# TIDC 2.10 Durability Evaluation of Carbon Fiber Composite Strands in Highway Bridges

Braedon Kohler, Mechanical Engineering, University of Maine PIs: K. Berube, R. Lopez-Anido, and A. Goupee

## Introduction:

- This project will enhance the transportation infrastructure durability as follows: a) MaineDOT will be able to monitor continuously the long-term durability of Carbon Fiber Composite Cables (CFCC) in the Penobscot Narrows Bridge, and b) Non-corrosive Carbon Fiber Reinforced Polymer (CFRP) strands will increase the longevity of highway bridges.
- The Penobscot Narrows Bridge is being used as a "living laboratory" to test this material
- CFCC demonstrates similar properties to steel but with much higher corrosion resistance, but the longevity of the material still needs to be determined.

## Objectives:

- Upgrade the acquisition system for sensors currently at the bridge (see Figure 1.)
- Implement external environment sensors
- Process the data with an analytical model
- Make a durability assessment of CFCC

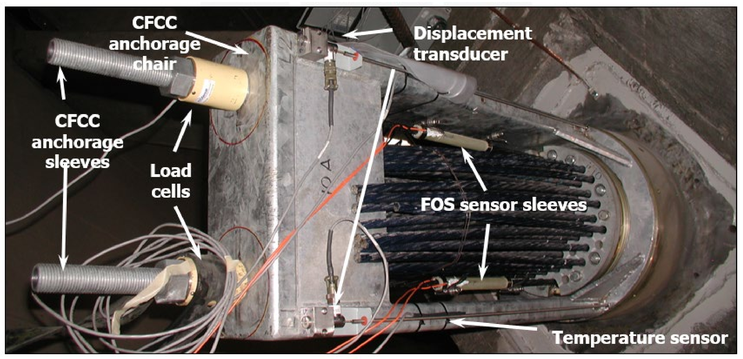


Figure 1: Structural health monitoring sensors for each pair of CFC cables inside the PNB

Acknowledgements: We thank the Maine DOT for facilitating access to the bridge.

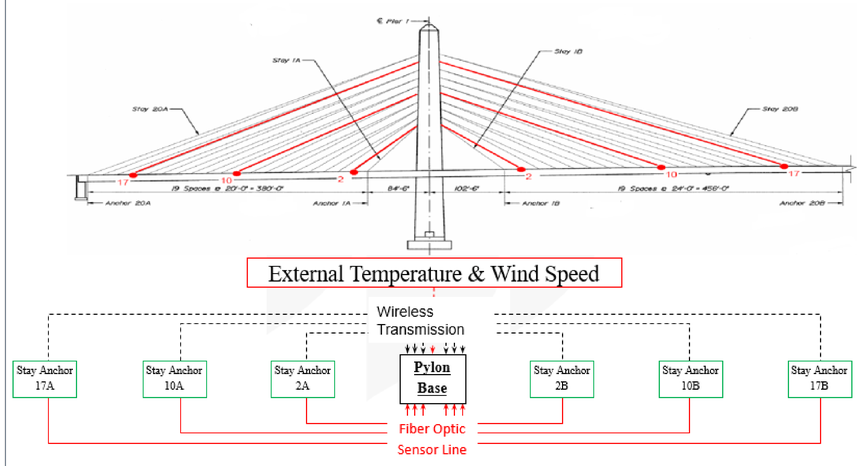


Figure 2: Layout of CFCCs in PNB and Proposed data acquisition system layout

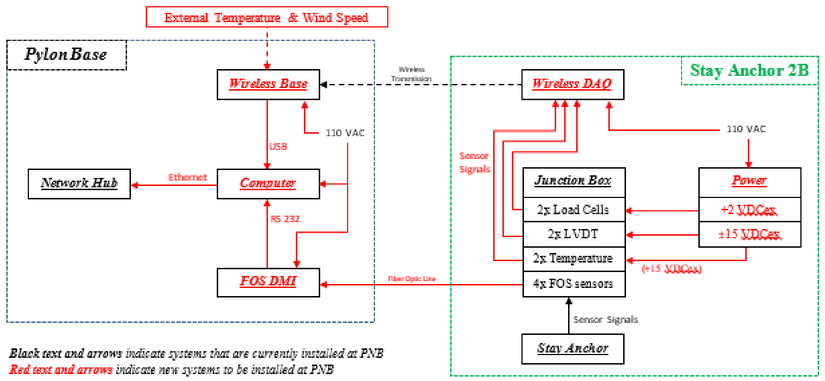


Figure 3: Details of Stay Cable System and Pylon Base

## Methods and Materials:

- Current structural health system at the bridge
  - load cells, fiber optic strain sensors, displacement transducers, and internal temperature sensors.
- Using wireless sensing units and a fiber optic conditioner (shown in Figure 2) we will be able to continuously collect data at the site remotely.
- Collected data will be processed in conjunction with a thermoelastic model to determine major deviations from the predictive model

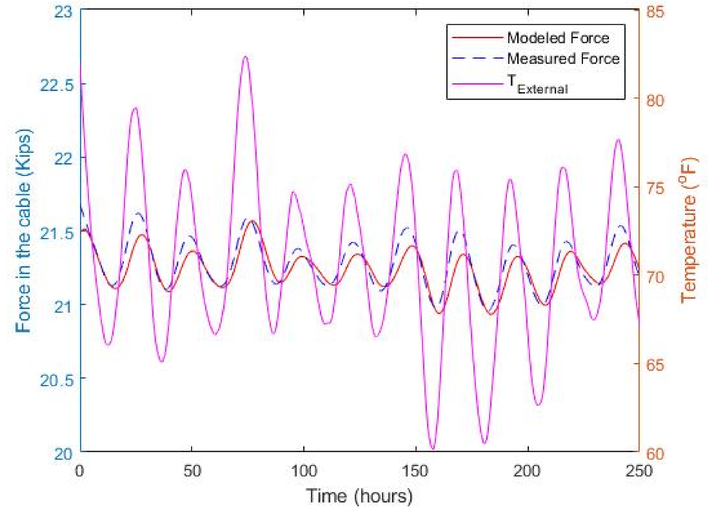


Figure 4: 10B Load and Temperature Data for 07/31/20-08/10/20

## Results and Future Work:

- In Figure 4 we can see the following:
  - No major deviation between measured and modeled forces
  - Load fluctuations in the cables mirror the change in the temperature at the bridge, which can be attributed to the difference in thermal expansion between the steel and CFCCs.
- As we continue to model our cables we plan to upgrade the model to include the newly added weather data.
- The wireless system to be implemented also needs multiple power supplies and junction boxes to be installed to complete the data acquisition system. See Figure 3 for items that need to be installed, which are pictured in red.