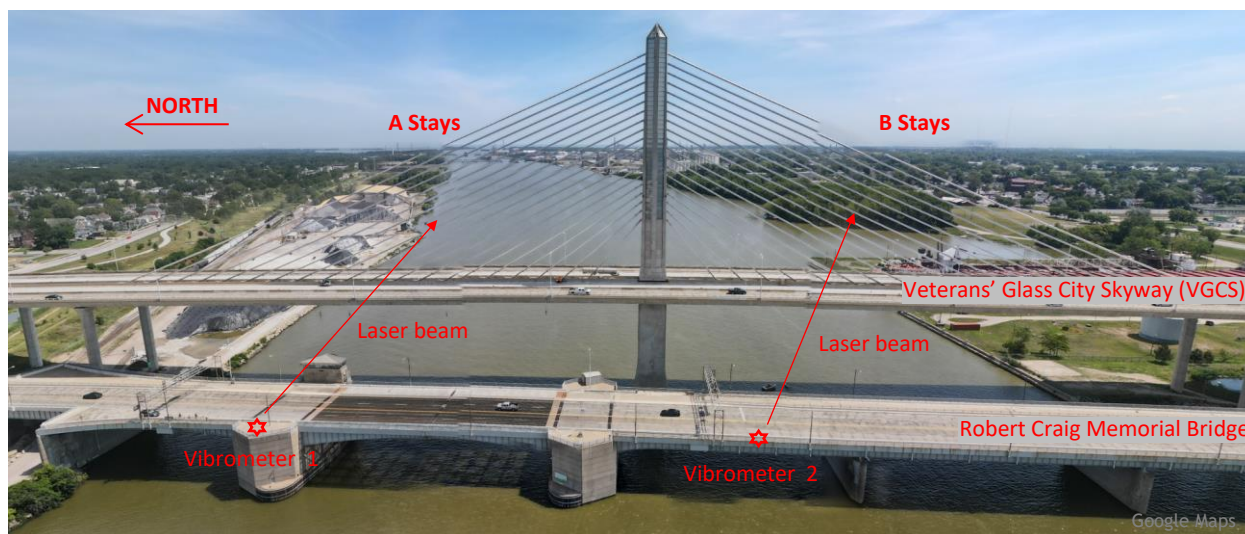


# Ohio Department of Transportation Research Project Fact Sheet



## Veterans' Glass City Skyway Bridge Main Cable Evaluation

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*Fig. 1 Laser vibrometer measurements to estimate the forces in the stay cables of the VGCS.*

### The Problem

The most critical and prevalent condition causing cable deterioration is the corrosion of the steel strands inside the stays. Stay cables of the Veterans' Glass City Skyway (VGCS) have unique design features to help reduce and delay strand deterioration. These features also make it difficult to inspect the strands using currently available non-destructive evaluation (NDE) methods. The objective of this study is to identify practical nondestructive methods for monitoring and assessing the condition of the strands of the VGCS using existing technologies and develop a long-term monitoring and assessment plan (Fig. 1).

### Research Approach

The research approach includes the following:

- Conduct a literature search on the published studies and project reports.
- Reach out to firms providing NDE services and experts in national committees on NDE.
- Identify a collection of NDE methods that are applicable to the VGCS stays.
- Evaluate the effectiveness, reliability, and site-deployment characteristics of each method.
- Identify candidate vendors and the estimated costs for the applicable methods.
- Use the most suitable methods to assess the current condition of the VGCS stays.
- Develop a long-term monitoring and assessment plan.

### Findings

- The deterioration of strands typically starts at the anchorage zones as opposed to the free lengths of the strands. The applicable methods for the inspection of these zones include visual inspection methods, and material sampling and testing.
- The applicable methods for the global health assessment include the vibration-based stay force estimation methods.
- The applicable methods for the free lengths of the strands include magnetic flux leakage (MFL) testing using a custom-designed magnet, or pulling and replacing a few selected strands and testing them in a laboratory.

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*This research was sponsored by the Ohio Department of Transportation and the Federal Highway Administration.*

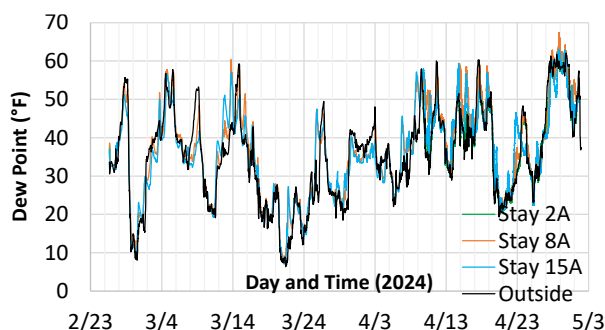
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- The visual inspection study used a borescope and inspected the lower ends of 14 stays. The inspected strands appeared in very good condition with no signs of strand damage, chipping, or corrosion. The dusty state of the strands implies no water runoff and dry conditions (Fig. 2).
- The environmental condition assessment study used six internal and two external temperature and humidity loggers and found no evidence of excessive moisture accumulation inside the stays. The conditions inside the stays are found to be slightly more humid than the outside conditions (Fig. 3).
- The stay force estimation study conducted using a laser vibrometer on 20 stays found no credible concern for the health of the stay cables of the VGCS (Fig. 4a). The deviation of stay forces from the forces measured by the contractor in 2007 is under 10%, which is within the margins of expected deviation (Fig. 4b).



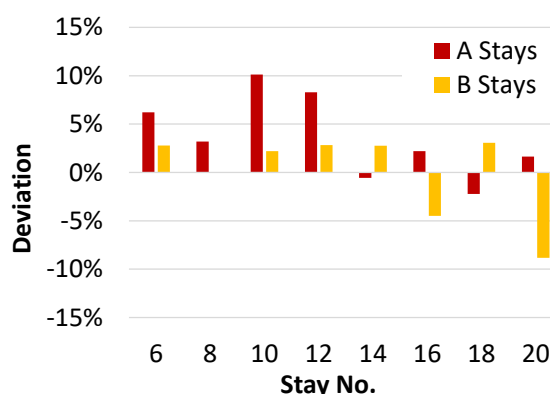
*Fig. 2 Sample photo from the borescope inspection.*



*Fig. 3 Dew point variation (an absolute measure of how much moisture is in the air) inside stays versus outside.*



*Fig. 4 (a) Stay 16B is aimed with a laser vibrometer;*



*(b) Measured forces versus forces at construction.*

## Recommendations

- Apply the identified non-destructive evaluation methods as a part of a regular inspection program.
- Establish a periodical cable tension estimation program, with a 4-year measurement cycle, to monitor the global health of the VGCS.
- If evidence of notable strand deterioration is detected, consider the evaluation methods for the free lengths of the strands.
  - One option is to design a custom magnet for magnetic flux leakage testing. This study should also investigate if custom hoist and cooling systems are necessary.
  - Another option is to pull and replace a few selected strands and test the pulled strands in a laboratory to determine the extent of the deterioration.
  - Both options should be evaluated and compared for their cost, practicality, and reliability before a decision is made if/when necessary.

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