

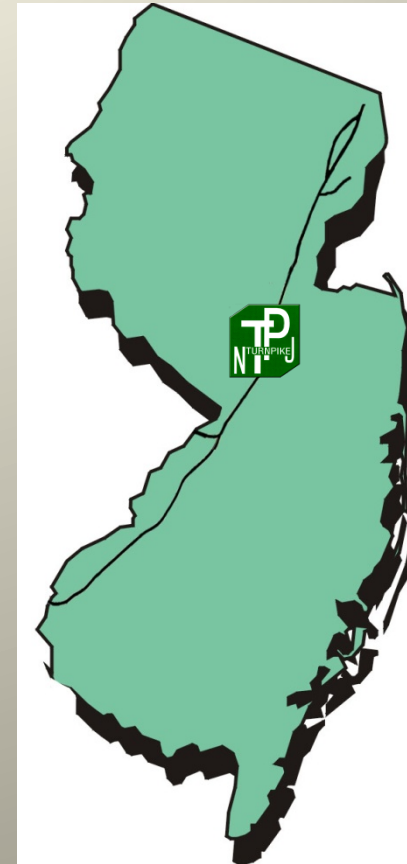
Viaduct Structure Rehabilitation

**Bridge Deck Reconstruction, Miscellaneous
Structural and Roadway Improvements,
and Repainting of Structural Steel,
Structure No. E109.83**

Introduction

NJ Turnpike Roadway

- **Opened 1951**
- **500 bridges**
- **148 mile facility**
- **250,000 ADT each direction**
- **Regional Transportation Link**



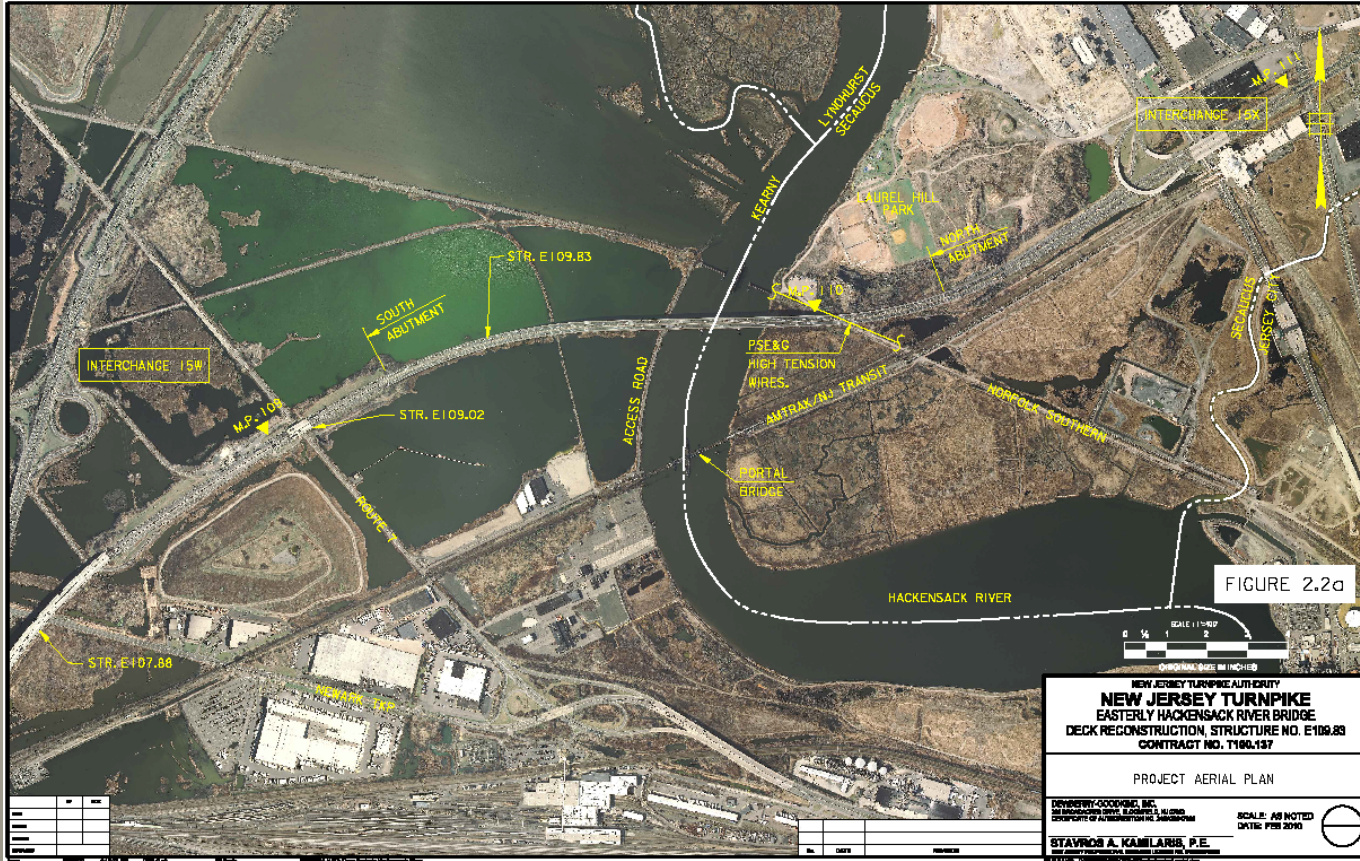
Introduction

Easterly Hackensack River

- **One of 7 'major' Turnpike Bridges**
- **Structure is approximately 1.0 mile (5,620') long**
- **38 spans (3 spans over Hackensack River)**
- **3 – 12' lanes in each direction with 12' right shoulder and median barrier between roadways**

Project Overview

Project Location – Aerial View



Project Overview

Project Photos



Project Overview

Project Photos – North Approach Spans



Looking Northeast

Project Overview

Project Photos – River Spans



Looking Southeast

Project Overview

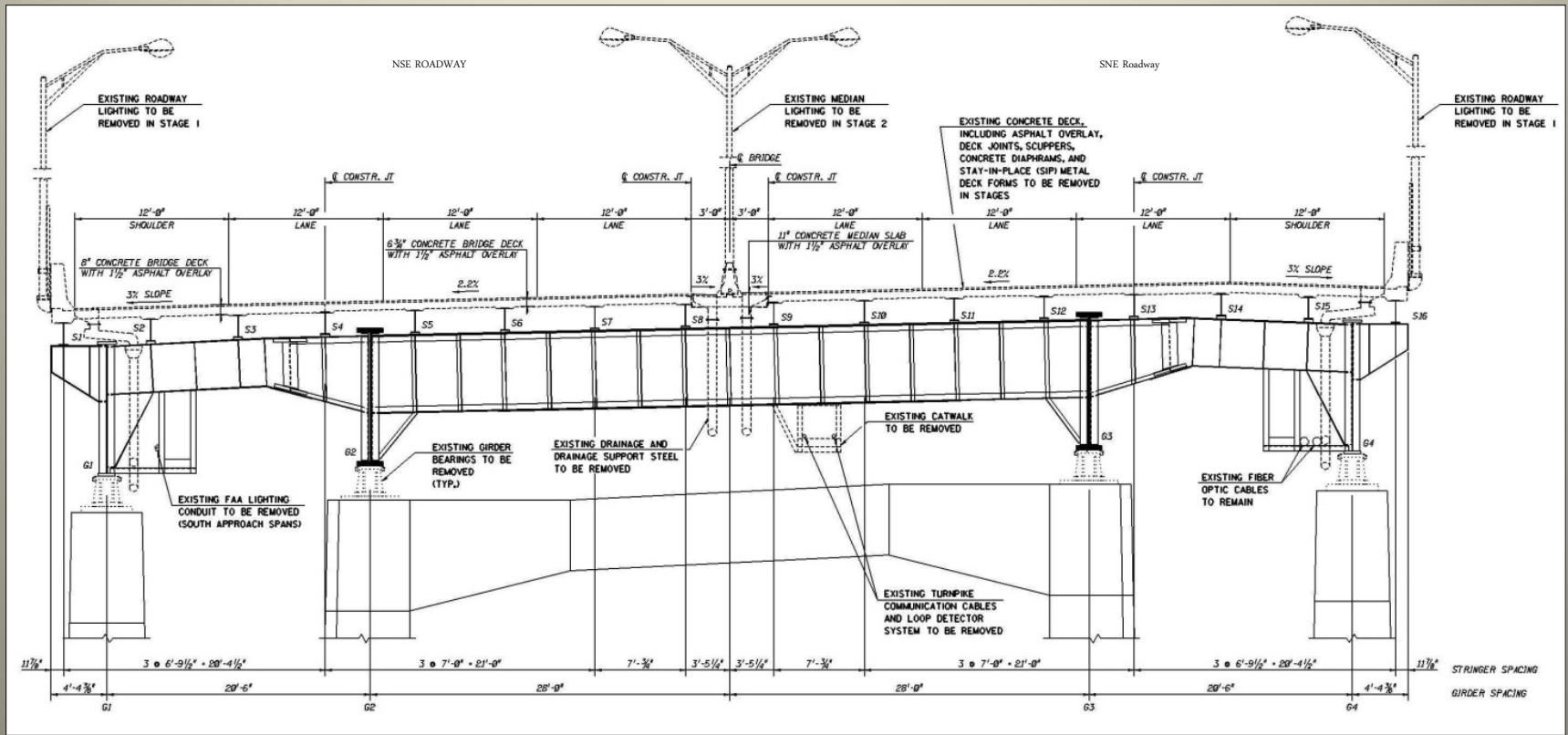
Project Photos – River Spans



Looking Northwest

Project Overview

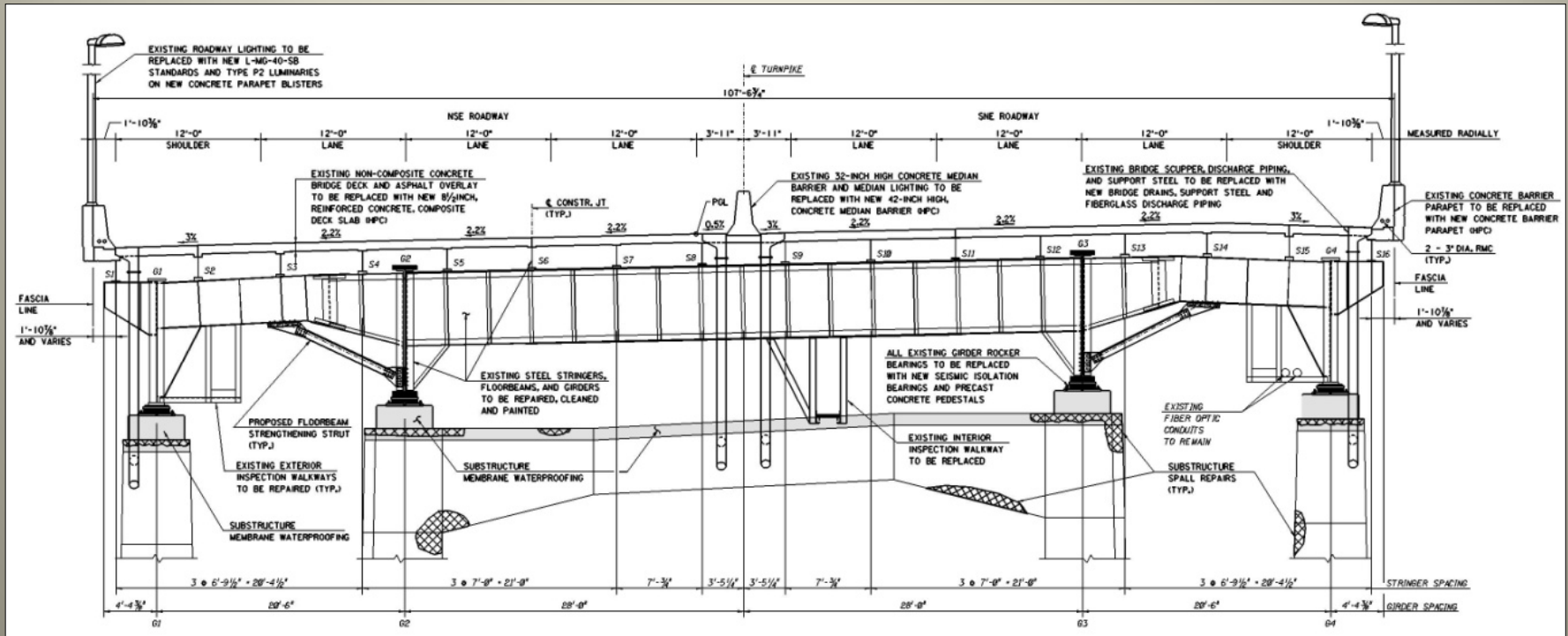
Existing Bridge Cross Section



Looking North

Project Overview

Proposed Bridge Cross Section



Looking North

Project Overview

Project Goals

- **Maintain current traffic operations (3 lanes of traffic in each direction) during peak hours.**
- **Minimize traffic disruptions while maximizing productivity and safety during construction.**
- **Be sensitive to environmental constraints and minimize environmental impacts.**
- **Design for a full bridge redecking with a holistic approach that would address other concerns including superstructure and substructure repairs, repainting of structural steel, seismic retrofit, and strengthening or replacement of members, as needed.**
- **Design to achieve an additional 75 Years of service.**

Project Overview

Scope of Work Elements

- **Bridge deck Reconstruction**
- **Structural steel repairs/retrofit (girder, floorbeam, stringer)**
- **Stringer replacement**
- **Redundancy improvements**
- **Stringer bearings repair/replacement**
- **Seismic Retrofit (Rocker bearing replacement with seismic isolation bearings)**
- **PEOSHA/Inspection Access Improvements**
- **Substructure repairs**
- **Fender system repairs**
- **Repainting of superstructure steel**
- **Roadway lighting improvements**
- **Drainage improvements**
- **Approach roadway improvements**
- **Rock mitigation (security measure)**
- **Construction staging/MPT**
- **Environmental permitting**
- **Utility and RR Coordination**

Constructability

Working over tough terrain

- **Years of work in tight conditions with multiple crews**
- **High level access needed for steel repairs and retrofit work**
- **Full containment needed for repainting work**
- **Ability for inspectors to access all points of work required**
- **Answer: build a dance floor under everything.**



Answer: build a dance floor under everything.

Deck Replacement

Existing Condition

- **Two Deck Sections in service since built in 1951 and widened in 1972.**
- **Non Composite with supporting stringers**
- **Obsolete finger style joints allowed water flow into structure steel**
- **60 year old portions of the deck were heavily patched and paved**



Deck Replacement

Replacement Choices –what goes, what stays

- **Traditional Cast in Place high Performance Concrete deck.**
- **Made composite with existing stringers in approach spans.**
 - Existing stringers in salvageable condition
- **Made composite with new stringers in main river spans unit.**
 - Existing stringers in poor condition due to open deck joints.



Simple Approach Spans



Continuous River Spans Unit

Deck Replacement / Steel Repairs

Why Replace the Stringers?

- Stringers in the River Spans Unit had section losses at the joint locations.
- The original 1951 stringers were coated with lead paint and would have been expensive to clean and repaint.
- Original grade 36 steel rated low.
- New weathering steel stringers were cost effective, stronger, never needed repainting, and did not require repairs.
 - Cost to repaint a 100' long stringer at \$12/SF and repair end deteriorations was estimated at \$18,400.
 - Cost to replace a 100' long stringer with a new stringer at \$2.50/lb. was \$17,800.



Girders and Floorbeams Stripped of Stringers

Steel Repairs

Organizing the Chaos

- **5000 feet of Girder/Floorbeam/Stringer superstructure arrangement to rehabilitate meant a lot of repairs**
 - **5 different types of stringer repairs**
 - **14 different types of floorbeam repairs**

The Philosophy

- **Reduce repair types by making them larger or more inclusive .**
- **Consolidate repairs of the same type to make the repair cheaper by getting a 'bulk rate'.**
 - **100 identical 'big' repairs are cheaper than 50 'small' repairs that are all different.**



Adding Redundancy

Hybrid Construction Headaches

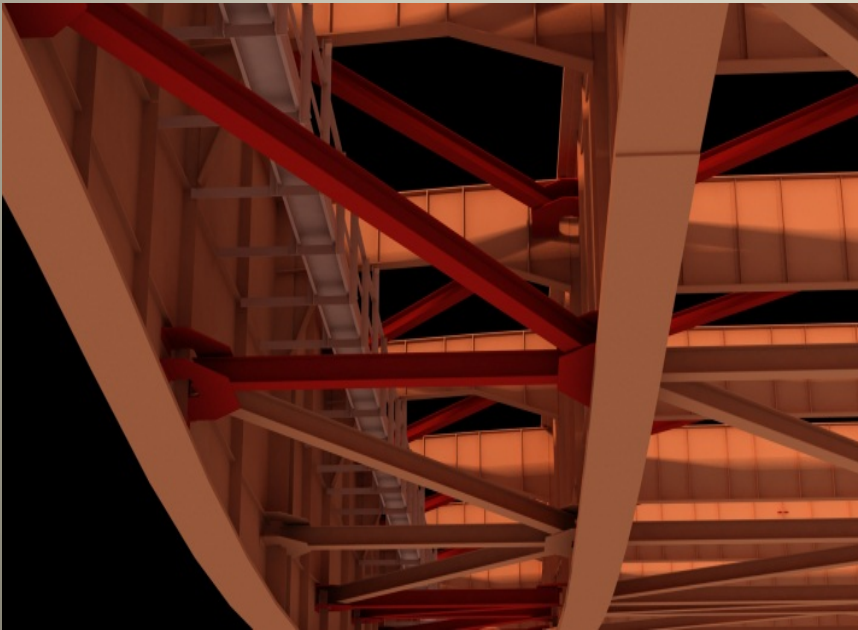
- **4 girder system with non prismatic floorbeams.**
- **Inner girders designed ASD and built-up riveted plates.**
- **Outer girders designed LFD and welded plate construction.**
- **50% stiffness difference between girders.**



Adding Redundancy

Final Solutions

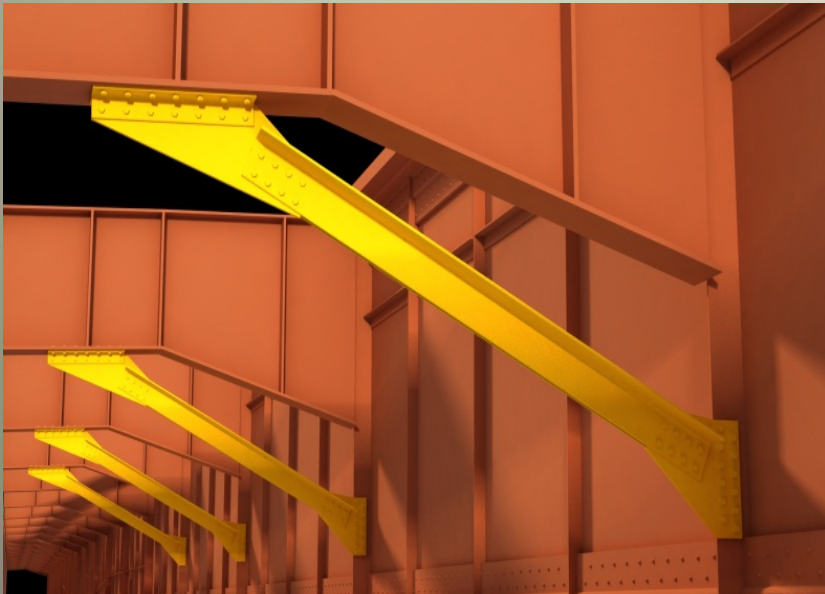
- **For the continuous river spans unit – add lateral steelwork to create an effective box truss.**



Adding Redundancy

Final Solutions

- For the much shorter simple span approach spans, a slimly kicker bracket to reinforce the floorbeams is enough.



Seismic Retrofit

Scope of Work

- Existing rocker bearings to be removed and disposed of
- Install new seismic isolation bearings
- Use of Precast concrete pedestals and steel bolsters
- Geometric and Time Constraints



Existing Condition

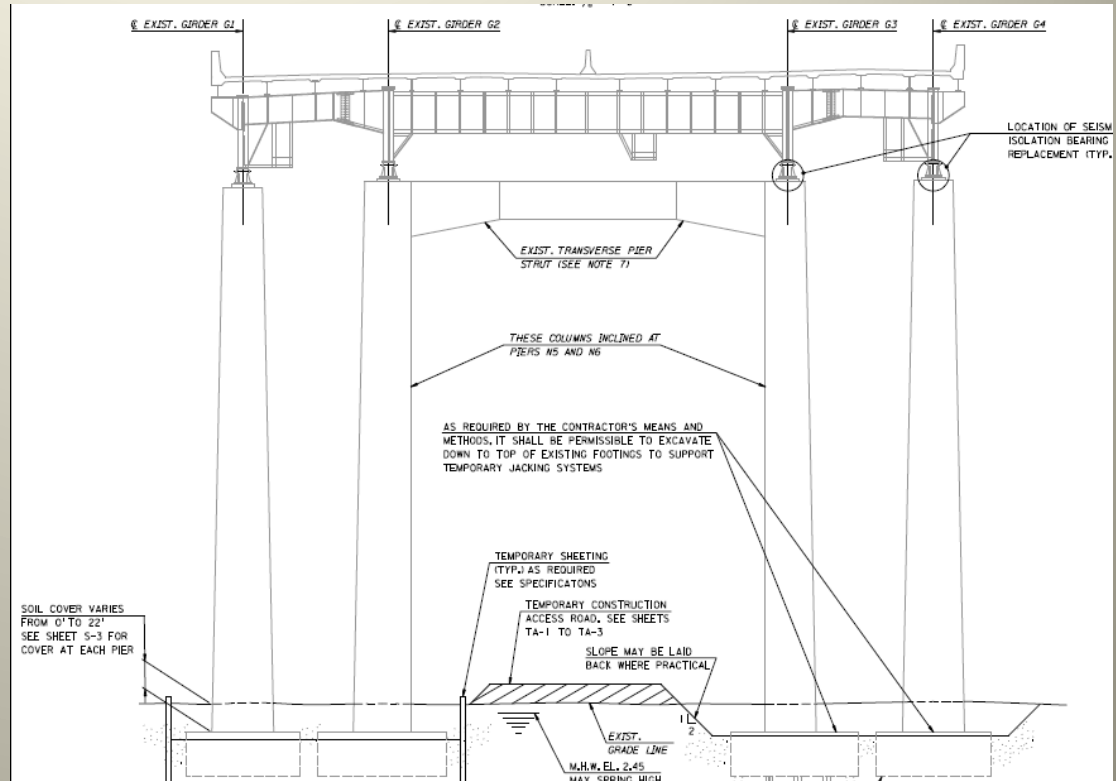


Similar Proposed Condition

Seismic Retrofit

Jacking Heavy Loads

- Pier heights in excess of 90'.
- Bearing loads in excess of 1000k
- Difficult Terrain
- Can't dictate means and methods to the Contractor.



Typical Pier Elevation

Conclusions and Lessons Learned

Fast Points

- **Contractors can be valuable partners – Value Engineering solutions can save everyone money and improve finished product quality. The crash tested barrier is a prime example of this.**
- **Proper design of steel repairs is a key component to cost control. Re-usable details don't need to be renegotiated like new details. Always expect repairs to grow after sandblasting.**
- **Bridge deck construction quality is strongly related to planning your deck pours and planning around live load vibration. Tying deck reinforcement to prevent vibration can be an effective mitigator of deck cracking when pouring under live load.**
- **Redundancy of structures is not guaranteed based on meeting abstract criteria. A Rational approach is most important.**
- **Seismic retrofit design and construction is a combination effort on the part of the engineer of record, the contractor, and the bearing manufacturer. Treat it that way.**