Geocomp
Technologies to manage risk for infrastructure

Project Brief

Gold Star Memorial Bridge Fiber Optic Monitoring

Client:
HAKS Engineers and Architects

Location:
New London & Groton, CT

Service Provided:
Provided multiple technical design options and associated costs for installation of remotely accessed strain and temperature monitoring system.

Value Provided:

- Data used to validate a structural model that accurately represents real-world conditions of the bearing and their conditional effect on the structure
- Cost of monitoring program was a fraction of the cost of potential bearing replacement and saved the State millions of dollars in extending the service life of the structure

Background & Project Challenges

The Gold Star Bridge is comprised of two steel truss bridges, each with eleven traffic lanes, which carry Interstate 95 and U.S. Route 1 across the Thames River between New London and Groton, Connecticut.

The Gold Star Bridge's design uses a rocker bearing support system. When functioning normally, each bearing allows a limited amount of rotational movement at each pier to accommodate for thermal expansion and contraction across the bridge's superstructure. This helps to relieve potential stress incurred by thermal deformation. Immobilized rocker bearings, however, can cause thermal and load-induced stresses to build up in key structural components, leading to potentially unsafe conditions.

During a routine maintenance inspection, it was discovered that a set of rocker bearings had become stuck at one of the piers. in response, HAKS Engineers, as the contracted structural evaluation team, was tasked with recommending an appropriate monitoring program. Several different sensor system types were considered, including vibrating wire, resistance sensors, and fiber optics. Ultimately, a fiber optic system was selected, which increases the durability of the sensor array and allows for in-house quality assessment testing and assured sensor reliability during and after the installation.

Geocomp Role & Accomplishments

Geocomp designed the final monitoring package to include temperature and strain fiber optics as the primary sensor elements; both the "restrained" and a companion "free-moving" span were chosen as sensor installation sites for taking comparative response measurements across the bridge structure. In addition, a gusset plate was selected to evaluate stress incurred from load paths on adjoining structural members. Fiber optic accelerometers were utilized at each pier to detect potential static friction slippage or movement – a possible result of built up stresses suddenly overcoming the static friction forces between the frozen rocker bearings and the pier.

Since measured stresses primarily are induced thermally, the overall system was designed to compensate for temperature fluctuations and differentiate between separate types of thermal strains. The completed system collected and posted data autonomously from the 80-count sensor array to a secure web-server for remote real-time data collection and monitoring.

Sensor data was collected continuously to evaluate strain (stress) variations due to daily and seasonal temperature changes and cycles. This in-depth information was used comparatively to validate a finite element model of Gold Star Bridge spans for structural evaluation to provide recommendations to the Connecticut Department of Transportation.