Portage Creek Bridge - Canada

Project Description:

Portage Creek Bridge is located in Victoria, British Columbia (BC). The bridge crosses Interurban Road and the Colquitz River at McKenzie Avenue. Built in 1982, the Ministry of Transportation and Highways Bridge Engineering Branch designed the bridge prior to the introduction of current bridge seismic design codes and construction practices. The original design did not meet today's standard requirements for resisting earthquake forces, so the bridge was retrofitted to bring it up to code.

Portage Creek Bridge – Victoria, British Columbia, Canada

Quick Facts:

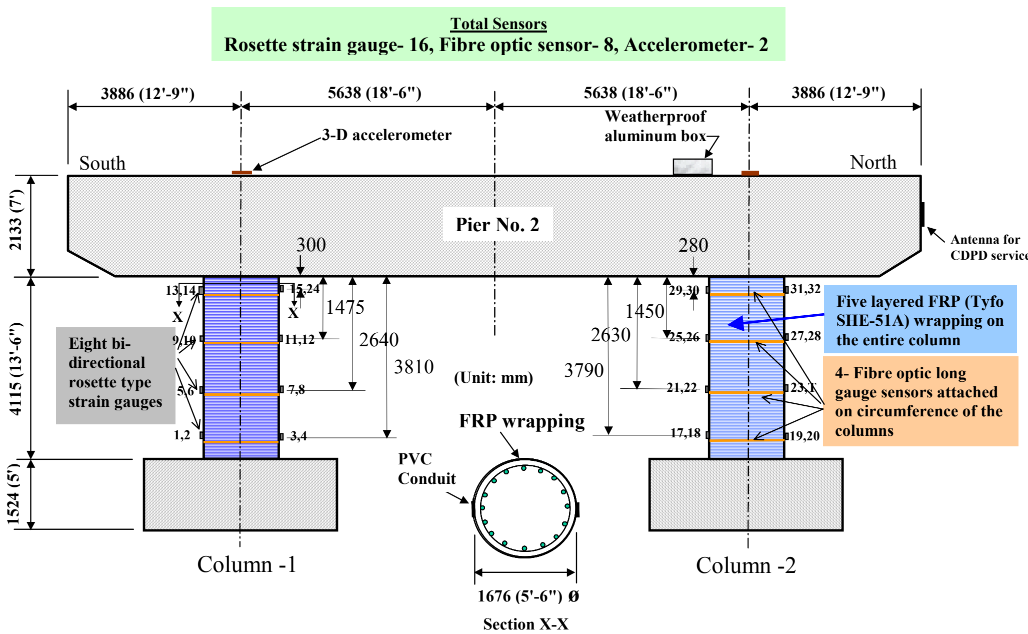
- **Name and Location:** Portage Creek Bridge - Victoria, BC, Canada
- **Owner:** Ministry of Transportation and Highways Bridge Eng. Branch, BC
- **Structure category:** Medium span steel bridge with a reinforced concrete deck
- **Spans:** 3 spans with total length of 410 ft (147 ft / 163 ft / 100 ft)
- **Structural system:** 3 steel girders with a reinforced concrete deck supported on two reinforced concrete piers and abutments on H piles
- **Start of SHM:** October, 1998
- **Number of sensors installed:** 26
- **Instrumentation design by:** ISIS Canada – University of Manitoba

Description of Structure:

The Portage Creek Bridge is described as a 125m (410ft) long, three span structure with a reinforced concrete deck supported on two reinforced concrete piers, and abutments on H piles. The deck has a roadway width of 16m (52ft) with two 1.78m (6'6") sidewalks and aluminum railings.

Purpose of Instrumentation:

Classified as a Disaster Route bridge, the Portage Creek Bridge was retrofitted to prevent collapse against expected seismic loads. The retrofit included strengthening the two short columns of pier No.2 with five layers of GFRP wraps with a total thickness of 5 mm. The main purpose of the bridge instrumentation is to monitor the performance of the bridge under an earthquake, specifically the response of pier No. 2. Long gauge fibre optic sensors integrated with strain gauges and accelerometers are being used to measure the strains in different locations.



Elevation of Pier No. 2 with sensor locations

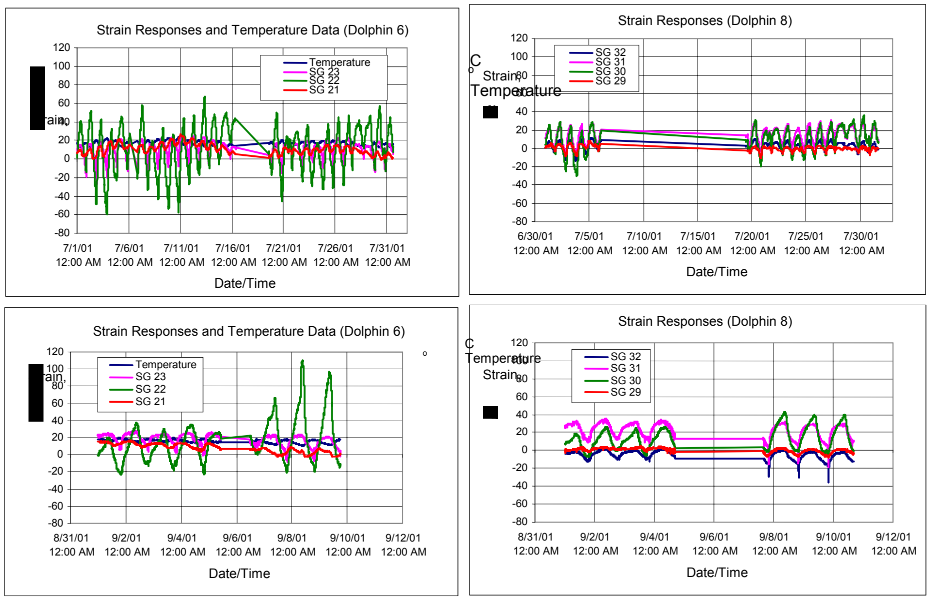
Sensor Details:

Type	Number	Location
Long gauge fibre optic sensors	8	4 at each Column for pier No.2
Bi-directional strain gauges	16	8 at each Column for pier No.2
3-D accelerometers	2	Top of the pier cap (Pier No.2)

Examples of outcomes:

The Data Dolphin Data Logger with Data Dolphin software is being used to measure strain and temperatures of the columns. The data is usually downloaded from the memory card and saved as Comma Separated Variables files and displayed as a graphical relation between strain and temperature versus time.

The data measurement frequency increased, especially when using accelerometers to record the dynamic data of seismic events. A video camera has been installed so that strain variations can be synchronized to traffic movements and data communication has been recently established for the bridge. The following figure shows some of the measured data plotted as time versus strain responses and temperatures for the mentioned data loggers. Some Dolphin units have an identical hole in their measured data. That means they stopped recording data at precisely the same time and started up again at the same time.



Measured strain and temperature

Benefits of using SHM technologies in the project:

Using SHM technologies in the Portage Creek Bridge project provides the following benefits:

- Measured data from the various sensors that are integrated into the SHM system determines structural performance under in-service conditions, diagnoses faults, and quantifies the risk of failure.
- Seismic strengthening with FRP is an effective and economical method of retrofitting for improvement in ductility and base shear resistance of existing structures.
- Designing bridges for seismic resistance and monitoring has become a priority in areas of moderate to high seismicity.
- After installing the remaining data loggers to on Pier No. 2, the Portage Creek Bridge is considered a model smart bridge for continuous remote monitoring.

References:

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Mufti, A.A., *Guidelines for Structural Health Monitoring,* Design Manual #2, ISIS Canada, September, 2001.

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