

Case Study: The Sarcee – Trans-Canada Highway Overpass Rehabilitation

Robbe Drugmand, M.Eng., E.I.T.
Design Engineer

March 15-17, 2017



2017 Spring Convention | March 15-17 | Montreal, Canada

Overview



- Background History & Information
- Client Expectations
- Preliminary Investigation
- Evaluation
- Rehabilitation



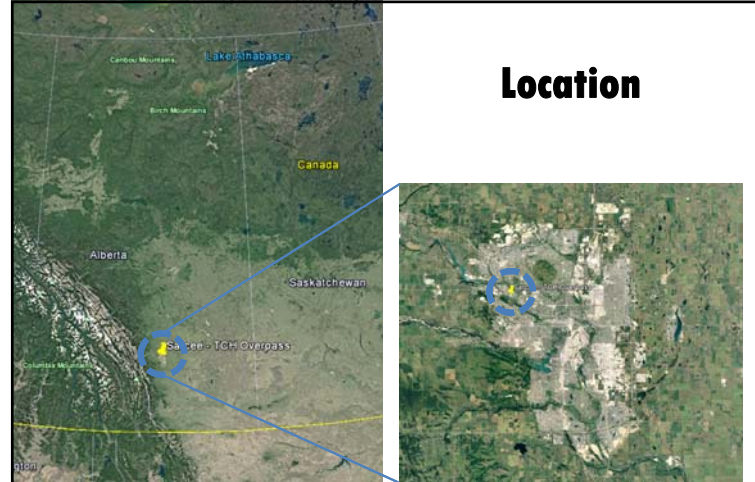
2017 Spring Convention | March 15-17 | Montreal, Canada

Location

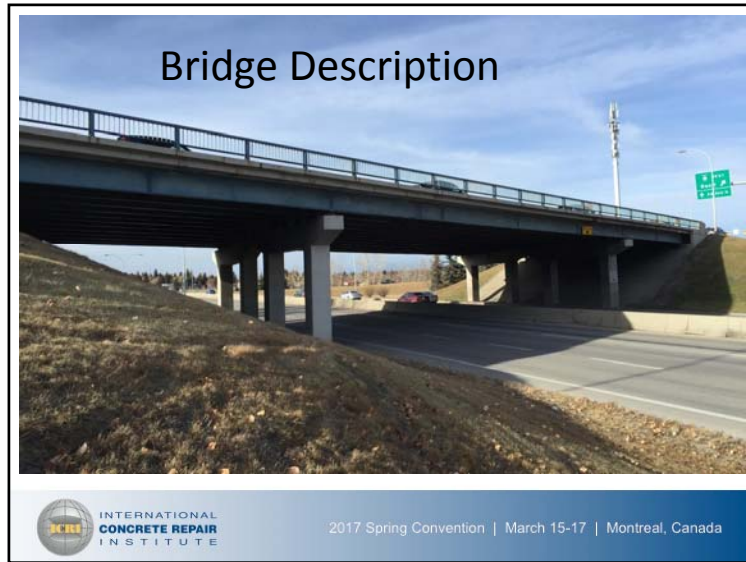


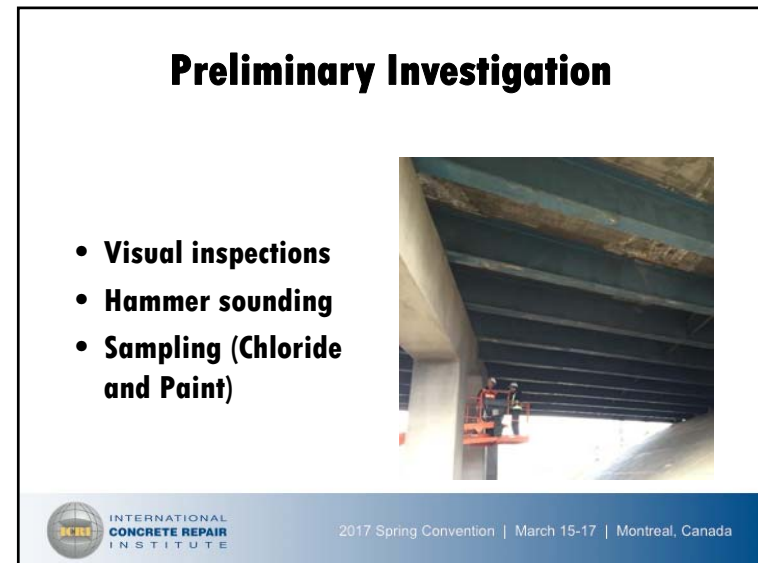
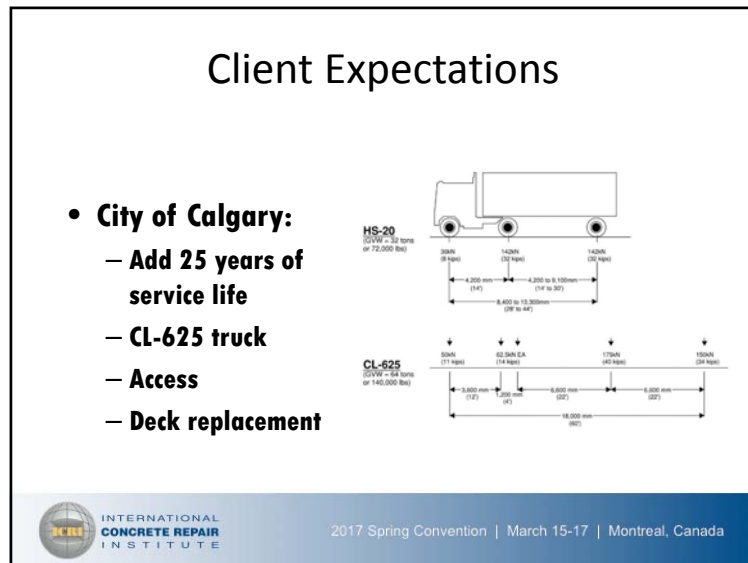
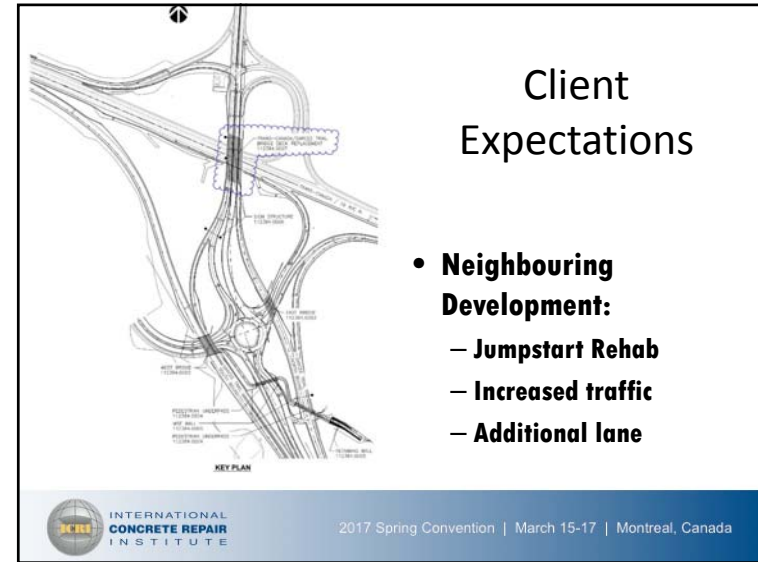
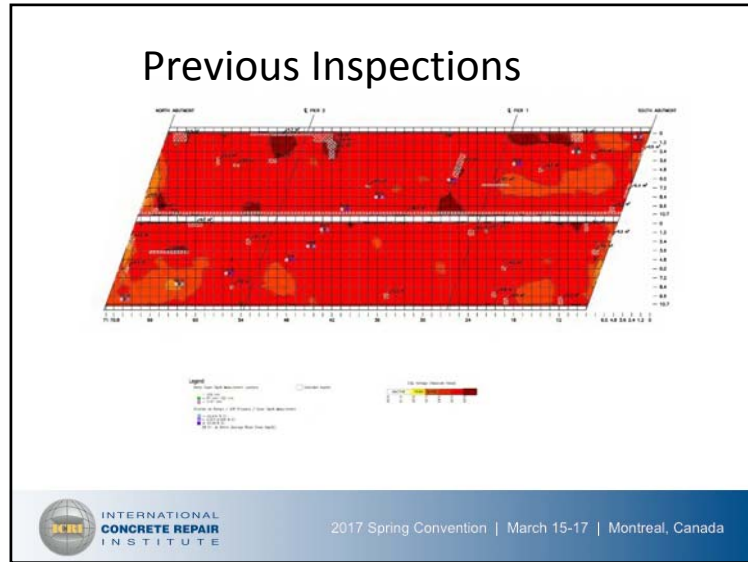
2017 Spring Convention | March 15-17 | Montreal, Canada

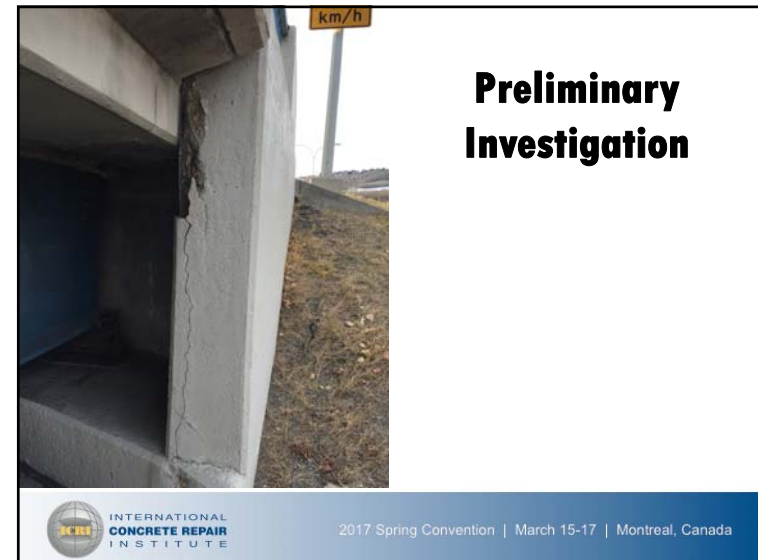
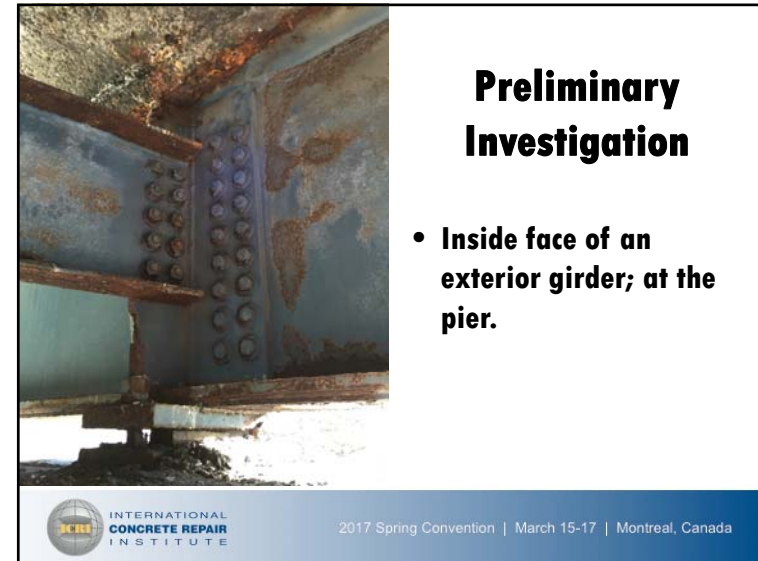
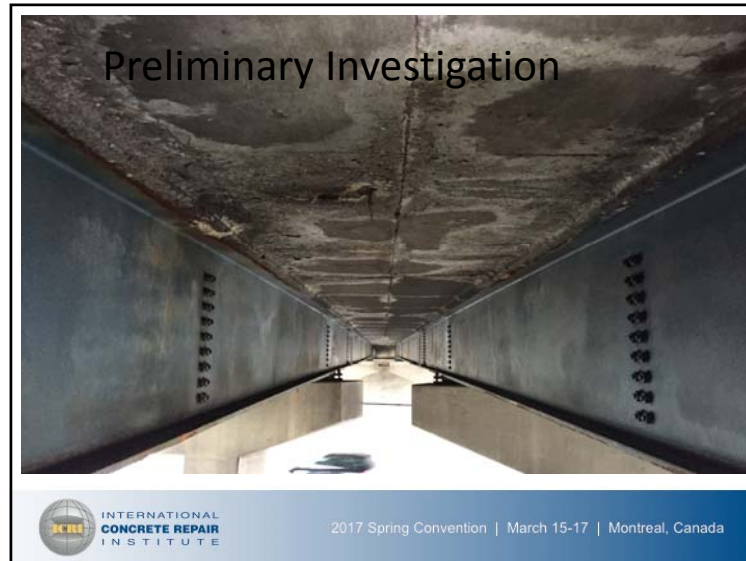
Location




2017 Spring Convention | March 15-17 | Montreal, Canada










Preliminary Investigation

INTERNATIONAL CONCRETE REPAIR INSTITUTE

2017 Spring Convention | March 15-17 | Montreal, Canada



Preliminary Investigation

INTERNATIONAL CONCRETE REPAIR INSTITUTE


2017 Spring Convention | March 15-17 | Montreal, Canada

Evaluation

- **CHBDC 2014 vs. AASHTO 1961**
- **Higher Loads:**
 - +40mm Asphalt
 - +50mm Concrete
 - Concrete Barriers
 - CI-625
- **5 lanes vs. 6**

INTERNATIONAL CONCRETE REPAIR INSTITUTE

2017 Spring Convention | March 15-17 | Montreal, Canada



Evaluation


- **As-built Drawings**


INTERNATIONAL CONCRETE REPAIR INSTITUTE

2017 Spring Convention | March 15-17 | Montreal, Canada

Evaluation

- **Looked at:**
 - Girders, Bearings, Piers, Piles, Abutments, ...
- **Did not consider:**
 - Bearings
 - Deck





INTERNATIONAL
CONCRETE REPAIR
INSTITUTE


2017 Spring Convention | March 15-17 | Montreal, Canada

Evaluation

- **The Live Load Capacity Factor** **14.15.2.1 General**

$$F = \frac{UR_r - \sum \alpha_D D - \sum \alpha_A A}{\alpha_L L (1+I)}$$

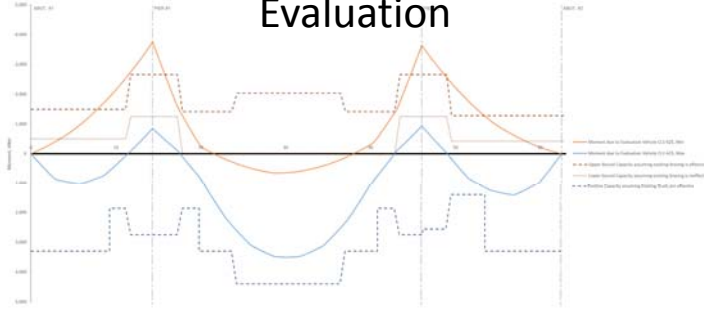
- **If less than 1.0, necessitates an upgrade.**



INTERNATIONAL
CONCRETE REPAIR
INSTITUTE


2017 Spring Convention | March 15-17 | Montreal, Canada

Evaluation



APPENDIX A: Moment Envelope for Evaluation Loads

- **Girders:**
 - **F varies between 0.5 and 1.4 for flexure**

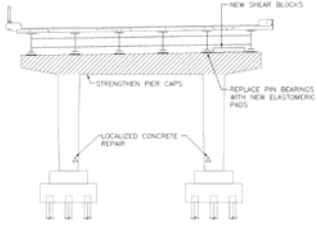



INTERNATIONAL
CONCRETE REPAIR
INSTITUTE

2017 Spring Convention | March 15-17 | Montreal, Canada

Evaluation

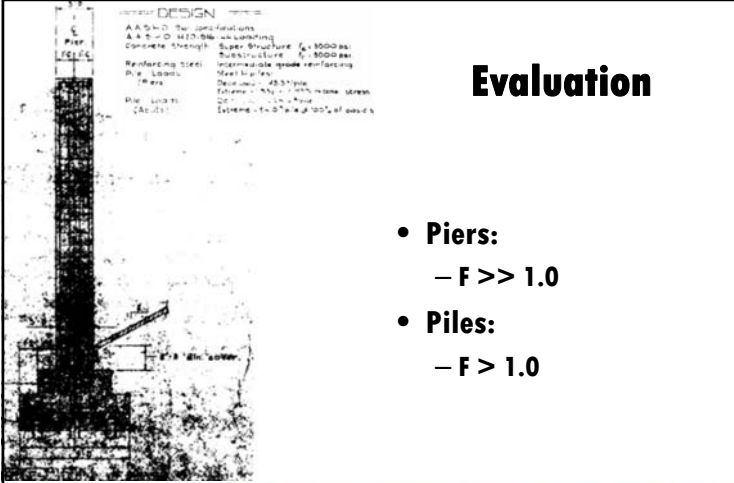
- **Pier Caps:**
 - **F as low as 0.6 in flexure and shear.**





INTERNATIONAL
CONCRETE REPAIR
INSTITUTE

2017 Spring Convention | March 15-17 | Montreal, Canada



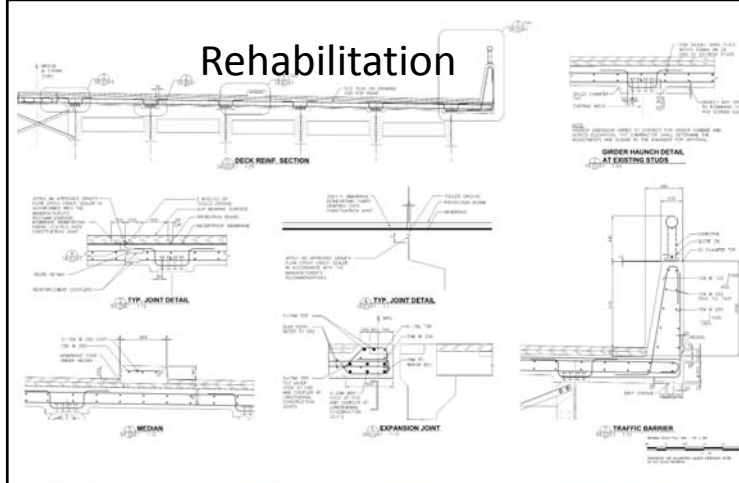
DESIGN

AA 5b-D 2nd approximation
 AASHTO 14(2) 90m span bridge
 Concrete through Super Structure $f_c = 3000$ psi
 Substructure $f_c = 3000$ psi
 Reinforcing steel: AASHTO 43.5% steel
 Max. Load: Extreme - 1.0 to 1.5% of design
 (AASHTO)

Evaluation

- **Piers:**
 - $F \gg 1.0$
- **Piles:**
 - $F > 1.0$

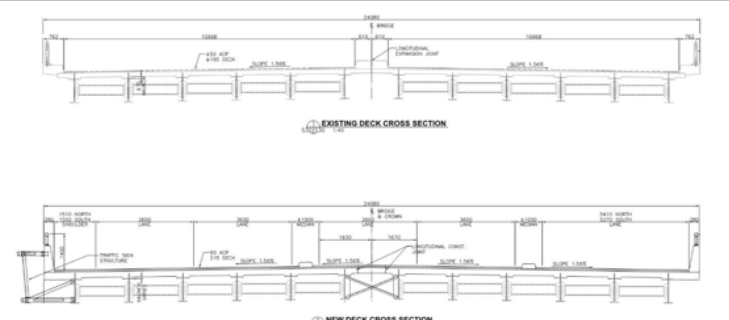
INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada



Rehabilitation

DECK REINF. SECTION
 GIRDER HAUNCH DETAIL AT EXISTING STUDS
 TYP. JOINT DETAIL
 MEDIAN
 EXPANSION JOINT
 TRAFFIC BARRIER

INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada

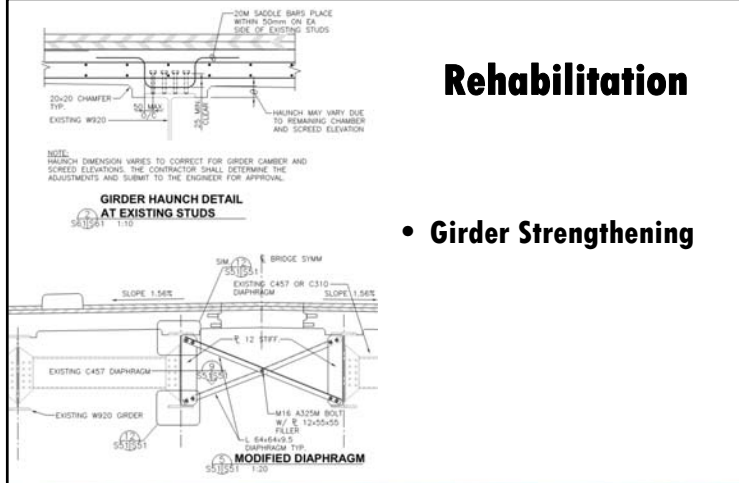


EXISTING DECK CROSS SECTION
 NEW DECK CROSS SECTION

Rehabilitation

- **Deck Replacement:**
 - Thickness
 - Design Life
 - Joints

INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada

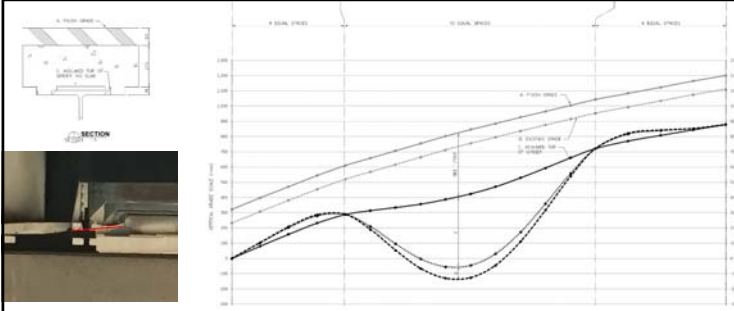


Rehabilitation

- **Girder Strengthening**


20M SADDLE BARS PLACE WITHIN 500MM ON EA. SIDE OF EXISTING STUDS
 20-20 CHAMFER TYP.
 EXISTING #20
 HAUNCH MAY VARY DUE TO REMAINING CHAMFER AND SKEED ELEVATION
 NOTE: HAUNCH DIMENSION VARIES TO CORRECT FOR GIRDER CAMBER AND SKEED ELEVATIONS. THE CONTRACTOR SHALL DETERMINE THE ADJUSTMENTS AND SUBMIT TO THE ENGINEER FOR APPROVAL.
 GIRDER HAUNCH DETAIL AT EXISTING STUDS
 BRIDGE SWM
 EXISTING C457 OR C310 DIAPHRAGM
 SLOPE 1.54%
 EXISTING C457 DIAPHRAGM
 EXISTING W20 GIRDER
 M16 A320M BOLT W/ E-12-00450 FILLER
 L SAUSAGE'S DIAPHRAGM TYP.
 MODIFIED DIAPHRAGM

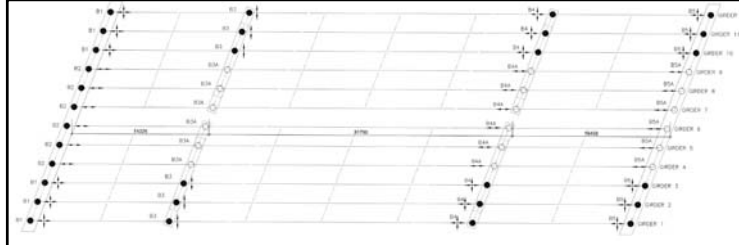
INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada



Rehabilitation


- **Haunch the Deck**


 INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada



Rehabilitation


- **Bearings:**
 - Replacement of neoprene (12)
 - Make-good of 40% of bearings (18)
 - Replacement for additional translation (18)

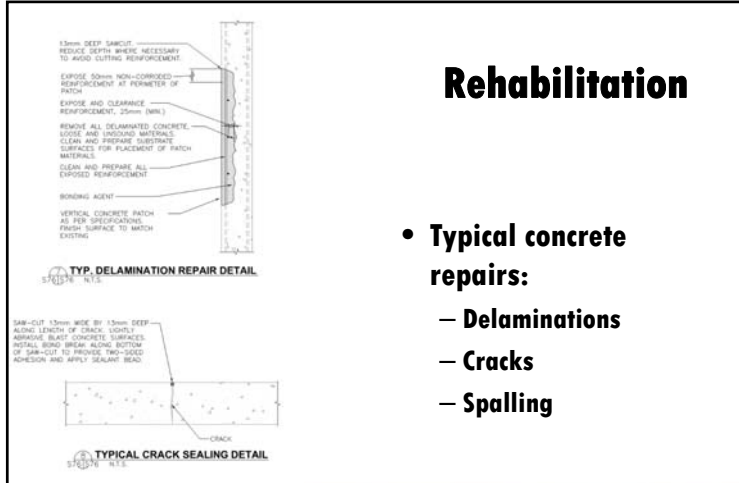
 INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada



Rehabilitation


- **Piers**
 - CFRP wrap and strips

 INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada



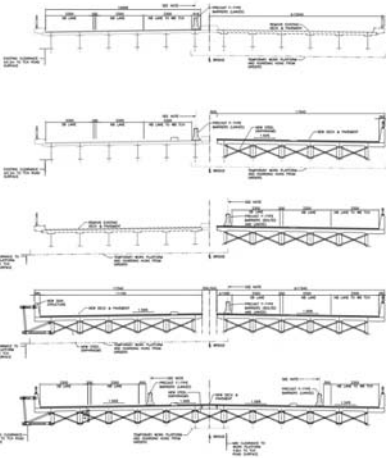
Rehabilitation


- **Typical concrete repairs:**
 - Delaminations
 - Cracks
 - Spalling

 INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada

Rehabilitation

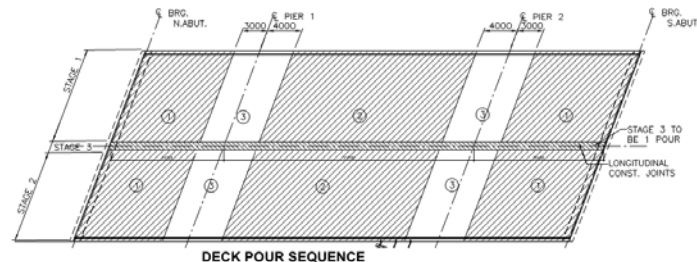
- Construction Staging




 INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada

Rehabilitation

- 3 Pours per construction stage





 INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada

Thank You

QUESTIONS?

Robbe Drugmand, M.Eng., E.I.T.
Design Engineer
 March 15-17, 2017

 Creative Thinking Practical Results
 INTERNATIONAL CONCRETE REPAIR INSTITUTE
 2017 Spring Convention | March 15-17 | Montreal, Canada