Beddington Trail Bridge – Canada

Project Description:

The Beddington Trail Bridge is the first prestressed concrete bridge in Calgary and was completed in 1993. Instead of steel reinforcement, it was decided to use CFRP tendons, which made it the first bridge in the world to use CFRP reinforcement. It was also the first bridge in the world to use fibre optic Bragg grating sensing.

Figure 1: Beddington Trail Bridge - Calgary, Alberta, Canada

Quick Facts:

- **Name and Location:** Beddington Trail Bridge – Calgary, Alberta, Canada
- **Owner:** City of Calgary
- **Structure Category:** Continuous Span Bridge (Girder Bridge)
- **Spans:** 2 (22.83m and 19.23m)
- **Structural System:** 26 pre-stressed girders in all; 4 with CFCC, and 2 with Leadline Rods
- **Start of SHM:** 1993
- **Number of Sensors Installed:** 18

Instrumentation Design by: ISIS Canada – University of Manitoba

Description of Structure:

The 42.06m long bridge acts as a simply supported span for its own weight and the weight of deck slab. Each girder is pre-tensioned with 26 or 22-1/2" (12.7 mm) diameter steel strands to resist these loads. The two simple spans made continuous with post-tensioning consisting of 12-1/2" (12.7 mm) 7 wire strands. Four of the twenty-six bulb-tee precast girders

were pre-tensioned by two types of CFRP tendons. Four of these girders were pre-tensioned using Carbon Fiber Composite Cables (CFCC), 5/8" (15.2 mm) in diameter, produced by Tokyo Rope, Japan. The other two girders were pre-tensioned using 5/16" (8 mm) Leadline bars, produced by Mitsubishi Kasei, Japan. The CFCC strand has an area of 0.176 in ^{2} (113.6 mm ^{2}).

Purpose of Instrumentation:

Since this was the first FRP reinforced bridge in the world, engineers found it reasonable to install instrumentation for the first time in the world. They wanted to monitor the FRP's durability and experiment with sensors in the field.

Sensor Details:

Type	Number	Location
Fibre optic Bragg Grating sensing	20	Girders

Examples of Outcomes:

The following figure is a typical dynamic response to a truck load crossing the bridge at 60 km/hr. The test was conducted in 1999 and repeated in 2004.

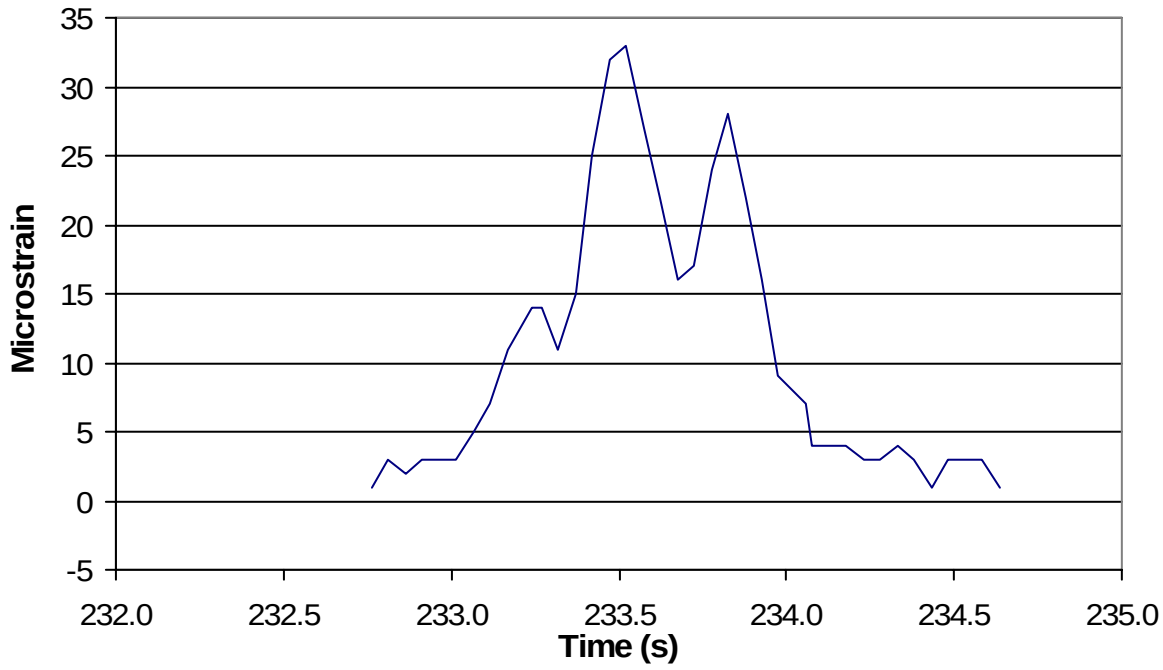

Figure 2: Dynamic Field Testing of Beddington Trail Bridge in 1999

Benefits of Using SHM Technology in Project:

The benefits of using the SHM technology in the Beddington Trail/Centre Street Bridge are:

- Pioneer fibre optics in field applications
- Discover how FRP reacts in field applications
- Prove that the sensors can survive the construction of the bridge

References:

Measures, R.M., Alavie, A.T., Maaskant, R., Ohn, M., Karr, S., Huang,S. (1995) *A Structurally Integrated Bragg Grating Laser System for a Carbon Fibre Prestressed Concrete Highway Bridge,* Smart Mater. Struct., Vol. 4, pp. 20-30.

Rizkalla, S. and Tadros, G., (1994) FRP for Prestressing of Concrete Bridges in Canada, American Concrete Institute, Special Publication. Vol. 215, pp. 75-90.

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