Monitor Optics Systems

Optical Sensing Solutions for Structural Monitoring

www.monitoroptics.com

CASE STUDY

Monitoring Strain in Airport Pavements Using Fibre Bragg Grating Sensors

Air transport is today witnessing an enormous development and the traffic load on existing airports is constantly increasing. Moreover new and heavier commercial airplanes are introduced.

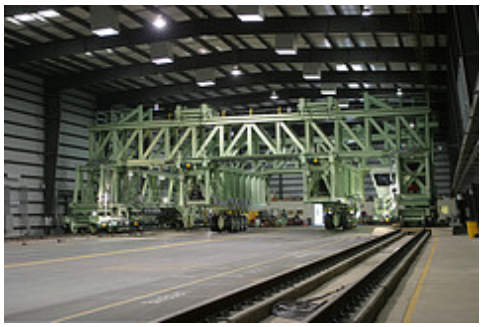
The design of airport pavements is continuously developing in order to meet the challenges of the air transport requirements. The United States Federal Aviation Administration (FAA) manages a test centre that is dedicated solely to the development and study of pavements for airports runways and taxiways, the National Airport Pavement Test Facility (NAPTF).

This state of the art test facility employs a great number of sensors. However some of these are not as survivable as desired, especially during the embedding phase. Moreover electric sensors require a number of leads per sensor and this introduces more survivability concerns and difficulties in the installation.

Monitor Optics had the opportunity to participate in a test to prove the feasibility of using fibre optics sensors to monitor strains in concrete and asphalt pavements.

Monitor Optics provided strain sensing cables that were embedded in different types of pavements. The sensors will form an important part of the data collection system during the tests that will be performed on the two pavements.

The sensing cables employed were developed by Monitor Optics to achieve an easy to install distributed FBG based strain and temperature sensors. These innovative sensors make possible the installation of the hundredth of sensing points required by this project in a short time and with the maximum reliability.



Sensors Network

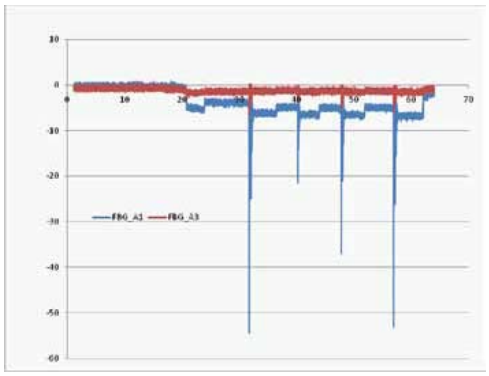
One sensor was embedded into the asphalt pavement and one into the concrete pavement.

In the asphalt pavement the sensor was embedded along the mid line in a slot on the top of the bottom layer surface. The upper asphalt layer was then laid on top of it and compacted.

In the concrete pavement the sensor was embedded in a slot on the pavement surface. A curved sensor layout was chosen to allow locating each FBG in correspondence with existing sensors previously embedded in the concrete.

The exit point of the cables from the pavements was accurately designed to guarantee the survival of the fibre optics cables carrying the signal to the interrogator. The connectors were protected by inserting them in rugged metal enclosures that provide easy access.

Data Acquisition and Processing



Data from the sensors was acquired during the asphalt laying process and during initial impact tests. Demodulation of the FBG signals was provided by a Micron Optics Sm130 interrogator controlled by a laptop computer.

During the future tests on the pavements dynamic data will be acquired using a Micron Optics Sm130 interrogator. The acquisition frequency will depend on the type of test carried out. The tests will include impact tests and simulated aircraft traffic using the NAPTF test rigs.

Data from the FBG based sensing cables will be analysed together with data acquired from other types of sensors normally used at the NAPTF

Results

Monitor Optics' sensing cables have proved that they can be easily and very quickly installed in airport runway pavements.

The sensors have proved their survivability when embedded between asphalt layers. All the FBG sensors survived the asphalt laying and rolling phases, proving that the sensing cable is very suited for use in new construction asphalt pavements.

The sensing cables embedded in concrete proved that retrofitting of concrete pavements with the sensor is a fast and cost effective solution.

The capability of providing a high number of sensing points with a minimum number of cables was particularly appreciated and Monitor Optics' sensing cables have been judged an ideal solution for the installation of medium/large sensing network over long distances.