

## Inspections and Monitoring

The BQE cantilevers are experiencing widespread corrosion along the length of the corridor, with the most notable deterioration occurring in and around the portions of the roadway deck that house the structure's expansion joints that are located roughly every 50 feet along most of the project corridor.

NYC DOT is actively engaged in using all available analysis methodologies to further the prediction of the remaining life of the structure and will continue updating the projections as appropriate. In addition to NYSDOT's biennial inspections program, NYC DOT has developed a formal yet flexible monitoring program along the project area. More frequently collected data allows NYC DOT to verify and validate previous predictions about the structures' current and future performance, which in turn gives the agency increasing confidence to make decisions around the timing and types of repairs needed, and potentially around weight restrictions that need to be imposed on the structure. Below is a summary of the ongoing efforts aimed at obtaining the fullest picture of the structure's overall condition possible:

- Weigh-in-motion (WIM) sensors measure the weights of vehicles, by axle and by overall weight, and provide distance between the axles as vehicles drive over them. This information is critical in understanding the level of traffic loads on the structure. In September 2019, NYC DOT installed WIM sensors on the BQE near Pearl Street. By the end of spring 2020, NYC DOT expects to finish installing additional sensors for the lanes near Hicks Street. The agency and its academic partners will continue collecting data and will regularly calibrate both sets of sensors. NYC DOT will also install cameras to better understand the truck configurations that pass over the sensors.
- Structural Monitoring
  - Concrete cores were previously taken from different parts of the structure in 2016 and provided valuable information of the capacity of existing structures. Additional cores will be taken at strategic locations so that existing corrosion levels can be actually observed up close and used to verify predicted corrosion rates against those existing core samples.
  - Ground-penetrating radar (GPR) is a noninvasive imaging technology that uses radar to produce an image of a subsurface. The triple cantilever sections of the BQE have already undergone GPR and related testing programs. The information from these tests provides critical insights such as the current level of section loss in the reinforcement, which indicates a reduction in capacity and durability. NYC DOT will continue to use these methods at regular intervals to monitor corrosion levels and other anomalies within the structure that may not be visible in the early stages. This will include testing of sections of the cantilevers that were not tested to the same level previously.
  - Strain and deflection sensors measure the structure's reaction to vehicles on the roadway. These measurements were completed at two spans on each roadway

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direction in 2019. They are used to validate predicted bridge performance evidenced in current computer models, as well as will provide a baseline for future measurements. Additional measurements will be taken to provide ongoing reference information.

- Vibration monitoring has been conducted by NYC DOT of the cantilever structures and neighboring residences of Brooklyn Heights. The first round of monitoring was originally implemented in response to general community concerns and completed in 2017. New measurements were taken in 2019 for comparison against previous data. These measurements allow NYC DOT to assess a correlation between the vibrations of the structure and the perceptible vibrations of the adjacent residences. The monitoring devices will be left on the Columbia Heights abutments for ongoing, regular data collection and analysis.
- Structural Assessments
  - NYC DOT has performed numerous walkthroughs of the corridor, most recently in November and December 2019. These visits include visual inspections of the interior of the structures where accessible. Aside from providing the opportunity to provide general visual monitoring, the visits allow for identification of additional location-specific testing and measurements or analysis. Moving forward, NYC DOT will continue with similar walkthroughs on a monthly basis, which would also provide the opportunity to perform other data gathering tasks and any repairs yet to be identified. This effort is in addition to the regular bridge inspection program that is managed by NYSDOT for all bridges. NYC DOT is in close coordination with NYSDOT to share information from field visits.
  - NYC DOT will continue the dialogue with bridge engineering experts at the Federal Highway Administration (FHWA), New York State DOT (NYSDOT), and the American Association of State Highway and Transportation Officials (AASHTO) to review and provide input on the overall methodology ongoing analysis such as updated load ratings and other structural assessment effort that is done using the data gathered from all the methods listed above.