DIMETIX
LASER DISTANCE SENSORS
SWISS PRECISION

Application Brief:

Multi-sensor/multi-axis Structural Health Monitoring

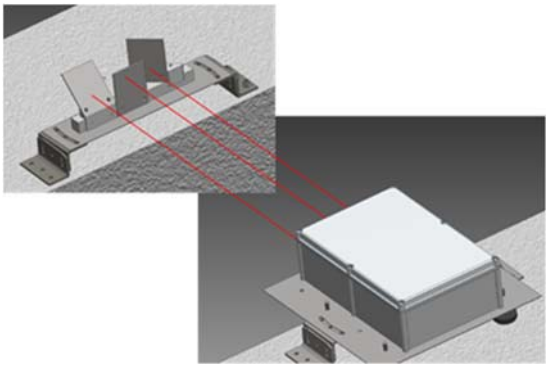
Industry: Engineering & Construction

Application: Multi-sensor/multi-axis Structural Monitoring

Sensor: Dimetix FLS Laser

Summary: A structural health monitoring (SHM) system utilizing Dimetix laser distance sensors was implemented during a long-term study of two of the piers on a Western PA bridge monitored on three axes for movement under load. For context, a common criticism of SHM systems is the inability of the system to translate raw sensor measurements into actionable information that can be used for management decision making. Reasons for this shortcoming include poor anticipation of the ultimate use of the SHM system, measurement complexity, and the lack of a comprehensive input-output characterization of the SHM system. For this case study, allowable thresholds were computed based upon superstructure load strength and substructure serviceability limits, as well as a limit associated with expansion joint allowable movement as measured by the non-contact laser distance sensor SHM arrays.

Overview



An SHM system utilizing Dimetix laser distance sensors was developed and commissioned for use during a long-term study of two piers on a Western PA bridge monitored on three axes for movement under load. Key physical details of the project included the following:

- Approximately 60 feet between piers
- Each SHM system contained three Dimetix FLS-C10 lasers, mounted in a sealed windowed enclosure
- Lasers were daisy chained and connected via RS422 to a Campbell Scientific remote data monitoring system
- Lasers were aimed at target plates mounted on a common rail
  - Target 1: 45 degree vertical (Z axis)
  - Target 2: Perpendicular (X axis)
  - Target 3: 45 degree horizontal (Y axis)

Challenge: A common criticism of Structural Health Monitoring (SHM) systems is the inability of the system to translate raw sensor measurements into actionable information that can be used for management decision making. Reasons for this shortcoming include poor anticipation of the ultimate use of the SHM system, measurement complexity, and the lack of a comprehensive input-output characterization of the SHM system. To address these challenges, it is important to recognize that sensor location and specification alone does not constitute an SHM system design. Instead, the design must include definitions of performance-based allowable thresholds directly correlating to structural safety, traffic safety, or operational limits. This Dimetix laser sensor based SHM system represents a framework for performance-based design of SHM systems, and an actual case where such an SHM system design was integrated into a bridge management system.

Solution: Allowable thresholds were computed during the development stage based upon superstructure load strength and substructure serviceability limits, as well as limits associated with expansion joint allowable movement as measured by a series of non-contact laser distance sensor arrays. These threshold limits were used within a live visualization during a critical construction event where the bridge owner was able to assess real-time performance of the bridge. The planning and implementation of the system is a step forward in addressing the challenge of how SHM systems can be used to understand structural system response to predetermined input and, more importantly, to provide a context within a bridge management system for understanding a structure's ability to withstand specified limits.

Key Application Notes:

- The planning, design and implementation of the Dimetix laser based SHM system provided a means of translating raw sensor measurements into actionable information for management decision making and understanding a structure's ability to withstand predetermined limits
- The approach to the project represents a step forward in addressing the challenge of providing context for the data collected by an SHM system within a bridge management system

In conclusion, the Dimetix lasers were vital to properly monitor the structure and its condition during the study. For more information on Dimetix lasers or the projects in which they can be applied, please call us at 484-212-0636 or visit our website at www.dimetix-usa.com.