

Built-Environment Pressure Scanning – Validating Structural Integrity



THE CHALLENGE

APPLICATION: BUILT ENVIRONMENT WIND TUNNEL TESTING

The Application:

In the development of taller and ever-more complex buildings, a blend of CFD (Computational Fluid Dynamics) and Wind Tunnel testing is used to ensure that buildings are structurally safe, unlikely to cause discomfort or be susceptible to fatigue and failure. Often theoretical calculations will not be representative of reality, especially in a highly complex structure. In addition to the integrity of the structure itself, consideration must be given to the effects on buildings in the surrounding vicinity. An initial desk study may determine the necessity for use of a powerful simulation tool, the Wind Tunnel.

Where wind tunnel testing is required, a highly-detailed scale model (usually 1/200th or 1/400th, depending on available wind tunnel constraints) is constructed representing the structure under test and the buildings and landscape nearby. This is constructed in a model shop from detailed architectural plans, either by assembly of sectional fabrications or by 3D printing of models, which are often mounted on a rotating platform. This platform can usually be rotated through 360° to assess directional wind actions that would otherwise be difficult to visualise. The model is installed in the wind tunnel and subjected to extended testing over a wide range of wind directions and velocities, often up to 60 m/s. Data is gathered from numerous locations on the model to identify any areas that require further analysis or evaluation.

The Measurement Challenge:

Models vary considerably in design and diversity and may represent a building, bridge, chimney, sports stadium, offshore platform or wind turbine tower, where use criteria are being considered. These models are fitted with numerous sub-1mm pressure tapings that allow the localised pressure to be

accurately measured at, often, 300-500 measurement points. The model and platform are usually supported on a multi-directional force balance. The data is used to determine whether the structure will perform as expected over a spectrum of wind conditions. Testing can be expensive and time-consuming, so ensuring efficient gathering of high quality, valid data – every time - is vital.

Accurate and consistent data from a proven and reliable measurement device ensures that measurement effects are minimised and the data truly represents the effects of wind and turbulence on a full-size structure. Based upon the analysis of the multitude of data gathered, decisions can be taken as to whether the structure is acceptable or needs design modifications, such as the addition of aerofoil sections, vortex disruptors, dampers or other such devices.

Challenges in the measurement of so many local pressures can be addressed with the use of pressure scanners which gather vast amounts of synchronous data very quickly and accurately, transferring this to a data acquisition system. Self-zeroing scanners with purge facilities are used to ensure that the data is consistently and accurately measured with minimal downtime or intervention. Often the pressure sensors will be regularly checked, calibrated and zeroed to ensure accuracy and repeatability of the scanned pressure data in-situ between test points and data frames. Usually multiple pressure scanners are multiplexed to gather data from many models and often space constraints may prove to be an issue in the wind tunnel environment.

Typical Users:

Government, Commercial and University research establishments own and operate the wind tunnels. They are usually contracted to gather appropriate data to present to the structures architectural team. Some built-environment consultants operate their own wind tunnels and offer a comprehensive turnkey consultancy for their clients, providing data and solutions.

THE SOLUTION

SCANIVALVE MPS 4264 PRESSURE SCANNER EXCELS IN THIS APPLICATION

Compact, high performance Pressure Scanner

- ✓ Dedicated sensor for each channel (up to 64 channels)
- ✓ High Accuracy temperature compensated sensors
- ✓ Network-ready Ethernet for quick system integration
- ✓ Fast data collection up to 2500 samples/channel/second
- ✓ Dynamic Zero Correction for unmatched sensor stability
- ✓ IEEE1588-2008v2 PTP compatibility
- ✓ Removable headers for installation flexibility
- ✓ Integral web-server
- ✓ Simple LabVIEW integration



©Evolution Measurement 2017

Application Note: 008/05/17

The **Scanivalve MPS 4264** pressure scanners are mounted within the model or under the rotating platform to collect the huge amount of data being generated under test. Ethernet outputs and power supplies can be multiplexed through local Scanivalve hubs, further adding to the compactness of the solution, with one hub handling real-time synchronous data of over 500 live pressure measurements.

Often very low wind speeds need to be detected in this application and this requires scanners with very low range calibrations, combined with high accuracy, repeatability and sensitivity. **Scanivalve MPS** is suitable for use as low as full scale ranges of 4" H₂O, with other custom ranges possible to suit all applications.

High-speed Ethernet data rates of up to 2500Hz/channel, in "Fast Mode" maximise the amount of valuable data that can be gathered during a single test run. This data is collected in any common Engineering Unit, presenting the test engineers with meaningful data for analysis. Shortening test runs can save the user considerable time and cost.

Removable headers on the scanner mean that 64 tubes be conveniently connected before the scanner is installed in the tunnel and adds to the versatility of using one scanner on multiple models, avoiding unnecessary downtime during test periods. The headers can remain fitted to the model for later use.

Integration of the Scanivalve MPS is quick and simple. The integral web-server allows the scanner to be set up from a PC and further integrated into a LabVIEW package, avoiding the need for any separate signal converters or marshalling cabinets.

Where low channel counts are required and space is not an issue, users look to the **Scanivalve DSA**, where 16 channels of data can synchronously be measured and transferred via Ethernet. Again, these can be "daisy chained" via Ethernet and time-stamped allowing highly accurate synchronisation of data from many compatible measurement sources.

In addition to a versatile range of high performance pressure scanners, Evolution Measurement offer the widest range of accessories including pressure tubulations, tubing and connectors that enable the test model to be commissioned very quickly and efficiently.

For more Information:

Download the datasheets:

<http://www.evolutionmeasurement.com/wp-content/uploads/2016/11/MPS4264-Evolution-Measurement.pdf>

<http://www.evolutionmeasurement.com/product/accessories/>

Or talk to us about your requirements: Evolution Measurement Ltd. 7 Regents Court, South Way, Walworth Business Park Andover, Hampshire SP10 5NX Telephone: +44 (0) 1264 316470

Email: enquiries@evolutionmeasurement.com