

Rehabilitation Options

July 25, 2019



DRAFT

Why are we here?

Our Goal:

- Respond to the panel's request for information on rehabilitation options

Our Agenda:

- Frame the challenge
- Understand evaluation criteria
- Present four options
- Open the discussion

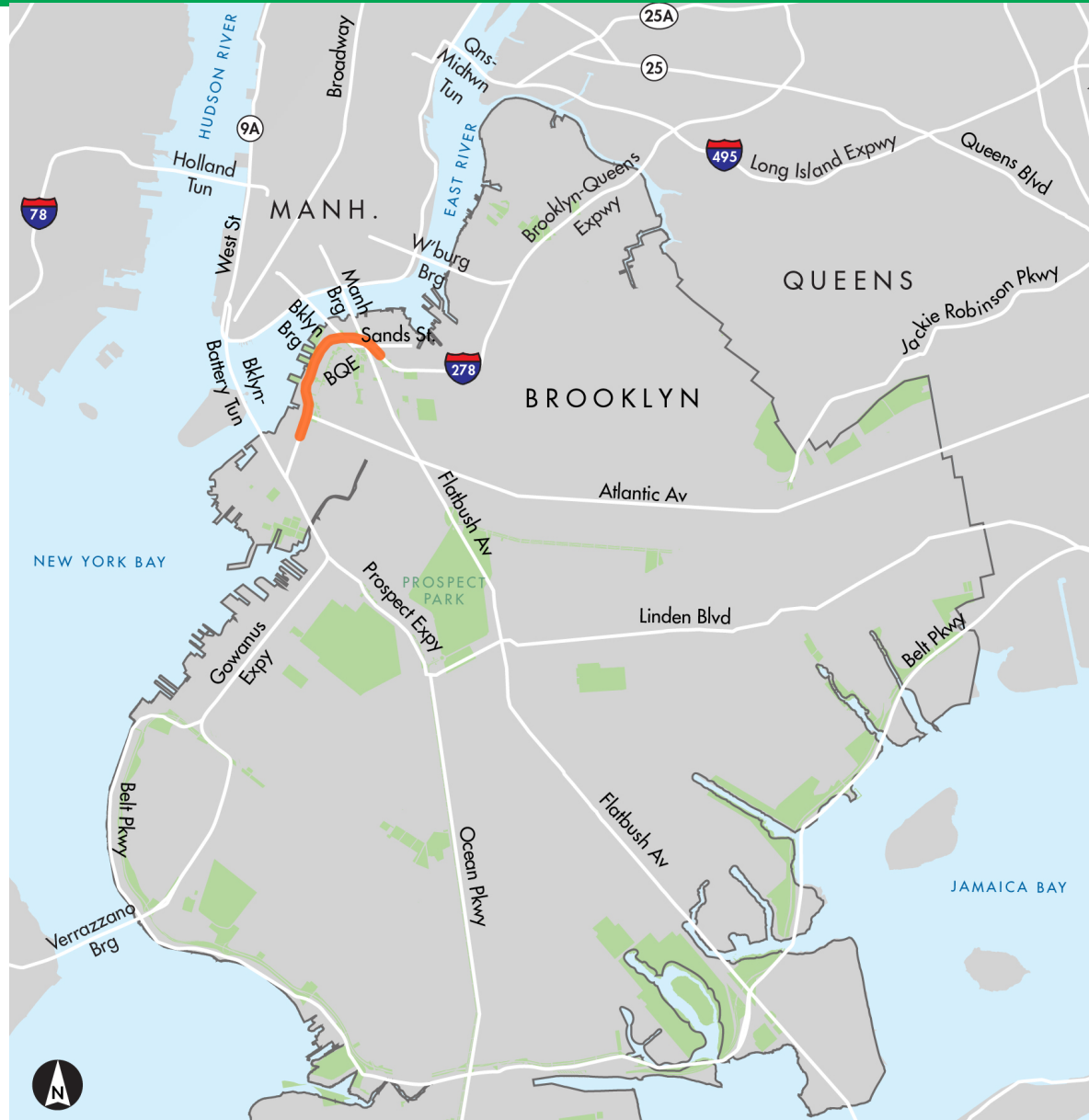
Our Presentation:

- Provides the information needed to evaluate options
- Presents the challenges and solutions in an easy to understand way
- Is supported by data and analysis, available in appendix

So, where are we?

Framing Our Challenge

- As the only interstate in Brooklyn, the BQE is an important link in the network
- At 70+ years, it is well over its design-life



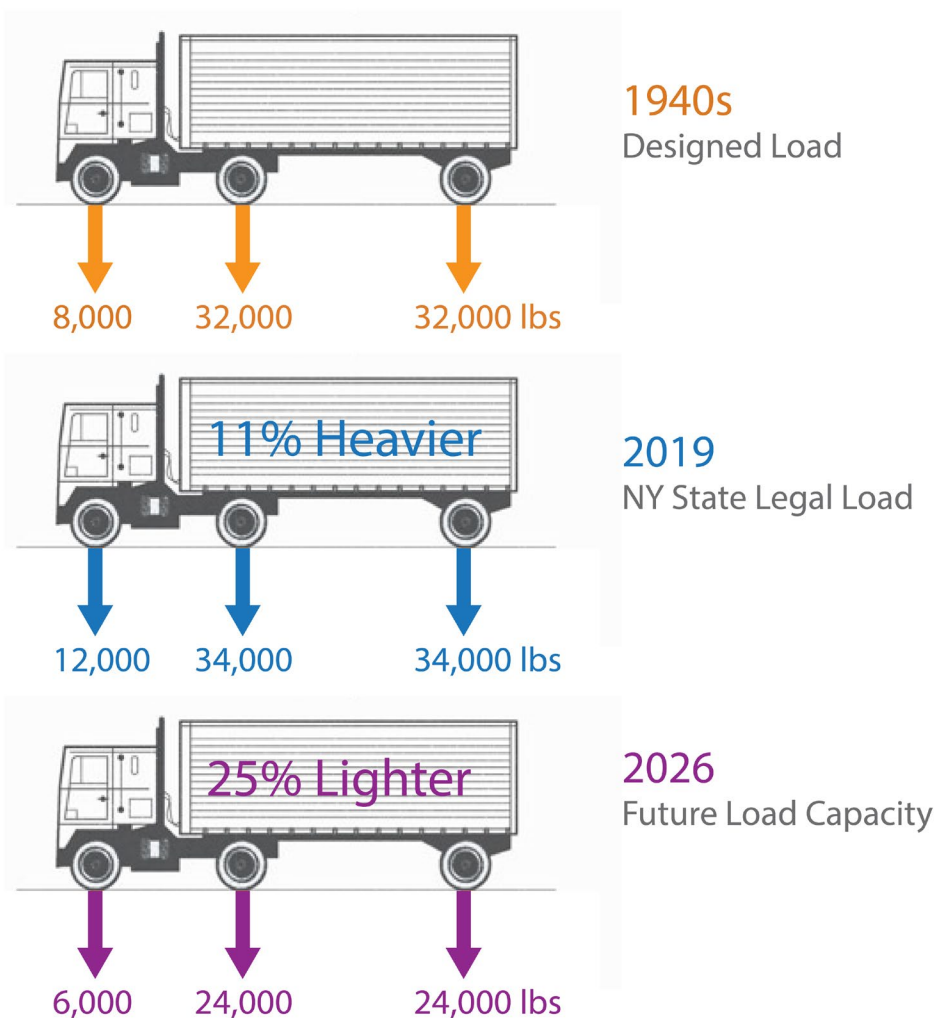
Framing Our Challenge

- Trucks rely heavily on the route and worsen the cantilever's deteriorated condition
- Compared to opening day, the BQE has:
 - **MORE** trucks
 - **BIGGER** trucks
 - **HEAVIER** trucks
 - **FASTER** trucks



Framing Our Challenge

- The BQE carries a load greater than what it was designed for
- A large population of heavier, “illegal” trucks also use the road



Framing Our Challenge

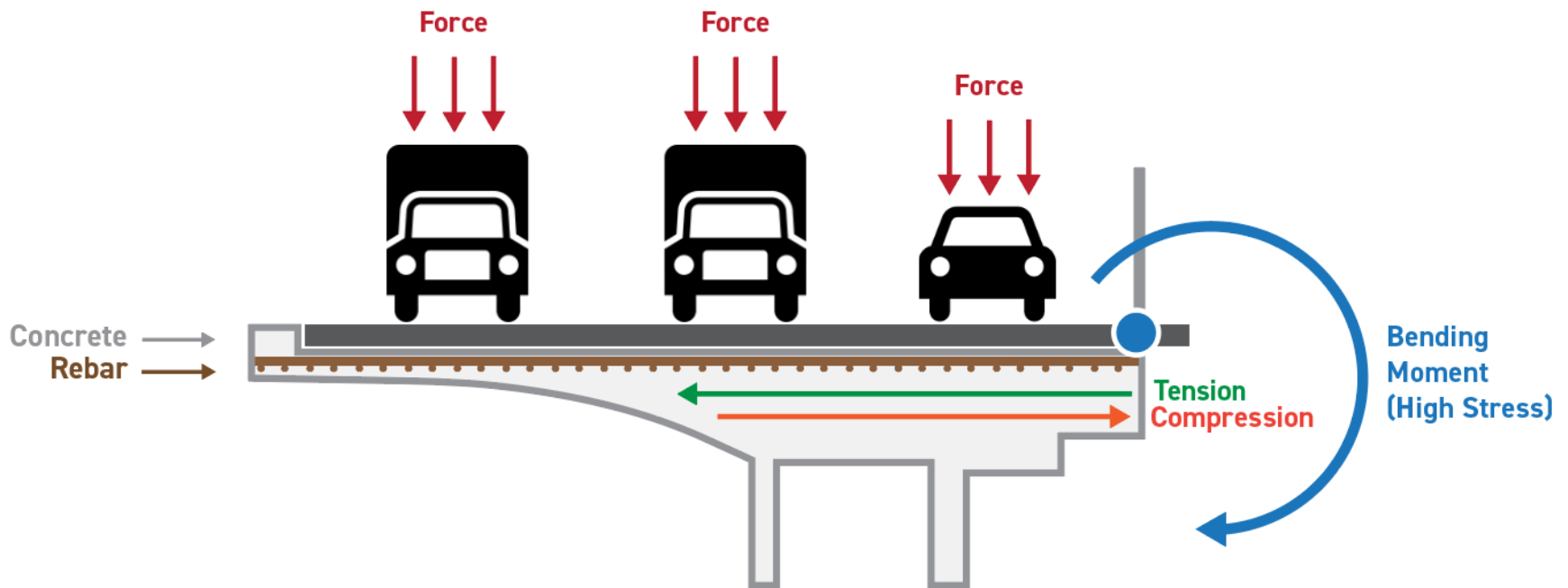
- Furthermore, BQE Triple Cantilever is a uniquely engineered structure



Framing Our Challenge

In simple terms, what is a cantilever?

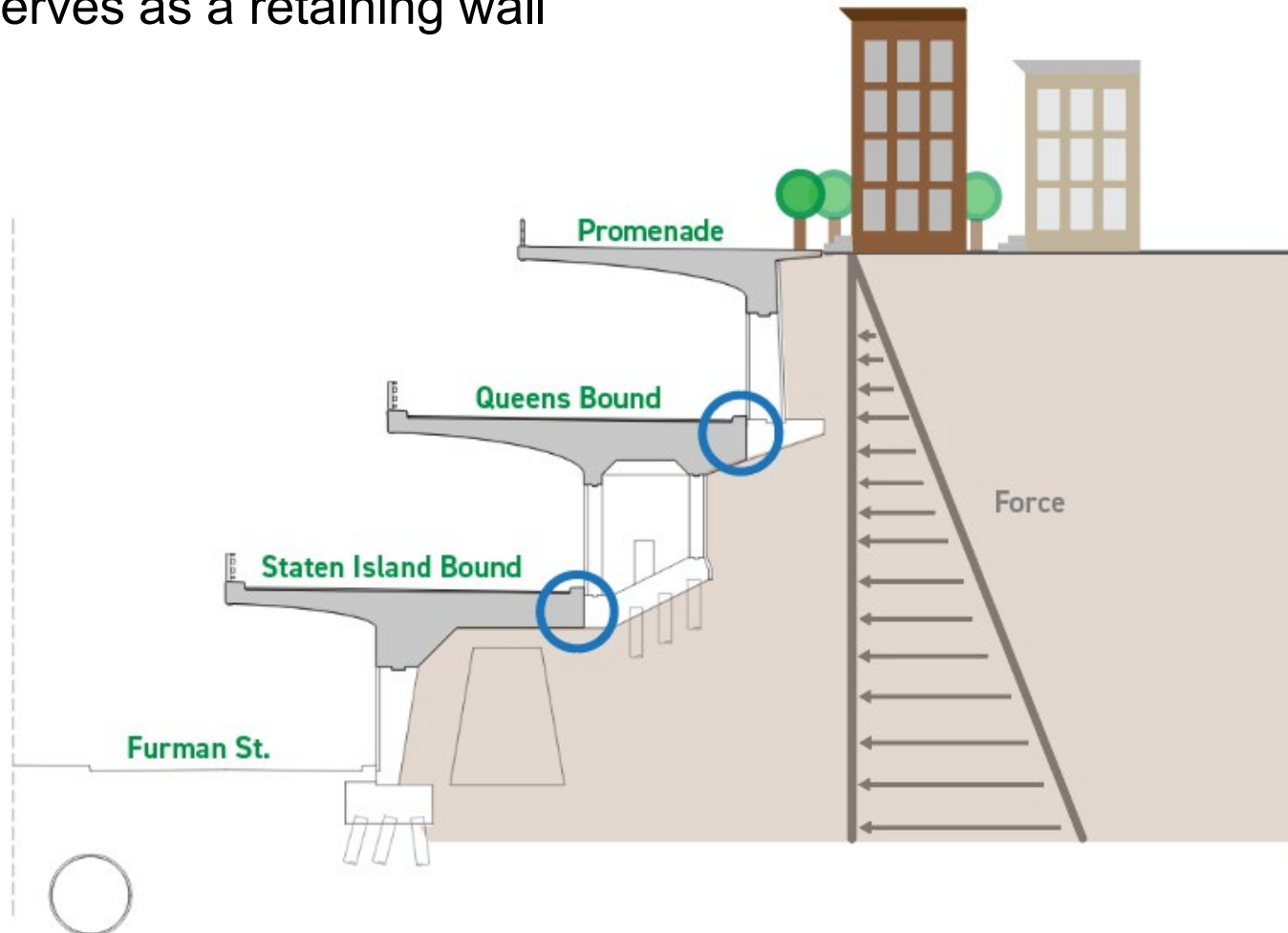
- A deck supported by an anchor at one end



Framing Our Challenge

What makes the BQE unique?

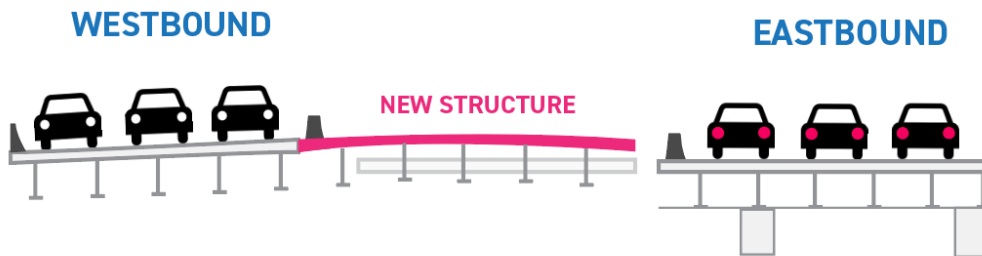
- A *single* reinforced concrete structure with three Cantilevers that serves as a retaining wall



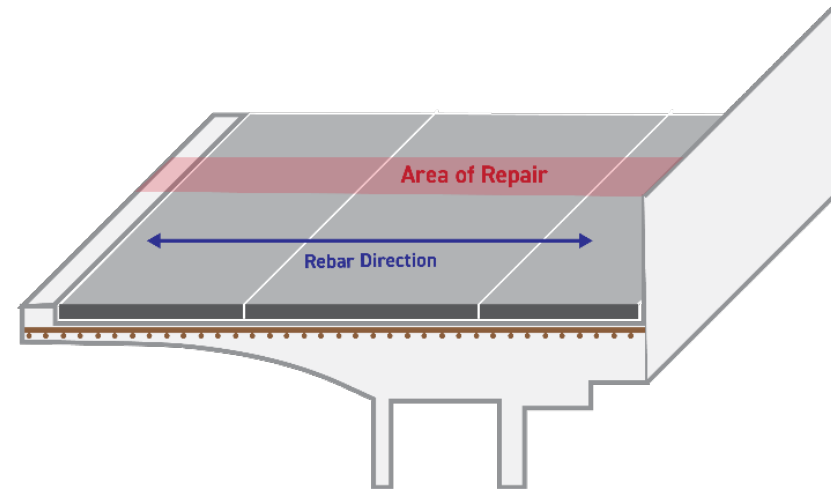
Framing Our Challenge

Why does it make our lives so difficult?

- Traditional lane-by-lane rehabilitation is not an option



**Belt Parkway Repair
(shift traffic)**

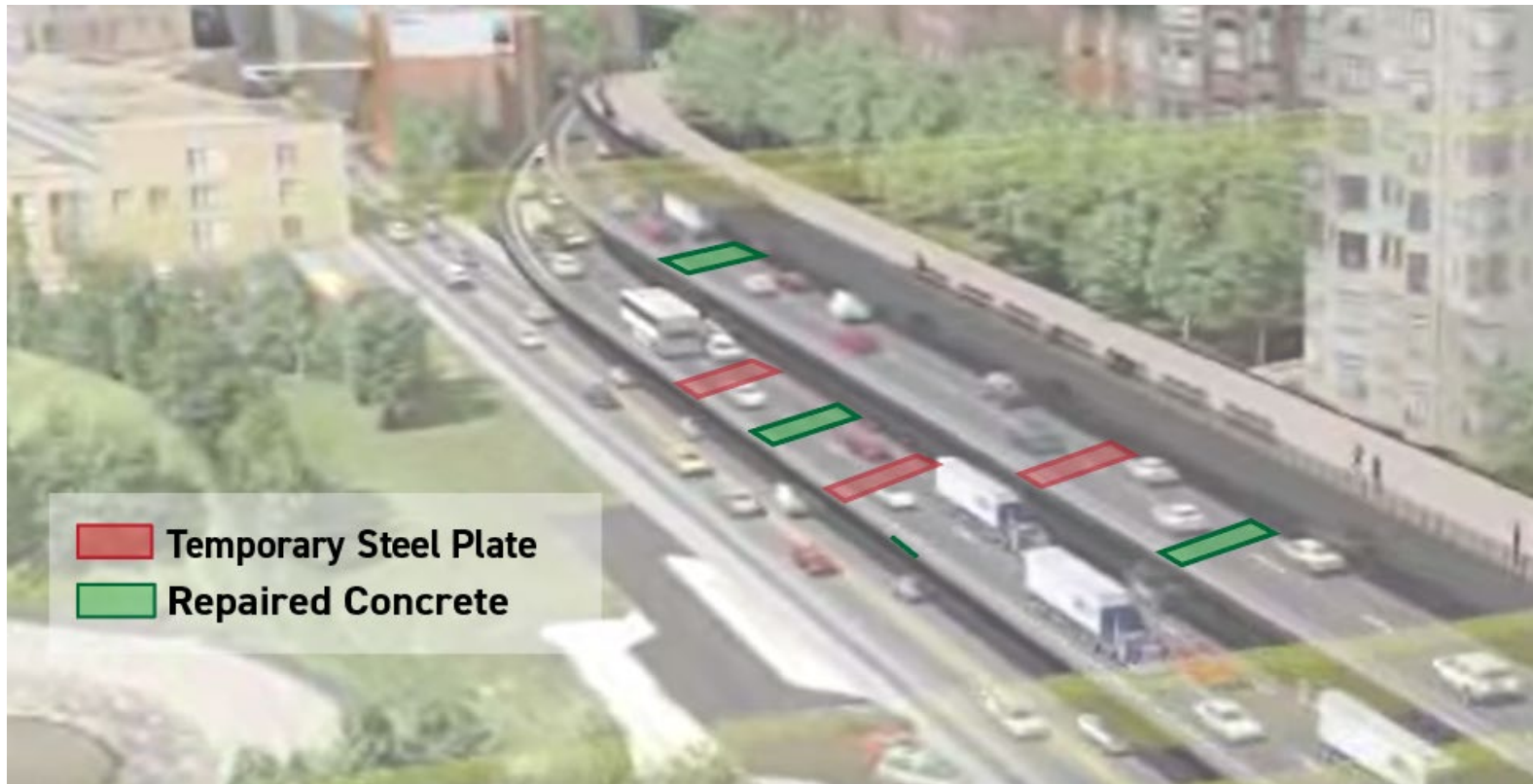


**Triple Cantilever Repair
(Full Closure Required)**

Framing Our Challenge

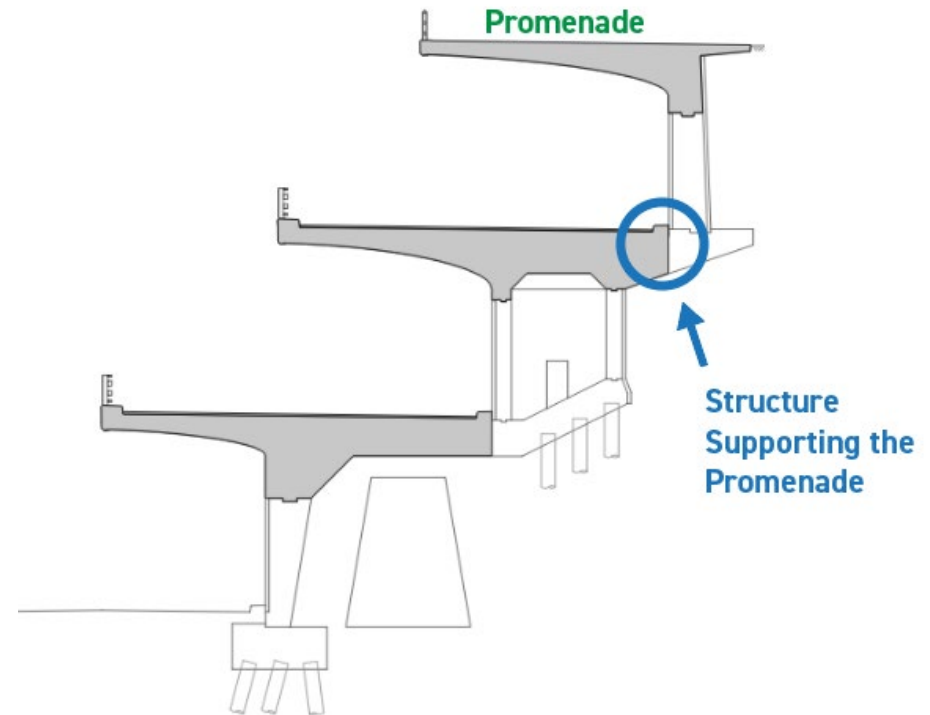
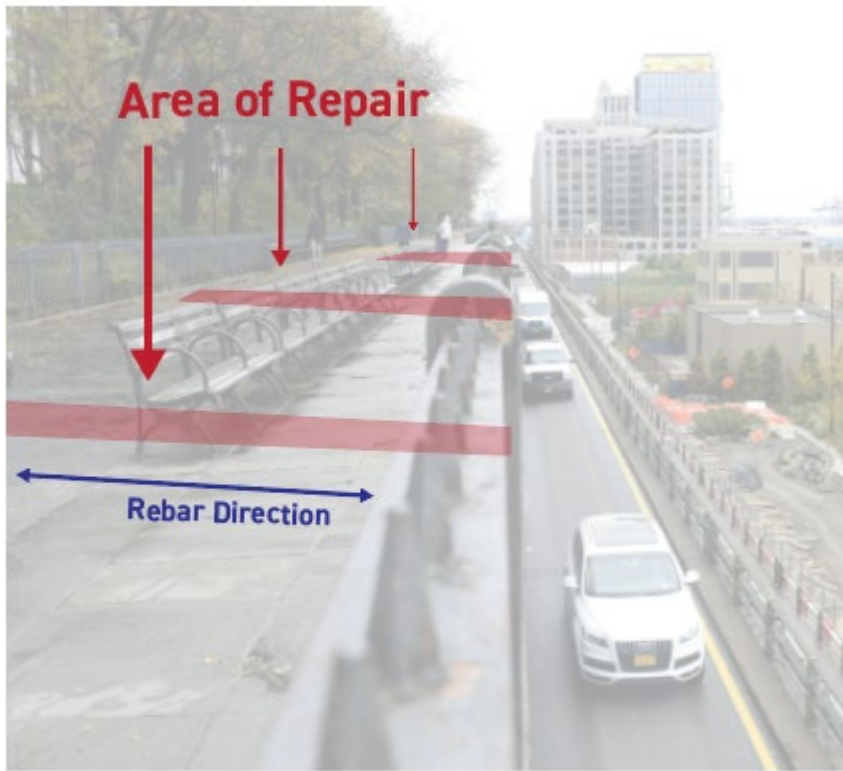
Why does it make our lives so difficult?

- Only small sections can be completed to ensure stability



Framing our challenge

- The Promenade is tied to the structure and must also be repaired in segments.



Framing Our Challenge



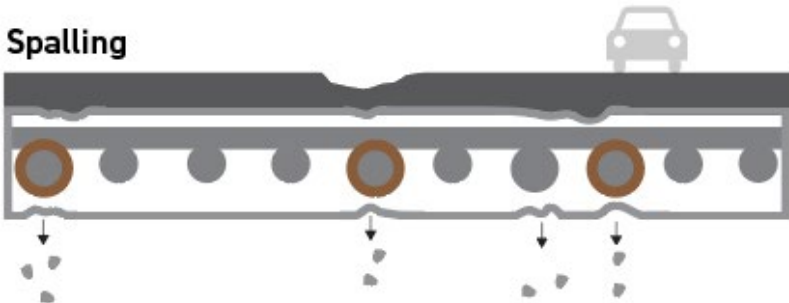
New Condition



Corrosion



Spalling



Hole in Deck



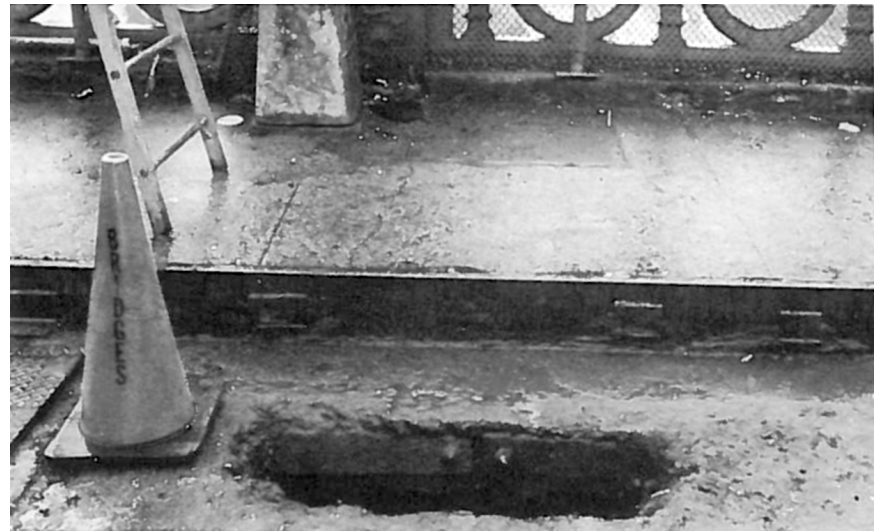
Corrosion in Reinforced Concrete



Video credit: [Cortec Middle East](#)

What is it?

- Replacement of deteriorated deck sections only
 - Like fixing a cavity in a tooth



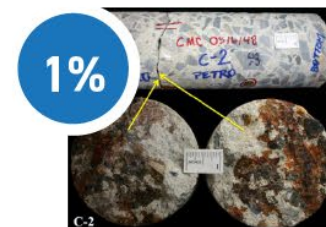
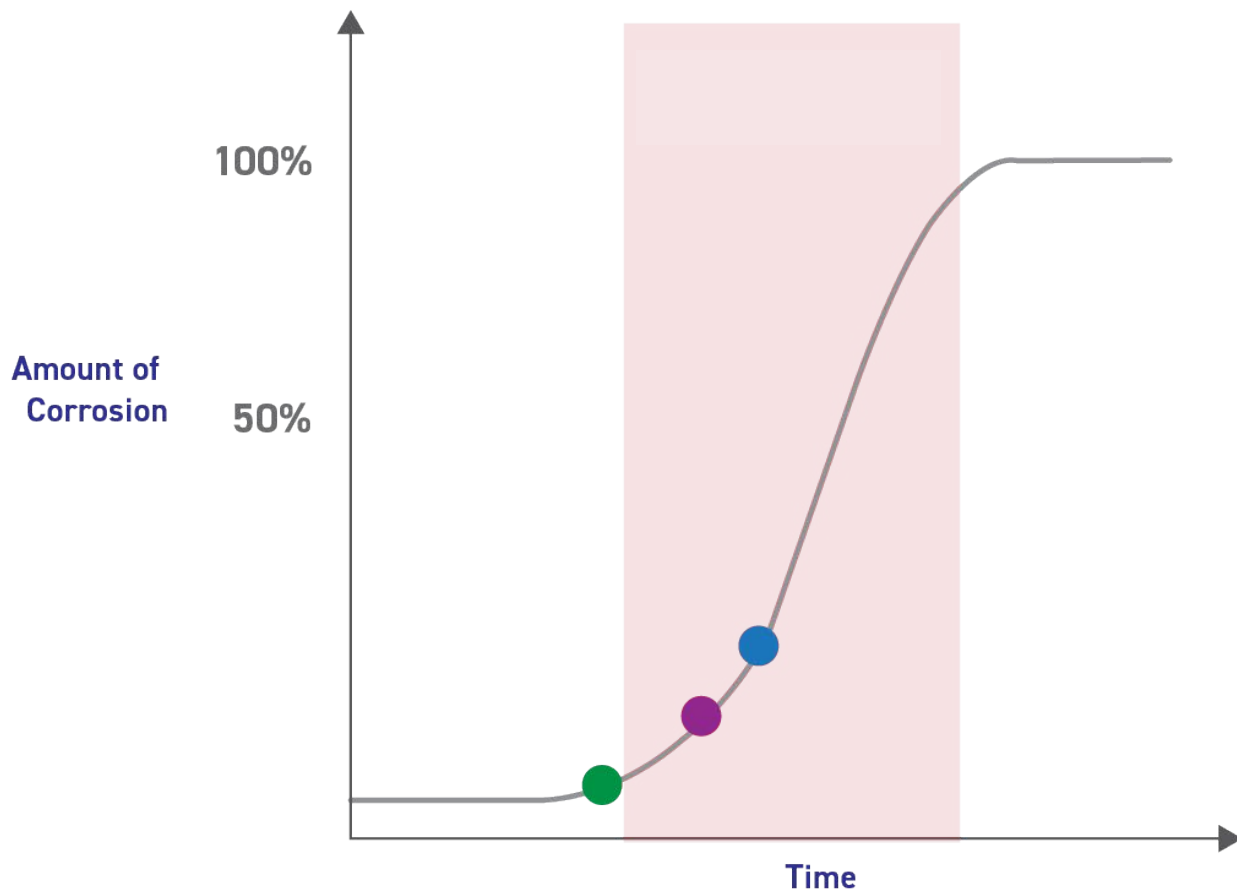
Framing Our Challenge

Redacted for security reasons

Framing Our Challenge

What's going on right now?

- Corrosion continues at an accelerated pace

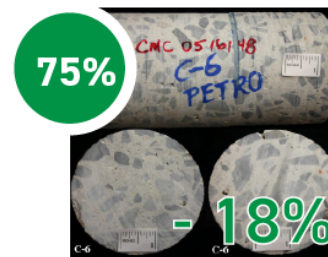
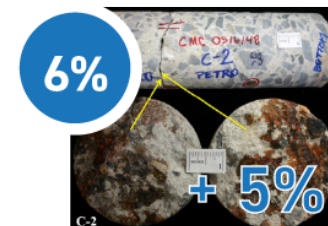
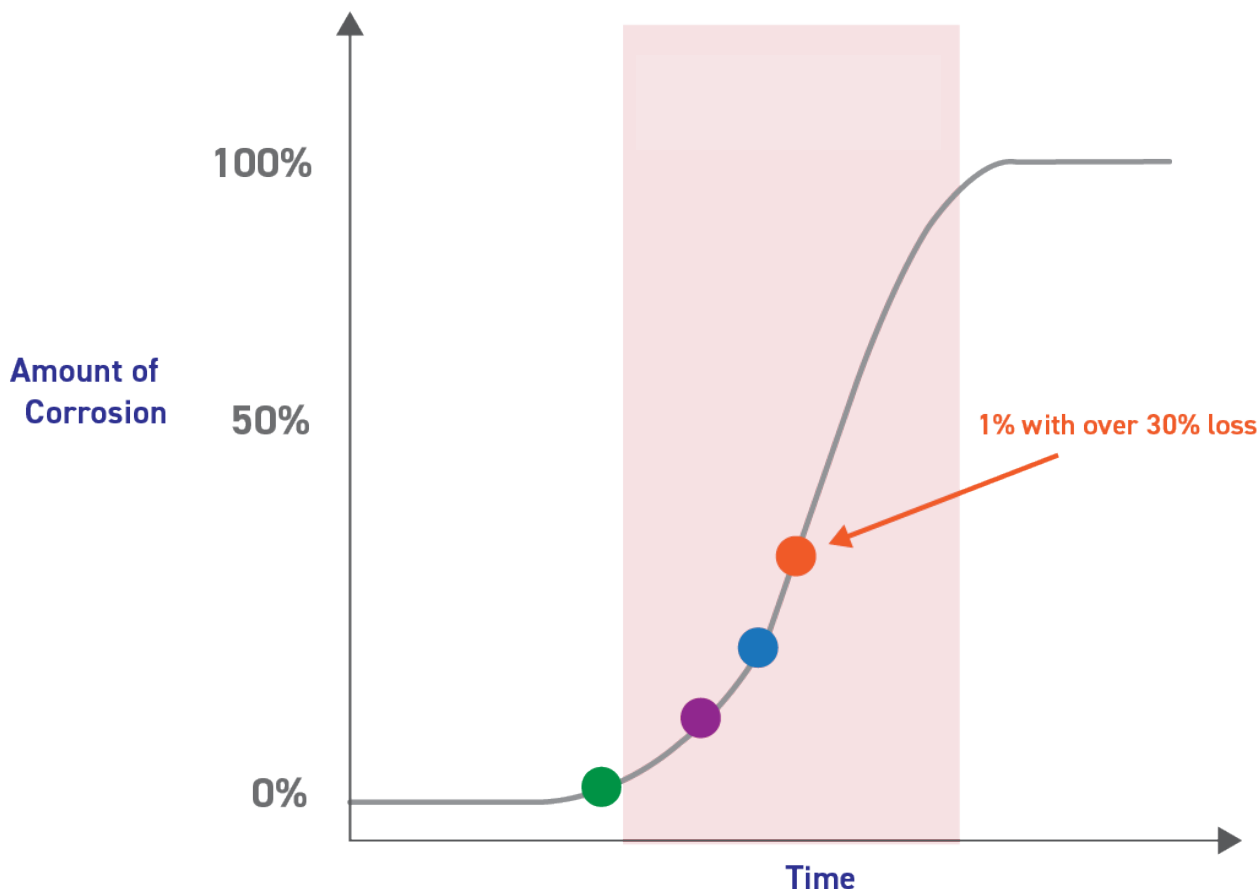


2016 Study

Framing Our Challenge

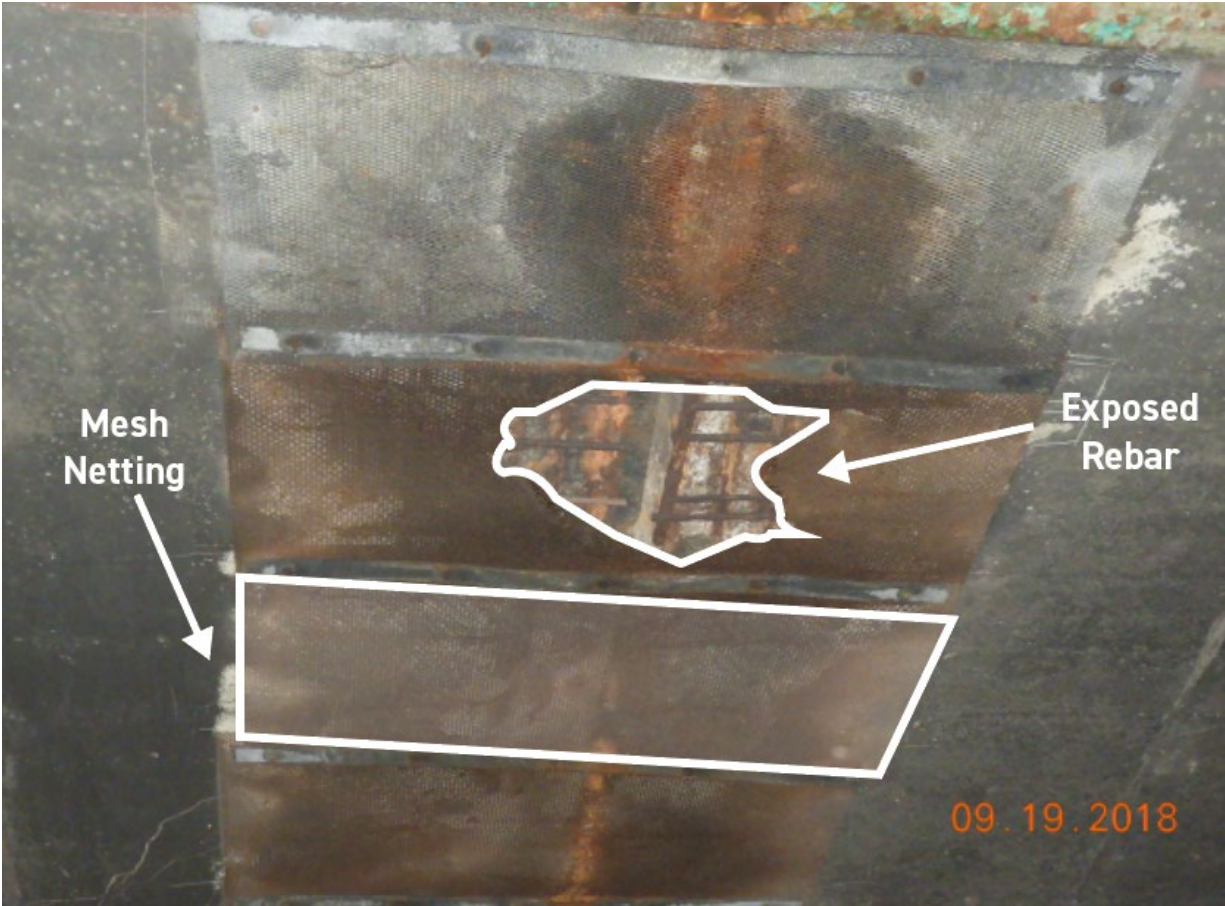
What's going on right now?

- Corrosion continues



2026 Prediction

Framing Our Challenge



Current Safety Inspections

Yellow Flag Condition – Hicks Street Retaining Wall



Current Safety Inspections

Yellow Flag Condition – Hicks Street Retaining Wall

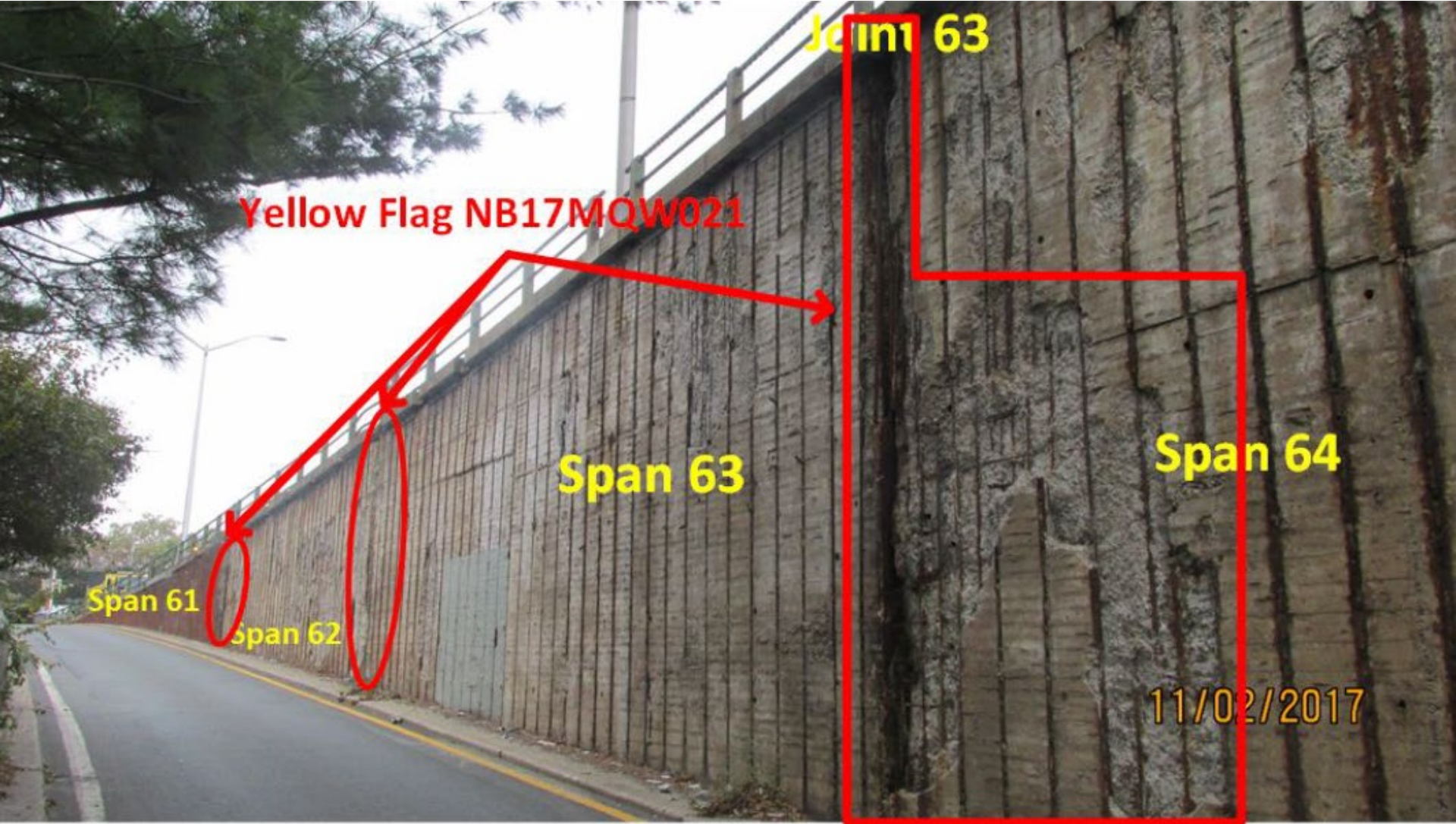


Current Safety Inspections

Yellow Flag Condition – Hicks Street Retaining Wall



Framing Our Challenge



Framing Our Challenge



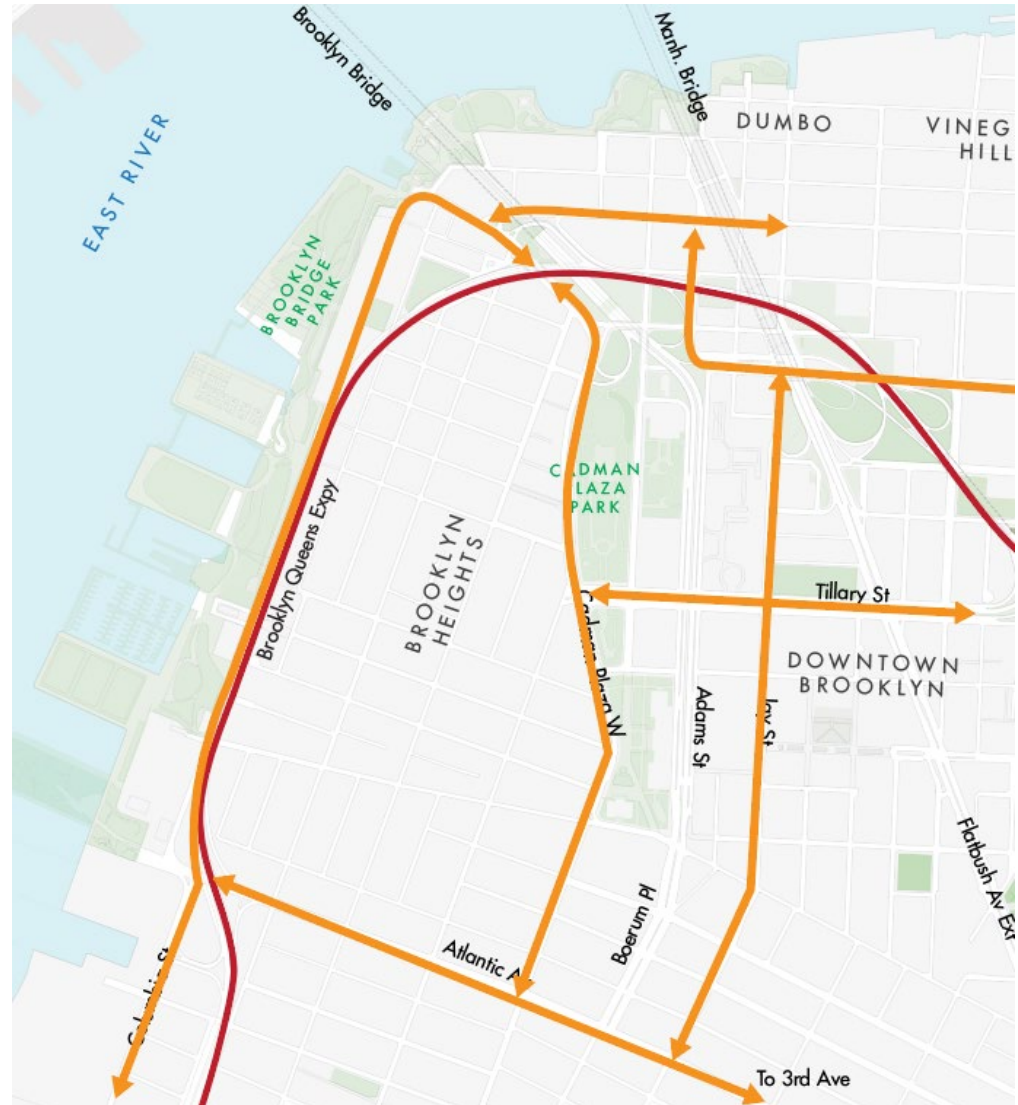
Part of Yellow Flag
NB17MQW013

09/25/2017

Framing Our Challenge

If not addressed,
the anticipated
progression is:

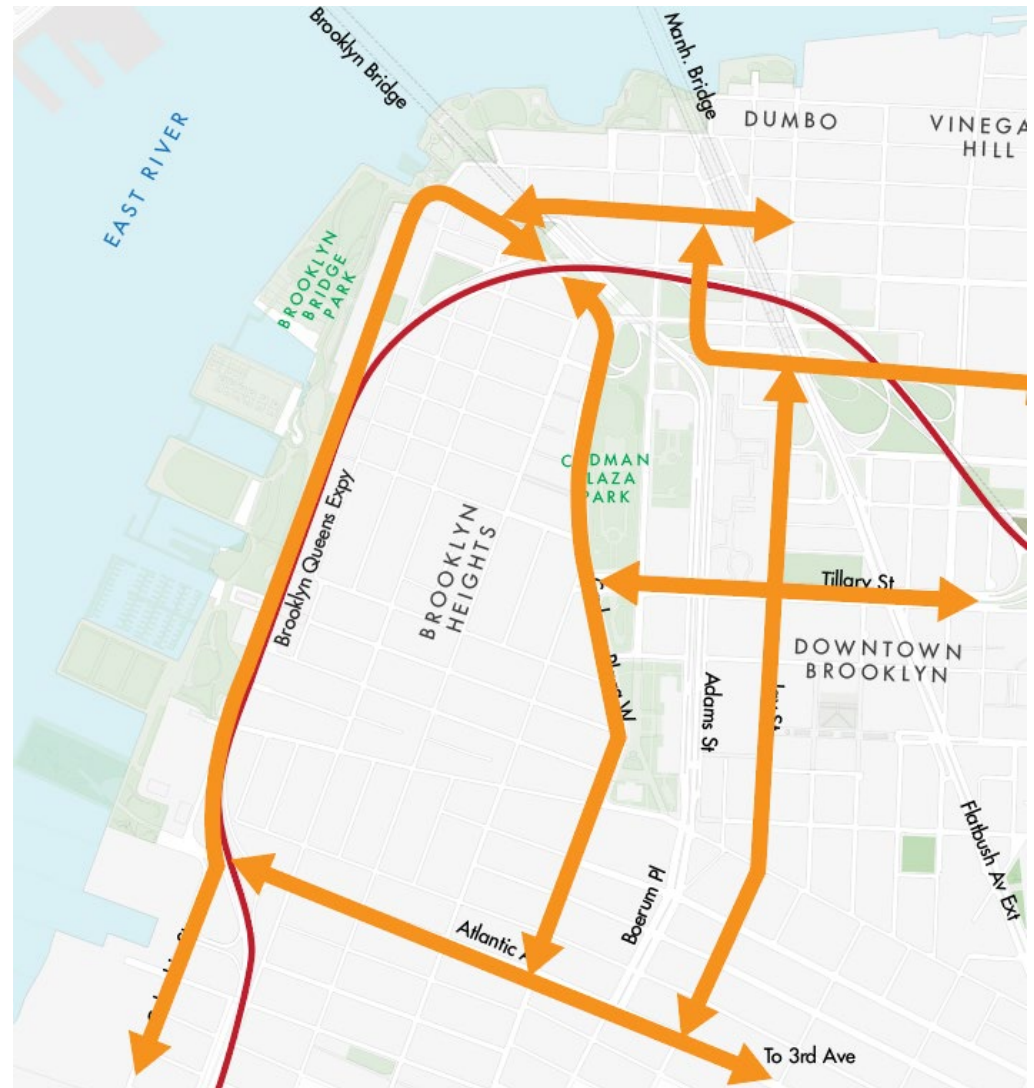
1. Large trucks removed



Framing Our Challenge

If not addressed, the anticipated progression is:

1. Large trucks removed
2. All trucks removed



Framing Our Challenge

If not addressed, the anticipated progression is:

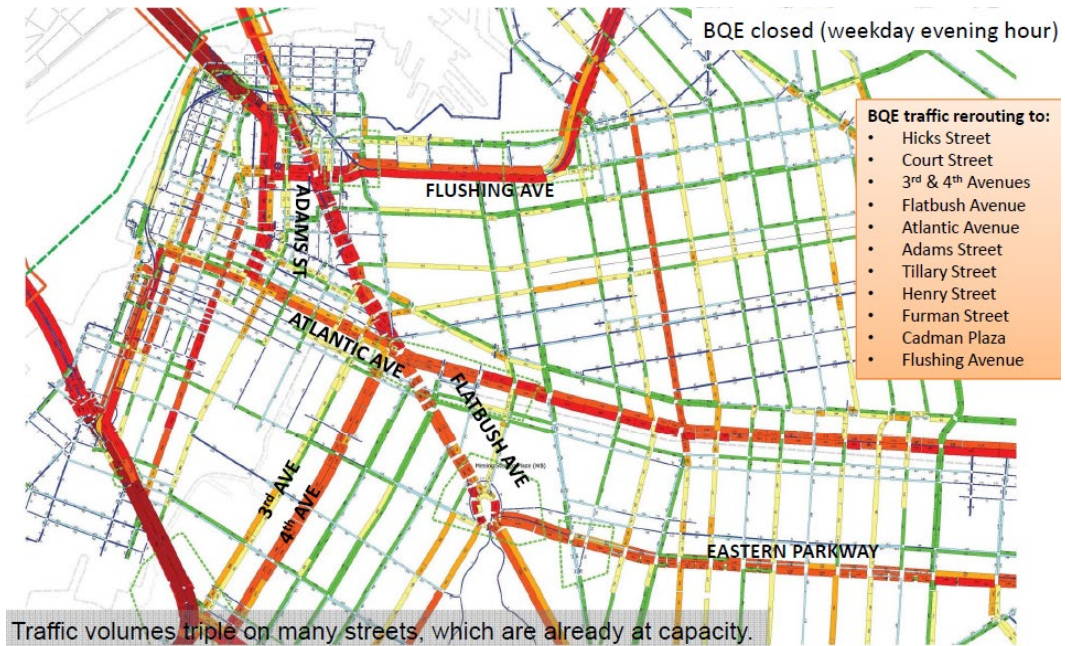
1. Large trucks removed
2. All trucks removed
3. All traffic removed



Framing Our Challenge

The Inevitable Case

- Any one of these scenarios involve trucks pushed to local streets
 - Congestion



Framing Our Challenge

The Inevitable Case

- Any one of these scenarios involve trucks pushed to local streets
 - Congestion
 - Physical impacts to local streets



Framing Our Challenge

The Inevitable Case

- Any one of these scenarios involve trucks pushed to local streets
 - Congestion
 - Physical Impacts to local streets
 - Safety: Trucks & people do not mix



Framing Our Challenge

*The nature of structures – when they're strong, they're strong.
When they're weak, they're difficult to predict with certainty.*

Framing Our Challenge

When does this all happen?

- Conditions continue to deteriorate at an unknown rate
- Eventually, traffic will need to be removed
 - DOT's belief, based on available information, is 2026
- Could be sooner, could be later
- It can be debated, but must be addressed

Refining predictions

- DOT is Conducting risk-based assessment of structural failure
 - WIM sensors
 - Probabilistic Evaluations
 - Load and Resistance Factor Rating analysis
- Engage service life expert
 - Existing structure
 - Rehabilitation/Reconstruction schemes

So, what do we do now?

Developing Rehabilitation Alternatives

- Established criteria to evaluate options:
 - Initial cost
 - Future maintenance & service life
 - Strength of structure (i.e. truck type, size)
 - Safety
 - Construction Impacts

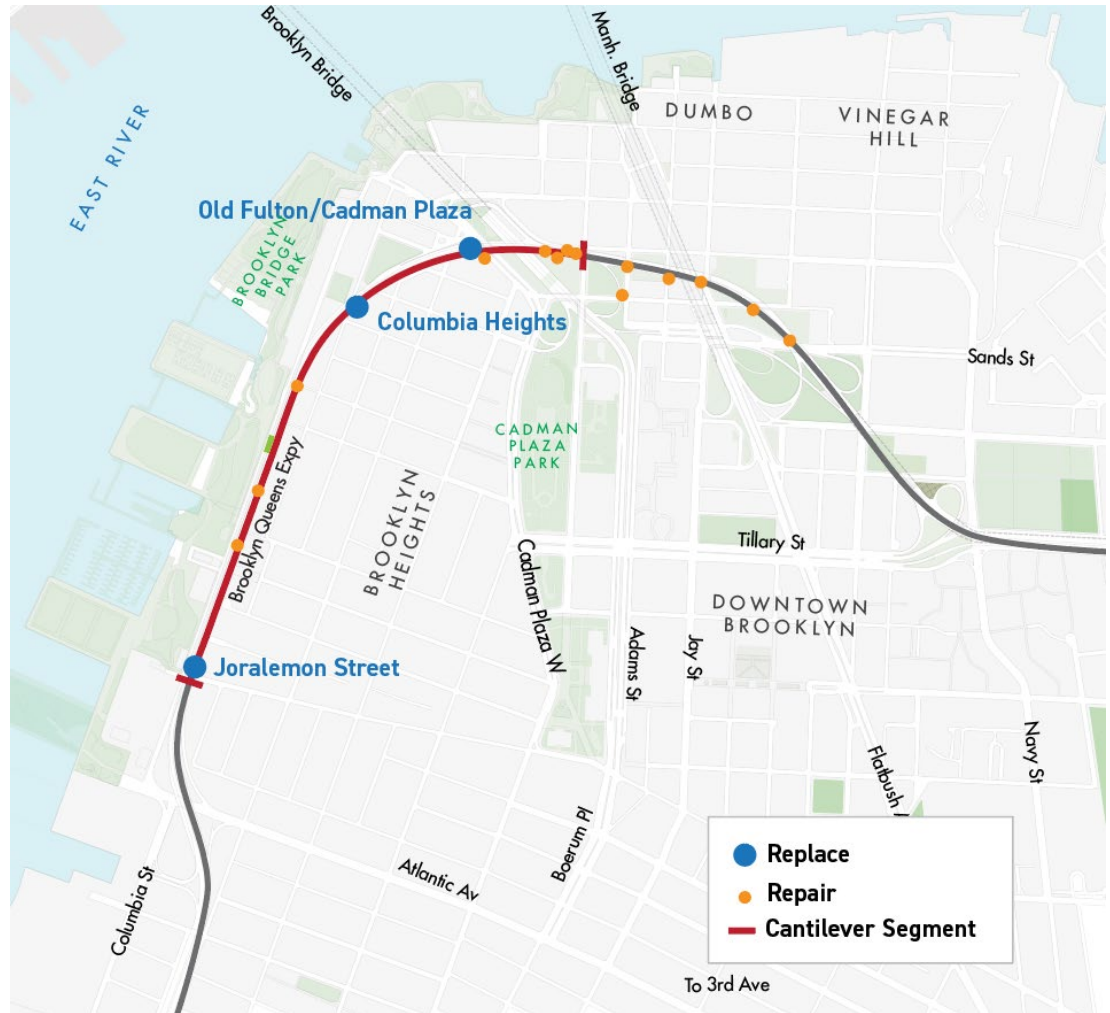
Developing Rehabilitation Alternatives

- Potential benefits that cannot be realized with rehabilitation:
 - Maximum vibration reduction
 - Full improvement to interchanges
 - Full improvement to connections between highway and arterial roadways
 - Increased and improved local connections for bikes and pedestrians
 - Vertical clearance improvements

Developing Rehabilitation Alternatives

Must happen in all options:

- Promenade will need to be reconstructed, using the method chosen for deck
- Repair of 21 bridges, replacement of the following three:
 - Columbia Heights
 - Joralemon Street
 - Old Fulton/ Cadman Plaza



So, what are the options?

Rehabilitation Alternatives

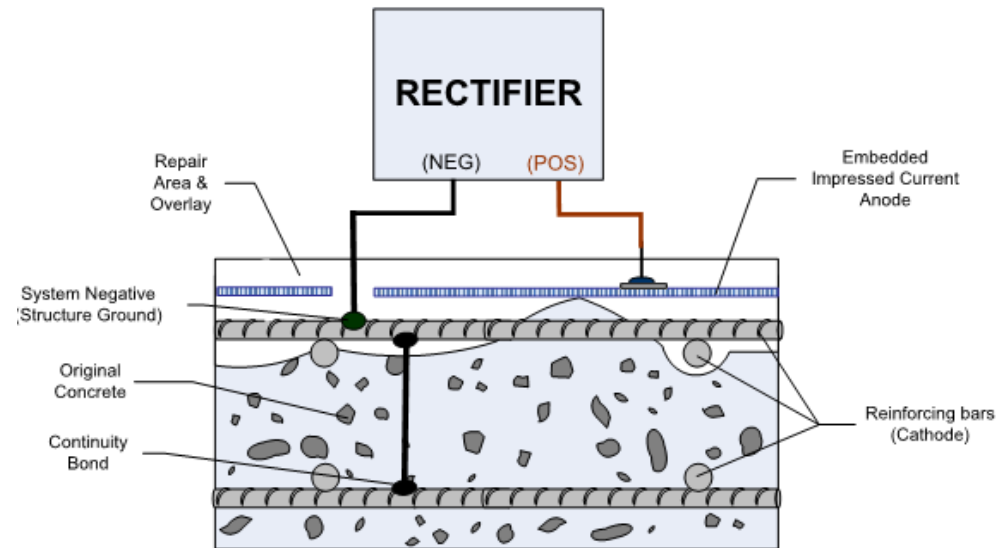
1. Preservation Method (Cathodic Protection)
2. Partial-Depth Deck Replacement
3. Partial Structure Replacement with Bypass
4. Complete Deck Replacement

1. Preservation Method

What is it?

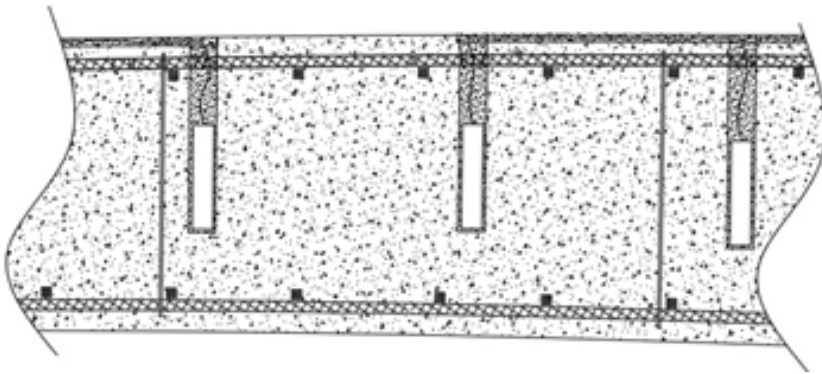
Impressed Current Cathodic Protection (Active)

- Requires power supply
- The Electrical Components require Regular Monitoring and Maintenance
- Highest Service Life extension ~ 40 years



What is it?

Passive Galvanic Cathodic Protection



Considerations

Active System

- Requires constant monitoring and maintenance (i.e. “fine tuning a piano”)
- DOTs throughout the country have abandoned this method

Passive System

- Does not address existing corrosion in the structure
- Installation is dependent on the type of system
- Requires removal of loose and deteriorated concrete
- Even if you arrest corrosion, larger trucks still impact the structure

2. Partial-Depth Deck Replacement

What is it?

- Replacement of deteriorated deck sections only
 - Like fixing a cavity in a tooth

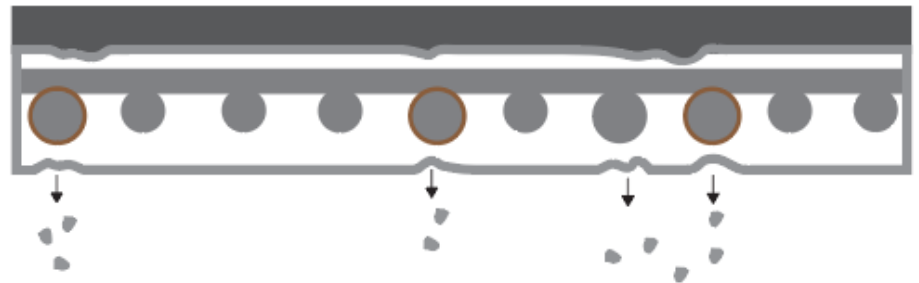
New Condition



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Partial-Depth Deck Replacement



Considerations

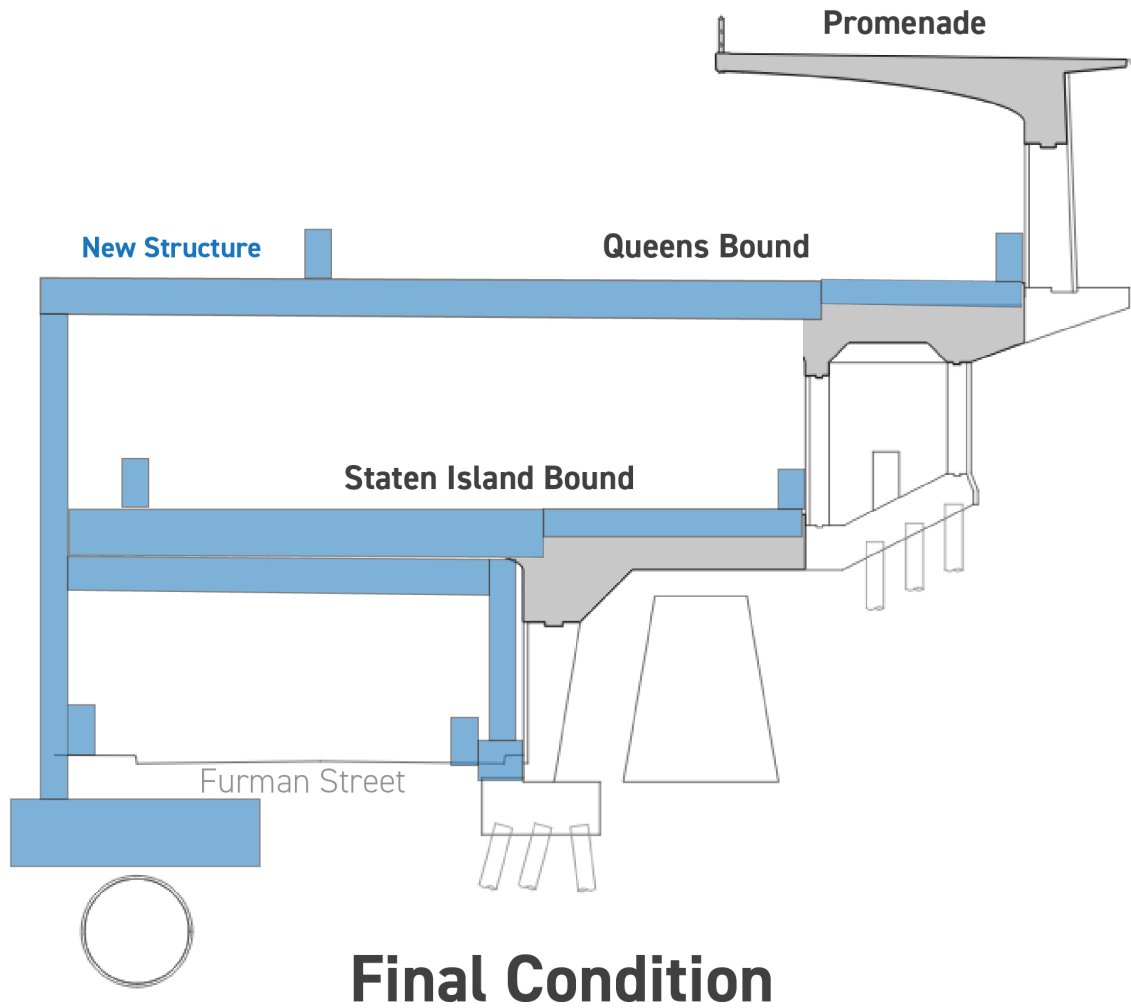
- Shortest service life
- Hard to know what conditions will be discovered
- Unrepaired structure continues to decay at unknown rate
- Deck “Halo”
 - Area surrounding the repaired section decays at a rapid rate



Figure 5. Deck showing halo effect.

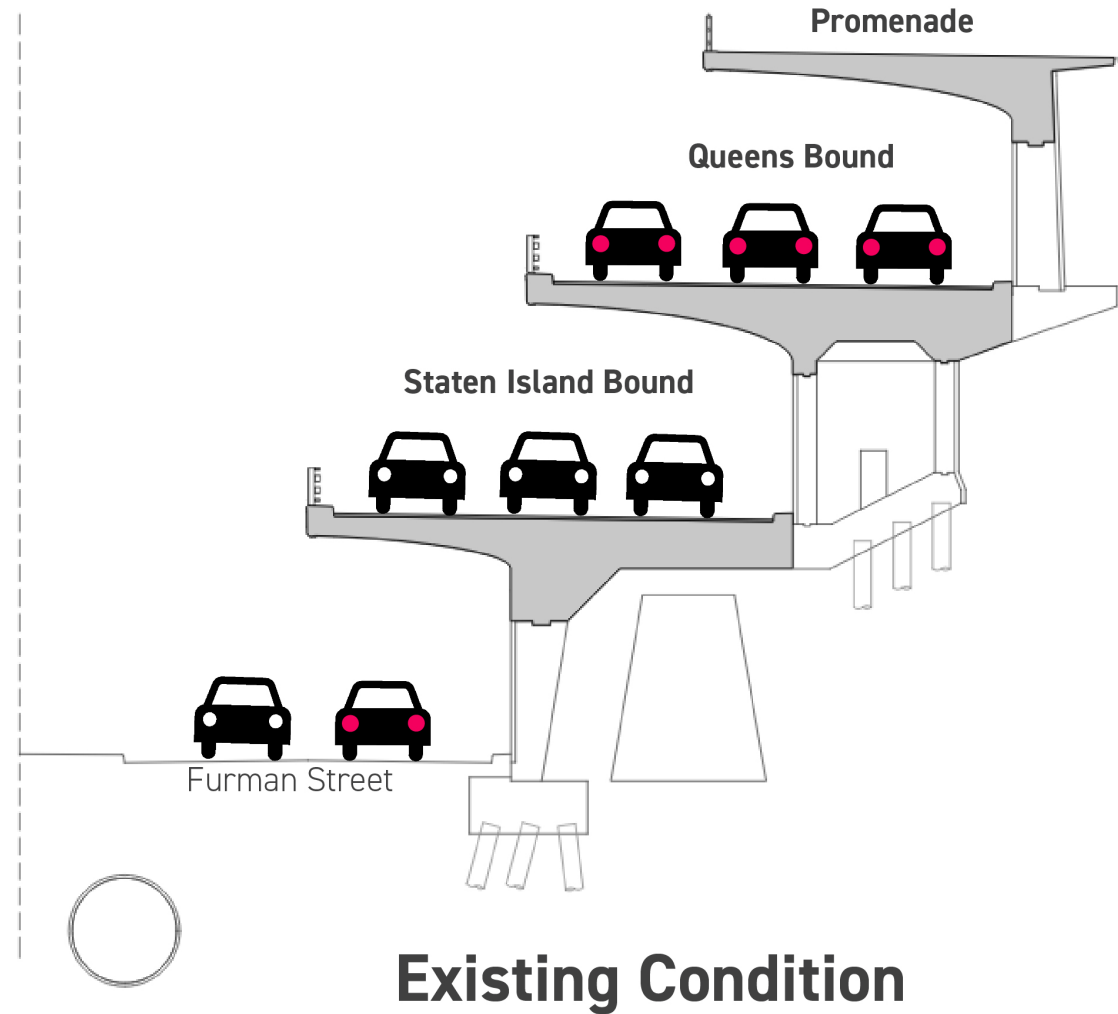
3. Partial Structure Replacement with Bypass

What is it?

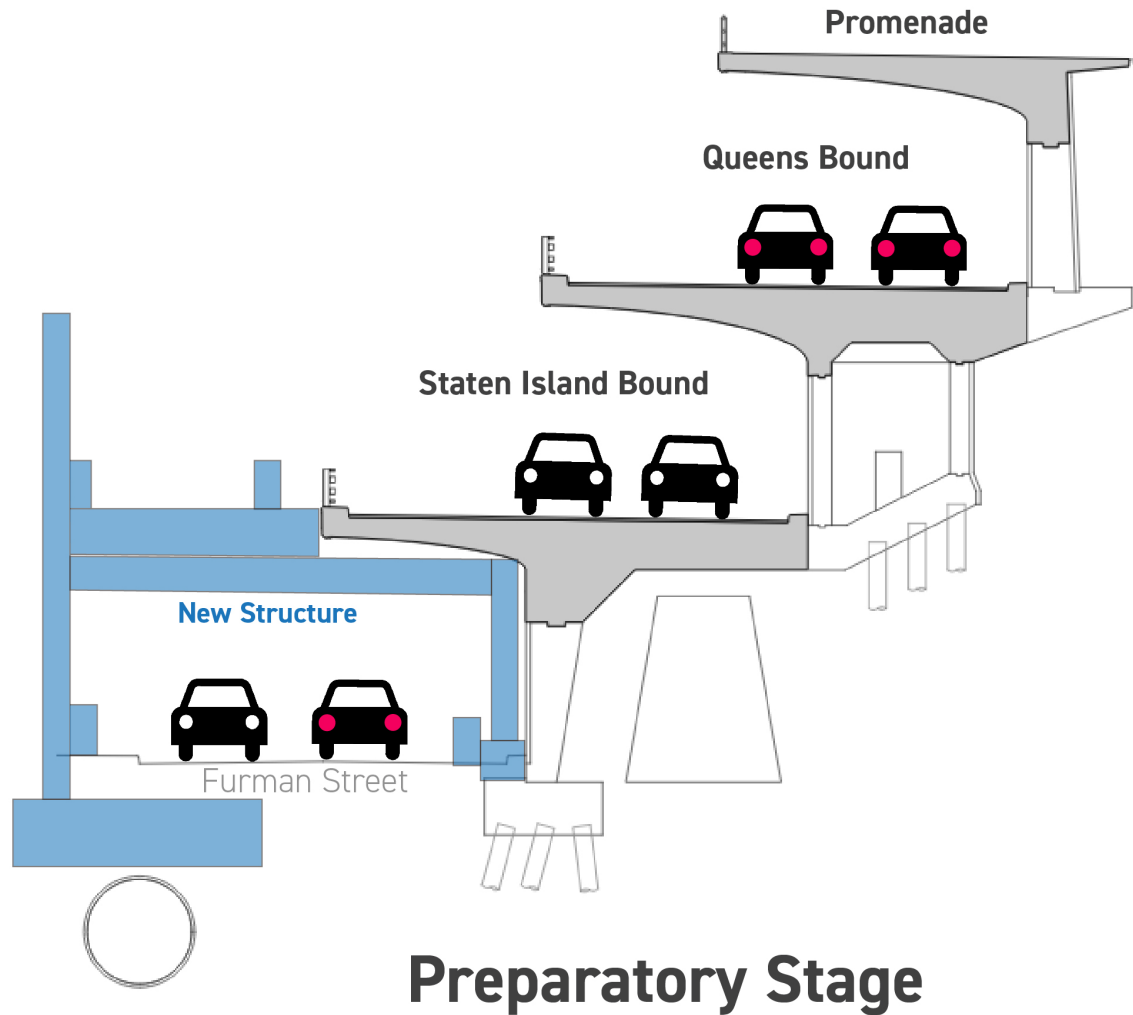


Final Condition

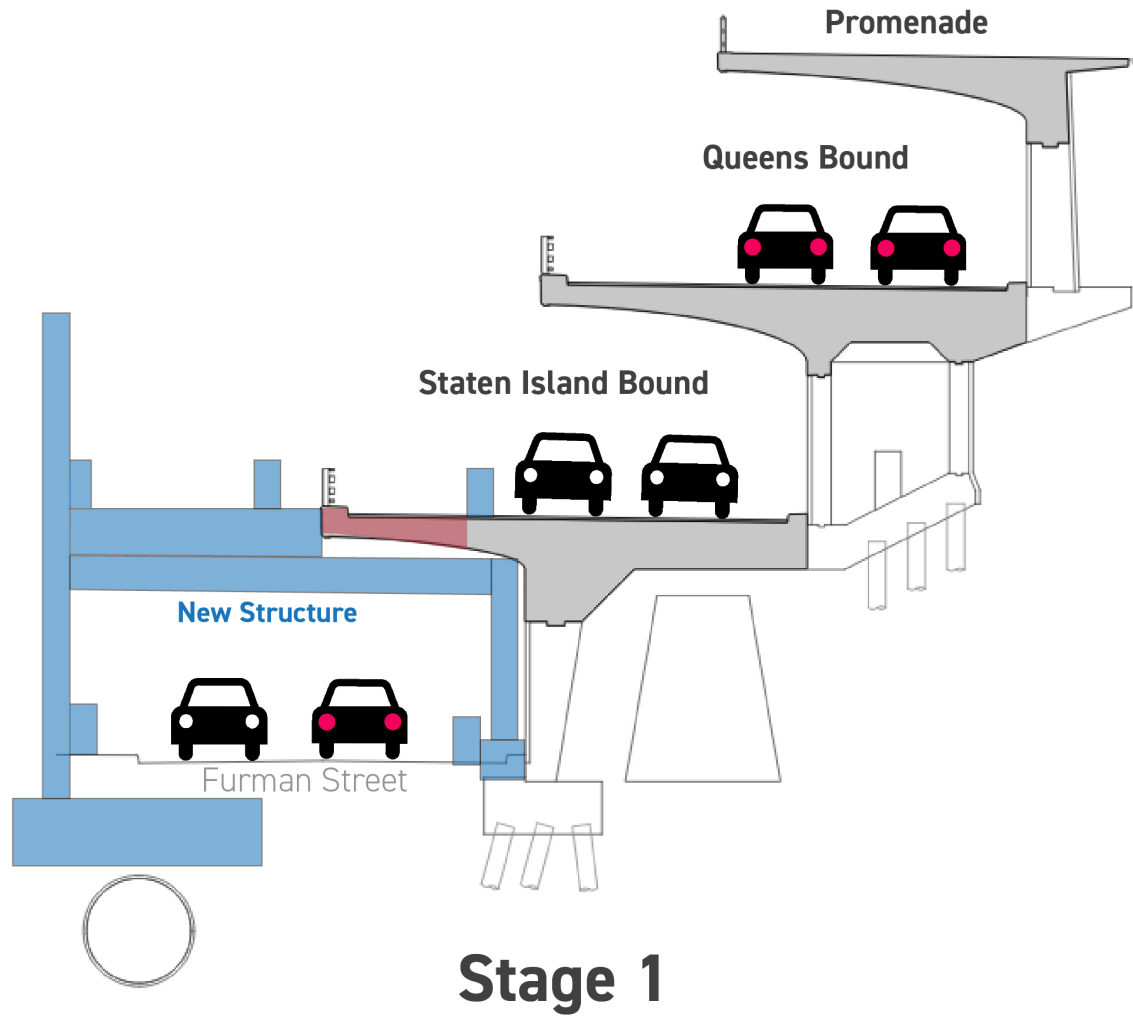
How?



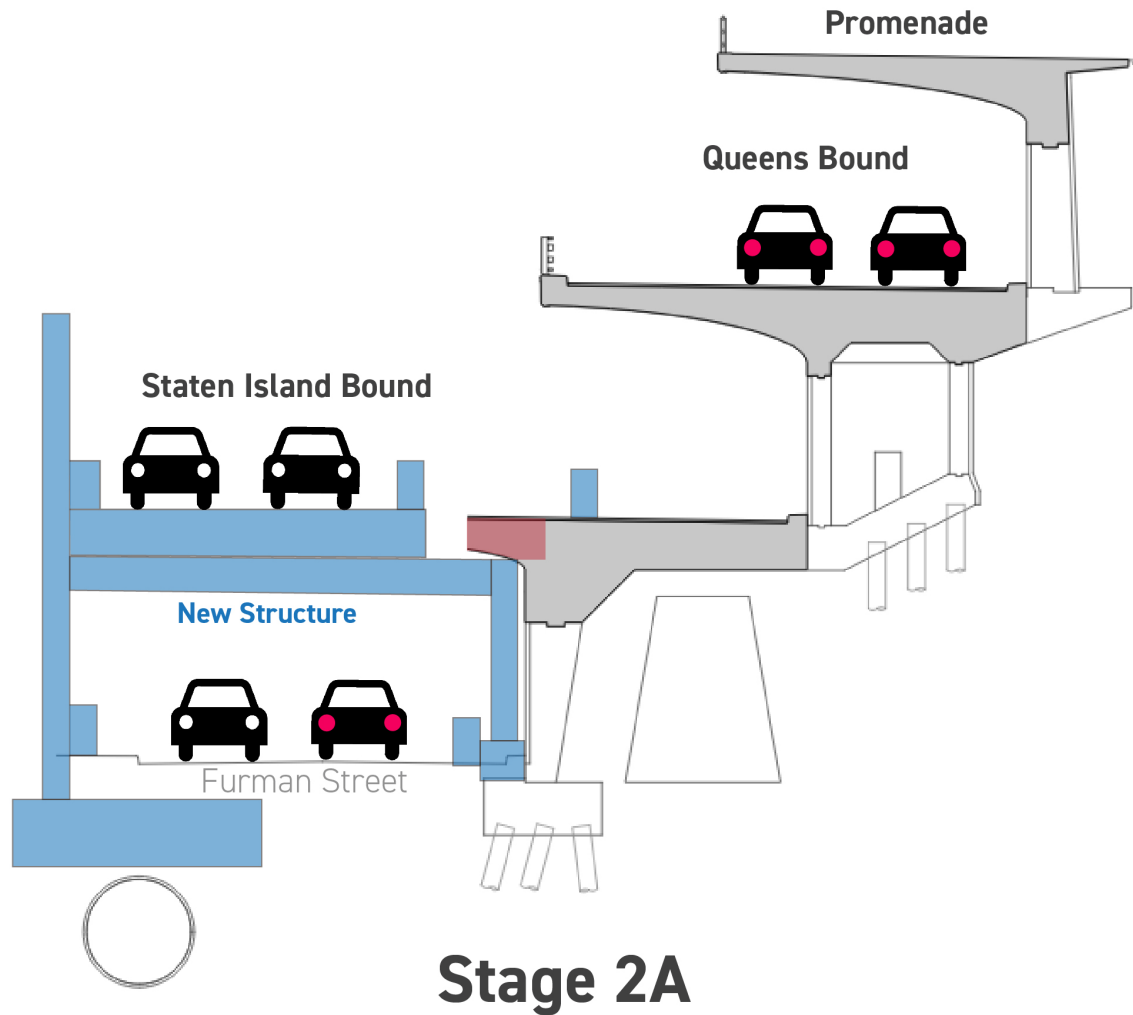
How?



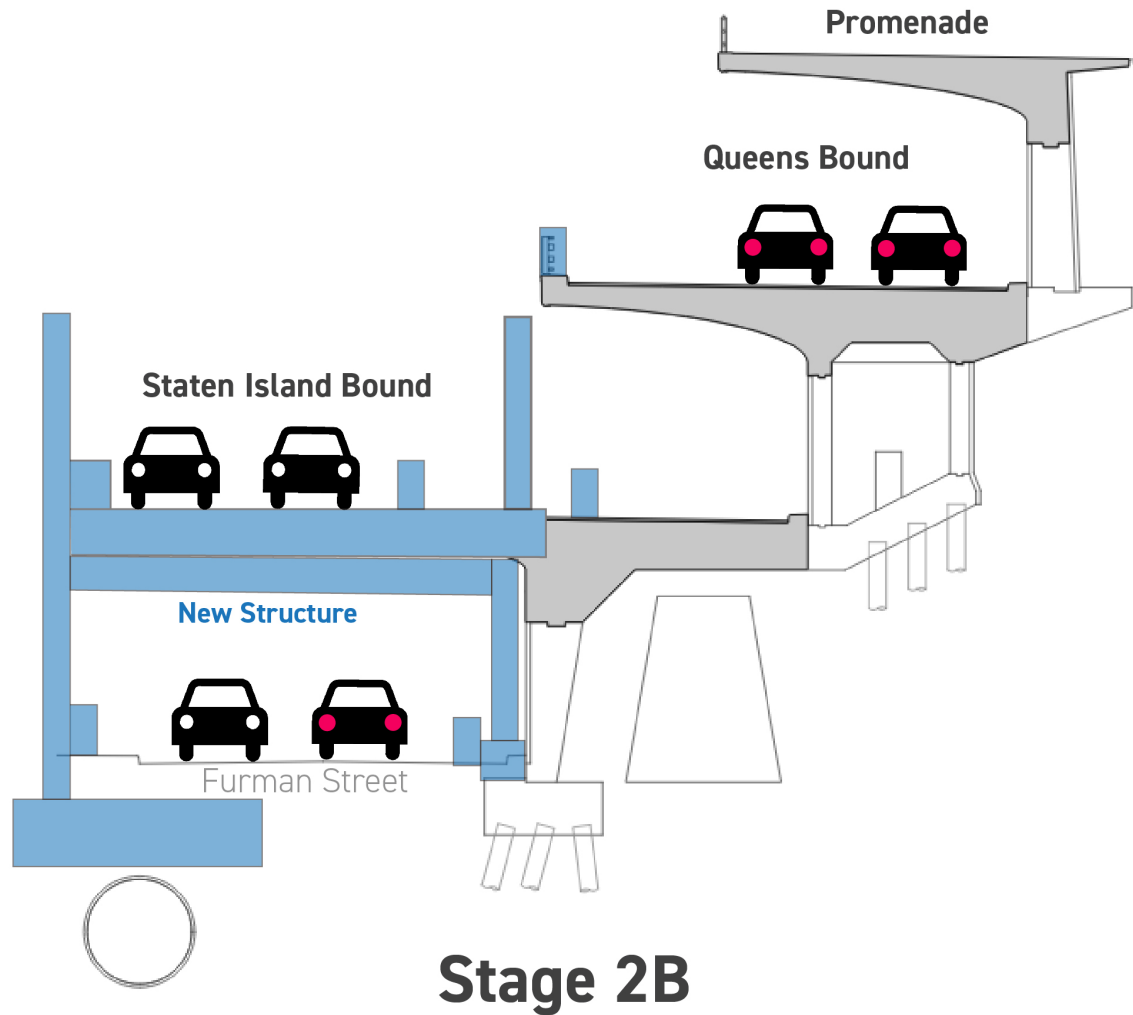
How?



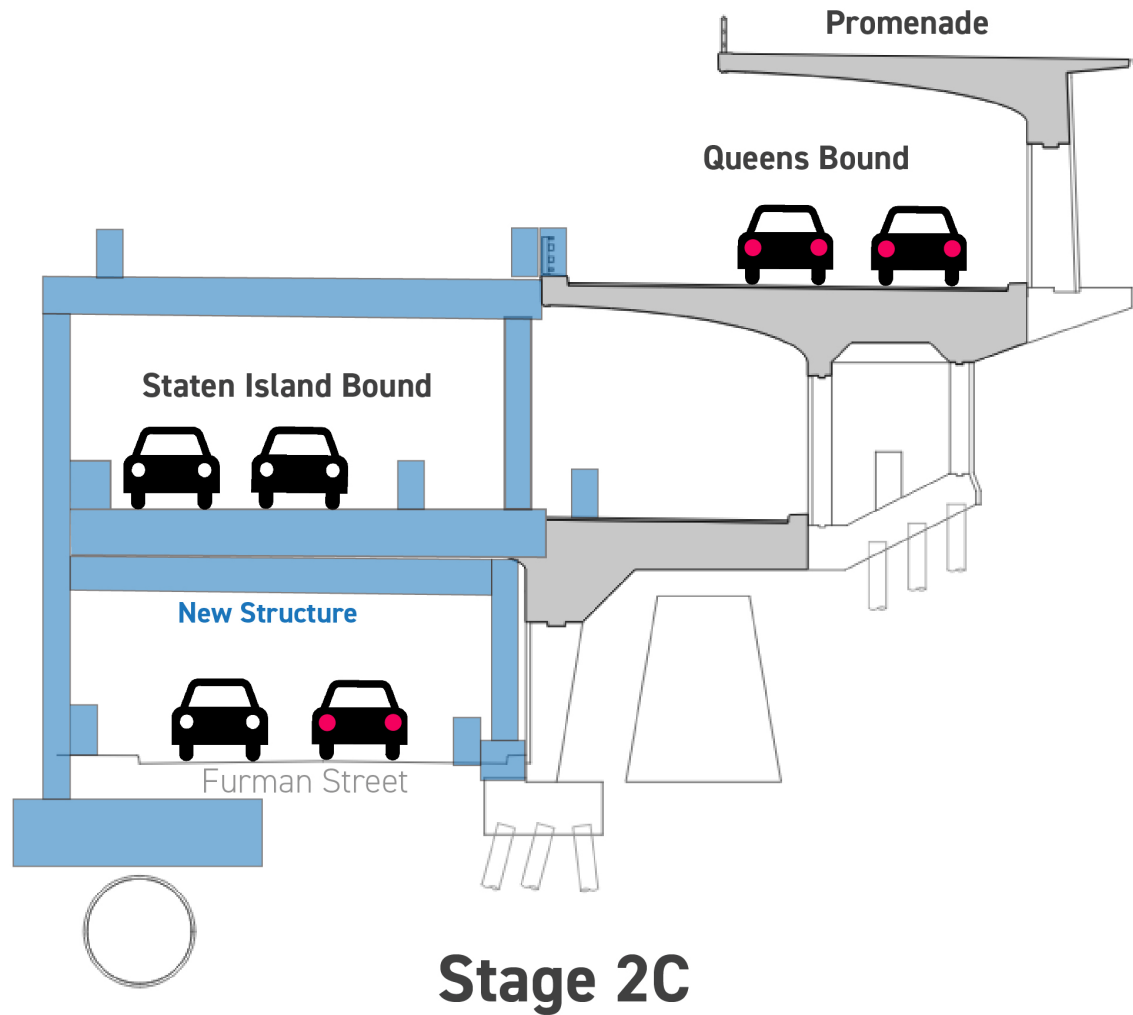
How?



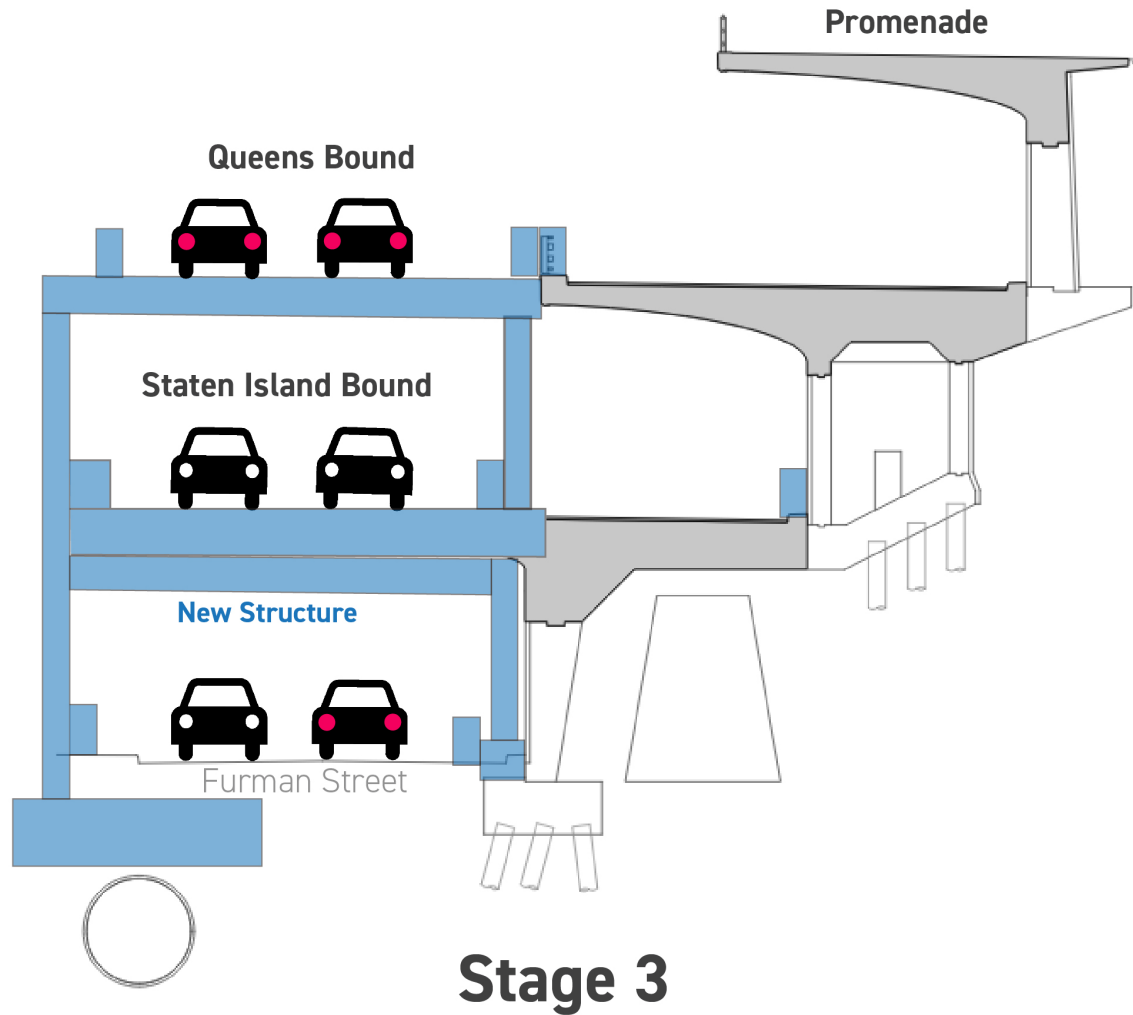
How?



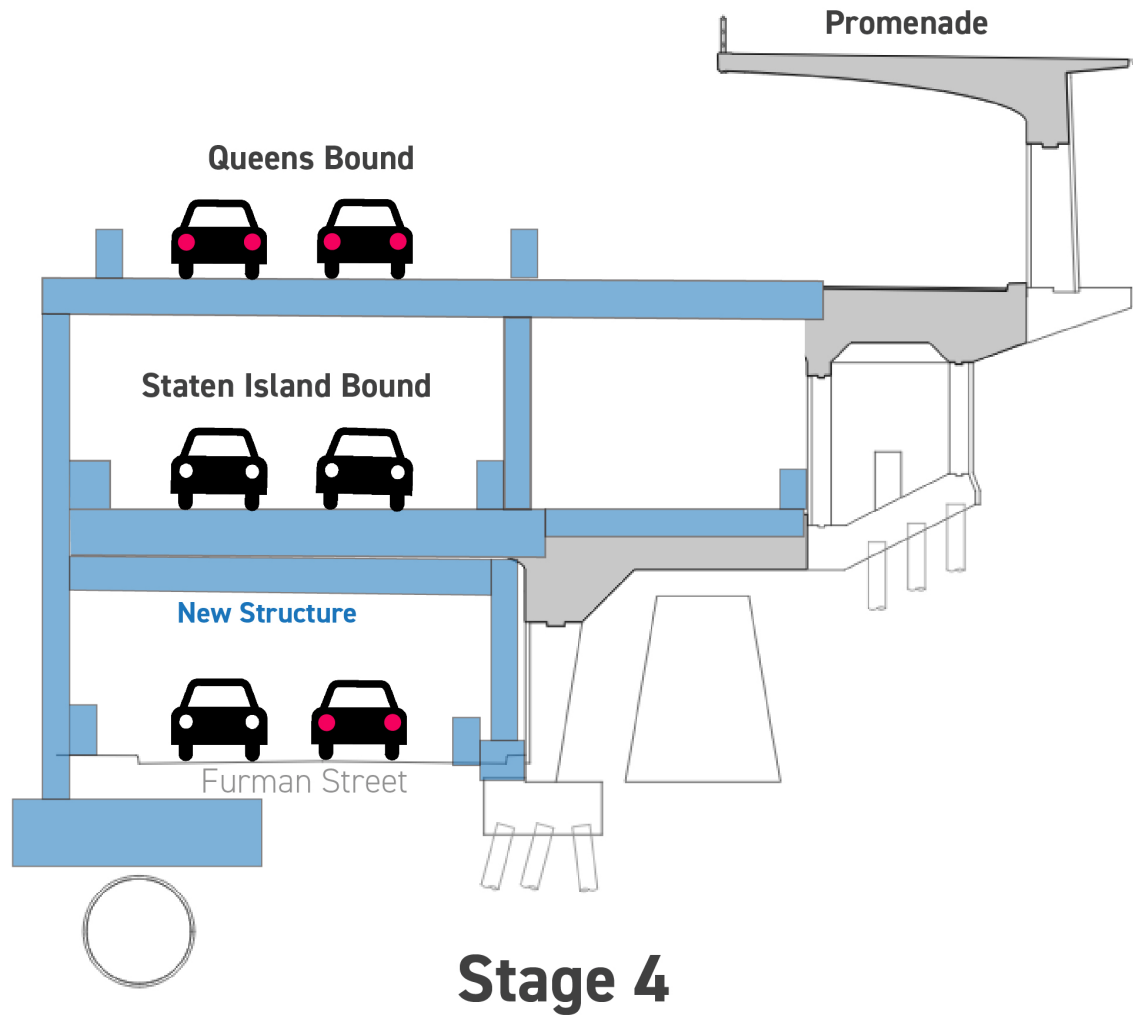
How?



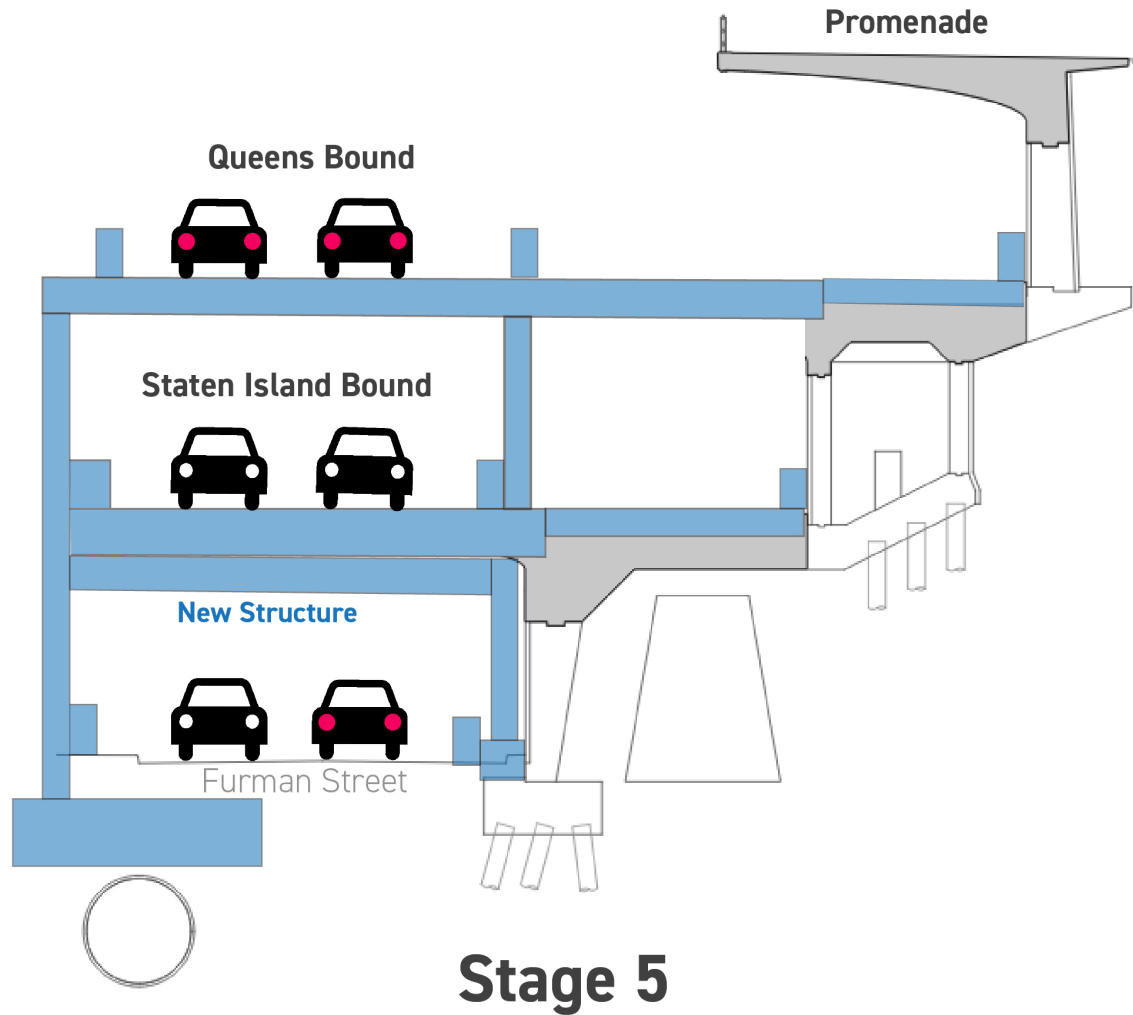
How?



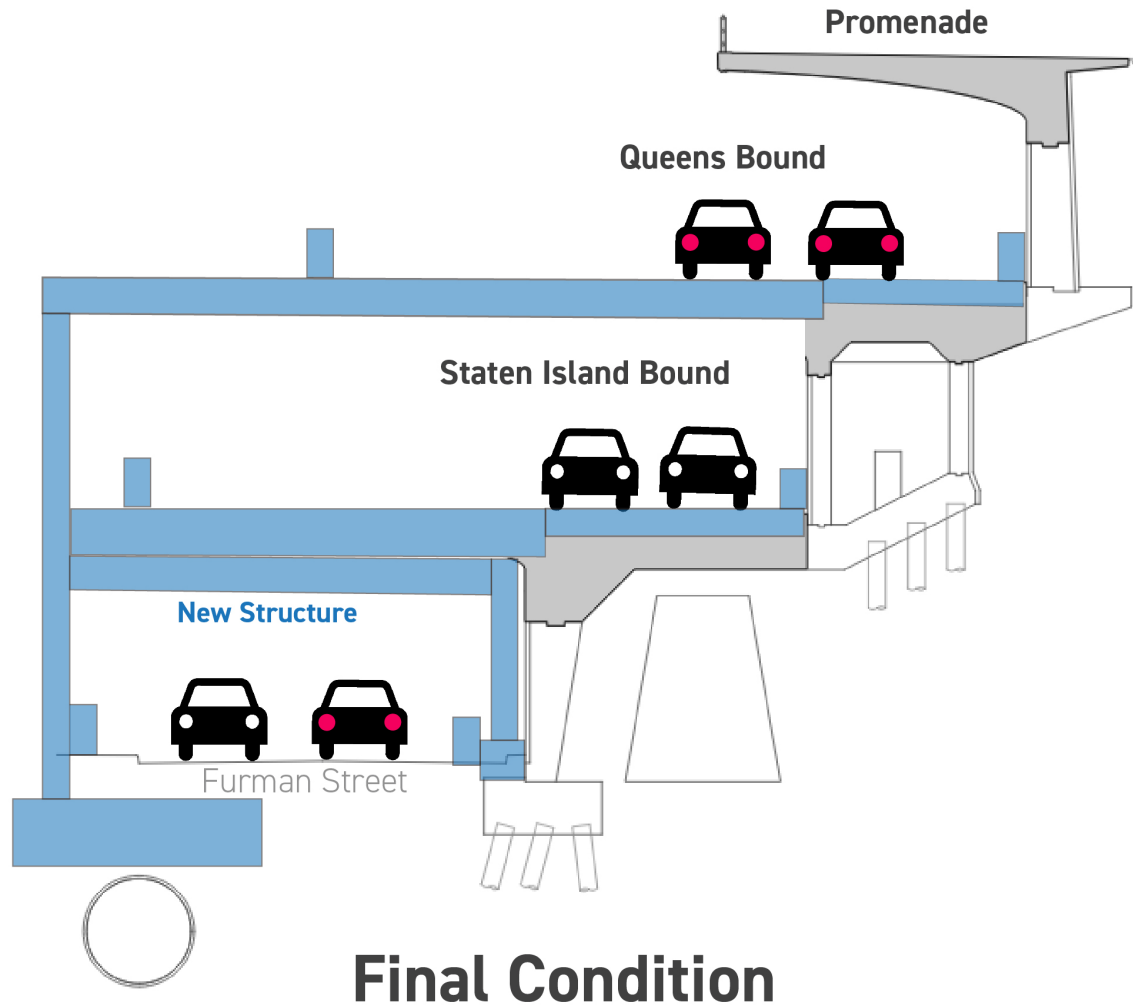
How?



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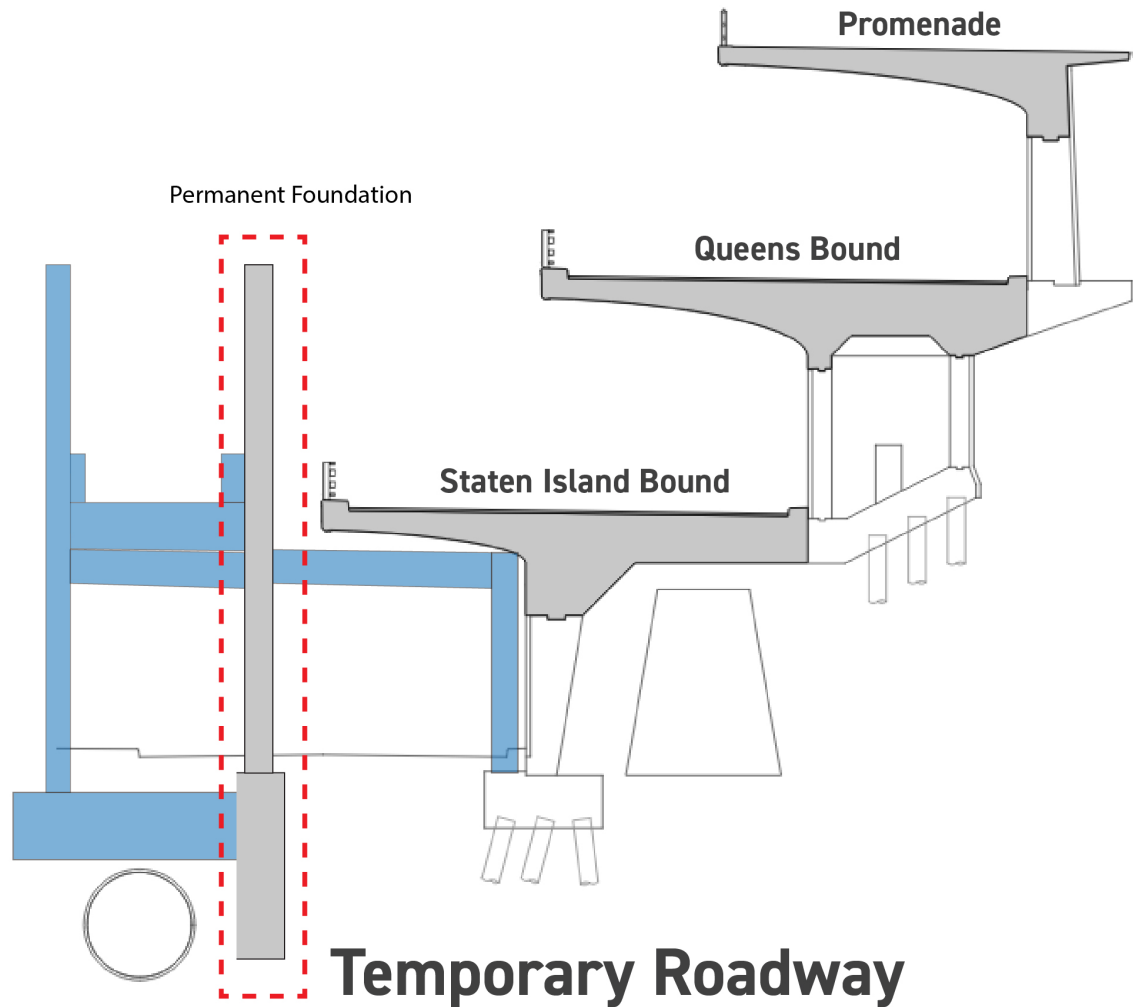


How?



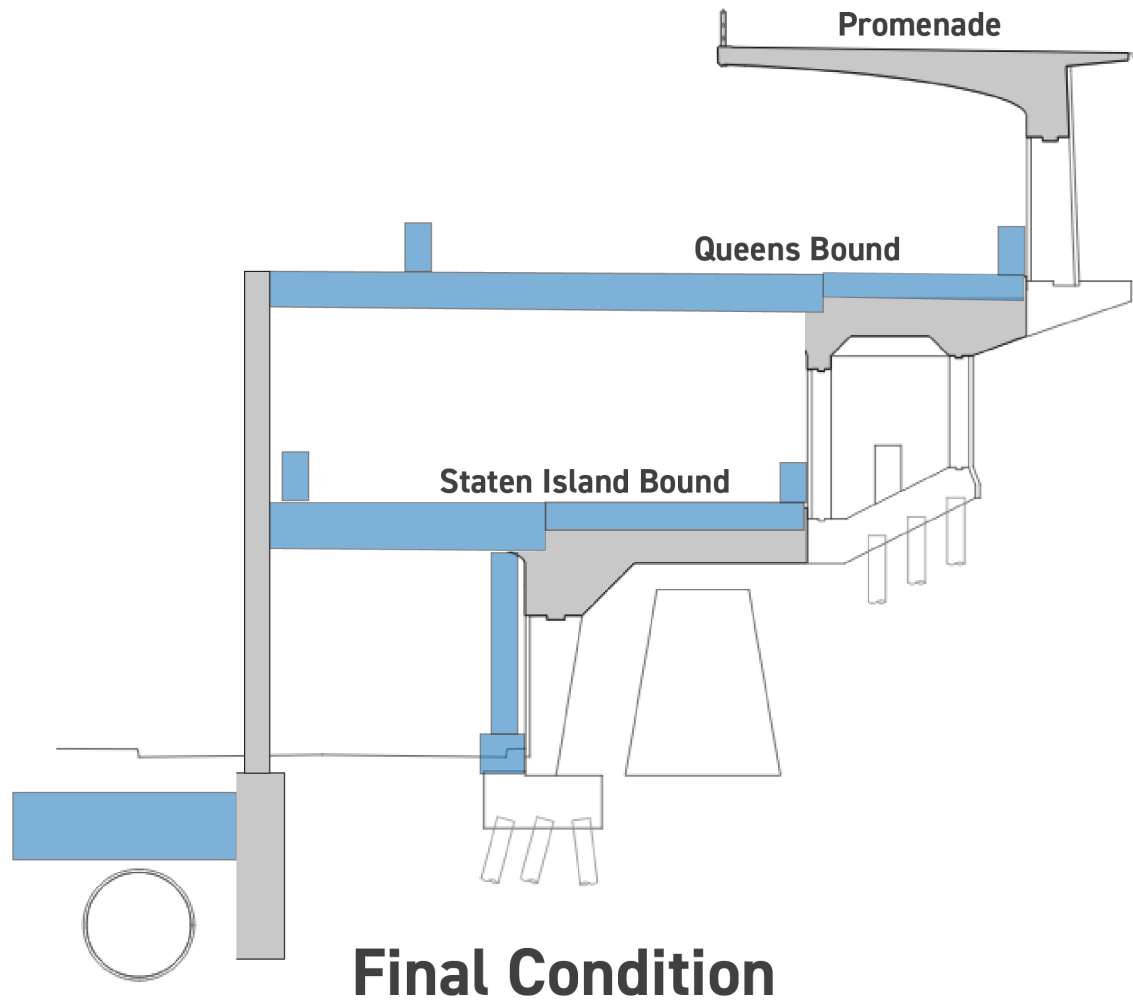
How?

Considering the interceptor, DOT is reviewing this option, which requires more steps and partial temporary structure



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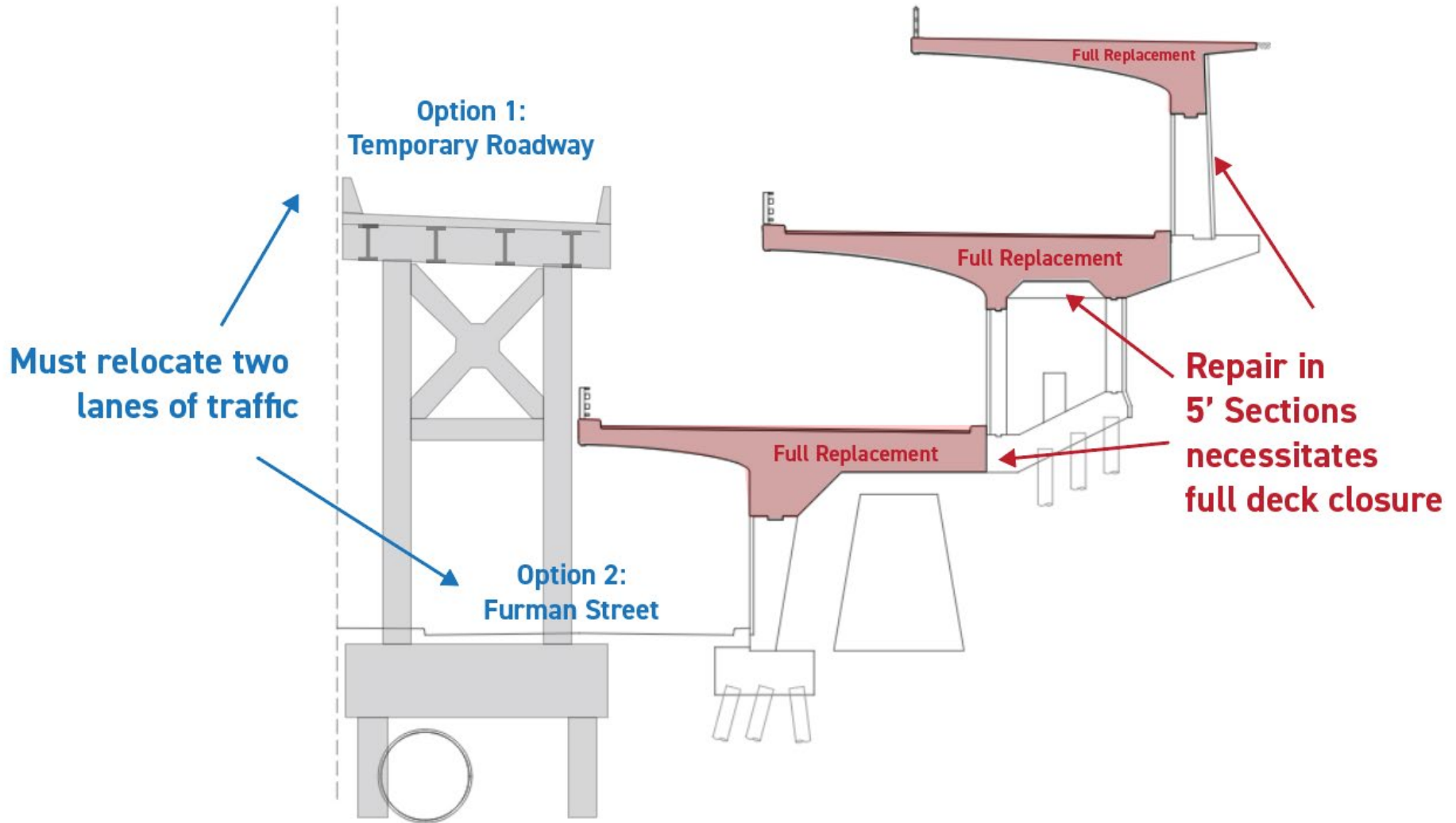


Considerations

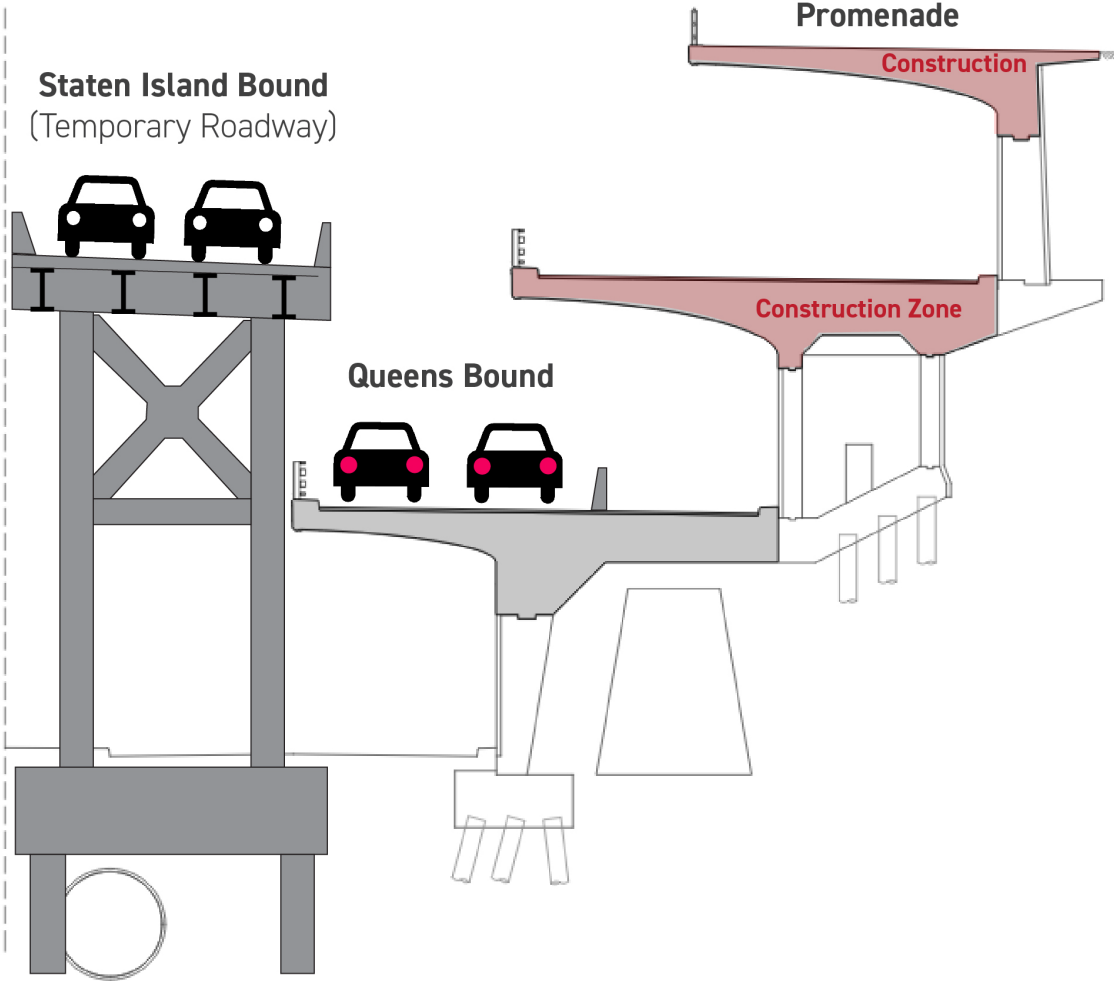
- Requires permanent columns every 50 feet
- Difficult to control the final aesthetics
- Overnight/weekend work
- Very similar to full replacement, but some benefits are left
- DEP needs clearance for sewer interceptor

4. Complete Deck Replacement

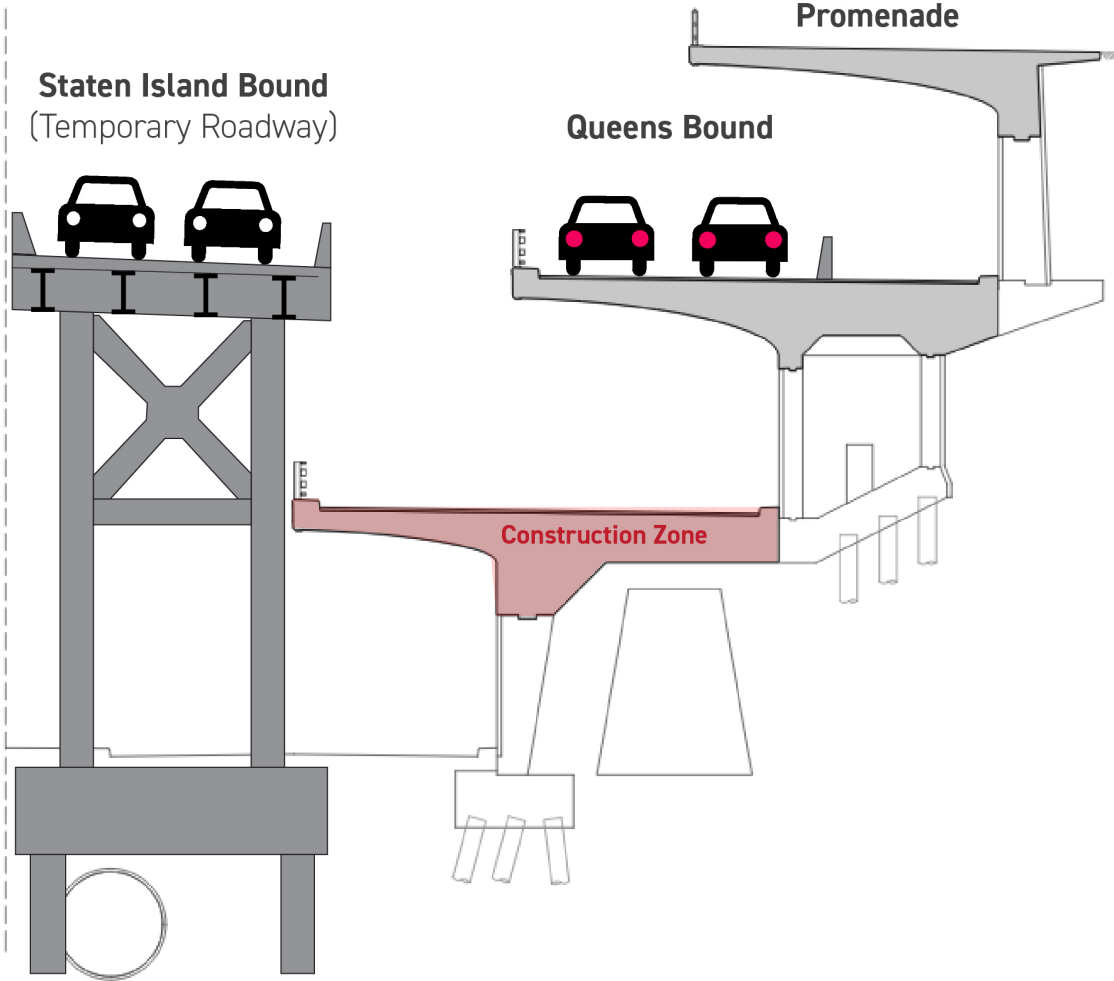
What is it?



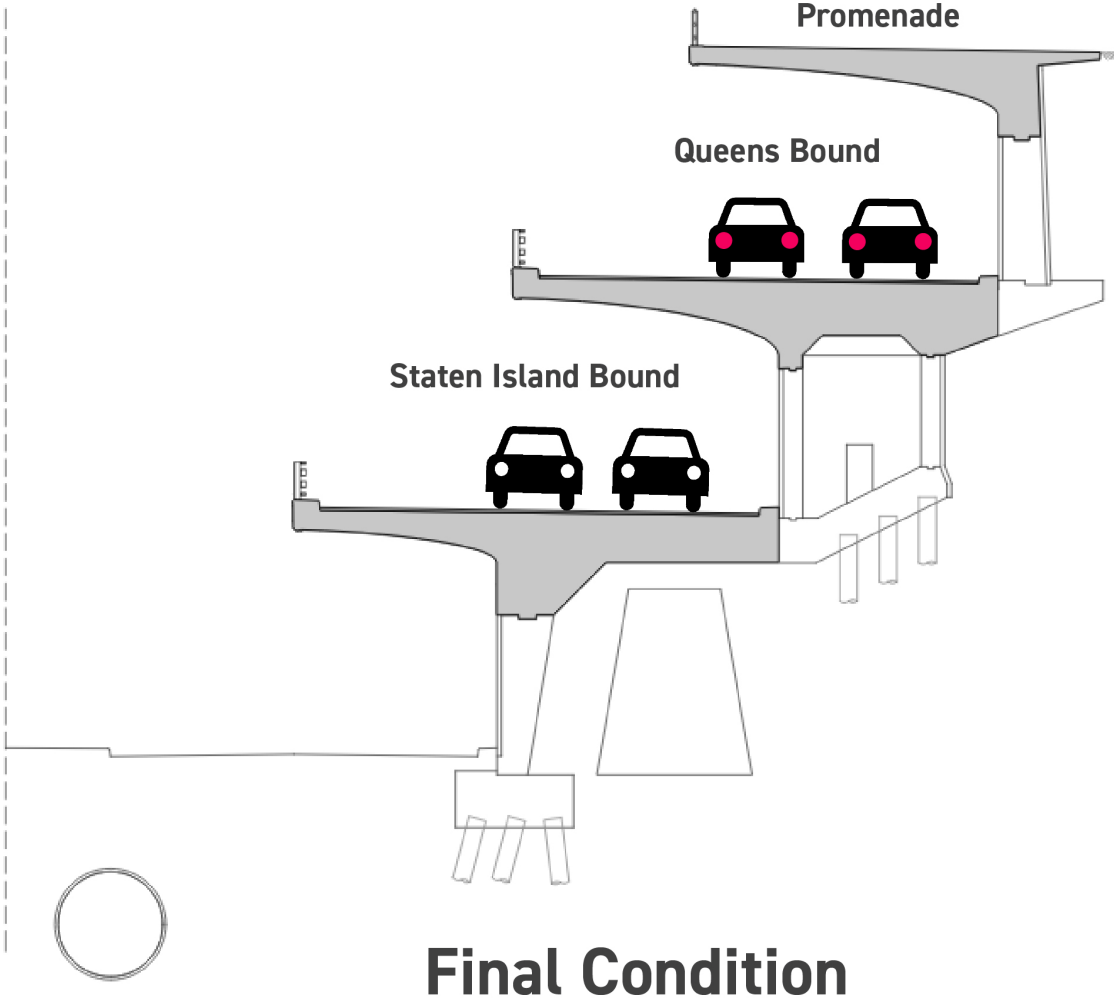
Option 1: Temporary Bypass



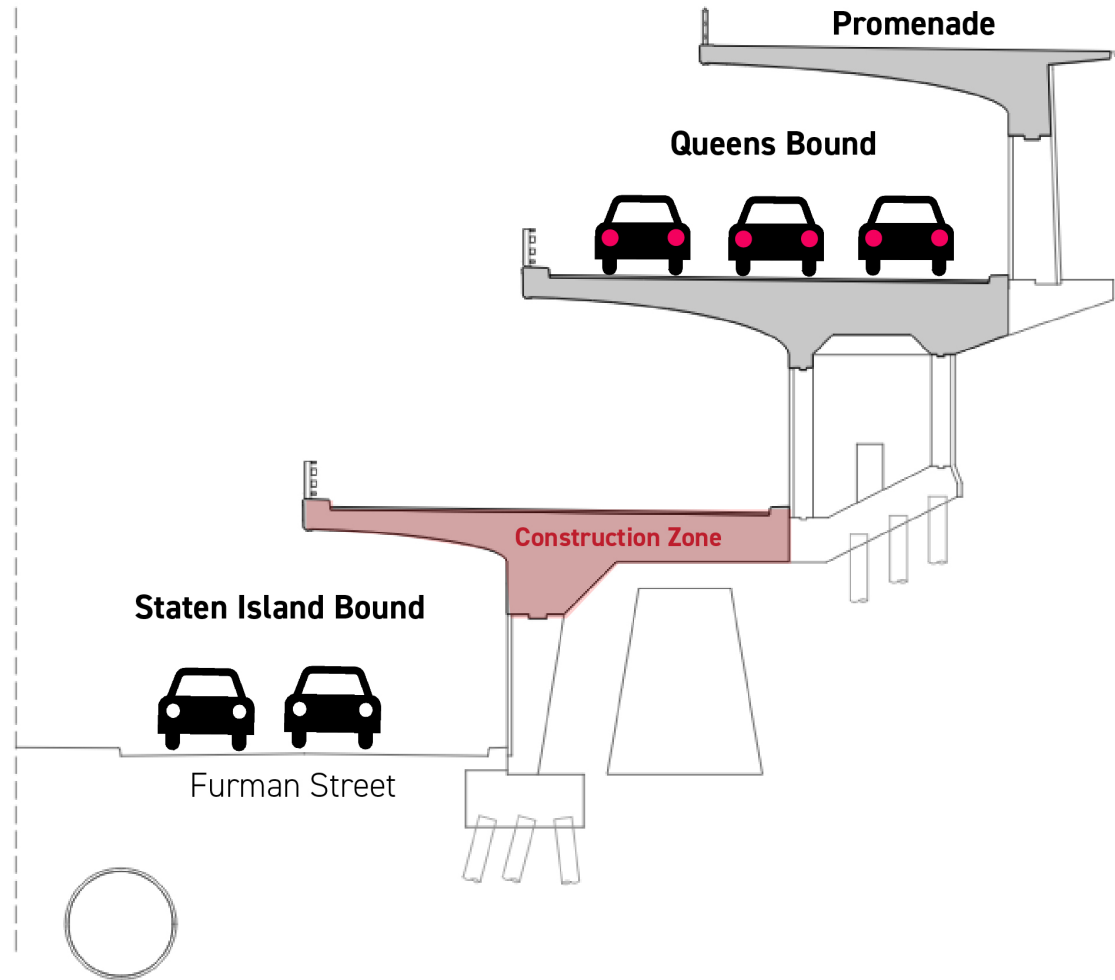
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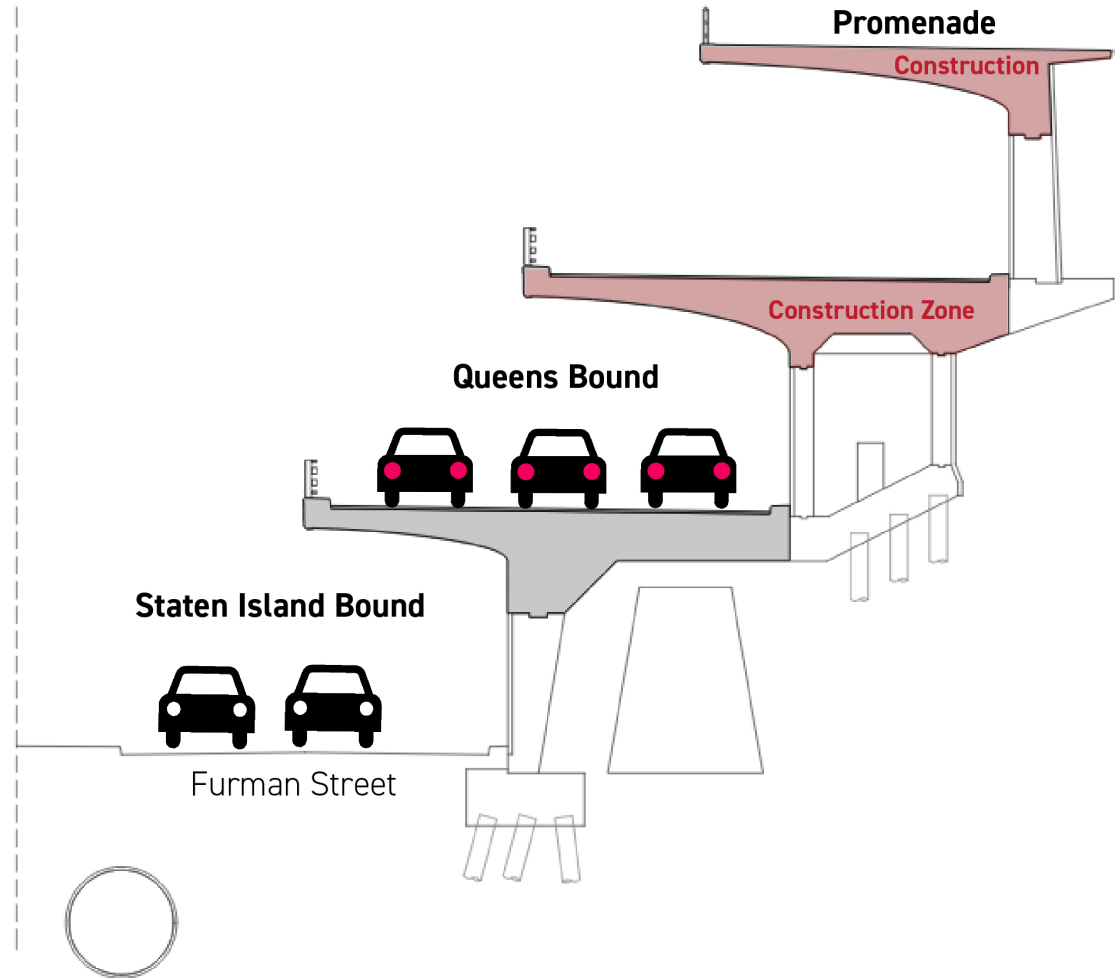
Option 1: Temporary Bypass



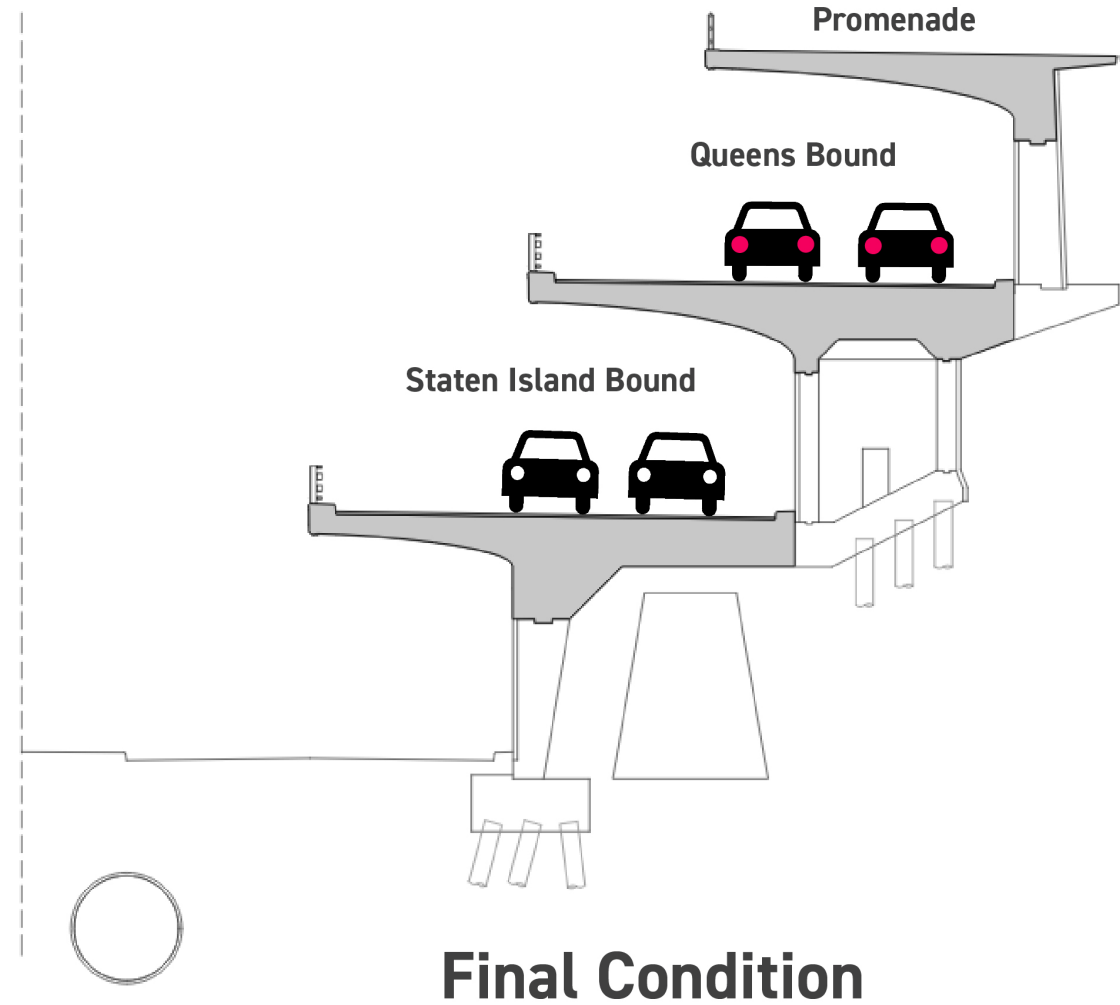
Option 2: Furman Street



Option 2: Furman Street

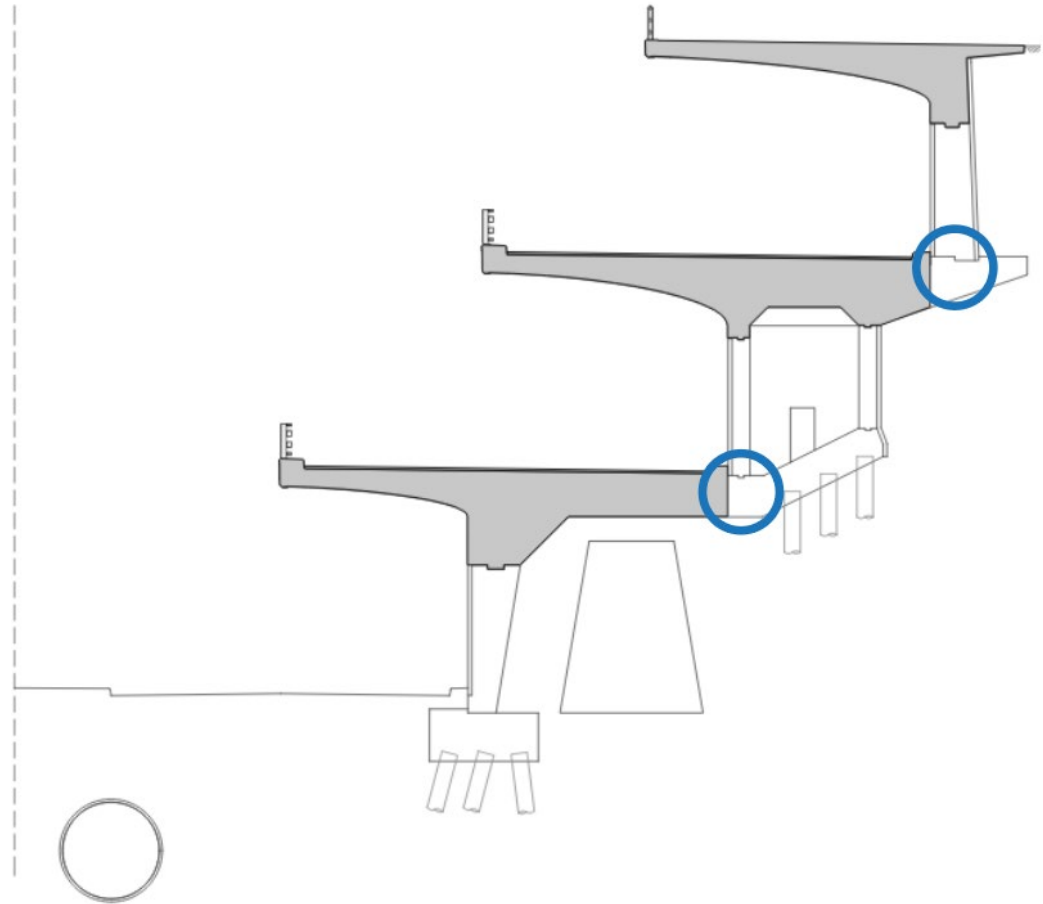


Option 2: Furman Street



Considerations

- Where does the weak point move?
- Still has joints which are prone to corrosion
- Vibrations still largely remain
- Lightweight concrete may get better load capacity, but there are limitations



Rehabilitation Alternatives

In review:

1. Preservation Method (Cathodic Protection)
2. Partial-Depth Deck Replacement
3. Partial Structure Replacement with Bypass
4. Complete Deck Replacement

Questions?