INSTRUMENTATION FOR COMMERCIAL WIND TUNNEL TESTING OF BUILDING DEVELOPMENTS

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Summary

The need to reduce wind tunnel testing time and processing of measured data has been examined. Replacement of hot wire/film velocity probes with ground level wind sensors and the development of a pneumatic switching device to replace the traditional Scanivalve are discussed.

It is only relatively recently that wind tunnel testing of buildings has moved from the preserve of Universities and Government funded research bodies to the commercial sector. This has been due to the growing acceptance by developers and regulatory bodies that wind tunnel testing is a cost effective method of predicting response to wind action. It is now accepted that for major building developments, the cost of wind tunnel testing is generally offset by reductions in the cost of glazing alone.

In addition, pleasant ground level wind conditions can make the development more attractive to potential tennants and attract shoppers to associated shopping plazas. Wind tunnel testing is used by some developers as a tool to identify high quality ground level or balcony level areas with adjustment of rental rates to reflect the nature of the area. As a result, maximum wind speeds specified by developers are sometimes lower than limits imposed by city safety regulations.

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For any testing program to be of use to a developer, time is of greatest importance as the design phase returns no capital for ever increasing capital outlays. It is thus essential that a wind tunnel testing facility be able to respond quickly to developers requests. If turnaround time is not better than a few weeks, the wind tunnel testing program may be abandoned. These time constraints were recognised during the development of the wind tunnel facility at Vipac. In contrast, far less pressure exists on research orientated facilities at Universities and research bodies. It was recognised that the major time constraints are

1. model making, and
2. the measuring and processing of a very large amount of experimental data.

This paper describes our developments in the second area. It is interesting to note that the development of the ground level wind sensor by Irwin (1981) occurred just prior to his leaving NRC Ottawa and joining a commercial wind tunnel facility.

The instrumentation system shown schematically in Figure 1 summarises the measurement, sampling and processing methods adopoted for the Vipac wind tunnel facility.

Its aim has been the processing of all measurement results on line with further time savings using parallel processing of input data. It is believed that parallel processing using multiple transducers is essential if testing time is to be kept to a realistic and affordable level. Current measurement systems in Australia generally can only sample 80 to 200 stations, well below the number of measurement locations required for accurate mapping of surface pressures.

Experience may enable taps to be located at all critical locations with further reductions introduced by model symmetry. However, with parallel processing the number of stations can be increased by an order of magnitude with a relatively small increase in hardware costs.

As part of the instrumentation development, sensors and other devices have been developed to minimise system downtime. Some of these devices are shown in the accompanying photograph. The ground level wind sensor developed by Irwin (1) is used for all plaza wind studies and this avoids problems associated with hot wire/film velocity sensors such as fragility and location reproducibility.

The Irwin sensor has significant advantages in terms of cost and ruggedness. It remains in a fixed location reducing set up time to a minimum. In addition it uses the scanivalve based system of switching pressure taps with two scanivalves used in parallel to simultaneously connect the two lines from a sensor to the single pressure transducer.

The remaining areas of interest are those of transducers and pneumatic switching. The selection of pressure transducers is governed by several factors as discussed in the previous papers.

The recently developed Honeywell 163PCD1036 differential pressure transducer shows promise and at approximately $150 is about one tenth the cost of comparable transducers from Setra and Druck. The Honeywell transducer is at present being evaluated at CSIRO by Holmes and by Vipac.

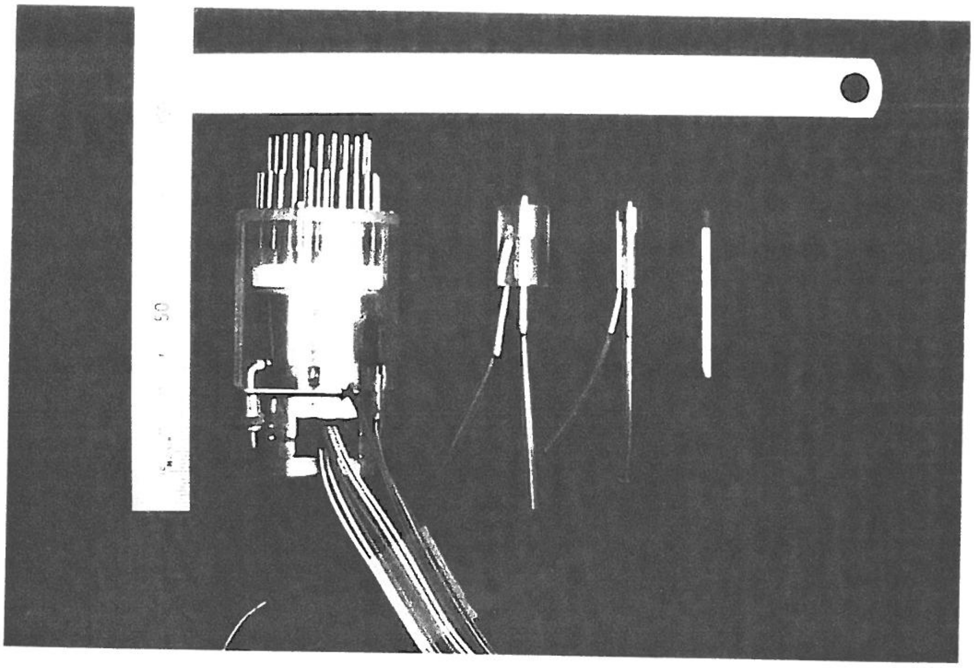
In the area of pneumatic switching, Scanivalve Corp have long held a monopoly on the field. Their devices perform well but are quite bulky and are little different from those introduced several decades ago. The use of latching solenoids as the drive system precludes backwards switching.

Vipac, in conjunction with Rechema, is developing a relatively simple and low cost device to replace the scanivalve. The use of a stepping motor in preference to latching solenoids simplifies power requirements and computer inter-facing. Reduced size means that these devices (tentatively named "IIL Port") may be readily mounted inside models, reducing the need for long tubing runs with their associated frequency response limitations. It is hoped that this device will be in commercial production before the end of 1984 and prototype devices are at present under evaluation in our wind tunnel and other test laboratory facilities.

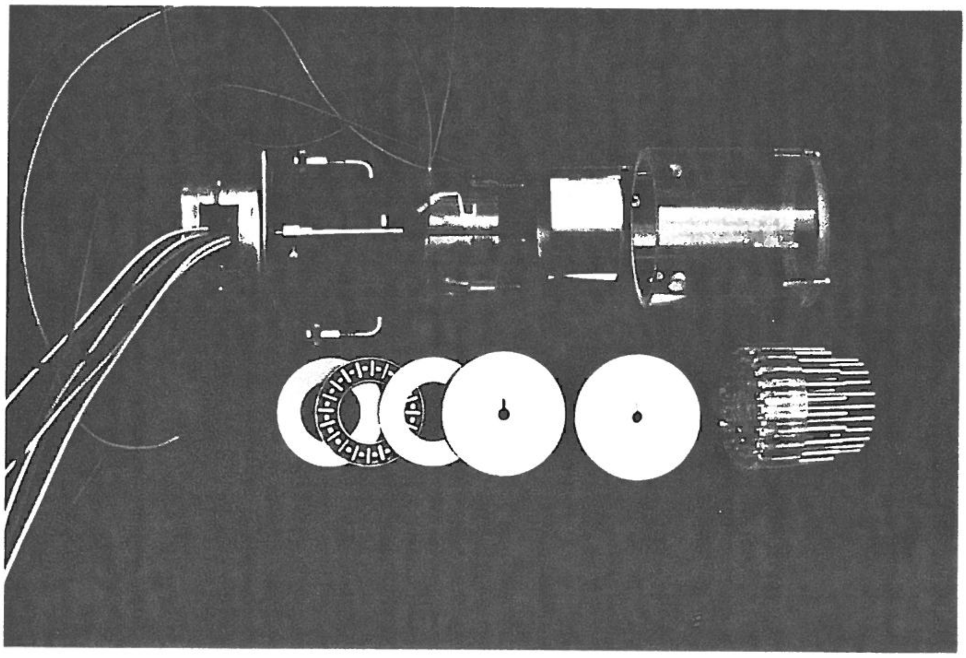
Other areas of development include the use of proximity probes (non contacting displacement transducers) to measure base bending moments or torsion on aeroelastic models.

With these developments typical wind tunnel test programs can show a turnaround of three to four weeks from start of model making to analysis of results.

Ref. Irwin, H.P.A.H. "A Simple Omnidirectional Sensor for Wind-Tunnel Studies of Pedestrian-Level Winds." Jr Wind Eng. & Indus. Aero. 7(1981) 219-239



IIL Port Pneumatic Switch and Irwin Ground
Level Wind Sensors (12 mm Ø, 6 mm Ø)



Exploded View of IIL Port Penumatic Switch

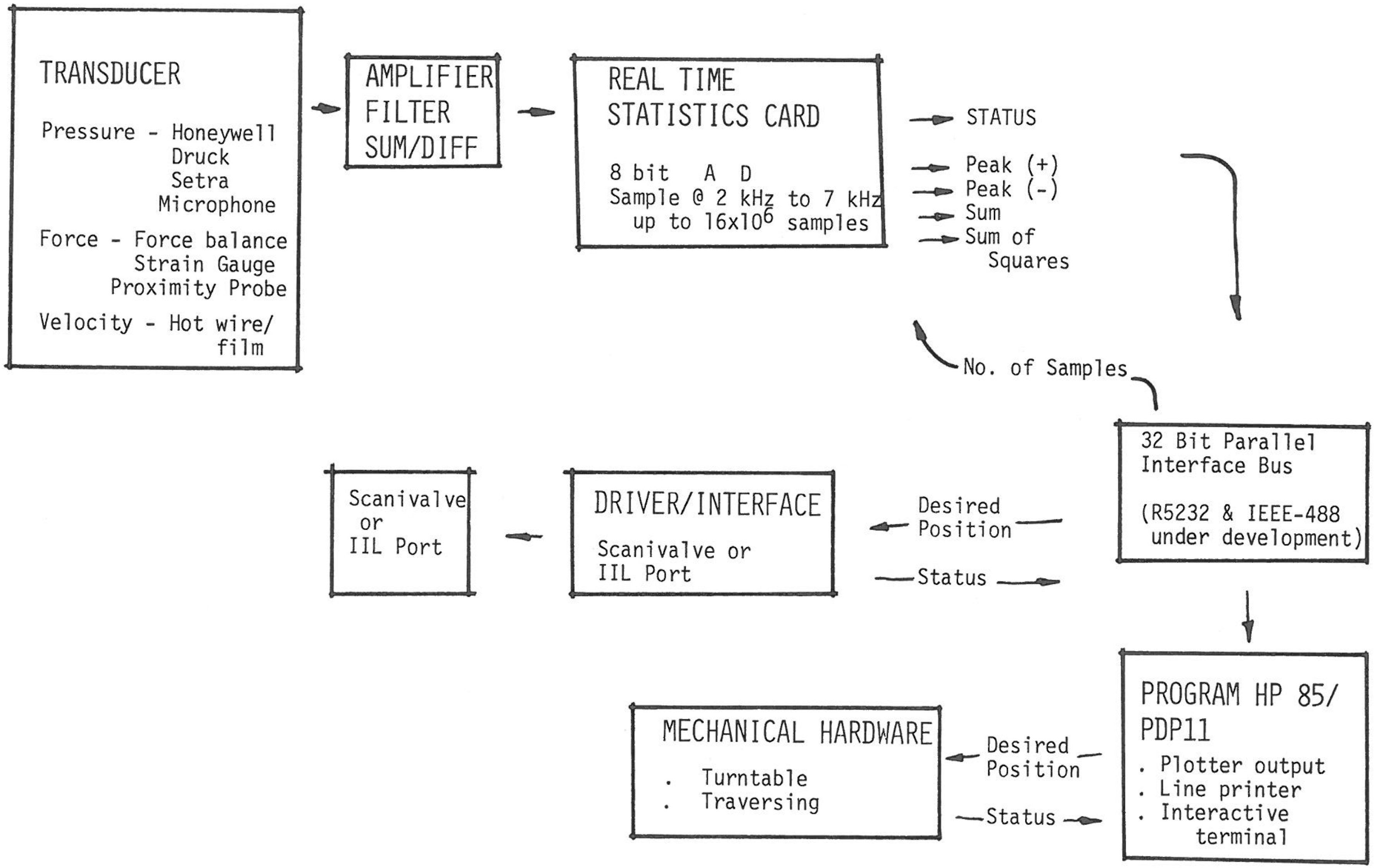


FIGURE 1: SCHEMATIC DIAGRAM OF WIND TUNNEL INSTRUMENTATION SYSTEM