

Michigan
Bridge
Conference



2015
Bay City, MI

Center for
Technology & Training

Michigan's
Local Technical
Assistance Program

US-131 Over the Muskegon River

Corey Rogers, P.E.

Bridge Construction Engineer

NB and SB US-131



- Each bridge is a three-span, 580 foot long, cast-in-place, post-tensioned concrete box girder structure resting 55 feet above the river on a pair of fixed piers.

Background Information

- Routine bridge inspections have previously indicated extensive cracking in webs and on underside of boxes near the piers at the anchorage points.
- A structure study conducted in 2013 by URS for MDOT indicated inadequate reinforcement in the diaphragms and webs above the piers as well as surrounding the top and bottom slab anchorages supporting the longitudinal post tensioning.



- Indirect supports and inadequate reinforcement result in cracking.
- Strengthening of the bridge is necessary to reduce the shear demands of the structure and correct the overstress calculated for the web principle tension.
- Pier modifications also are necessary to correct the indirect support scenario by providing bearing directly under the webs.

MDOT RFQ

- Proposed work plan (40 pts)
- Qualifications of team (30 pts)
- Submitter Experience (30 pts)

REQUEST FOR QUALIFICATIONS

MICHIGAN DEPARTMENT OF TRANSPORTATION
Grand Region

US-131 over Muskegon River

Job Number: 115159

Original Issue
March 3, 2014



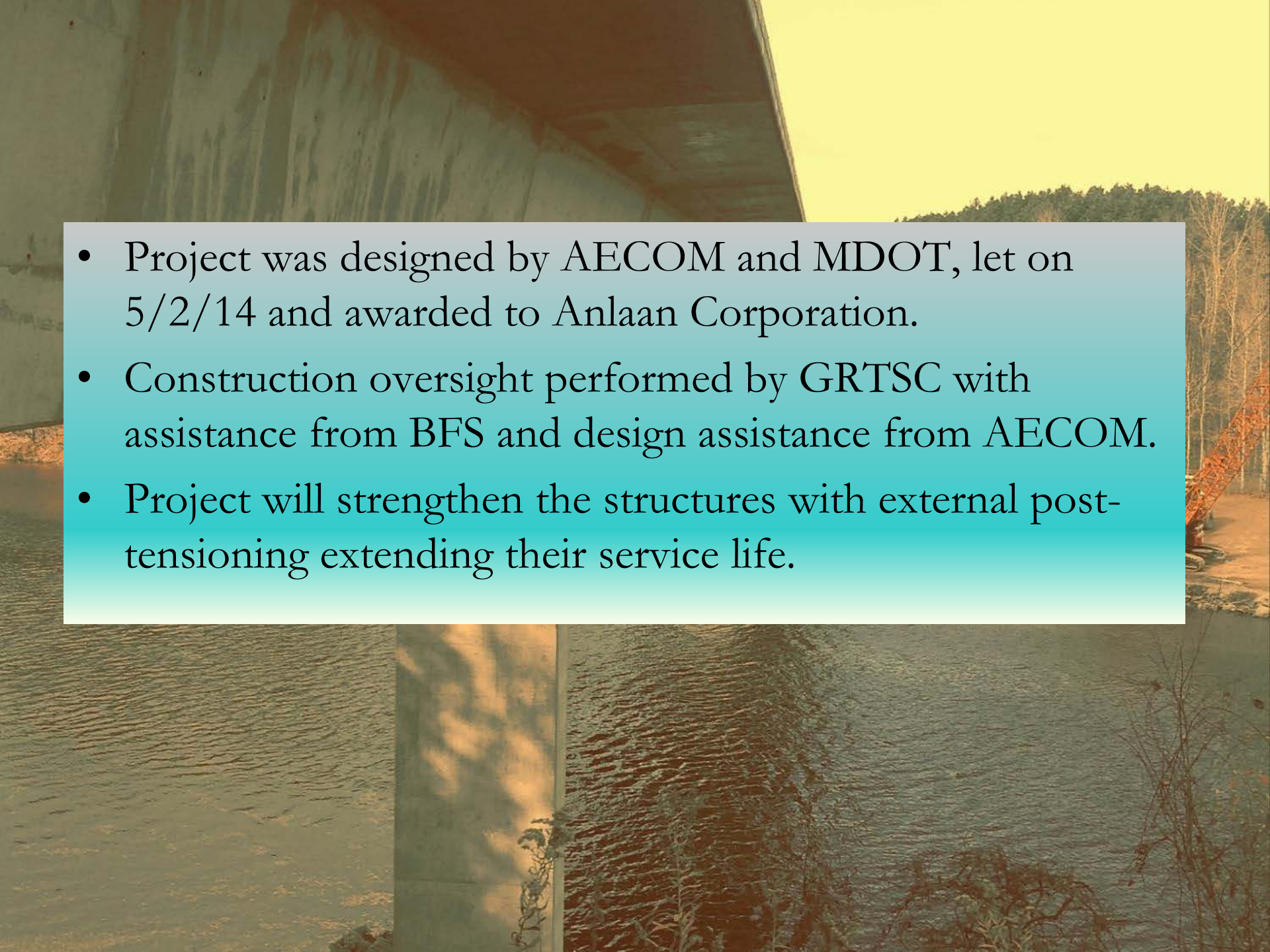
MDOT RFQ

- What were we looking for?
 - Acknowledgement of the access difficulties and temporary works
 - Specialty subcontractor for PT and flat jack work
 - Experience with complex projects
 - Competent team

MDOT RFQ



- 6 contractor submittals
- Short-listed to 4 based on scoring (85 pass)
- Anlaan/Freyssinet awarded contract
 - \$5 million.

- 
- Project was designed by AECOM and MDOT, let on 5/2/14 and awarded to Anlaan Corporation.
 - Construction oversight performed by GRTSC with assistance from BFS and design assistance from AECOM.
 - Project will strengthen the structures with external post-tensioning extending their service life.

Project Scope

- Pier Modifications
- Flat Jack Installation
- Diaphragm Retrofits
- External Post-Tensioning
- Articulating Concrete Block
- Joints and Epoxy Overlay
- Crack Injection
- Concrete Surface Coating

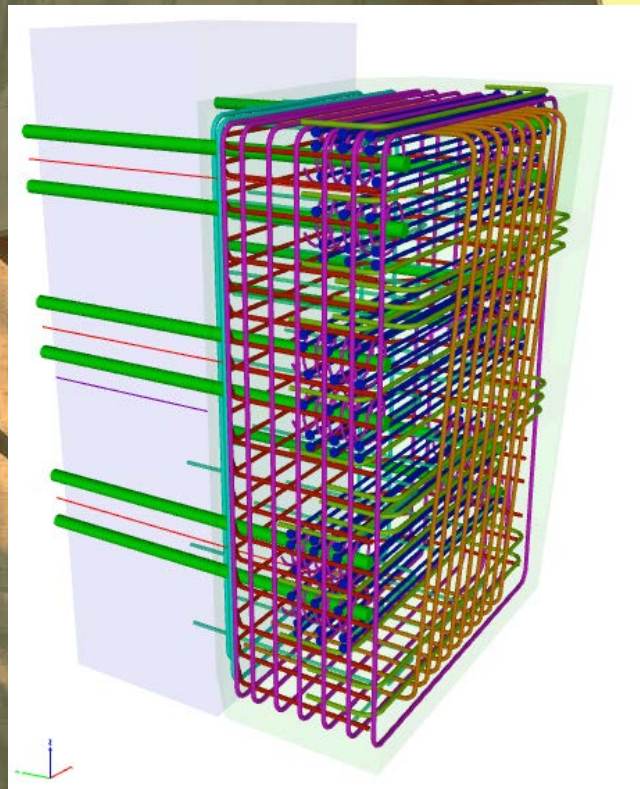
Corbel Material VECP

- Original design called for steel corbels to be attached to the piers that would hold the flat jacks to provide bearing directly under the webs.
- Contractor submitted a VECP to change corbels to concrete, total savings were roughly \$180,000 of which half will be direct savings to the project.
- VECP was reviewed and revised multiple times with final MDOT approval granted 11/19/14.

Corbels and Work Platforms

- Concrete corbel design provided by the Contractor's engineer included extensive steel reinforcement as well as a requirement for 6,500 psi concrete.
- Corbels were construct with two separate concrete pours, the first pour being about 1/3 of the total volume, which is designed to hold the weight of the remaining 2/3 pour.
- Work platforms were designed for the loading of the first lift of concrete for the corbels as well as worker and equipment live loading.
- Platforms are attached directly to each pier, four total, and are constructed mostly of wood members.

Pier Modifications



- Reinforced, cast-in-place, post-tensioned concrete corbels atop the existing piers

Work Platforms

- Designed by Williams and Works to support dead load of concrete.
- Corbels poured in two lifts
- Heating and Housing



Concrete Corbels

- Headed Bars
- Purple epoxy coating
- Grade DM concrete



Pier Modifications



- Corbels will support flat jacks which will be inflated to 700 kips lock-off load.

Flat Jacks

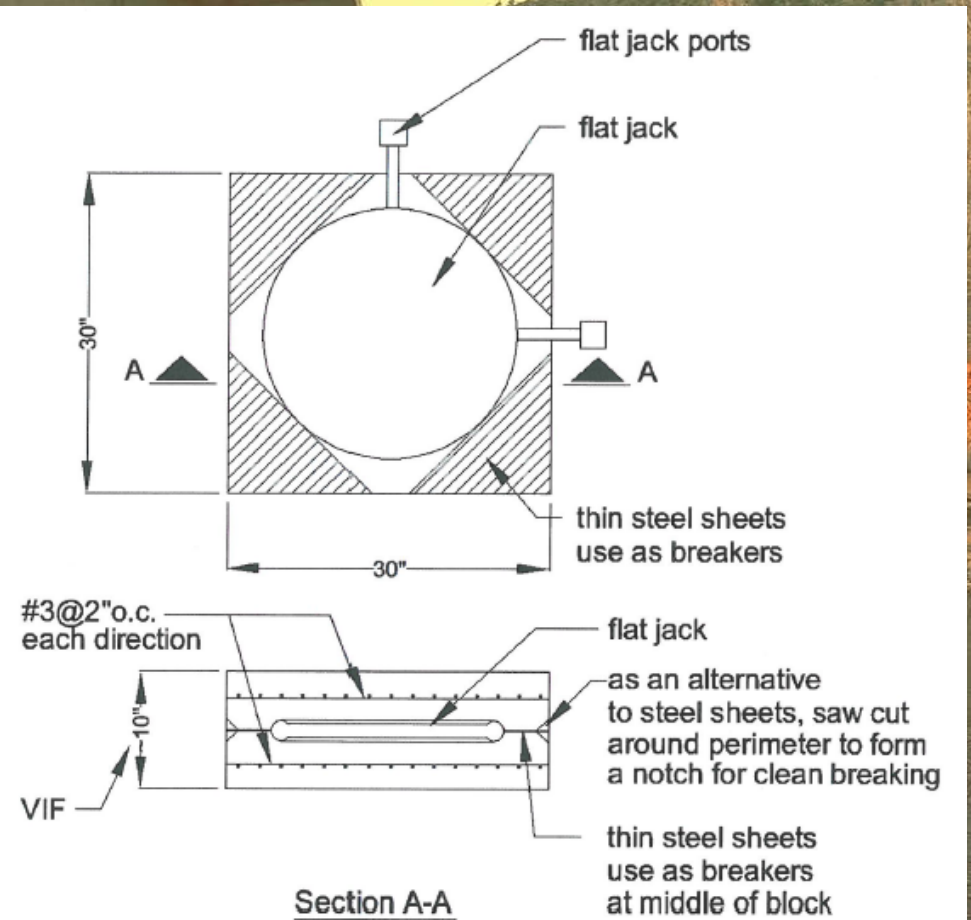


Fig.#2 - 600 mm Flat jack in concrete encasement block

Flat Jacks

- Precast 7000 psi concrete encasement
- 1/2" – 1" stroke
- Lock-off load of 700 kips
- Pumpable grout able to achieve 6000 psi within 48 hours.
- Fabric reinforced duck pads to be used in place of elastomeric pads to ensure no creep deformation results in a loss of bearing.

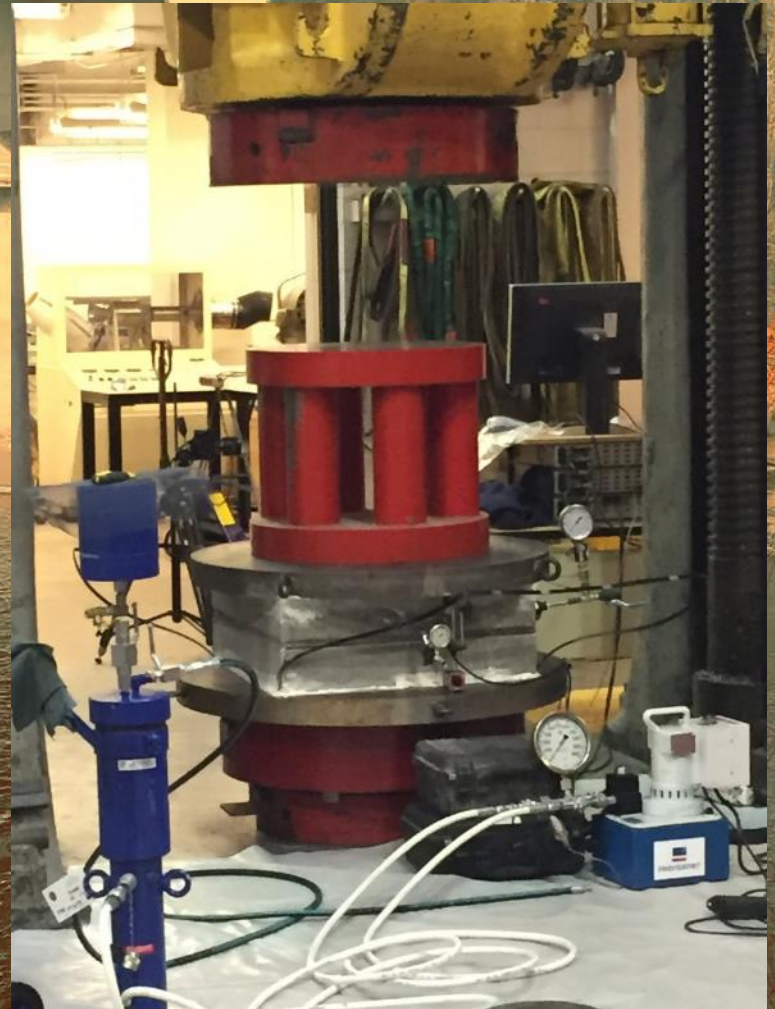
Flat Jacks Testing

- University of Illinois Urbana-Champaign
- 3 Million pound load frame
- Second largest in country

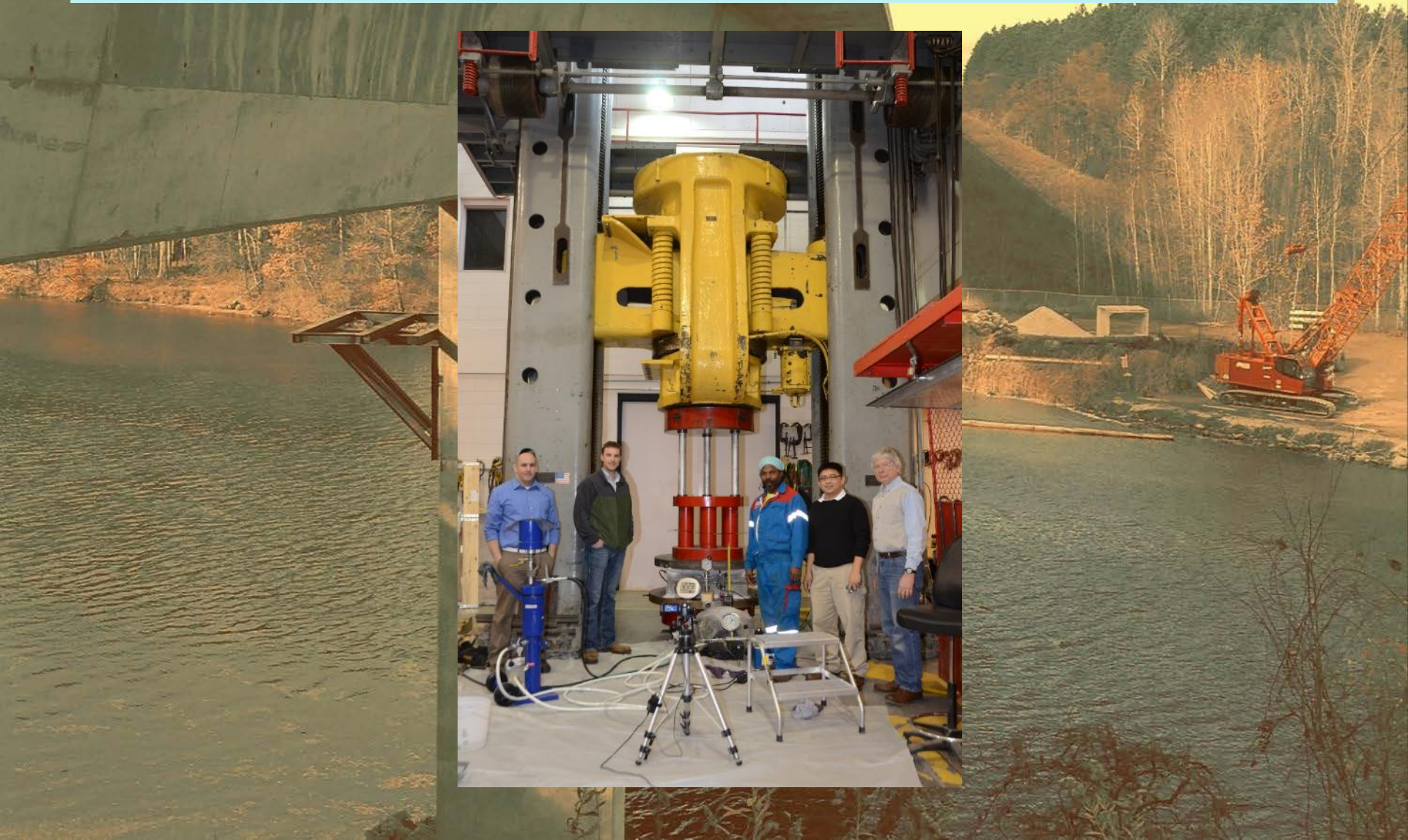


Flat Jack Testing

- Load to 350 kips, hold 5 minutes
- Load to 700 kips, hold 30 minutes
- Monitor pressures
- Lock-off and hold for 48 hours
 - Continual monitoring
- Ultimate load 2100 kips
- Cut test sample for inspection
- Jack calibration, gauge calibration



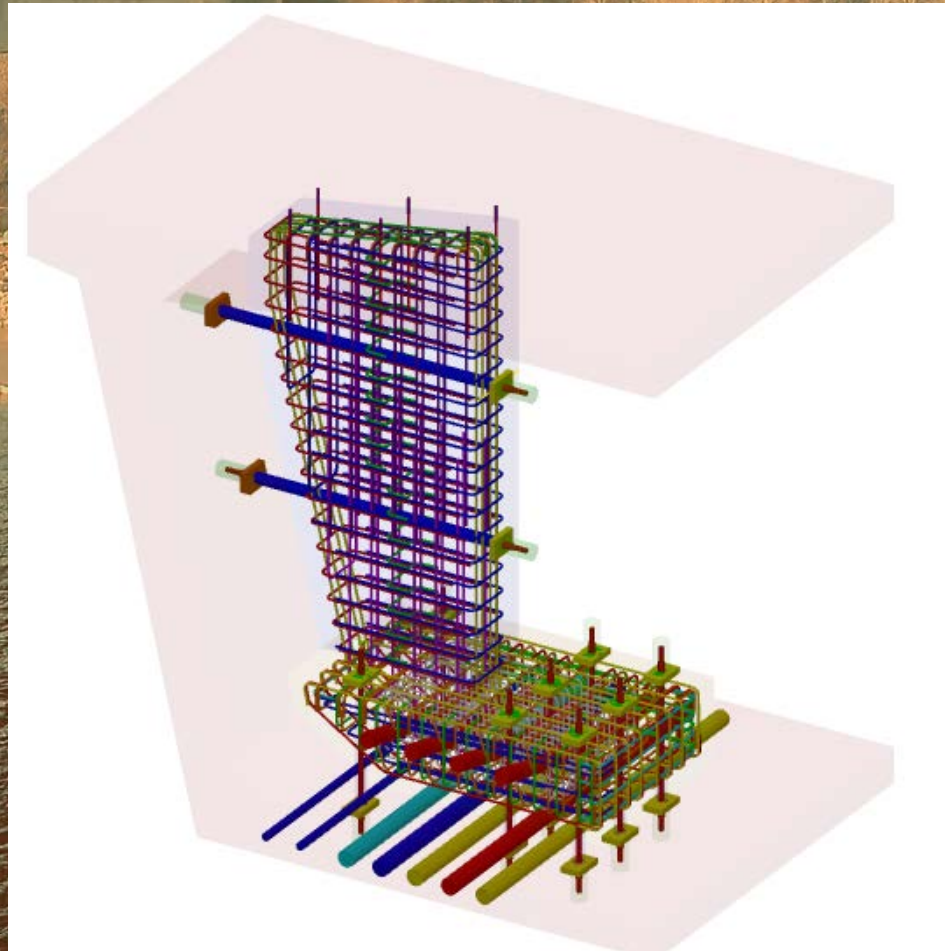
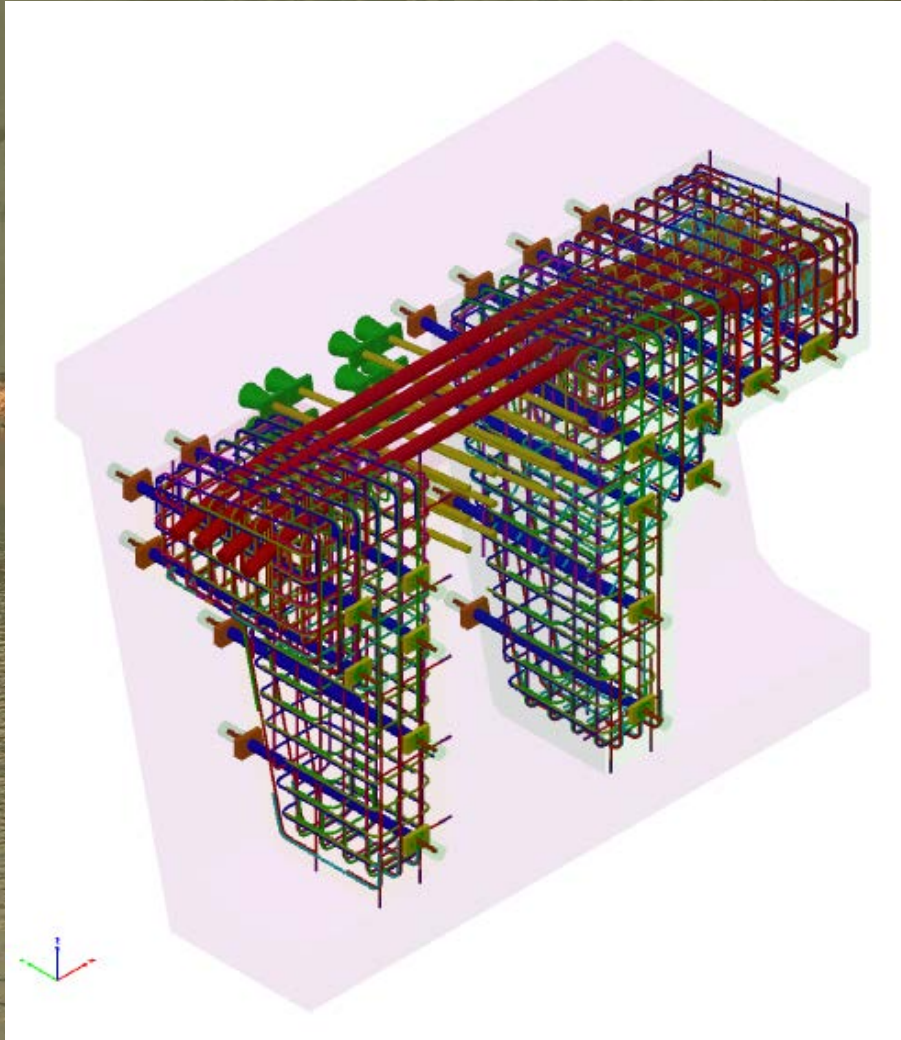
Flat Jack Testing



Corbels and Flat Jacks

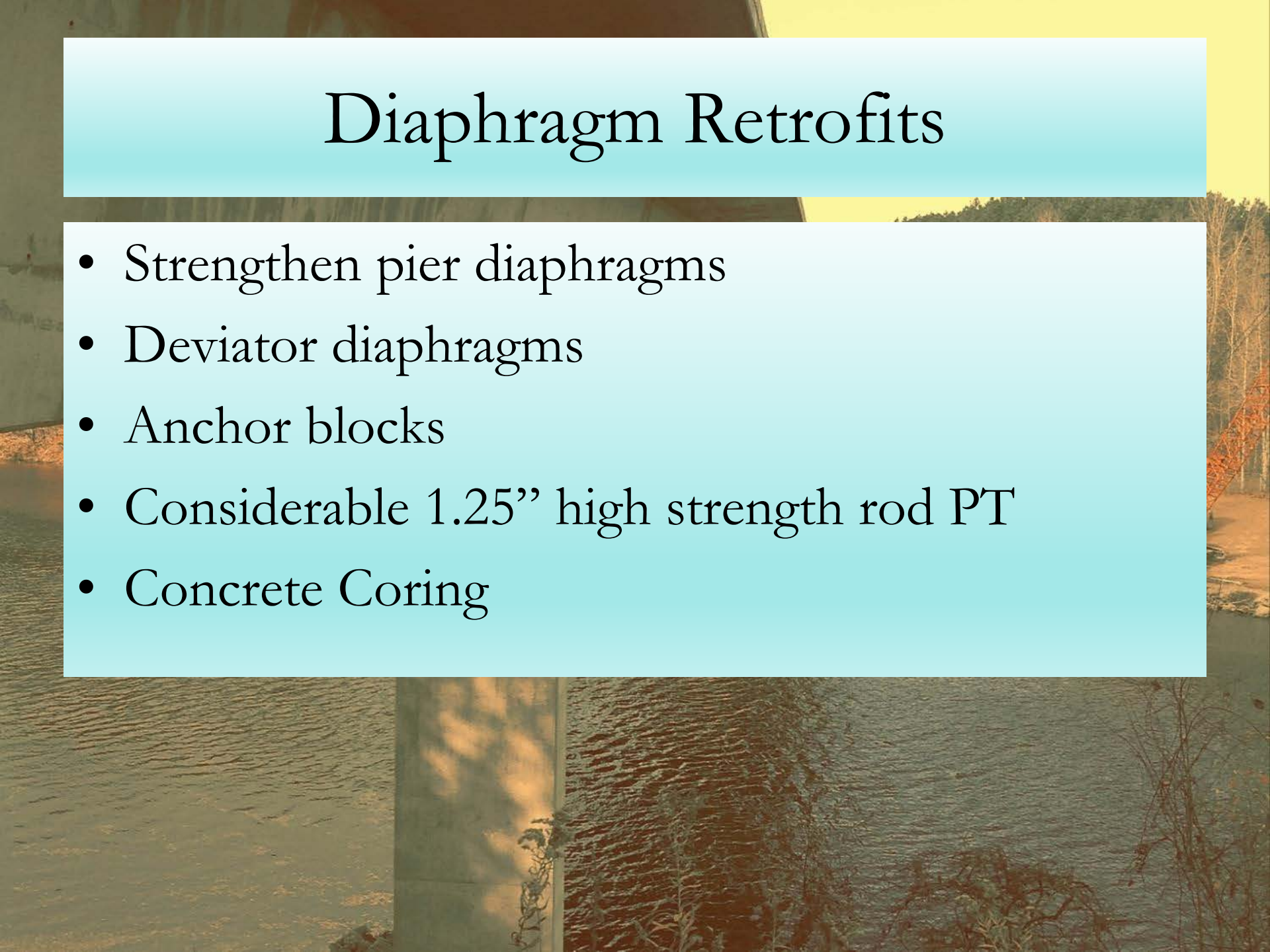
- The completed corbels will support the flat jacks under the box girder webs, including the pre-loading.
- Inflatable flat jacks will be permanently inflated with grout to a lock-off load of 700,000 pounds prior to any post tensioning taking place in the bridges.
- Jacking and grouting is required to be done without traffic live loadings, full freeway detours will be utilized.
- Once the grout is set up the bridges will be supported sufficiently to allow for the post-tensioning work to take place.

Diaphragm Retrofits

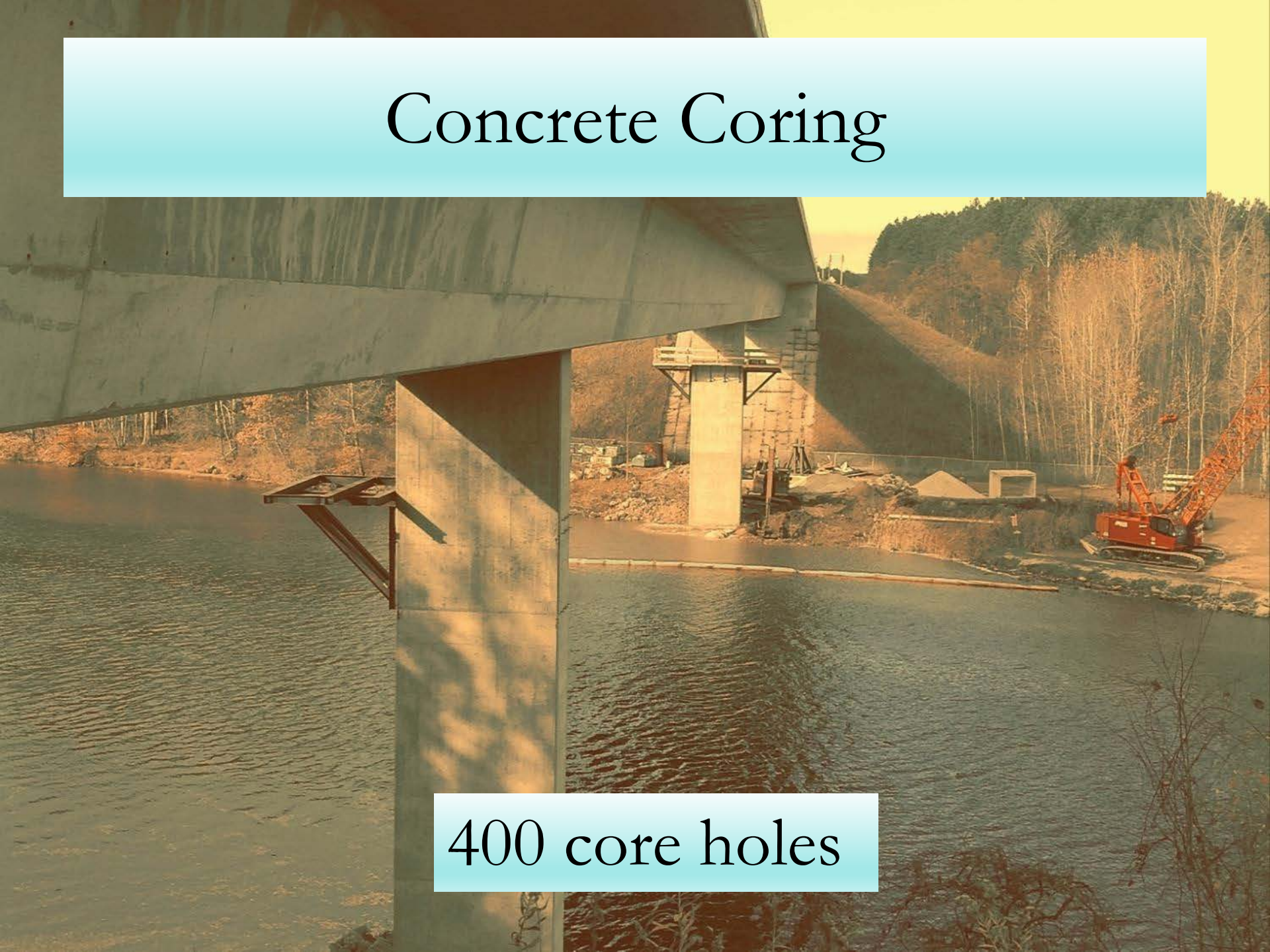


Diaphragm Retrofits

- Strengthen pier diaphragms
- Deviator diaphragms
- Anchor blocks
- Considerable 1.25" high strength rod PT
- Concrete Coring



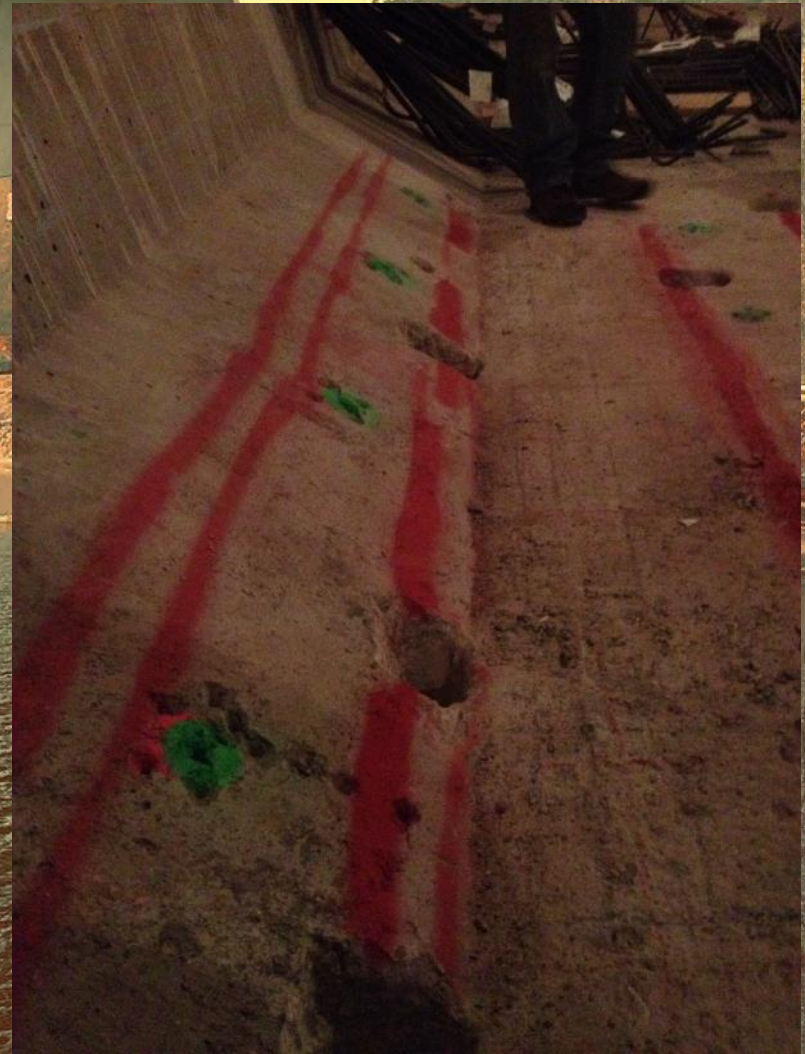
Concrete Coring



400 core holes

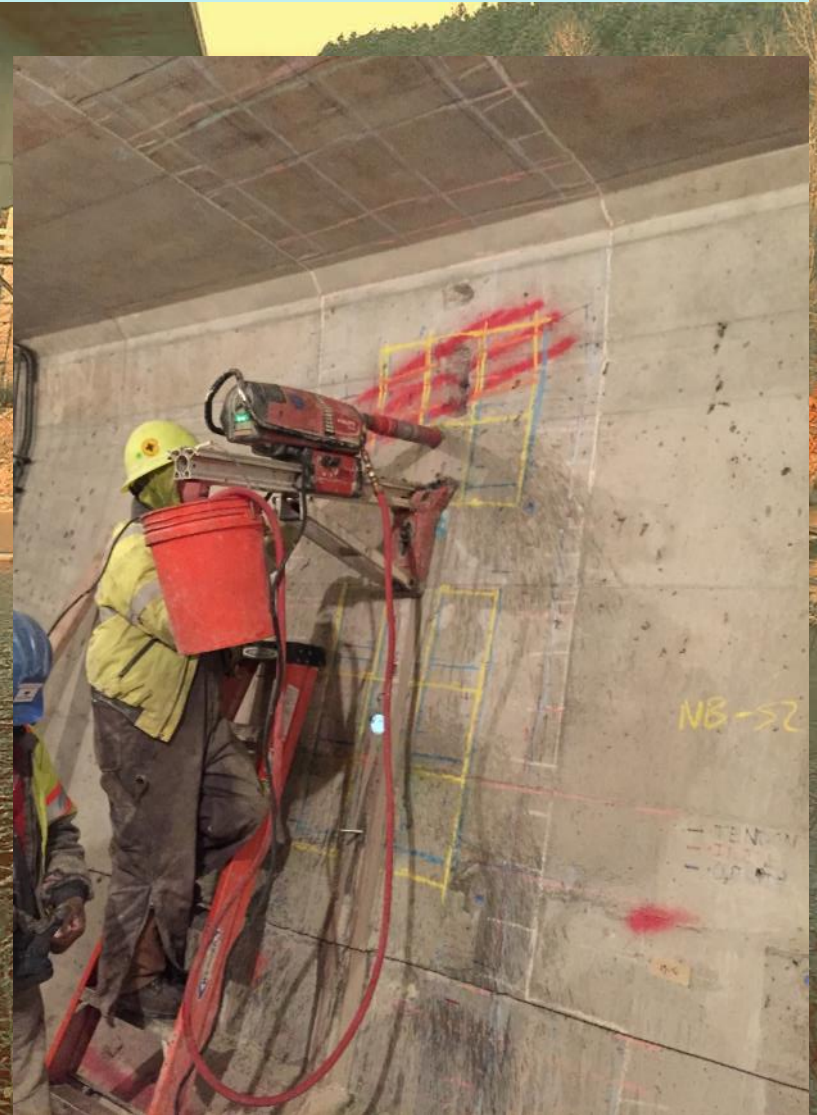
Concrete Coring

- Hand chipping to locate tendons
- 1/2" pilot holes to ID conflicts
- As-built
- 2.5" diameter core holes
- 2 tendon nicks



Concrete Coring

- Ground penetrating radar
- Hand chipping
- Careful coring
- Operator experience



Concrete Coring

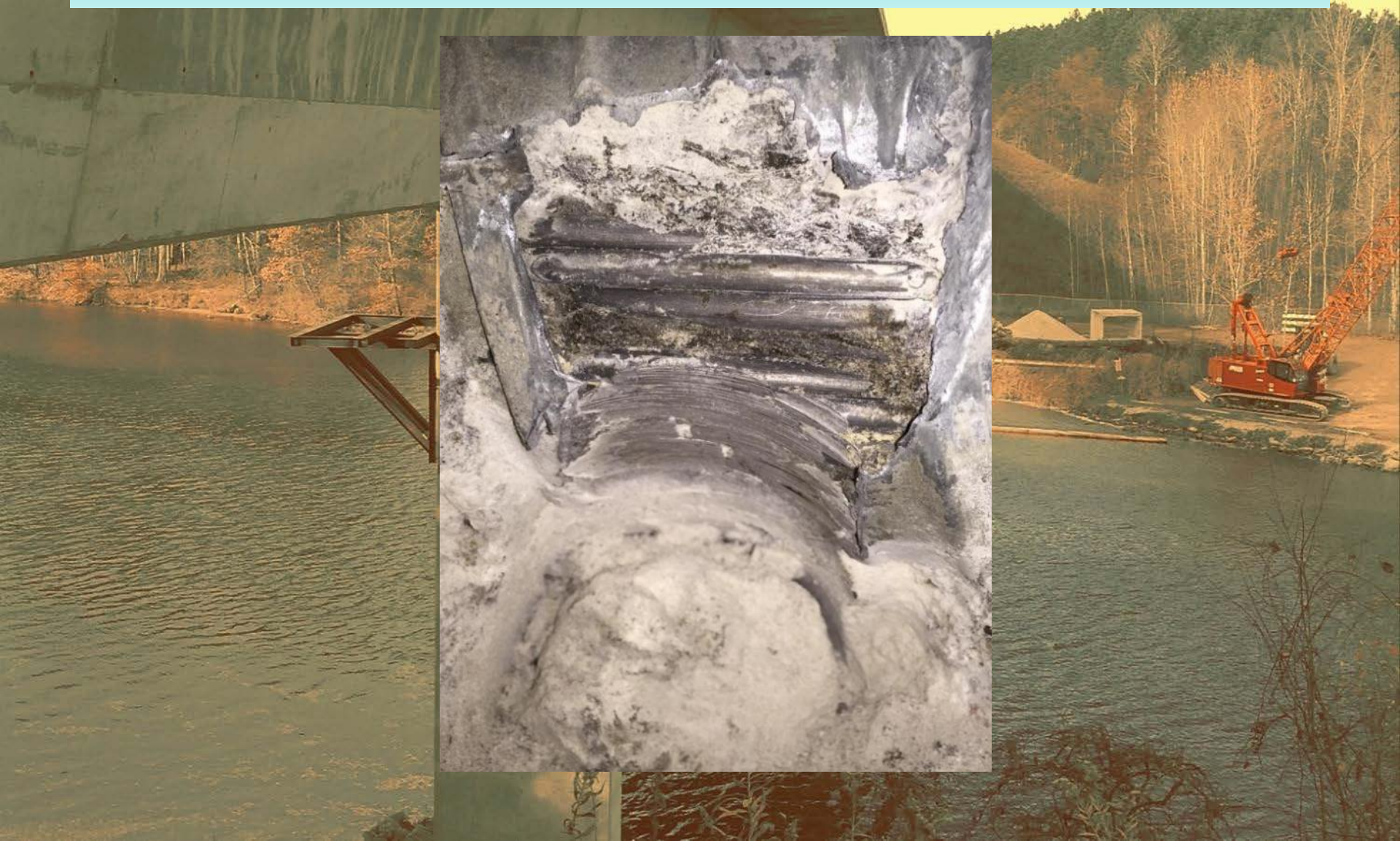
- Hammer drill damaged 2 wires during pilot hole exercises
- Existing tendons consist of 19 – 7 wire strands. (133-270ksi wires)
- Damage was below the allowable 2% per AASHTO spec.
- Prompted revised Exploratory Plan



Concrete Coring

- Second tendon nick (NB)
- Damage to 10 wires
- Prompted work stoppage and structural evaluation by AECOM
- Reevaluated Exploratory Plan
 - New GPR subcontractor
- Eliminated all Assumptions
- SB 100% successful

Concrete Coring



Concrete Coring and NDT Work

- Coring of existing diaphragms presents a challenge as they are four feet thick and GPR cannot penetrate to locate all existing steel.
- Due to concerns with cutting steel, order of operations is being modified to perform flat jack work prior to coring diaphragms. This will ensure the diaphragms are properly supported prior to cutting through any existing reinforcing steel.

External Post Tensioning

- Full length of the box
- Harped at the diaphragms
- Deviator diaphragms
- Anchor blocks (10' x 5')

External Post Tensioning

- Tendon size – 12 - .06” dia. Strands
 - 270 ksi low relaxation strands
- Spans 1-3 – 4 tendons, Span 2 – 8 tendons
- Stressed to 560 kips
 - Maintain approx. 450 kip load after anchor set
- Pressure grouting of ducts after stressing
 - Distances of 60’ at a height of 9’
 - Mock-up
- Full detour during PT work.

Articulating Concrete Block (ACB)

- The ACB work requires excavation around the piers and both hand placement and mattress placement of ACBs.
- Joints between mattresses that exceed 2” in width are to be grouted to protect the underlying geotextile material from UV degradation.
- On-site meeting was held with ACB manufacturer to determine practicality of work and come up with a plan for hand and mattress placements.

Articulating Concrete Block



Miscellaneous Work

- Approach replacements, deck patching, and anchor block replacement work were completed in the fall.
- Once the post-tensioning is completed a thin epoxy overlay will be placed on each deck
- Epoxy crack injection and concrete surface coating work will be performed.
- During construction it has been noticed that the existing diaphragms receive excessive condensation during cold night/warm day cycles.
- Consideration is being given to surface sealing the diaphragms as preventive maintenance.

Stakeholder Engagement

- Due to the full freeway detours, stakeholder engagement is a priority on this project to ensure the surrounding businesses and communities, including schools, are aware of the work and schedules.
- Freeway closure dates were restricted in the progress clause to coincide with FSU's calendar.
- Ice Mountain, a division of Nestle, has a plant on 8 Mile Road, which is to be utilized as part of the detour route. Multiple meetings have been held with their representatives to provide information and ensure impacts to their operations are as minimal as possible.

Questions?

