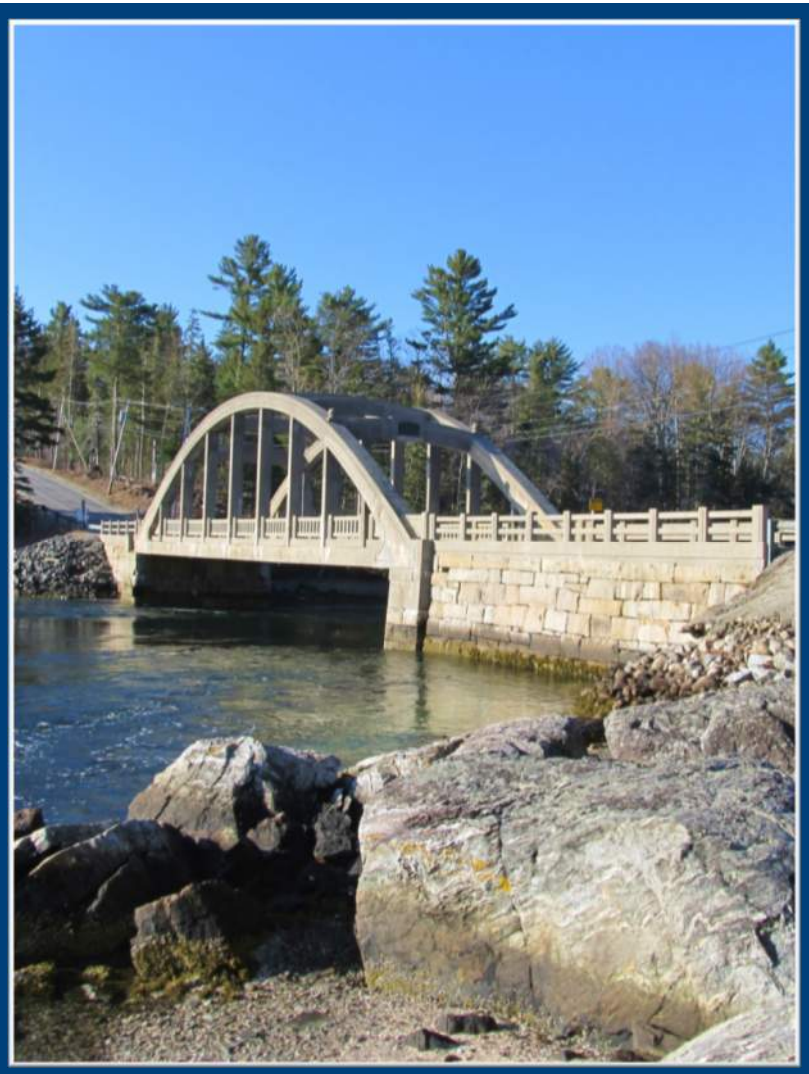
Falls Bridge Advisory Committee
Meeting #8 – Rehabilitation of Existing Bridge

Integrity - Competence - Service

MaineDOT

Meeting Agenda

- Process Review
- Project Purpose & Need
- Rehabilitation Scope
  - Load Capacity Improvements
  - Bridge Condition Improvements
  - Sidewalk & Ancillary Improvements
- Rehabilitation Strategies
- Constructability Considerations
- Next Steps



Project Purpose & Need

Purpose & Need Statement

Project: Blue Hill, Falls Bridge #5038 (WIN 17712.00)

Purpose:

The purpose of the project is to address the structural deficiency of the Falls Bridge and improve public safety within the project limits in a cost effective manner. A successful project will provide a bridge capable of carrying all legal loads, will not require additional capital improvements for at least 25 years, will achieve a minimum remaining service life of at least 50 years, and improve site safety.

Need:

The rating condition of the bridge elements are: 5 (fair) for the concrete superstructure, 4 (poor) for the stacked stone substructure, and 4 (poor) for the concrete deck. Further deterioration of the bridge elements may require a load posting. The bridge spans over a reversing falls that is a popular recreation area; however; the bridge and roadway do not meet geometric design standards which create safety concerns.

Project Purpose & Need

How do we satisfy the project purpose and need?

- Evaluate Bridge Load Capacity: Bridge must carry modern design loads
- Improve Overall Bridge Condition: Eliminate structural deficiencies
- Improve Public Safety: Explore measures for improving safety
- Provide Long-Lasting Repair: 50+ year service life, 25 years to next repair
- Identify a cost-effective solution: The rehabilitation should be cost-feasible

Rehabilitation Scope

Approach to evaluating Rehabilitation:

- Step 1: Identify deficiencies. Brainstorm & identify potential solutions
- Step 2: Initially assess & shortlist best options for further evaluation
- Step 3: Assess constructability, schedule, impacts, longevity & cost
- Step 4: Identify most suitable rehabilitation strategy

Rehabilitation Scope – Load Capacity

Bridge Capacity Evaluation

- Purpose: Assess safe load carrying capacity of the bridge
- Evaluation Approach:
  - Four step process completed in accordance with national standards
  - Step 1: Calculate structure self weight & vehicle loads
  - Step 2: Calculate capacity of bridge components
  - Step 3: Develop computer-based bridge model, apply loads
  - Step 4: Compare capacity to forces predicted by bridge model

3D Bridge Model

Rehabilitation Scope – Load Capacity

Bridge Capacity Evaluation

- Based on evaluation calculations:
  - Floorbeams & Tie Girders require strengthening as part of rehabilitation to meet current design standards
  - All other structural elements have sufficient capacity

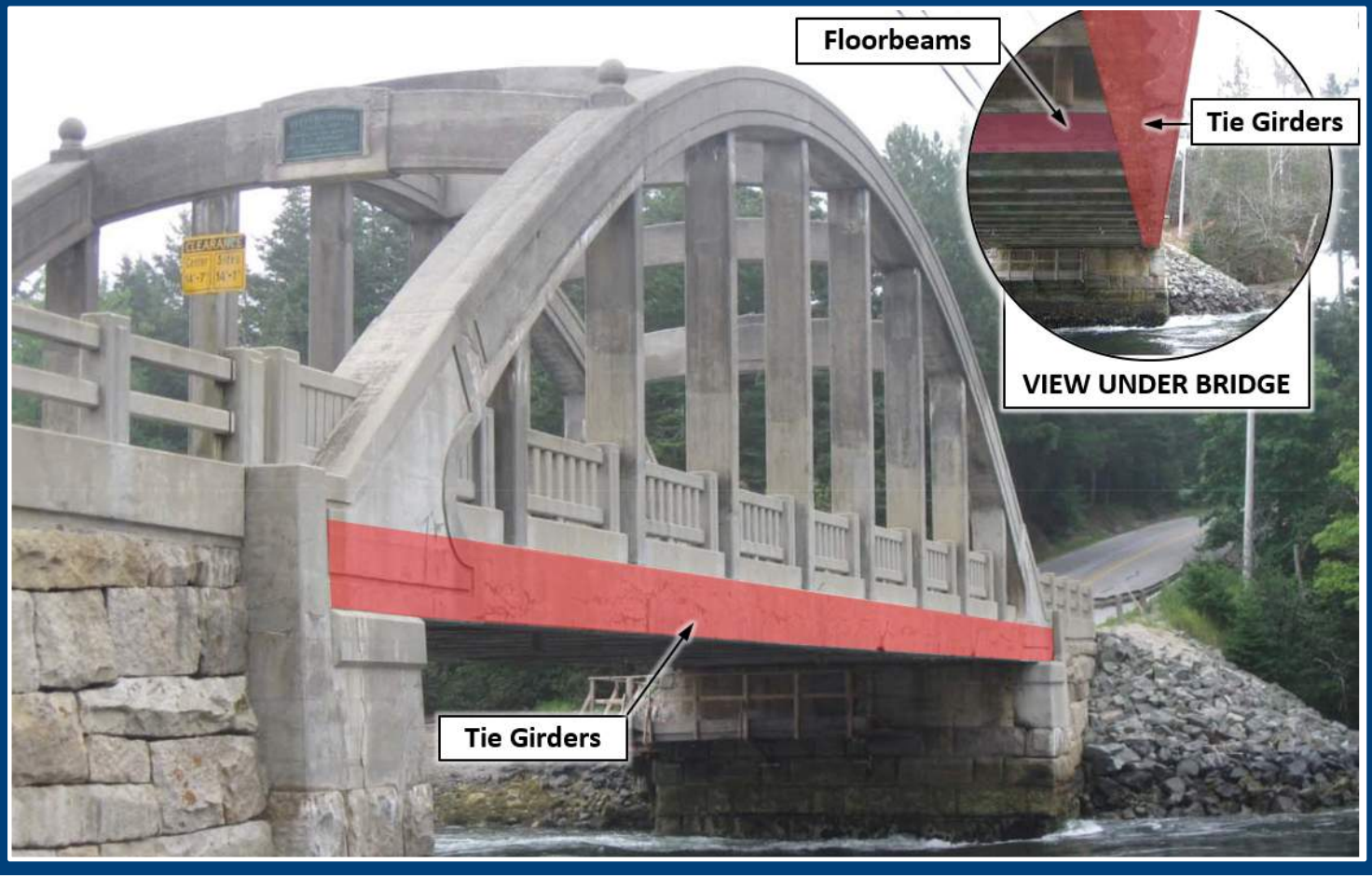
Representative Design Vehicle from 1926

Modern Day Truck

Rehabilitation Scope – Load Capacity

Bridge Capacity Evaluation

- Capacity of floorbeams and tie girders will need to be addressed to satisfy project purpose and need.



Rehabilitation Scope – Bridge Condition

Bridge Condition Evaluation

- Arch Rib Ends/Knuckles and Hangers: Heavy cracking and deterioration throughout with scattered locations of chloride contamination, extends ±6 Ft. above roadway.

Cracked Arch Rib End (Knuckle)

Deteriorating Concrete Hanger

Rehabilitation Scope – Bridge Condition

Bridge Condition Evaluation

- Bridge Deck and Floorbeam System: Extensive cracking and deterioration throughout.

Deterioration on Underside of Deck

Rehabilitation Scope – Bridge Condition

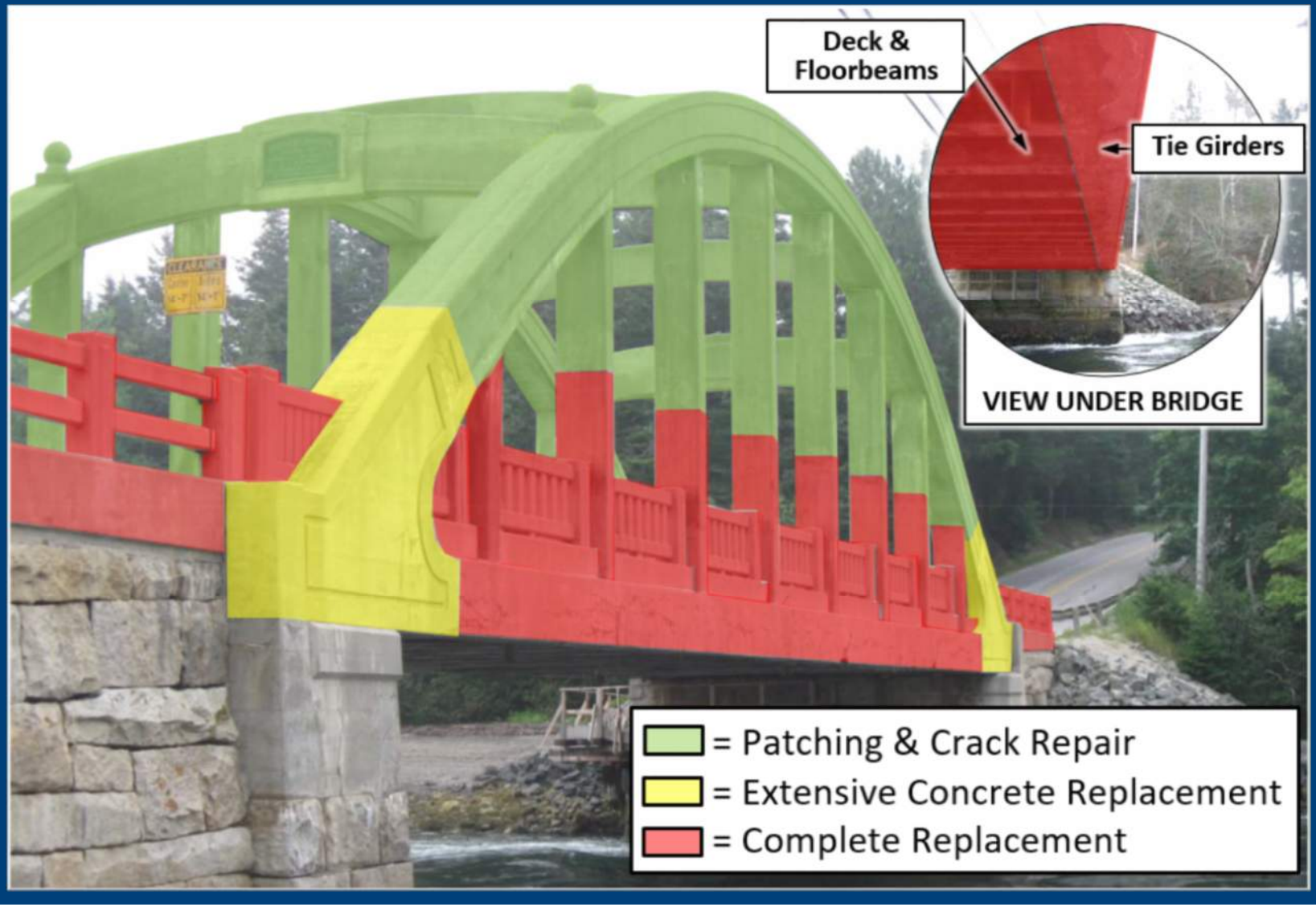
Bridge Condition Evaluation

- Tie Girders: Extensive cracking and deterioration throughout.

West Arch Tie Girder

Rehabilitation Scope – Bridge Condition

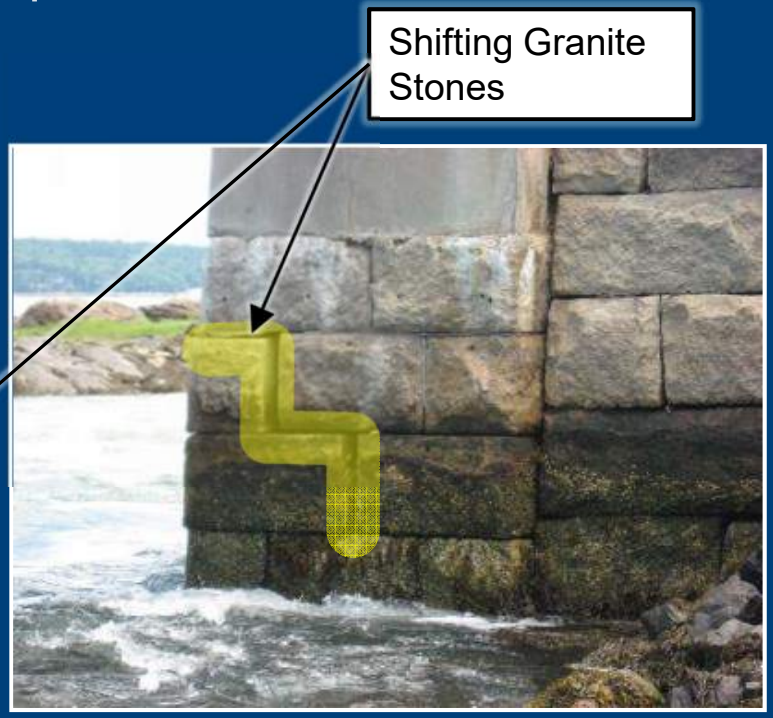
Anticipated Scope of Superstructure Rehabilitation



Rehabilitation Scope – Bridge Condition

Substructure Rehabilitation

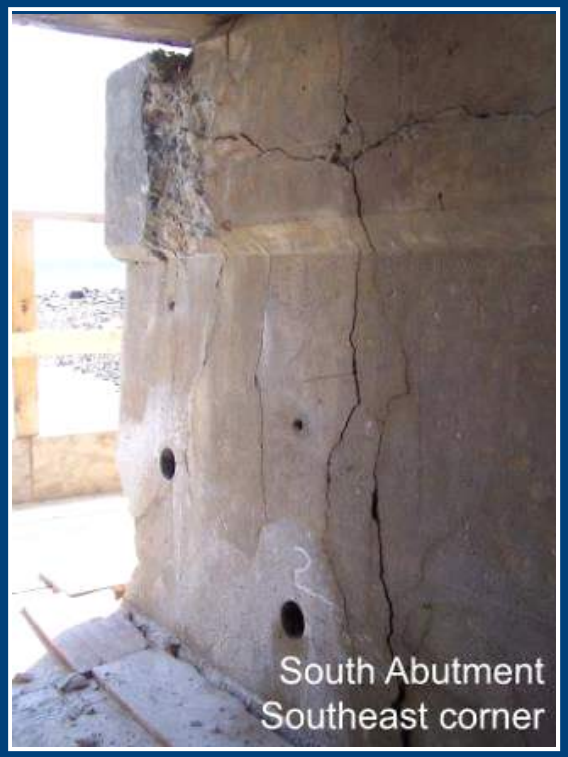
- Abutments – Masonry: Numerous shifting stones. Portions of abutment not supported by bedrock; stabilization required.



Rehabilitation Scope – Bridge Condition

Bridge Condition Evaluation

- Abutments – Concrete: Areas of heavy cracking and deterioration.

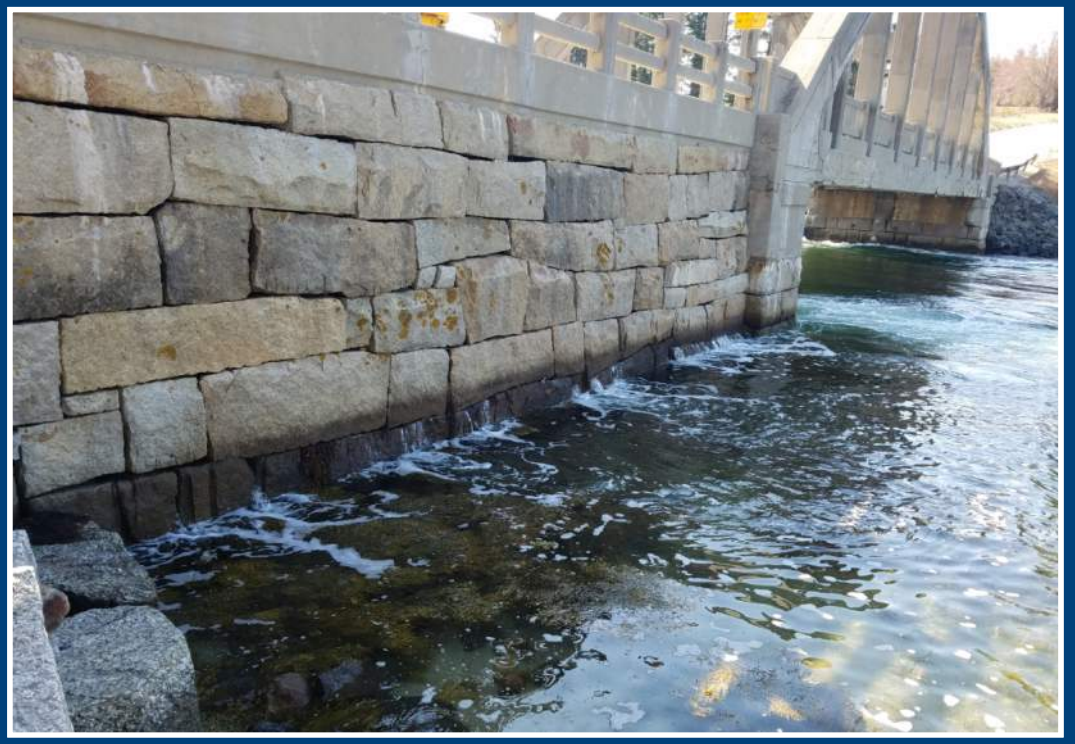


Rehabilitation Scope – Bridge Condition

Bridge Condition Evaluation

- Approach Retaining Wall: Numerous shifting stones. Water freely flows through wall. Stabilization and sealing required.

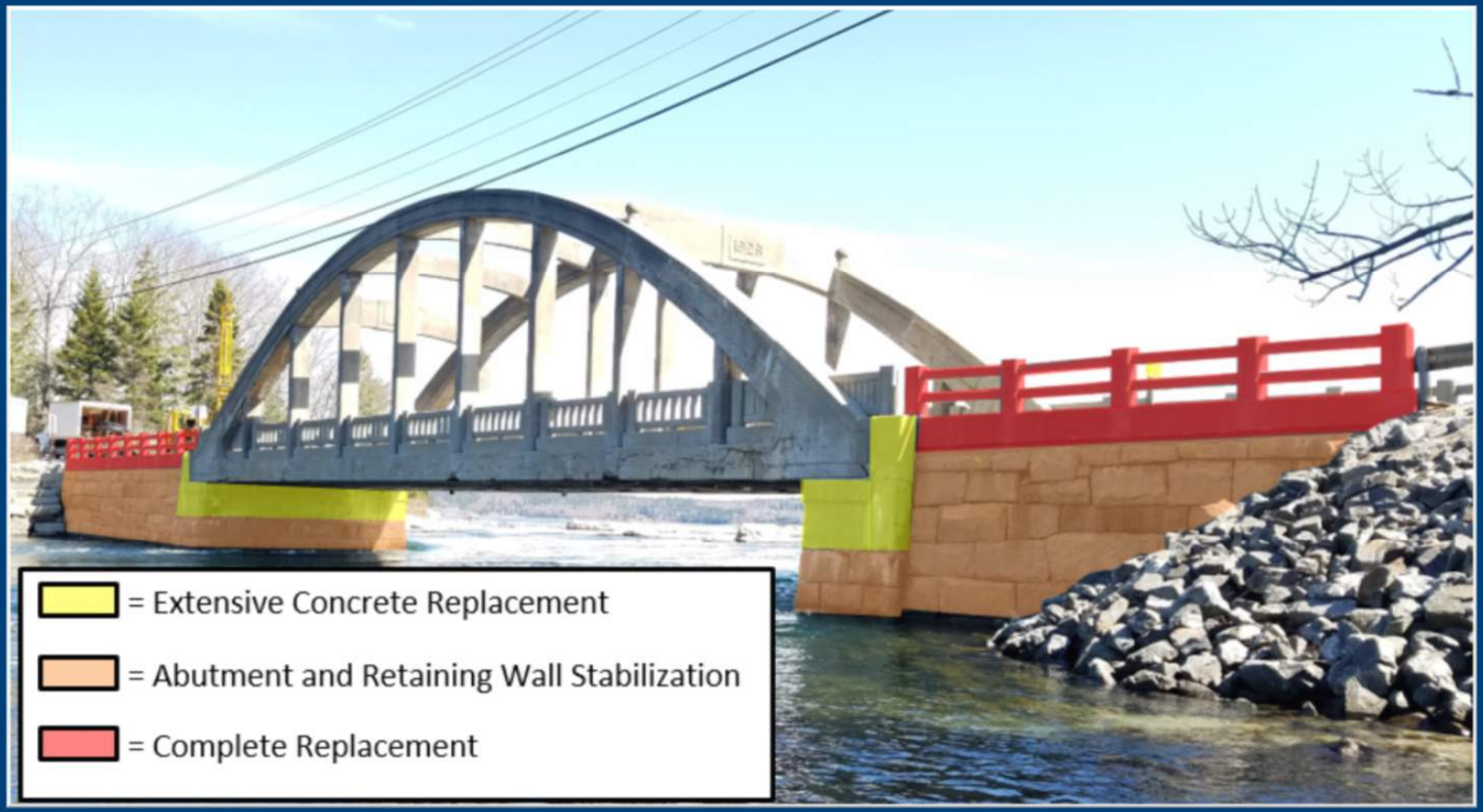
Wall During Construction
(note voids are smaller and less frequent)



Existing masonry voids and water penetration

Rehabilitation Scope – Bridge Condition

Anticipated Scope of Substructure Rehabilitation



Rehabilitation Strategies

Approach to evaluating Rehabilitation :

- Step 1: Identify deficiencies. Brainstorm & identify potential solutions ✓
- Step 2: Initially assess & shortlist best options for further evaluation
- Step 3: Assess constructability, schedule, impacts, longevity & cost
- Step 4: Identify most suitable rehabilitation strategy

Rehabilitation Strategies

Brainstorm and Identify Potential Solutions:

- Variety of solutions conceptualized and conceptually evaluated
- Goal was to identify options worthy of detailed constructability reviews
- The strategy for each bridge component was developed considering:
  - Load Carrying Capacity: Bridge must carry modern design loads
  - Bridge Condition: Repair areas of bridge deterioration
  - Sea Level Rise: Previous projects have considered 4' of sea level rise by year 2100.
    - Accommodating sea level rise will be considered together with other project constraints to assess to what extent sea level rise should be accommodated.
    - Sea level rise values of 0 feet, 2 feet and 4 feet will be considered.

Rehabilitation Strategies

Superstructure: Arch Rib Ends/Knuckles and Hangers

- Requires reconstruction and strengthening.
  - Arch Rib Ends/Knuckles: Extensive concrete replacement
    - Remove deteriorated concrete, exposing embedded steel plates and reinforcing steel.
    - Existing concrete between embedded steel plates to remain.
    - Cast new concrete to match existing geometry.
  - Hangers: Complete replacement (6 Ft. above roadway and down)
    - Remove deteriorated concrete, exposing reinforcing steel.
    - Cast new concrete to match existing geometry.

Rehabilitation Strategies

Superstructure: Bridge Deck and Floorbeam System

- Condition and load capacity makes rehabilitation impractical, replacement recommended.
  - Remove and replace with framing system similar to existing bridge
    - Cast-in-Place Concrete
    - Precast Panels could be used to accelerate construction
  - Lightweight materials could be used to minimize strengthening
    - Preliminary results indicate this approach does not help much.

Rehabilitation Strategies

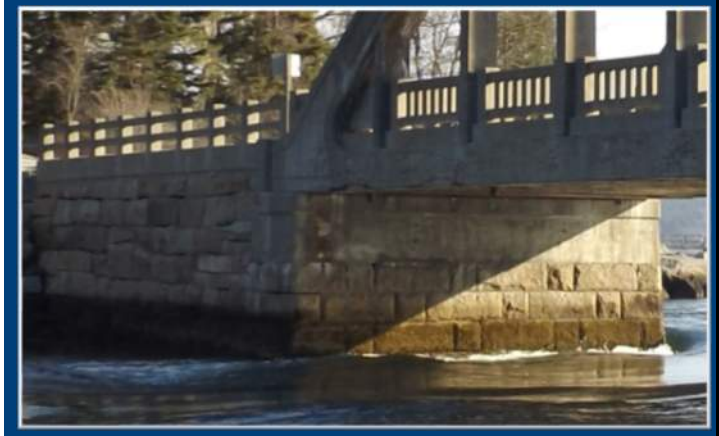
Superstructure: Tie Girders

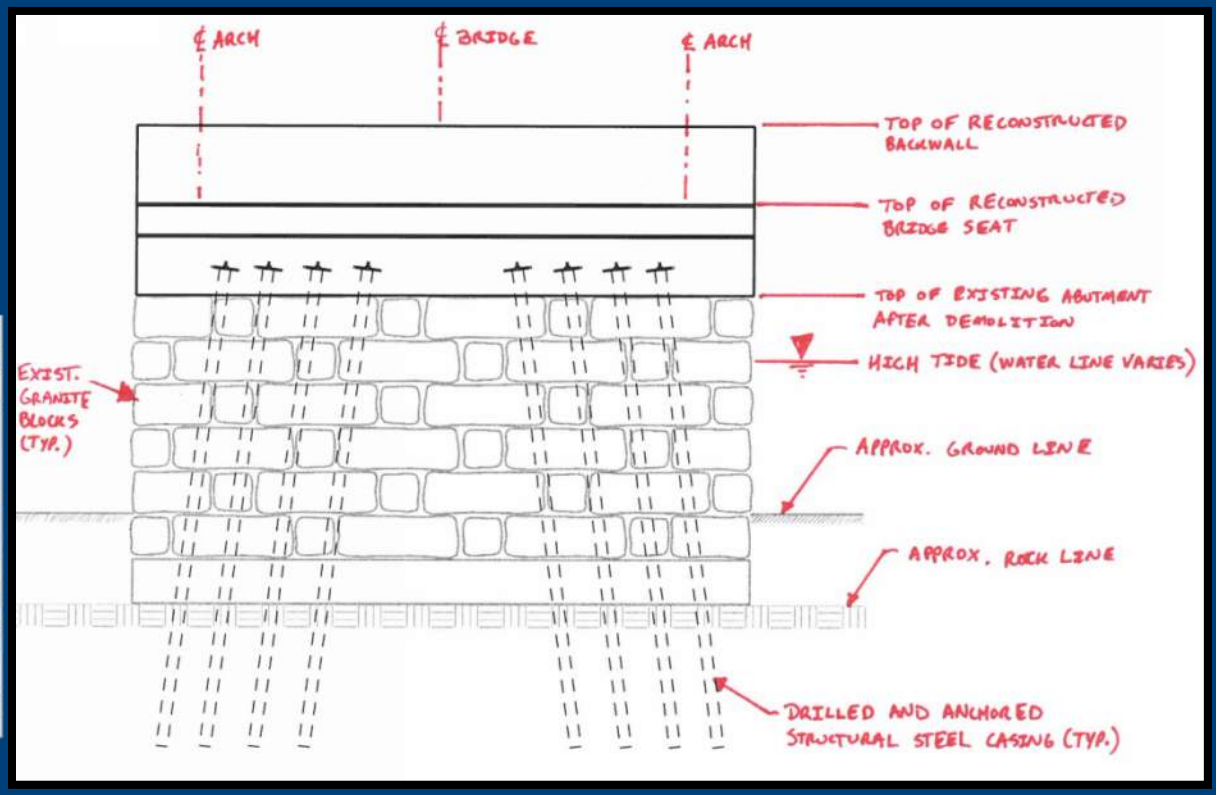
- Condition and load capacity require reconstruction and strengthening.
  - Remove all existing concrete, fully exposing original reinforcing.
  - Add additional reinforcing steel to increase capacity.
    - Combined with load reduction effort to minimize amount of addition steel.
  - Note: Adding sidewalk increases load resulting in more strengthening

Rehabilitation Strategies

Substructure: Abutments

- Address Abutment Capacity and Stability: Underpin with drilled casings.
- Requires reconstruction of the concrete abutment cap and arch end floorbeam.

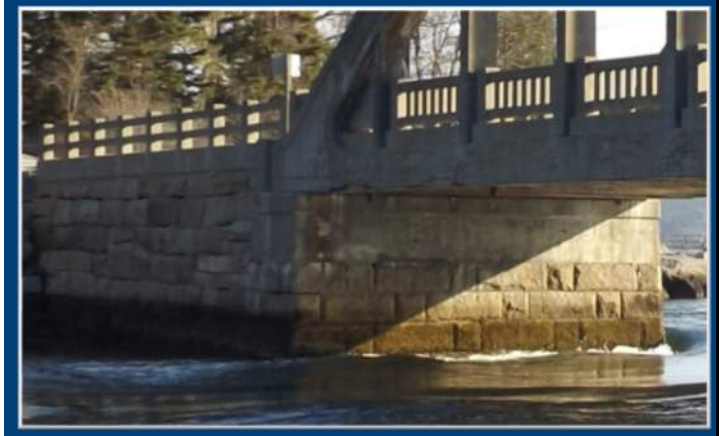


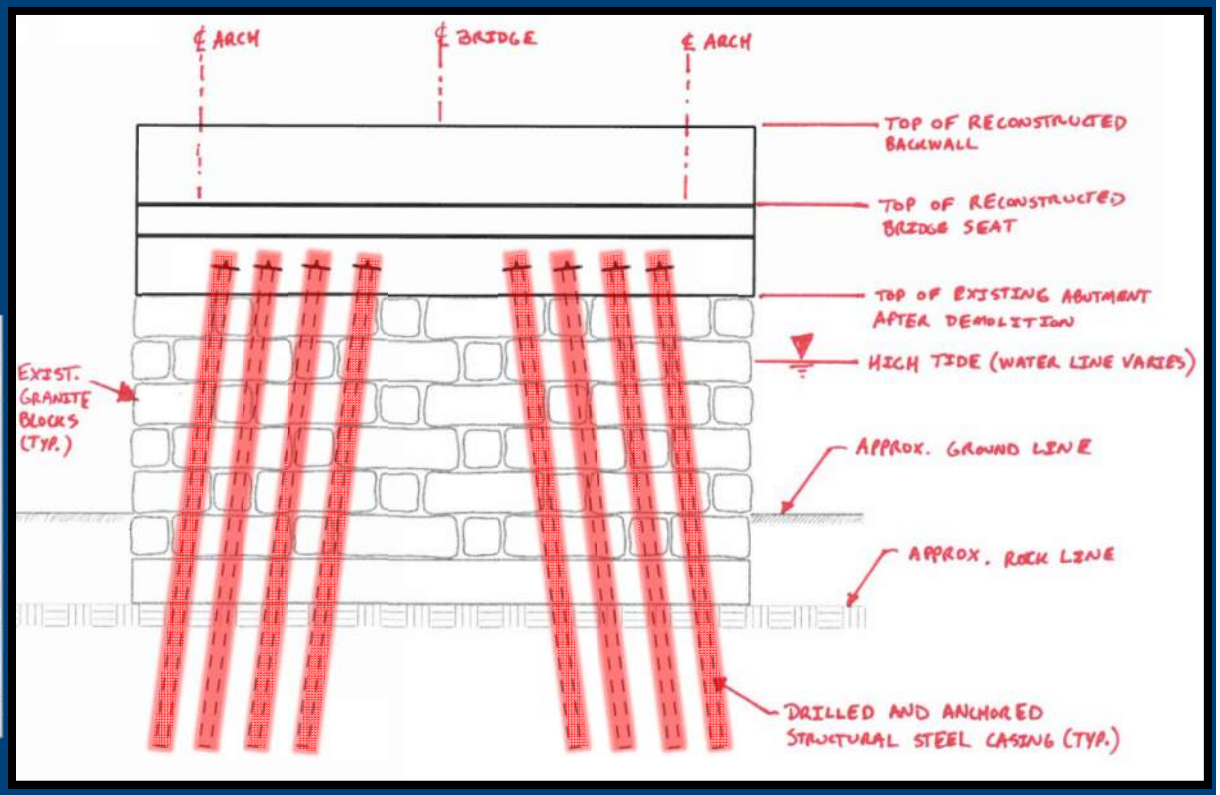


Rehabilitation Strategies

Substructure: Abutments

- Address Abutment Capacity and Stability: Underpin with drilled casings.
- Requires reconstruction of the concrete abutment cap and arch end floorbeam.

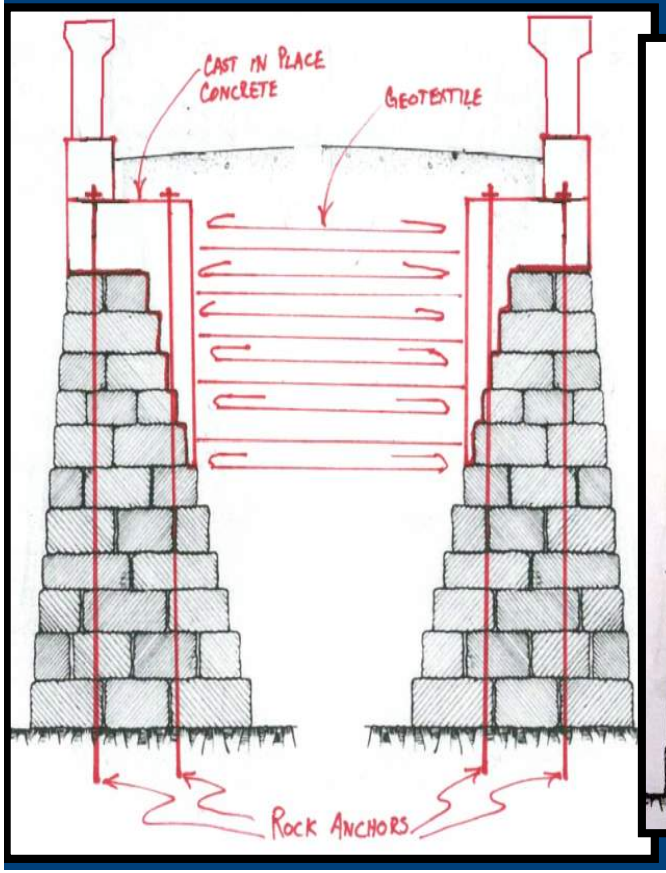


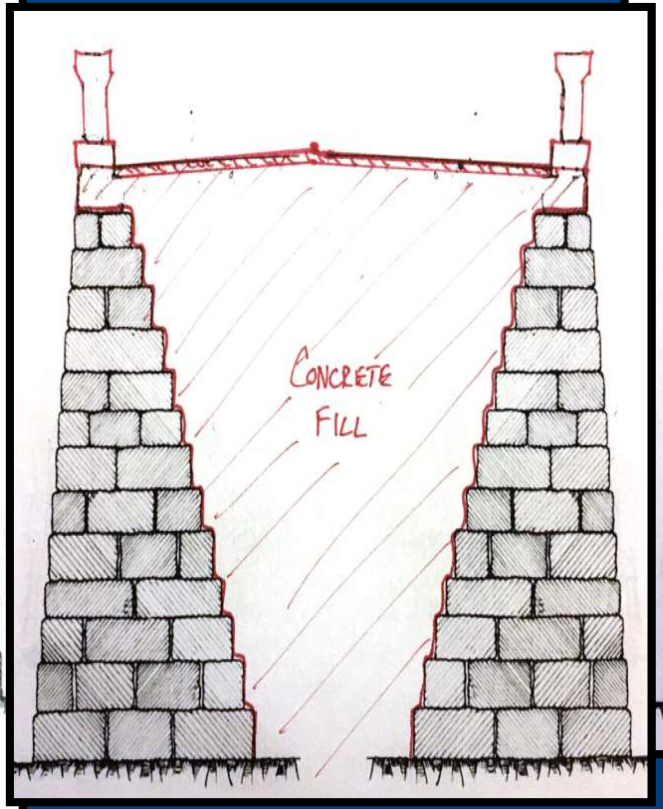


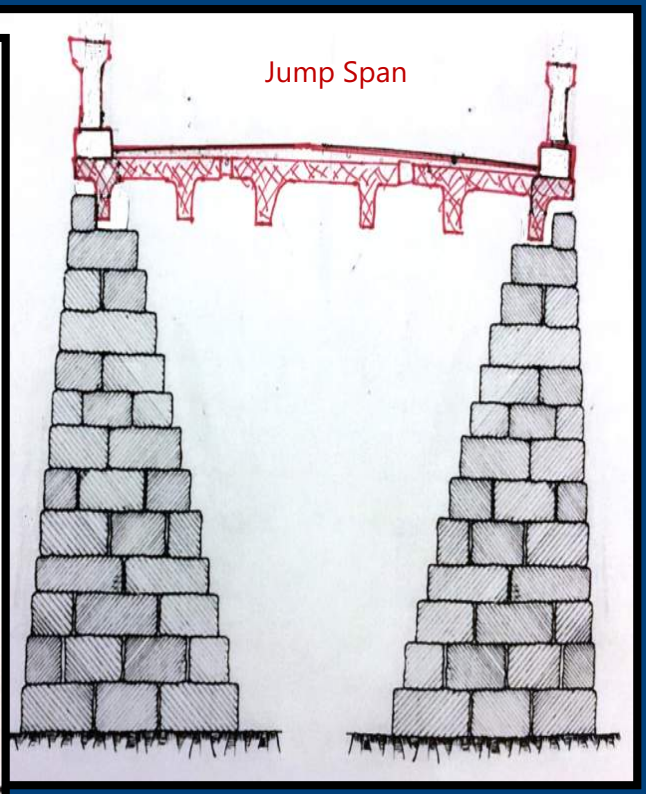
Rehabilitation Strategies

Substructure: Retaining Walls

- Address Wall Stability and infiltration: Various Solutions evaluated.



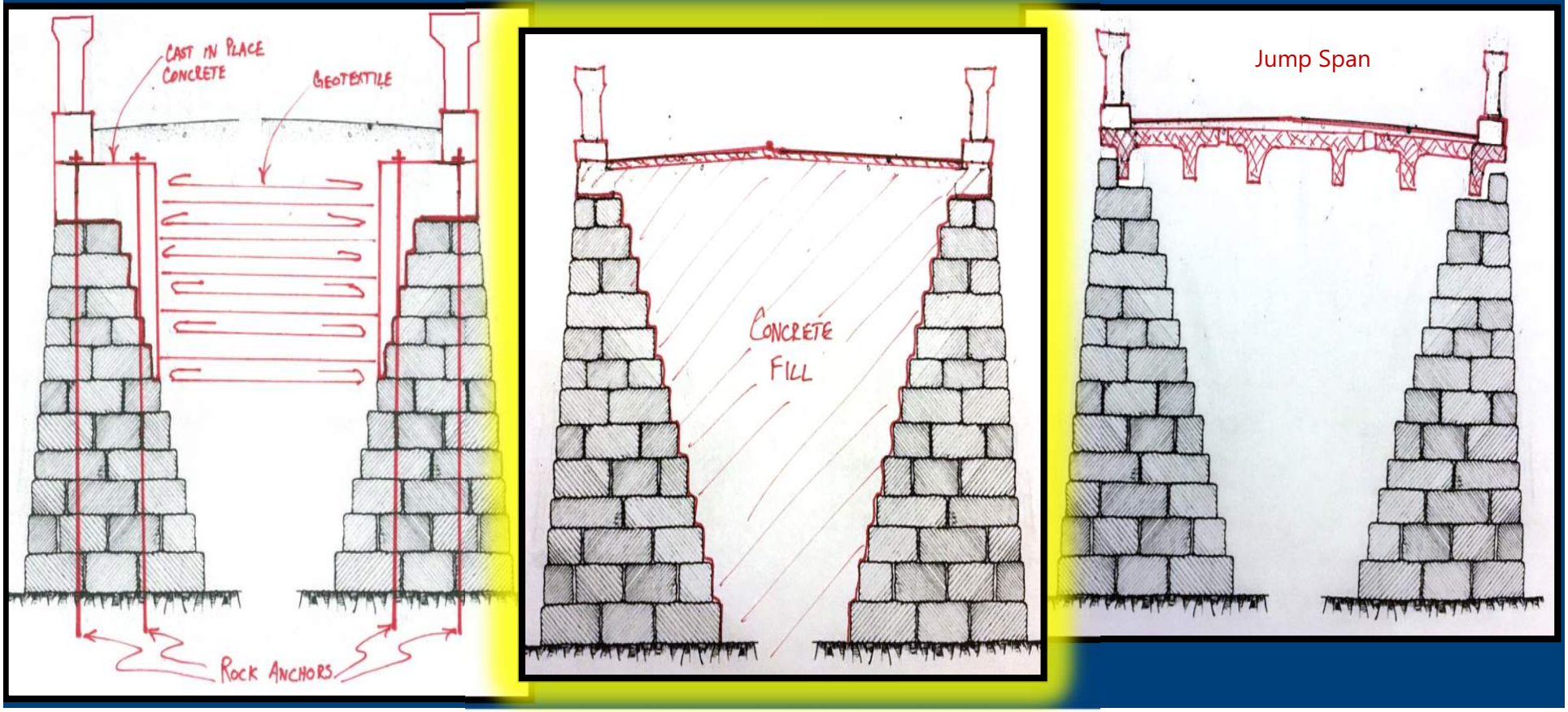




Rehabilitation Strategies

Substructure: Retaining Walls

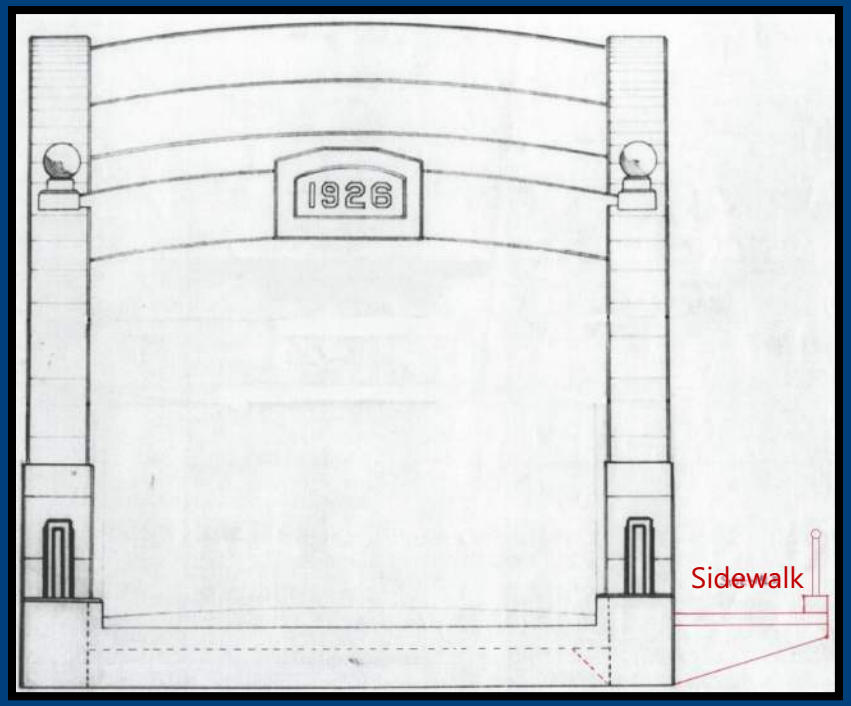
- Address Wall Stability and infiltration: Various Solutions evaluated.



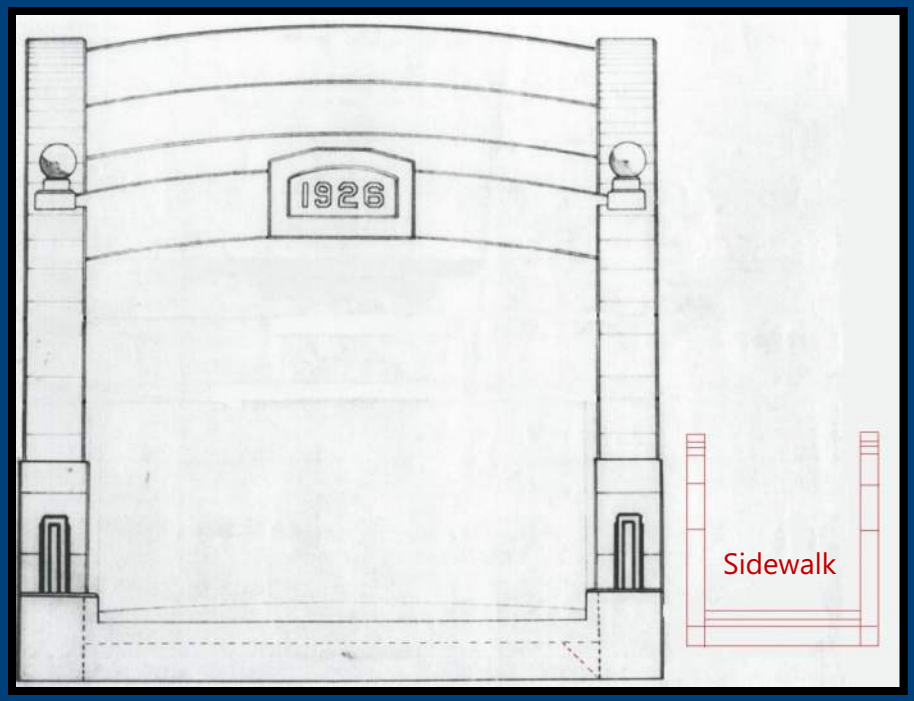
Rehabilitation Strategies

Sidewalk Addition – Superstructure

- Located outboard of existing bridge fascia



Cantilevered Sidewalk

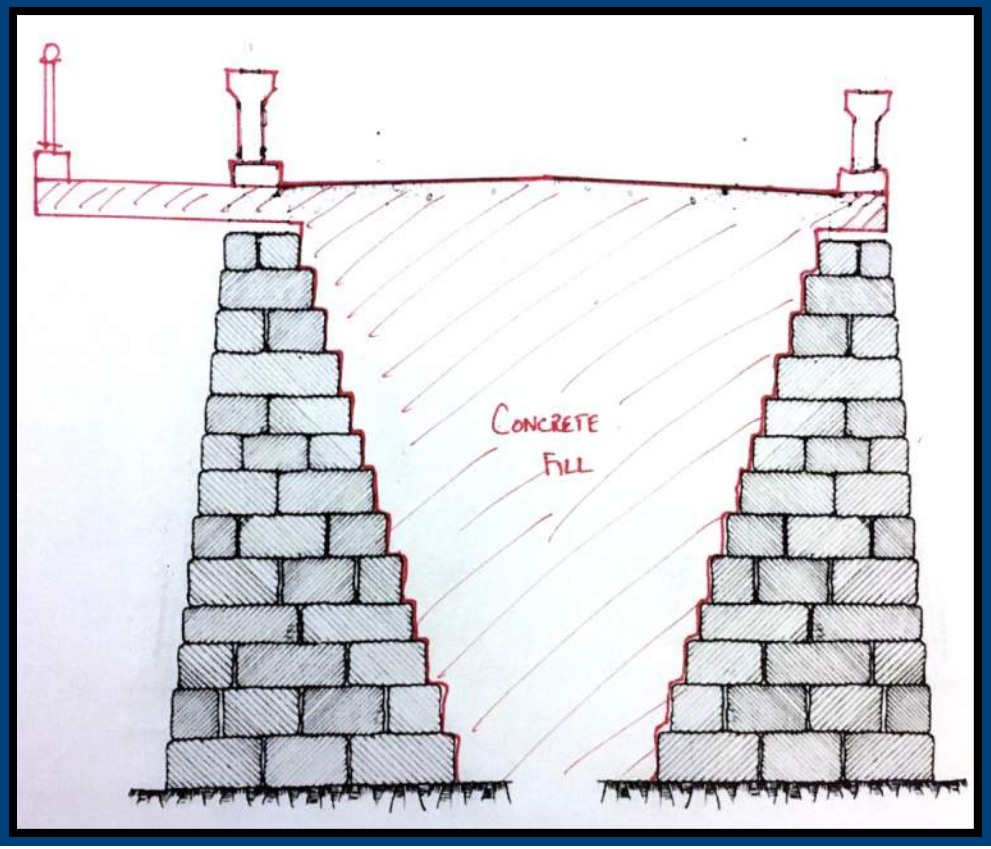


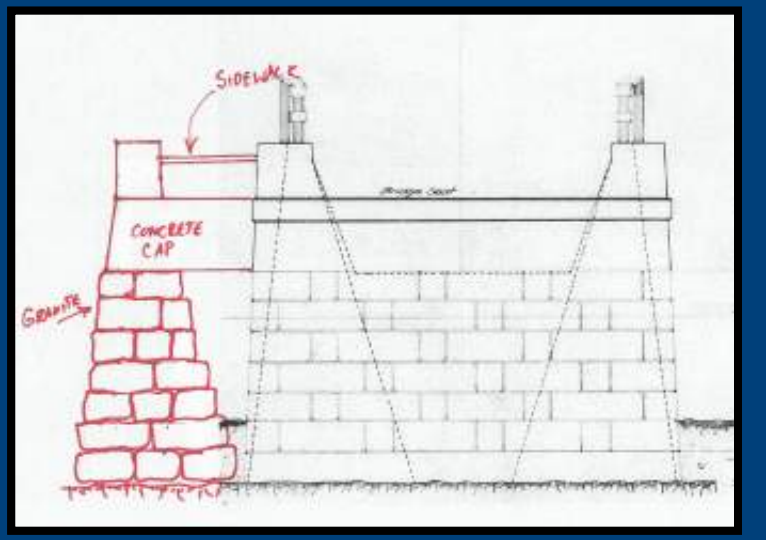
Independent Walkway Bridge

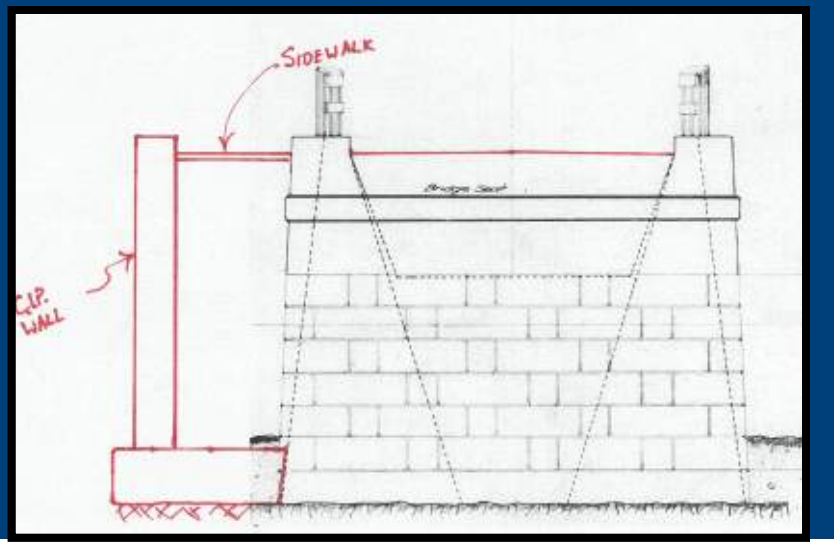
Rehabilitation Strategies

Sidewalk Addition – Substructure

- Widening of bridge approaches required



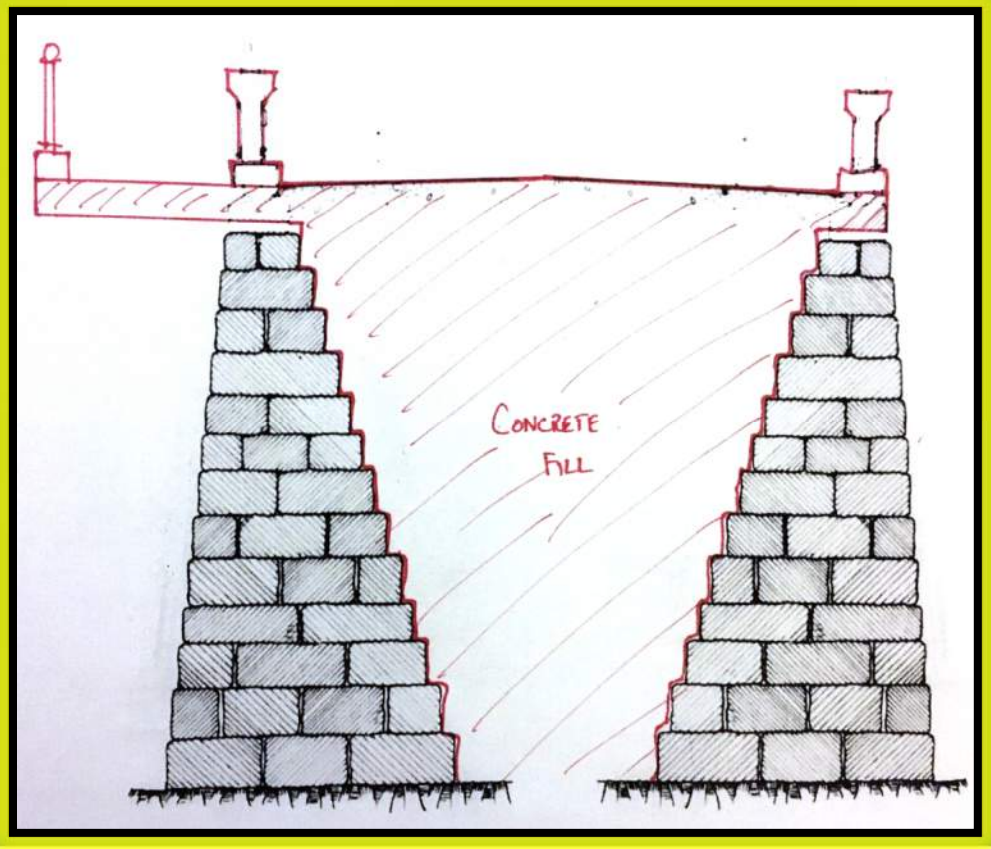


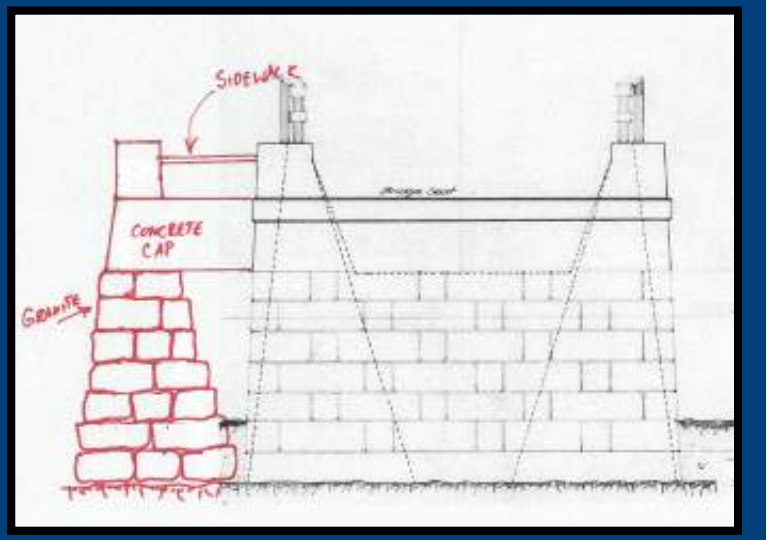


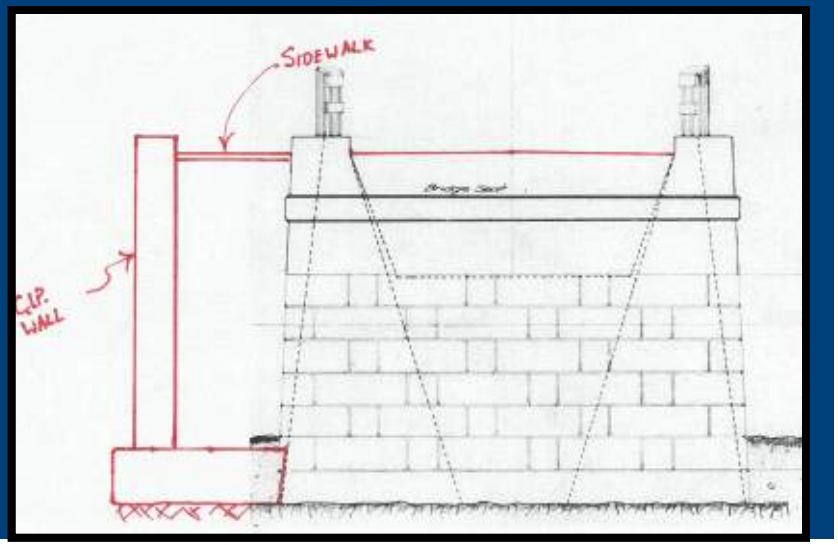
Rehabilitation Strategies

Sidewalk Addition – Substructure

- Widening of bridge approaches required







Rehabilitation Strategies

Ancillary Improvements

- Additional improvements will be considered, including:
  - Roadway Profile: Bridge and roadway raising to address sea level rise.
  - Bridge Rail: New rail meeting modern design standards will be used.
  - Guardrail: Roadway guardrail will be extended to meet standards.
  - Parking: A widened shoulder or parking area may be provided (input from BAC req'd).
- Evaluation of these features is ongoing.

Rehabilitation Strategies

Approach to Evaluating Rehabilitation:

- Steps 1 & 2: Identify, assess & short list initial options ✓ *Complete*
  - Superstructure
    - Replace deck, floorbeams and railings
    - Extensive concrete rehabilitation at tie girders, knuckles and hangers
    - Strengthen tie girders
  - Abutments & Retaining Walls
    - Strengthen / Reinforce abutments with drilled steel casings
    - Remove eroded fill within approaches, replace with concrete fill

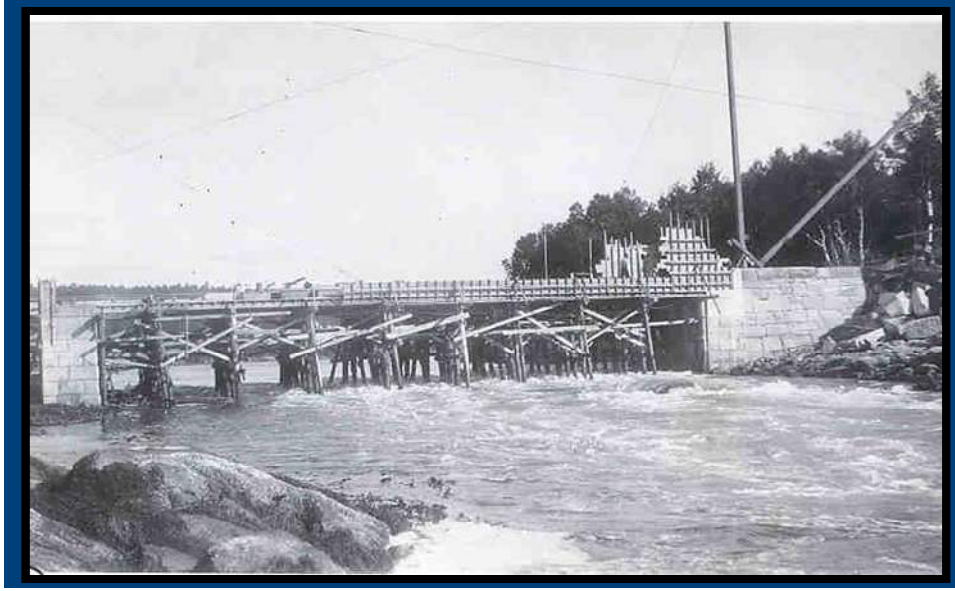
- Step 3: Assess constructability, schedule, impacts, longevity & cost
- Step 4: Identify most suitable rehabilitation strategy

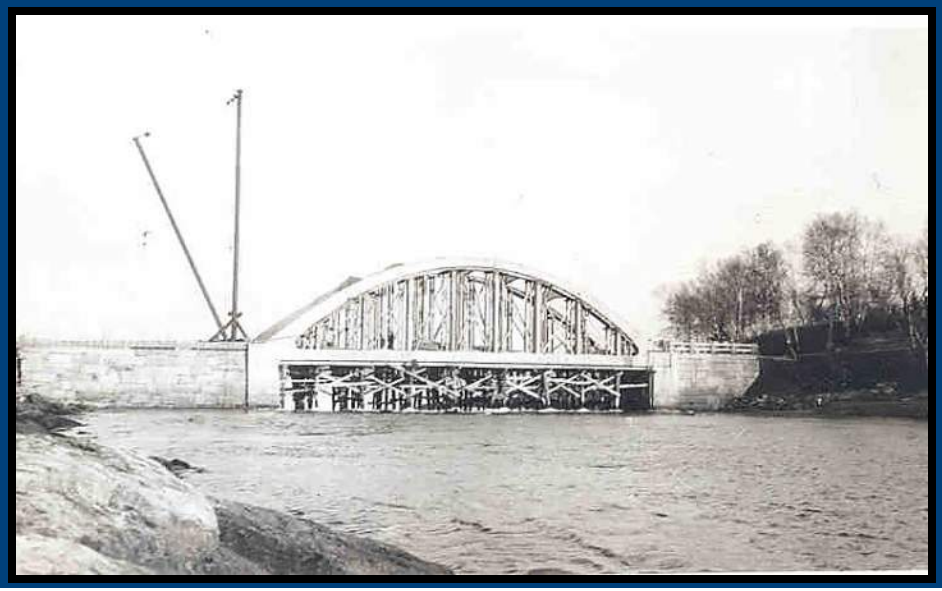
Assessment Underway

Constructability Considerations

Constructability - Superstructure

- What do the historical photos tell us about how it was built?
  - Bridge was continuously supported during construction.
  - Ensured stability during construction, minimized stresses in bridge.
- Rehabilitation should replicate this condition, required for any bridge raising.

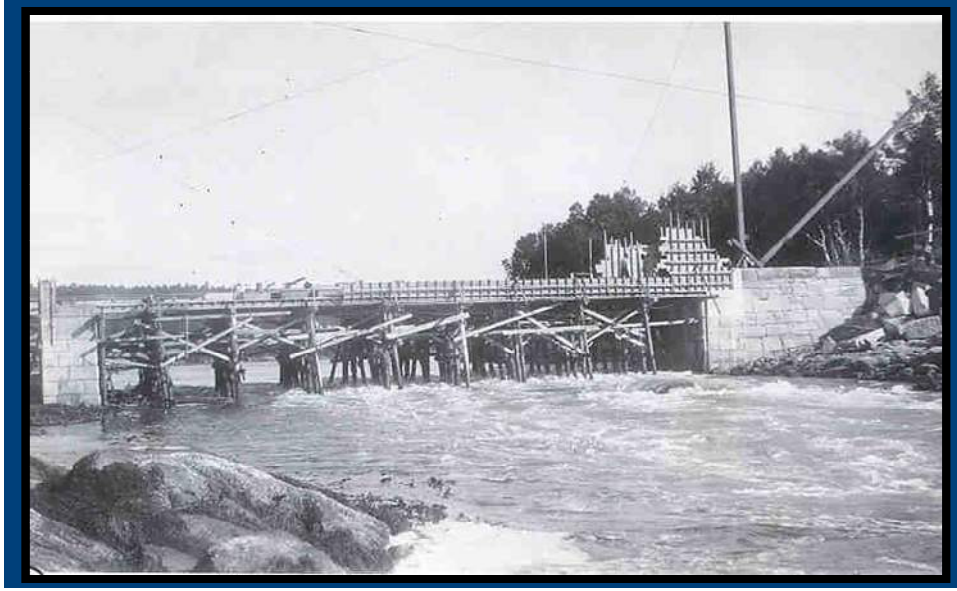


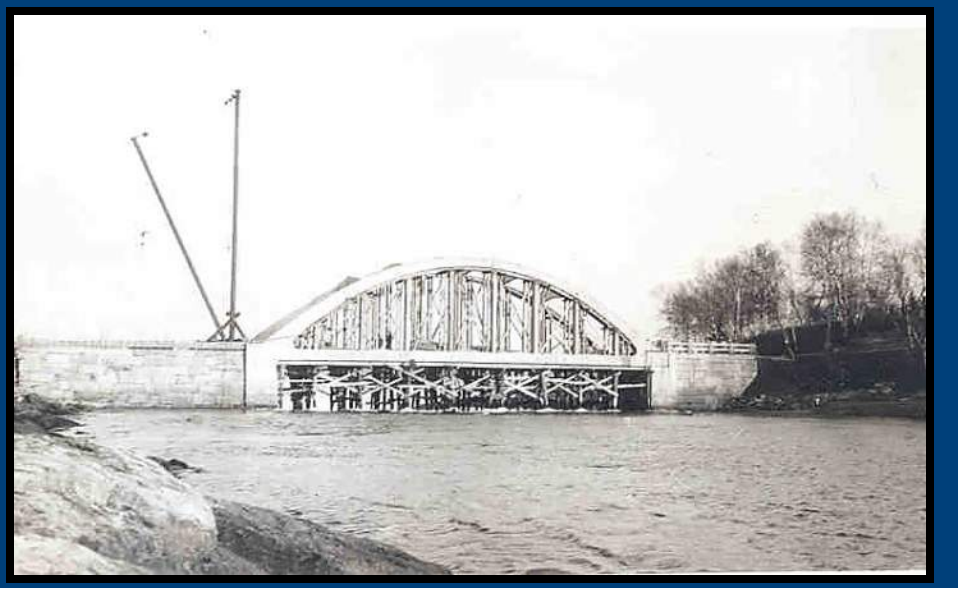


Constructability Considerations

Constructability - Superstructure

- Challenge #1 – Reinstalling all those temporary piles is impractical today
- Challenge #2 – The bridge is HEAVY!





Constructability Considerations

Constructability - Superstructure

- Challenge #1 – Reinstalling all those temporary piles is impractical today
- Challenge #2 – The bridge is HEAVY!

How heavy is HEAVY?

600 Tons

=

1,200,000 Pounds

Constructability Considerations

Potential Temporary Support Options

- Option 1: Temporary Bridge Insertion: Insert a temporary support through the arch over the roadway deck. Lift & support arches from approaches.

Constructability Considerations

Potential Temporary Support Options

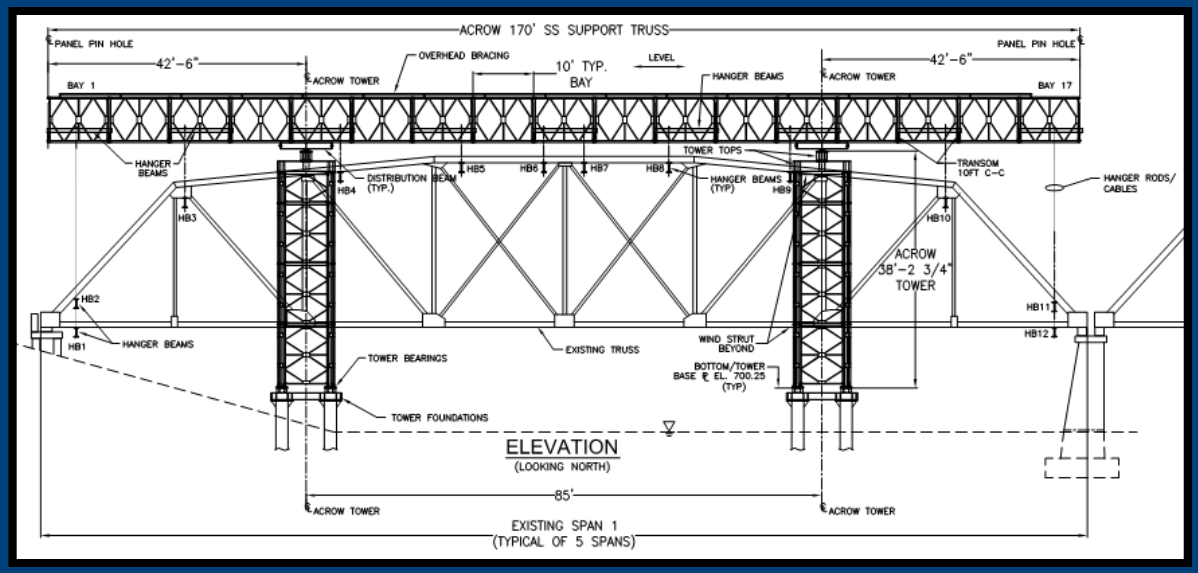
- Option 1: Temporary Bridge Insertion: Insert a temporary support through the arch over the roadway deck. Lift & support arches from approaches.

Bridge is too heavy.
Not technically feasible

Constructability Considerations

Possible Temporary Supports

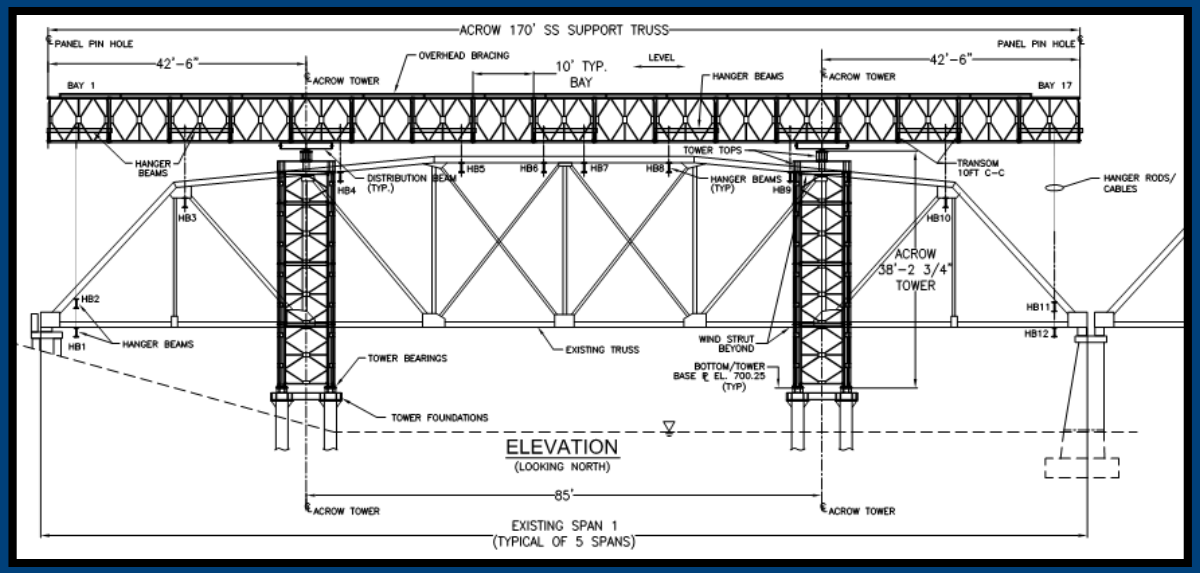
- Option 2: Overhead Support Structure: Construct temporary shoring towers alongside and structure above arch. Lift & support arches from above.



Constructability Considerations

Possible Temporary Supports

- Option 2: Overhead Support Structure: Construct temporary shoring towers alongside and structure above arch. Lift & support arches from above.



Pushing the envelope.
This *might* be feasible.

Constructability Considerations

Possible Temporary Supports

- Additional Options requiring additional evaluation:
  - Waterway Supports & Bracing: Construct large temporary support piers in the water.
  - Float in / Float Out: Use a barge to transfer arch to off-site work area - Shallow water!
  - Roll in / Roll Out: Create temporary support system to “roll” bridge onto north approach.
- All of these options have significant challenges & risk

Constructability Considerations

Constructability – Substructure

- Water Control: How do we keep the work area dry?
- Stabilizing Masonry: Do stones need to be stabilized during drilling? How?
- Fill Replacement: Fill has large stones. Will excavation destabilize the walls?
- Temporary Arch Supports: Will supports be in the roadway? Will they limit substructure repair operations?

Constructability Considerations

Constraints

- Right-of-Way
- Environmental
- Historical
- Archeological
- Utilities

Next Steps

Approach to Evaluating Rehabilitation:

- Steps 1 & 2: Identify, assess & short list initial options ✓ *Complete*
- Step 3: Assess constructability, schedule, impacts, longevity & cost
- Step 4: Identify most suitable rehabilitation strategy

Assessment Underway

- Next BAC meeting
  - Each short-listed concept will be evaluated considering:
    - Constructability – How do we build it? Can we accelerate construction?
    - Probable construction schedule
    - Conceptual estimated construction cost
    - Evaluation of impacts, including Section 106 (Historic) consultation
    - Assess & Populate evaluation criteria matrix
  - Results will identify the most suitable rehabilitation solution

Next Steps

Alternatives Matrix

Blue Hill Falls Bridge Renewal Project
MaineDOT WIN # 17712.00

Alternatives Matrix

Last Updated: 10/16/2017

Evaluation Criteria		Rehabilitation		Replacement		Alternative Concepts
		1A Rehabilitation In-kind	1B Rehabilitation with Sidewalk	2 Enhanced Girder Bridge	3 Tied Arch	4 Reroute Rt. 175 & Repurpose Bridge
Description & Cost	Alternative Description					
	Structure Type					
	Anticipated Service Life					
	Total Bridge Deck Area					
	Total Life Cycle Cost					
	Conceptual Construction Cost (2017 Dollars)					
Archeological						
Architecture						
Environmental						
Site Conditions						
Construction						
Community Needs						
Other						

Discussion