

Fugro Structural Monitoring

INSTRUMENTATION FOR LONG SPAN BRIDGES

INTRODUCTION

There has been much progress in bridge design in recent years with increasing use of advanced analytical design methods, use of new materials and new bridge concepts.

There have also been many advances in instrumentation which can monitor and analyse data to provide accurate information on the actual performance of bridges in service.

This instrumentation, properly applied, can assist in enabling continued progress in bridge engineering.

Performance monitoring of bridges can provide many benefits to bridge designers, constructors and operators. These include the following:-

- Design Verification
- Construction Monitoring
- Usage & Performance Monitoring
- Problem Identification
- Design Modifications
- Bridge Assessment
- Maintenance Planning



Figure 1: Humber Bridge

SENSOR SYSTEMS

Most of the measurement sensors are well proven and readily available commercially. These include:-

- WIND SENSORS – MECHANICAL & ULTRA-SONIC
- TEMPERATURE SENSORS
- WEIGH IN MOTION TRAFFIC LOADING SYSTEMS
- LINEAR ACCELEROMETERS
- INCLINOMETERS
- RELATIVE DISPLACEMENT SENSORS
- OPTICAL POSITIONING SYSTEMS
- HYDRAULIC LEVEL SENSING SYSTEMS
- STRAIN GAUGES



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The Fugro Group is an International Group with approximately five thousand staff in over thirty countries.

Our major disciplines are Geotechnics, Environmental and Survey.

DATA ACQUISITION AND ANALYSIS

Typically the number of individual sensors and data sampling rates necessary to characterise the response of a large bridge mean that care must be taken to avoid collecting unmanageable quantities of data.

The use of a multi-tasking central computer running FSM's **SIMS-NT** software allows pre-determined time periods of raw data to be automatically analysed and summarised in an appropriate form. (Statistic, load cycles, frequencies etc).

Threshold values for the statistics can be set to correspond to response events of interest (e.g. particular severity of environmental conditions) so that critical data sets are available for detailed study.

Key characteristics of the system include :

- Sampling combining slow and fast rates.
- Optimum distribution of data acquisition models.
- Means of communication between distributed modules (copper, optical fibre cable, radio telemetry).
- Maximum automatic data analysis.
- Convenient handling of analysed data.
- On site analysis console or remote access via telephone line or internet.
- Powerful data display and plotting tools to maximise the extraction of engineering information from the collected data.

DATA INTERPRETATION

It is important to define system objectives at the start of the project. This will ensure that system design, data acquisition regimes and analysis procedures are optimised.

Typical system objectives are :

- Direct usage and performance monitoring.
- Verification of design assumptions and processes, with a view to improving assessment models and safety evaluation.
- Use of advanced methods of damage detection and risk assessment with a view to extending service life.
- Use instrumentation to acquire knowledge and thereby optimise conventional inspection, assessment and maintenance procedures.

Typical objectives therefore combine increase in knowledge with lifetime cost reduction.

The FSM data acquisition processing software **SIMS-NT** and **SPIDAR-NT** are designed to provide powerful tools to assist the engineer in extracting the maximum engineering information from the data.

Figure 2: Lantau Fixed Crossing - Weather and Structural Health Monitoring System



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