

Wind Measurement on Bridges using 2-axis & 3-axis anemometers

Reference: AN0011

Introduction

Bridge structures, along with the traffic can be vulnerable to wind conditions and so in bridge applications it is important to monitor both wind speed and direction, however sometimes due to the height above ground and the design of the structure it is often also necessary to also monitor the vertical axis of the wind.

Monitoring

Basic wind monitoring can be simply the 2-axis anemometers, including the robust WindSonic and WindObserver especially for extremely high wind speed areas and are mainly used for transport safety, to stop high-sided or vulnerable loads during high wind conditions or to completely shut down the bridge if the conditions warrant it.

Robust, high accuracy 3-axis wind sensors are used where the vertical axis measurement is required and in these applications the wind information is important to determine cable vibration, wind loading on vehicle traffic or structural twisting of the bridge itself. The WindMaster, WindMasterPro and Research are used in these circumstances.

Installations

Gill 2-axis including WindSonic and WindObserver have been used for wind monitoring on bridges including worldwide including:

- Florida State Transport Authority
- Niantic River Amtrak Train Bridge (Connecticut)
- Fore River Bridge (Quincy, Massachusetts)
- Tobin Bridge (Boston, Massachusetts)





Gill 3-axis anemometers have been used for many bridge monitoring applications worldwide including:

- The Millennium bridge across the Thames in London
- Seven-road Bridge across the Bristol Channel.
- The Tsing Ma Bridge in Hong Kong.
- The Clifton suspension bridge across the river.
- Svinesund Road Bridge, joining Sweden and Norway
- Incheon Grand Bridge, 18 km cable stayed bridge connecting Incheon Airport to Mainland
- 2nd Penang Bridge, Malaysia (Sultan Abdul Halim Muadzam Shah Bridge), connecting Batu Maung & Batu Kawan



Millennium Bridge



Svinesund Road Bridge



Tsing Ma Bridge







Incheon Grand Bridge

Millau Viaduct, France

One bridge of particular interest is the Norman Foster designed Millau Viaduct, which is a 2460m long, 343m high bridge over the Tarn Valley in Creissels, France and is part of the A75 motorway with the vehicle deck sitting at nearly 275m above the deepest point of the valley.

The Millau viaduct's monitoring and instrumentation system was designed by a team of experts already involved in structural engineering of the bridge. The bridge monitors wind for both Operating Conditions" and "Structural Monitoring" as two completely separate monitoring systems, which for "Structural Monitoring" means the pylons, deck, masts and stays are equipped with a multitude of sensors. These are designed to detect the slightest movement in the viaduct and measure its resistance to wear-and-tear over time. Anemometers (wind load), accelerometers, inclinometers, temperature sensors are all used for the instrumentation network.

Early on during monitoring the "Operation Conditions" an issue did present itself with the bridge in the fact that the wind speed at the level of the bridge was "up to 151 km/hr," which is significantly more than the wind speed that would be found at ground level. This would cause serious issues driving on the bridge because the high wind speeds would push vehicles to the side, making driving dangerous. This problem was addressed by the inclusion of wind screens that reduce the effect of the "wind by 50%," effectively causing wind speeds on the bridge to reflect those on the ground.

There is even a small museum near the site in the Millau Viaduct Rest Area, where a WindMaster is also displayed.



Please contact us for a copy of the published paper:

"The Millau Viaduct: Ten Years of Structural Monitoring"