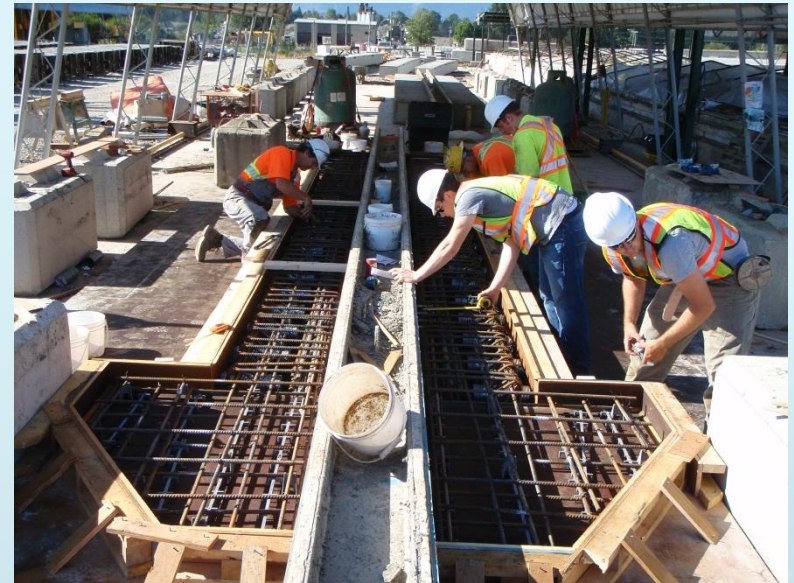


Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) In-Plant Bridge & Cattleguard Inspection Services



Ministry of Forests, Lands and Natural Resource Operations
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Quality Assurance - History

History of QA for Ministry of Forests (Lands, and Natural Resource Operations):

- Prior to 1982 -> Own Forces / Glulam
- 1982 – 1988 -> Steel Introduced
- 1988 – 1997 -> MoT In-Plant Inspectors
- 1997– 2002 -> Shared MoT/Private
- 2002 – present -> Privatized

Quality Assurance - History

Prior to 1982 – Own Forces / Glulam

- Glued-laminated structures
 - Intermittent in-plant inspections by MoF
 - Numerous problems with members not inspected, most requiring replacement before design life reached
 - Attempt by industry to introduce QC

Quality Assurance - History

1982 – 1988 –> Steel Introduced

- Steel girders introduced
- Minimal quality control
- Inspection assumed to be performed by Designer
- Problems encountered:
 - Inaccurate and poor quality fabrication
 - Variation in steel quality
- Premature cost of replacement of bridge structures

Quality Assurance - History

1988 – 1997 – >MoT In-Plant Inspectors

- Standards and specifications for design, materials & fabrication introduced
- Precast concrete components introduced
- MoT in-plant inspectors performed quality assurance based out of Lower Mainland
- Quality assurance concept superceded inspection

Quality Assurance - History

1997 – 2002 –> Shared MoT/Private

- MoT beginning to be unable to service MoF due to attrition
- MoT travelled from lower mainland
- Shared responsibility for quality assurance between MoT & private industry (competitive process)
- Reid Crowther / Sargent & Associates provided local presence

2002 – Present –> Privatized

- Privatized (Both MoT & MoF)
- Competitive process
- Sargent & Associates

Objectives of Quality Assurance Program

1. Quality in Conformance with Contract Documents
2. Consistency of Fabrication
3. Reliance by Engineer of Record
4. Efficiency
5. Fabricator's Perspective

1. Quality in Conformance with Contract Documents

- ▶ Quality Control (QC) v. Quality Assurance (QA)
- ▶ MFLNRO Requirements for Fabrication
- ▶ Reasons for Quality Assurance
- ▶ Example Deficiencies

Quality Control vs Quality Assurance

Quality Control:

- ▶ Manufacturer's documented system to ensure product meets the project requirements

Quality Assurance:

- ▶ Independent verification by the Owner's rep that product meets the project requirements – usually spot checks

MFLNRO Requirements

- i. Previous Fabrication Experience Requirements
- ii. Fabricator Certification:
 - Steel Structures:
 - Fusion Welding of Steel(CSA Standard W47.1)
 - Precast Concrete Structures:
 - Precast Concrete – Materials and Construction CSA Standard A23.4

i) Previous Fabrication Experience

MFLNRO Bridge Material Standard Template Language:

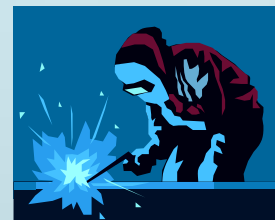
- ▶ Bidders, as identified in their quote, must satisfy one of the following requirements:
 - *The bidder has successfully designed (or retained a qualified engineer to design), fabricated, supplied and delivered on-time and otherwise satisfactorily fulfilled all terms of contracts for at least 5 bridges, similar in size, scope and complexity to those specified in this document, within the past 2 years and, at the request of the ministry, be able to provide proof* of such performance;*
 - OR
 - *The bidder has not successfully designed (or retained a qualified engineer to design), fabricated, supplied and delivered on-time, at least 5 bridges, similar in size, scope and complexity to those specified in this document, within the past 2 years, but can provide proof* that they are capable of performing this project within the time limits and requirements specified in this document.*
- ▶ Steel fabricator to have a QC Program in accordance with CSA W47.1 and W59

ii) Fabricator Certification Steel Structures



CWB (Canadian Welding Bureau) Certification:

- ▶ Certifies a fabricator meets the requirements of CSA Standard W47.1 – Fusion Welding of Steel
 - Division 1: In-house Welding Engineer
 - Division 2: Retained Welding Engineer (Revised in 2003)
 - Division 3: No Welding Engineer (Misc. Steel Only)
- ▶ In-house welding supervisors



ii) Fabricator Certification Steel Structures

CWB Scope:

- ▶ Initial certification
- ▶ Semi-annual audits of a fabricator's plant – usually lasts 2–3 hours
- ▶ Approve weld procedures
- ▶ Test welders – issue Welder's Tickets
- ▶ Spot-check of weld quality & consumables during audit



ii) Fabricator Certification Steel Structures

Limitations of CWB Certification:



- ▶ It is not a requirement of CSA W47.1 for the fabricator to have a QC program
- ▶ Retained / employed Welding Engineer reports to the Company – no independence
- ▶ CWB is concerned only with welding. Fabrication fit-up, etc. is not covered
- ▶ Very unlikely that any particular MoF project will be part of any CWB audit
- ▶ CWB assumes no responsibility for either a certified company's QC methods or a purchaser's inspection program

ii) Fabricator Certification Steel Structures

List of Certified Fabricators for Steel who Currently Manufacture MFLNRO Bridge Components

- ▶ Rapid-Span Structures Ltd. (Div. 1)
- ▶ Rapid-Span Bridges Inc. (Div. 1)
- ▶ Surespan Structures Ltd. (Div. 2)
- ▶ Pacific Industrial & Marine Ltd. (Div. 2)
- ▶ Magnum Fabricators Ltd. (Div. 2)
- ▶ Alpha Welding (Div. 3)
- ▶ Majestic Bridge Building Inc. (Div. 2)
- ▶ Stinger Welding Ltd. (Div. 2)
- ▶ Beamac Installations Ltd. (Div. 2)
- ▶ Marcon Metalfab Inc. (Div. 2)
- ▶ LE Steel Fabricators Ltd. (Div. 2)
- ▶ APT Industries Ltd. (Div. 3)
- ▶ Specialty Machine Works Ltd. (Div. 2)

ii) Fabricator Certification Precast Concrete



Canadian Standards Association:

- ▶ Certifies that a precast concrete manufacturer meets the requirements of CSA Standard A23.4 – Precast Concrete – Materials & Construction
- ▶ Fabricator must have a documented QC system
- ▶ (Historical Anecdote)



ii) Fabricator Certification Precast Concrete



CSA Scope:

- ▶ Quarterly audits of a pre-caster's plant
 - usually lasts 4–6 hours
- ▶ Audits QC documentation
- ▶ Audit material test reports (aggregates, cement, etc.)
- ▶ Spot-check pre-casting practices
- ▶ Mostly a “paper audit”

ii) Fabricator Certification Precast Concrete

CSA Limitations:

- ▶ Standards Council of Canada (SCC) has authority to accredit certifying agencies
- ▶ CSA accredited by SCC
- ▶ Recent lack of performance by CSA
- ▶ Introduction of CPCI
- ▶ Unlikely any particular MFLNRO project will be part of audit
- ▶ Fabricator QC program can be heavily influenced by production

ii) Fabricator Certification

Precast Concrete

List of Certified Fabricators for Precast Concrete who Currently Manufacture MFLNRO Bridge Components

CSA Certified Plants

- ▶ Rapid-Span Precast Ltd.
- ▶ Surespan Structures Ltd.
- ▶ Pioneer Precast Ltd.
- ▶ Lockwood Bros Concrete Products
- ▶ Armtec/Con-Force Structures Ltd.
- ▶ MSE Precast Ltd.
- ▶ APS Architectural Precast Structures Ltd.

CPCI Certified Plants

- ▶ Surespan Structures Ltd.
- ▶ Lockwood Bros Concrete Products (Pending)
- ▶ Armtec/Con-Force Structures Ltd.
- ▶ MSE Precast Ltd.
- ▶ APS Architectural Precast Structures Ltd.

Reason for Independent Quality Assurance (QA)

- ▶ “CWB” & CSA certification is essentially an “honour system”. Neither organization will certify a specific product meets project requirements
- ▶ Fabricators QC program can be heavily influenced by production. Only way to ensure unscrupulous manufacturers do not “cut corners” on quality
- ▶ Provides consistency of fabrication across the Province
- ▶ Due Diligence and risk management on behalf of the Ministry
- ▶ Reliance on QA by Engineer of Record

Quality Assurance

- ▶ Construction projects have a 1 year warranty period. MFLNRO implemented requirement of 1 year warranty for direct purchases.
- ▶ Many manufacturing defects may not show up for a number of years.

Quality Assurance Checklist Forms

- ▶ Structural Steel
- ▶ Precast Concrete

Common Deficiencies

Steel Fabrication:

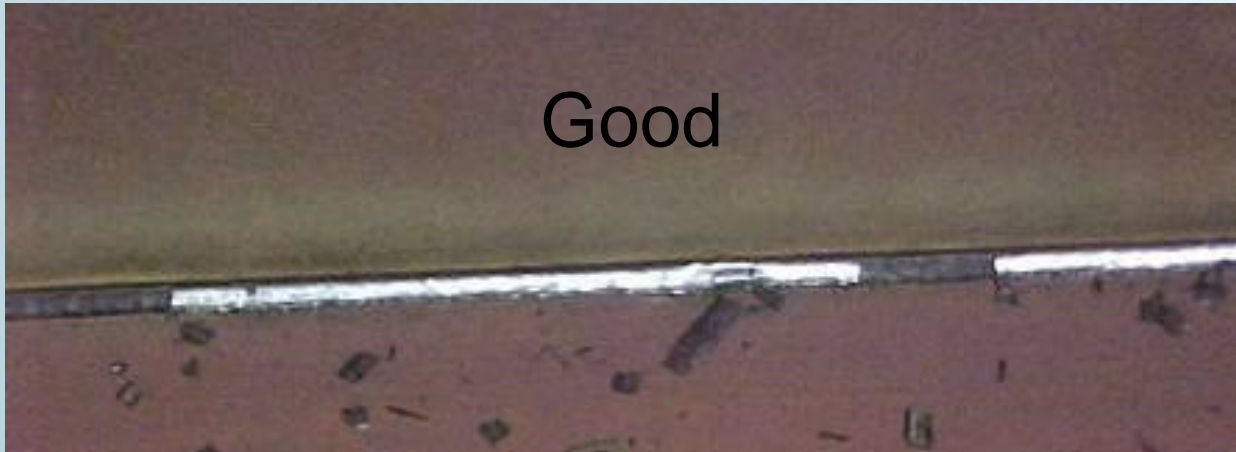
- ▶ Fabrication not in conformance with approved design drawings and specifications
- ▶ Material not as specified
- ▶ Incorrect selection of consumables
- ▶ Welder qualifications (expired or no ticket)
- ▶ Fabrication exceeds fit-up and dimensional tolerances
- ▶ No welding procedures; failure to follow
- ▶ Stress raisers in fracture critical members
- ▶ Weld defects (size, profile, porosity, workmanship)
- ▶ Inappropriate heating or bending of plate

Example Deficiencies – Steel

Poor (gaps, bad profile, spatter)



Good



Example Deficiencies– Steel



Weld slag and spatter on
base plate connection

Example Deficiencies– Steel



Incomplete weld on guardrail post

Example Deficiencies– Steel



Underfilled weld joint

Example Deficiencies– Steel



Undersized weld on a
cattle guard

Example Deficiencies– Steel



Galvanizing starting to flake off

Example Deficiencies– Steel



Overheating flange to straighten

Example Deficiencies– Steel



Faulty stud repairs

Example Deficiencies– Steel



Incorrect diaphragm
material being metalized

Example Deficiencies– Steel



All steel portable



Slot in web which would have gone undetected

Common Deficiencies

Precast Concrete:

- ▶ Improperly located / inadequate reinforcing
- ▶ Poor forming (dimensions, cleanliness)
- ▶ Missing, improperly located and incorrect inserts / hardware
- ▶ Inadequate concrete cover
- ▶ Concrete not meeting specifications
- ▶ Poor consolidation (honeycomb, voids)
- ▶ Poor finishing (surface defects)
- ▶ Premature shipping (insufficient strength)

Example Deficiencies – Concrete



Slab girder voids

Example Deficiencies– Concrete



Broken deck panel corner

Example Deficiencies– Concrete



Shrinkage Cracks

Example Deficiencies– Concrete



Improper hardware
casting

Example Deficiencies– Concrete

Proper Repair Procedure Implementation



Example Deficiencies– Concrete

Appropriate repairs
being implemented in
the field



Example Deficiencies

- ▶ Random sampling of results from approximately 20% of the past year's fabrication

Examples of Reliance on MFLNRO Backup Support

- ▶ 3 Steel Portable Bridges – Coast Region
- ▶ Steel Plate Girders – Northern Region
- ▶ Field Repair of Precast Bridge – Southern Region
- ▶ Field Repair of Precast on Steel Girder – Southern Region

Heat
discolouration
on splice



Multiple fabrication
issues
(3 Steel Portable
Bridges)

2. Consistency of Fabrication

- ▶ Comments from Program Initiation to date
- ▶ Comments from cattleguard experience
- ▶ Self-policing by fabricators

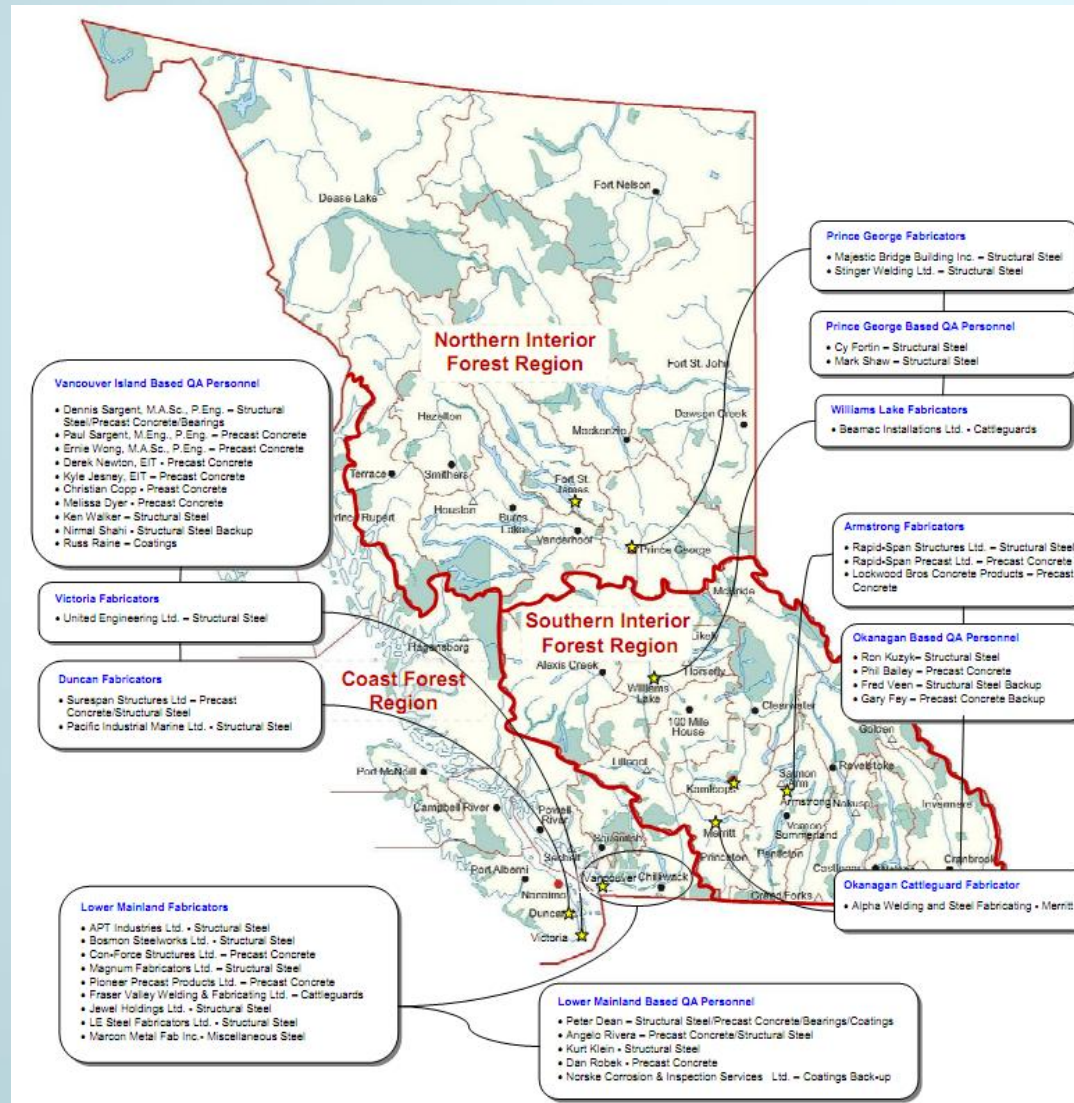
3. Engineer of Record

- ▶ Responsibility
- ▶ Experience with Fabrication
- ▶ Bridge fabrication quality control/quality assurance is a specialized field requiring unique training, knowledge, experience and specialized equipment
- ▶ Practicality of Timely Response and Access During Fabrication
- ▶ Reliance on Quality Assurance Program

4. Efficiency

- ▶ Strategic location of Experienced Quality Assurance Personnel
- ▶ Central Location for coordination
- ▶ Combine MFLNRO QA with Other Transportation Authorities

Staff Location Relative to Fabricators





MFLNRO Policy

All pre-fabricated bridge components for Ministry of Forest bridges shall be inspected in the plant by a ministry-appointed inspector. No work shall leave the plant until the inspector has declared the materials were produced in accordance with the approved designs and drawings

—Forest Service Bridge Design and Construction Manual

5. Fabricator's Perspective

- ▶ Independent inspection is cost-effective insurance to ensure good value to the Province
- ▶ From a fabricator's perspective, it assures a “*level playing field*” during the bid process
- ▶ Extra “set of eyes” can be an advantage to the manufacturer

CHBDC General Quality Requirements

C1.4.4.6 Quality Control and Assurance

- ▶ The provisions of the Code have been formulated and calibrated on the assumption that high standards of construction will be adhered to
- ▶ High standards of construction require that only competent and conscientious Constructors be entrusted with the work



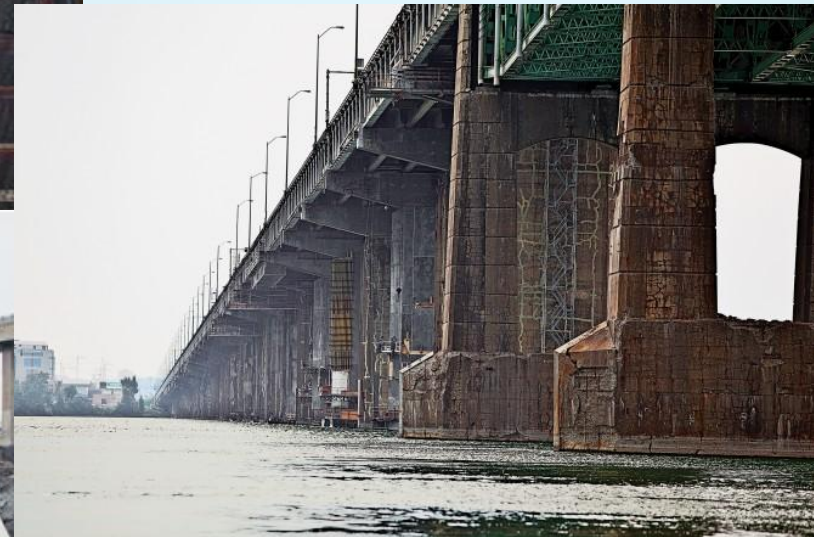
“Montreal is Falling Down”

Maclean's Magazine – August 23, 2011



“Our problem is we built most of the facilities in the '60s and '70s, and built them in a hurry. The result is that the quality control was not there.”

Prof. Saeed Mirza, McGill University



5 Killed, 6 Injured



De la Concorde, Montreal, Constructed 1970, Collapsed 2006

“You can argue, debate and twist and turn about all the factors, but the main cause of the collapse was the misplaced reinforcements . Period.”

Georges Archer, former president of the CSCE.

Peace Bridge, Calgary



“The city hired an independent company here to spot check welds completed in Spain. The company determined some of the welds do not comply”

***Mac Logan, City of Calgary
Transportation General
Manager***



