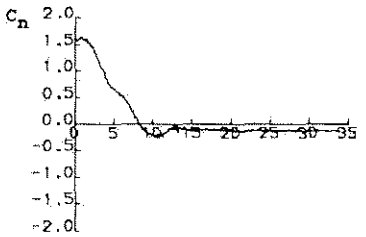
DYNAMIC CHARACTERISTICS FOR THE GUVA10

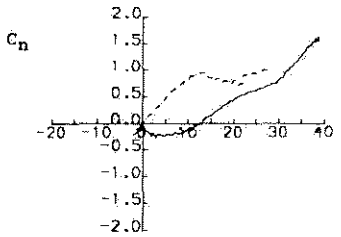
RUN REFERENCE NUMBER: 31481
DATE OF TEST: 26/2/92
REYNOLDS NUMBER = 1413690.
MACH NUMBER = 0.115
DYNAMIC PRESSURE = 942.76 Nm^{-2}
AIR TEMPERATURE = 29.2°C
NUMBER OF CYCLES = 5
SAMPLING FREQUENCY = 550.05 Hz.
MOTION TYPE: RAMP DOWN
REDUCED PITCH RATE = -0.03524
START ANGLE = 40.00°
LINEAR PITCH RATE = -295.07°S^{-1}
RAMP ARC = -41.000°
AVERAGED DATA OF 5 CYCLES

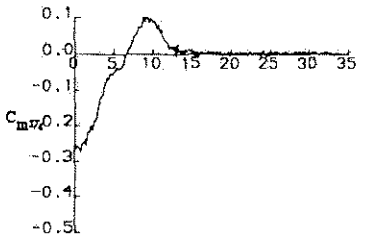


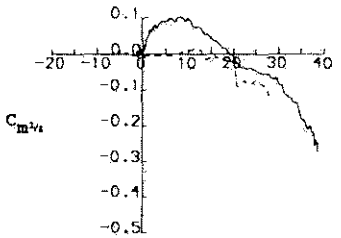


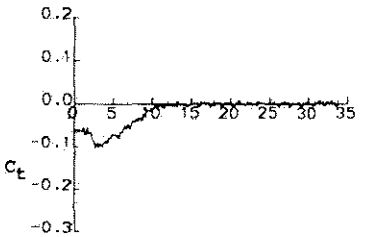


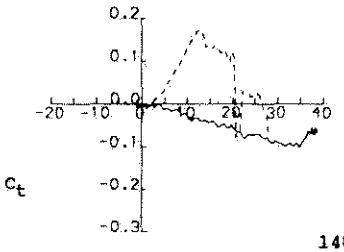








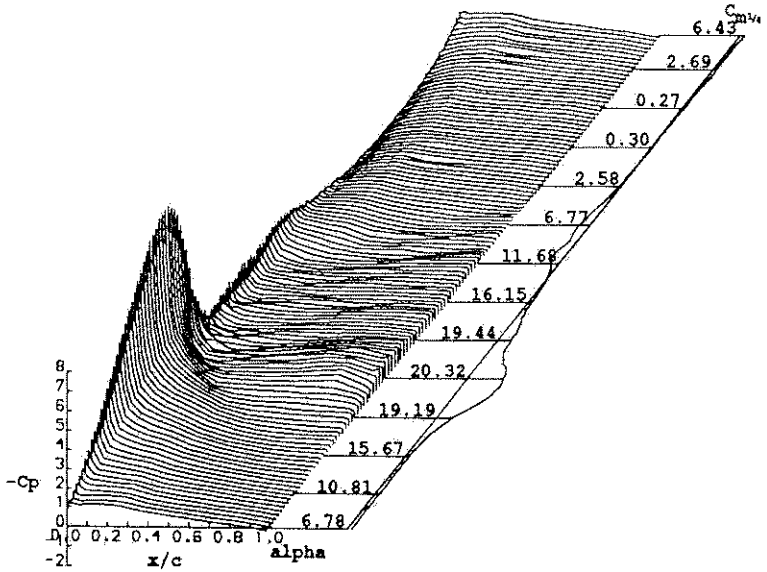


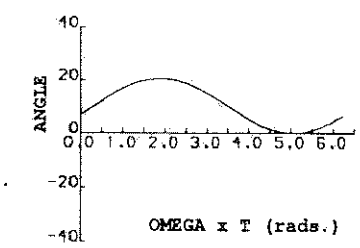


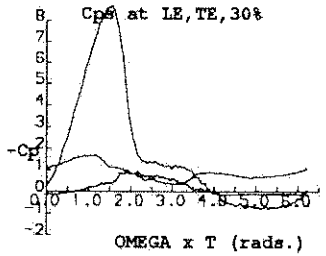
DYNAMIC CHARACTERISTICS FOR THE GUVA10

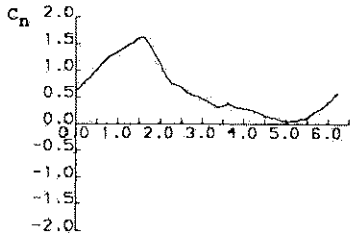
RUN REFERENCE NUMBER: 11881
REYNOLDS NUMBER = 1494594.
DYNAMIC PRESSURE = 979.88 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: SINUSOIDAL
MEAN ANGLE = 10.00°
OSCILLATION FREQUENCY = 2.330 Hz.
AVERAGED DATA OF 10 CYCLES

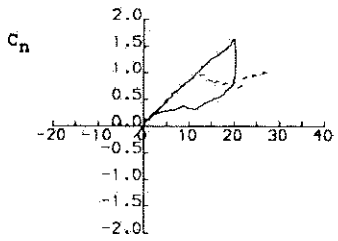
DATE OF TEST: 28/2/92
MACH NUMBER = 0.117
AIR TEMPERATURE = 21.8°C
SAMPLING FREQUENCY = 298.24 Hz.
REDUCED FREQUENCY = 0.100
AMPLITUDE = 10.00°

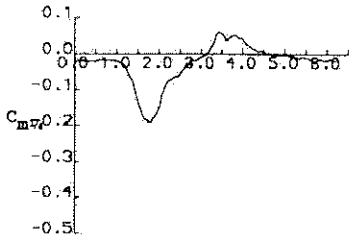


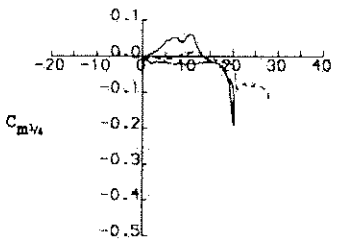


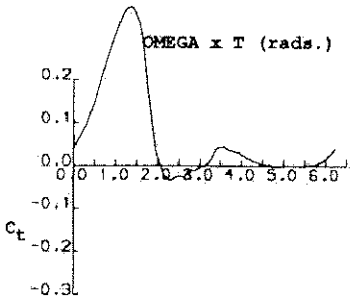


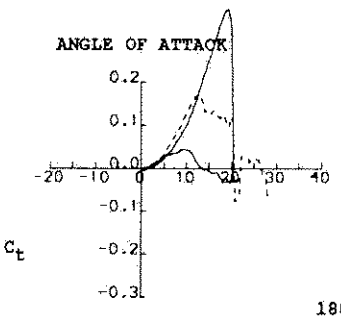












DYNAMIC CHARACTERISTICS FOR THE GUVA10

RUN REFERENCE NUMBER: 54771
REYNOLDS NUMBER = 1505466.
DYNAMIC PRESSURE = 986.39 Nm^{-2}
NUMBER OF CYCLES = 10
MOTION TYPE: VAWT FUNCTION
MEAN ANGLE = 0.00°
OSCILLATION FREQUENCY = 1.219 Hz.
AVERAGED DATA OF 10 CYCLES

DATE OF TEST: 5/3/92
MACH NUMBER = 0.118
AIR TEMPERATURE = 19.7°C
SAMPLING FREQUENCY = 156.03 Hz.
REDUCED FREQUENCY = 0.052
AMPLITUDE = 13.80°