

Application of NDT in Fatigue Assessment of Steel Bridges

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Fern Hollow Bridge, Pittsburgh, Pennsylvania



1973 - January 28, 2022

Images of the early investigation done by NTSB



National Transportation Safety Board

Severe corrosion!

Google map images- December 2020



Columns were severely corroded!

Google map images- December 2020



Looking West



Looking East

Google map images- December 2020



2015



2018



2020



2022

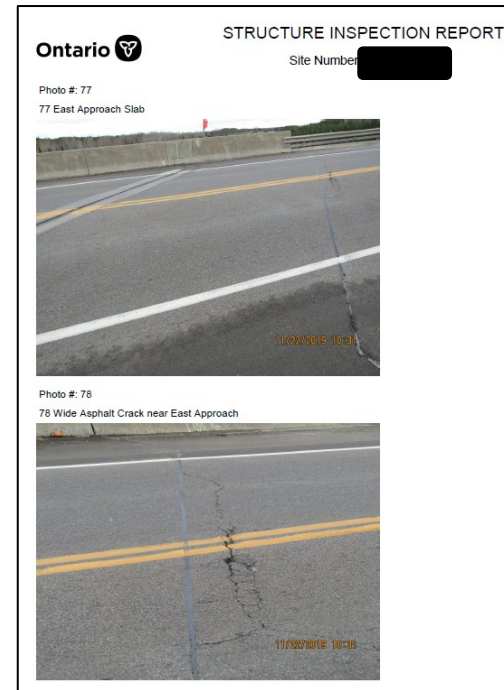
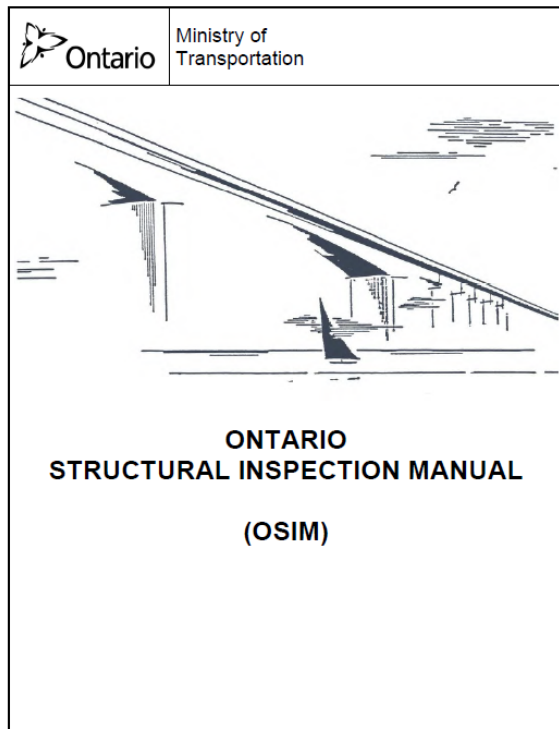
Deterioration of the bridge!

Is there any lesson we can learn?



Fern Hollow Bridge, January 28, 2022

Bridge management in Ontario

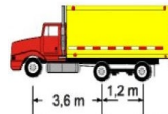
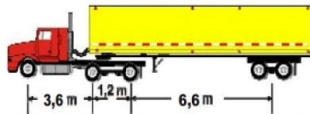
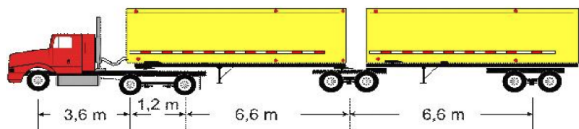


OSIM inspection every 2 years.

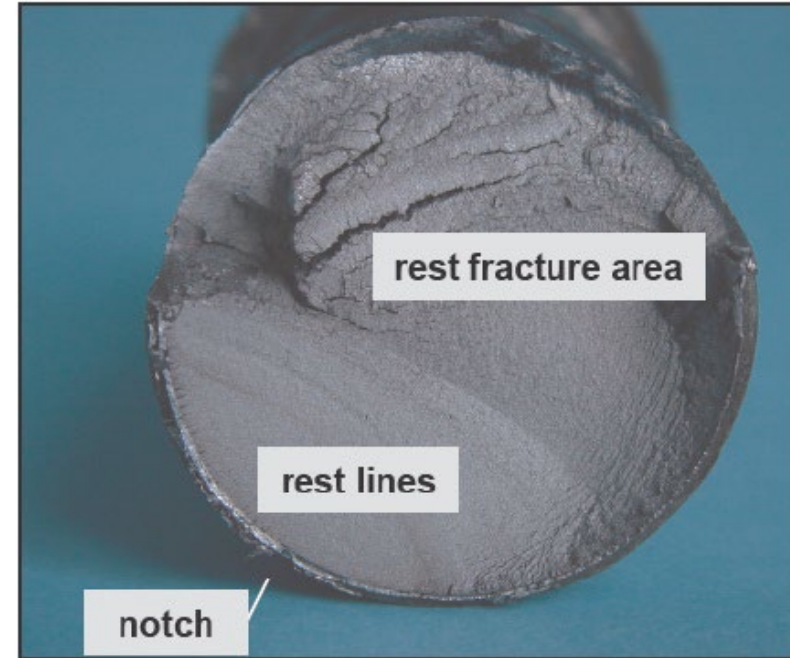
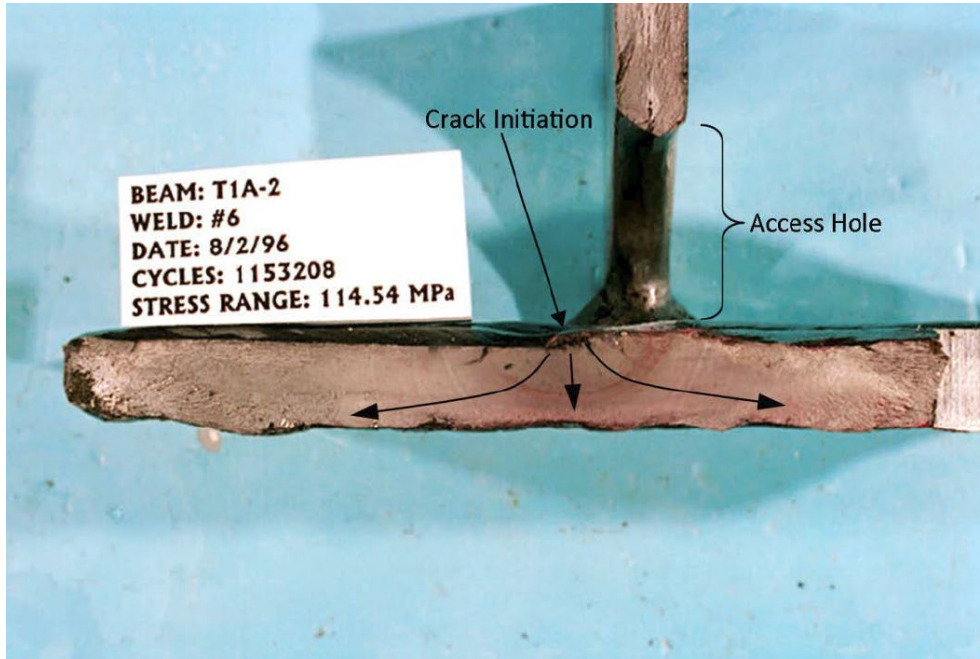
Fatigue inspection

<i>Fatigue Index</i>	≥ 50					< 50
<i>ADTT on Bridge (2 Directional Traffic)</i>	<i>ADTT $\geq 2,000$</i>		<i>200 < ADTT < 2,000</i>		<i>ADTT ≤ 200</i>	<i>All</i>
<i>Distortion Induced Fatigue Score</i>	≥ 25	< 25	≥ 25	< 25	<i>All</i>	<i>All</i>
Age of bridge at first fatigue inspection (see note 1)	15 years	25 years	25 years	35 years	<i>Not Required (Note 5)</i>	<i>Not Required (Note 5)</i>
Subsequent Fatigue Inspection Interval until 50 yrs age (see notes 2-4)	5 years	5 years	10 years	10 years		
Subsequent Fatigue Inspection Interval after 50 yrs age (see notes 2-4)	5 years	5 years	5 years	5 years		

ADTT: Average Daily Truck Traffic

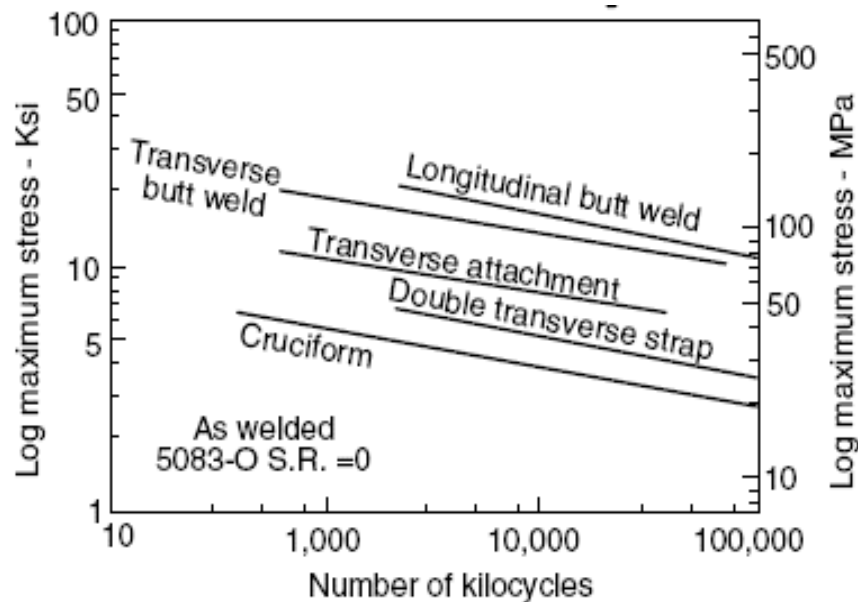
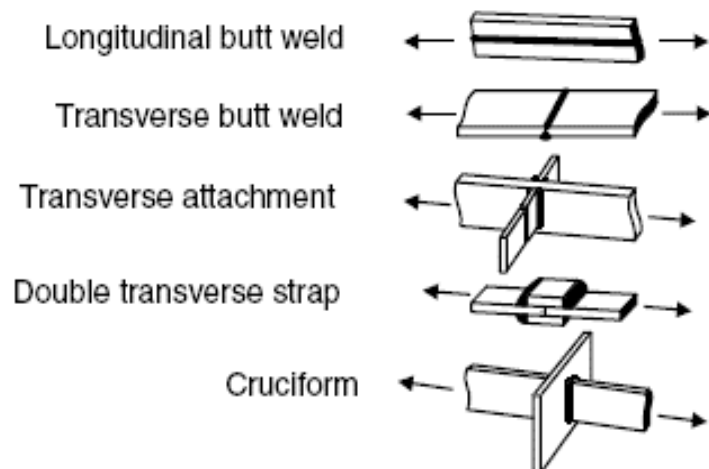


Fatigue failure



Initiation → Growth → Fracture

Joint configuration affects the fatigue life



Fatigue cracks in steel bridges



Corrosion





Why?

To save lives!

What?

How?

Inspection and Test Plan

What?

Professional Engineer

- Distortion Induced details
- Fatigue Prone details

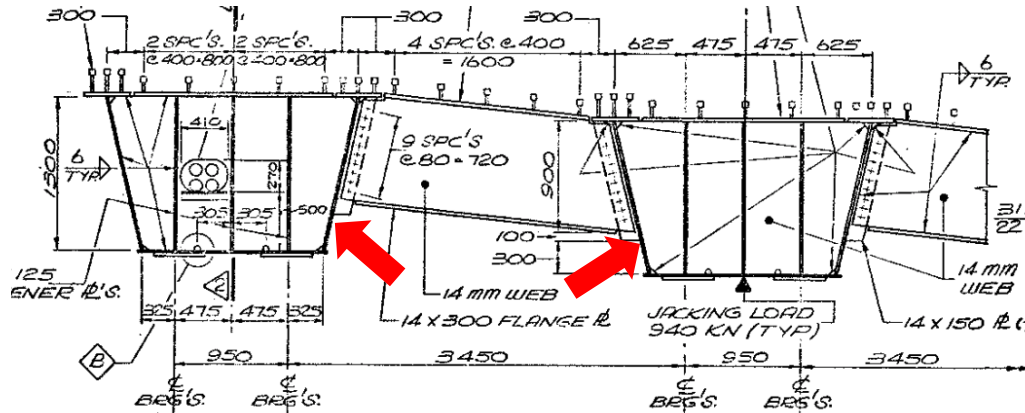
How?

NDT Expert (Level III)

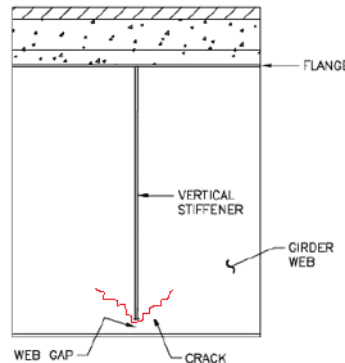
- NDT Method
- NDT Technique

Mechanically fastened connections of verticals	Cracking at net section of riveted connecting members and angle		MT21	D
Mechanically fastened connections of verticals	Cracking at net section of riveted connecting members and angle		MT19, MT20	D
Welded attachments on cross beam for stringers connection	Cracking at toe of the welds through parent metal		MT2, MT13	D
Bearing connection of stringers	Cracking at end of the welds through parent metal		MT22, MT23 (If accessible)	D

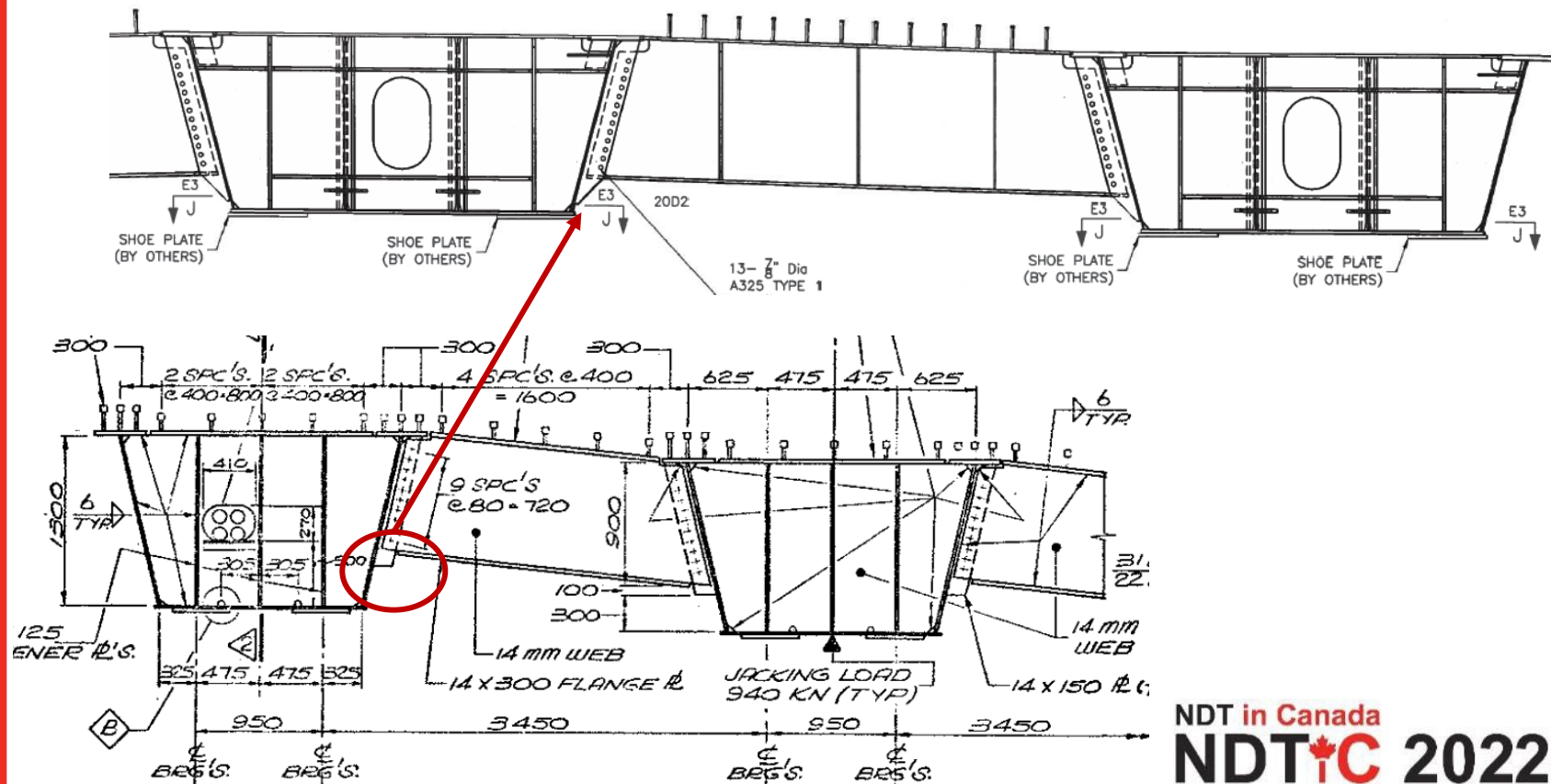
Distortion induced fatigue details



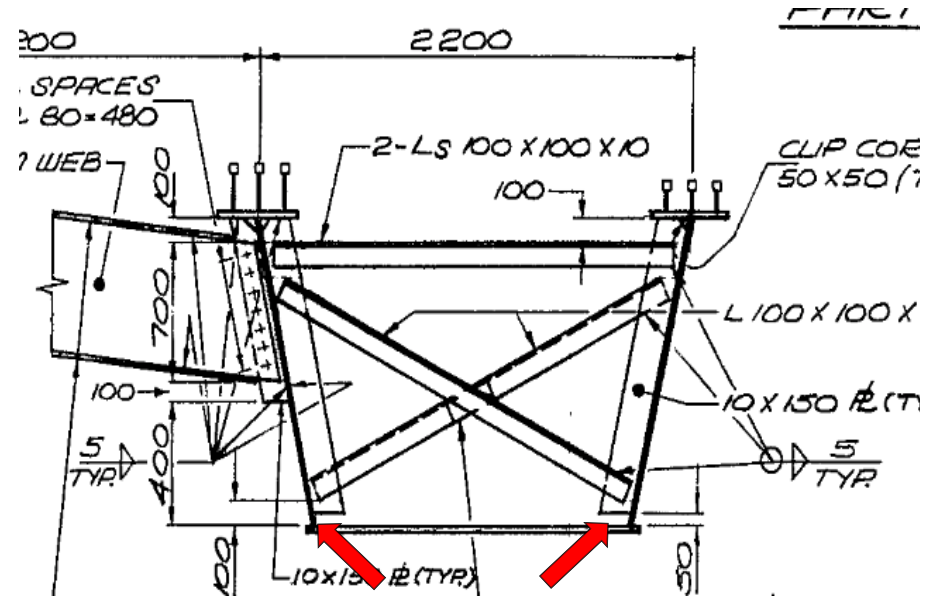
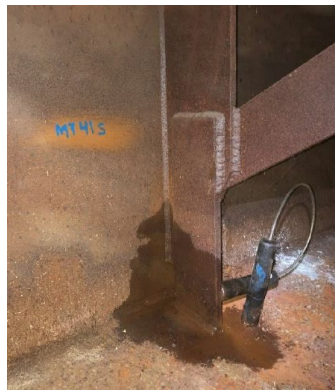
PART SECTION AT ABUTMENT DIAPHRAGMS



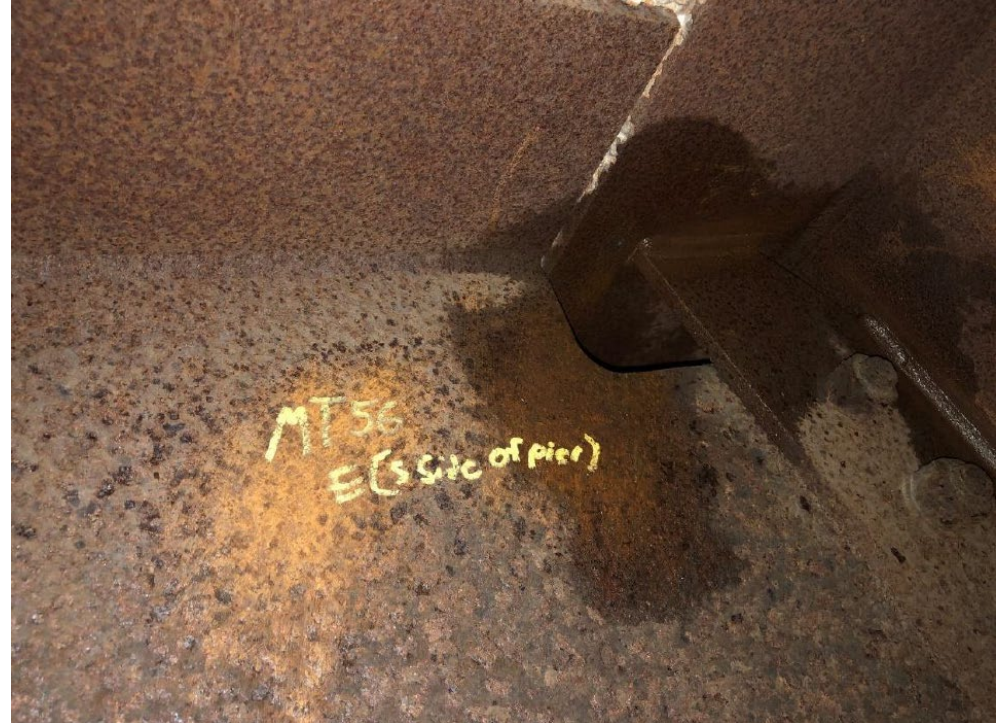
Updated design detail to eliminate the risk of fatigue cracking



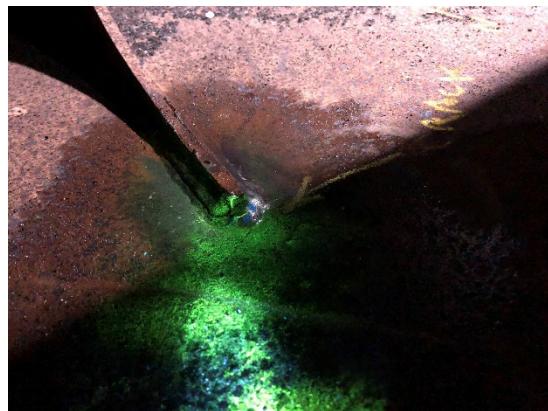
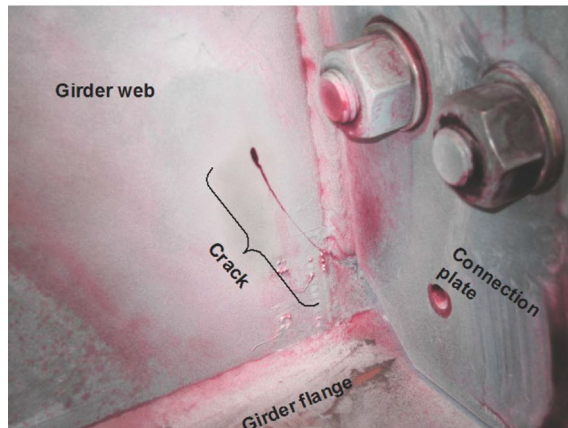
Distortion induced fatigue details



Fatigue prone details



Selection of NDT method and technique



Lighting condition

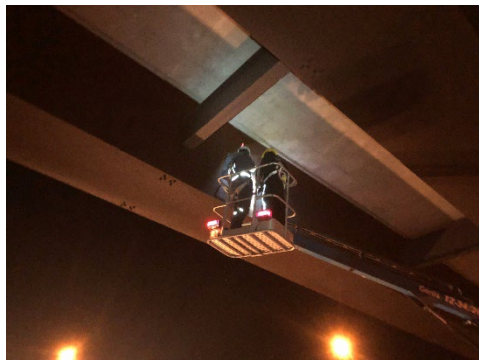
Temperature

Power source

Time limitations

Material type

Accessibility



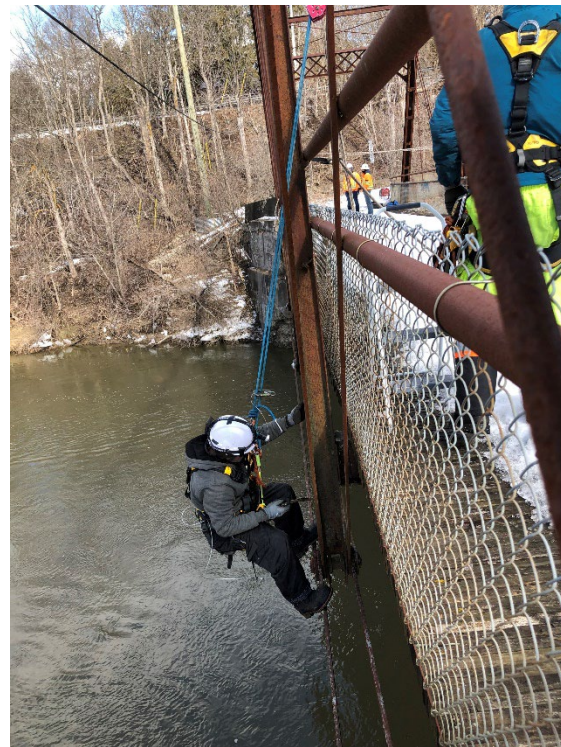
Aerial platforms

Accessibility



Bridge-master

Accessibility



Rope access

Traffic control





What should be inspected?

How should be inspected?

Inspection and Test Plan



Competency of Inspectors

Working outdoor

Working at height

Confined space

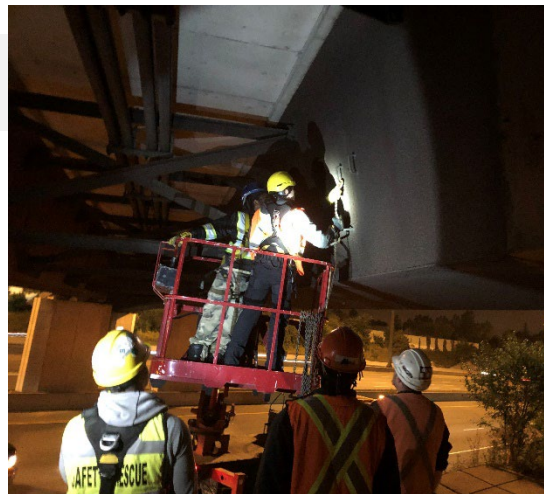
Night shifts

NDT technique

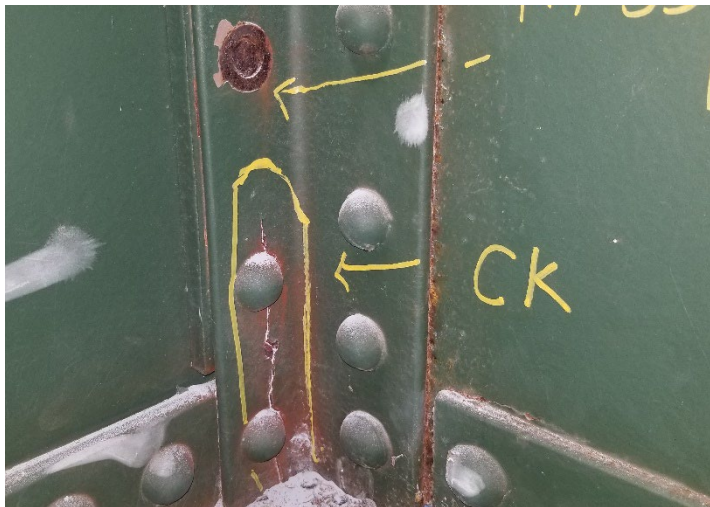
Using tools and equipment

Certification

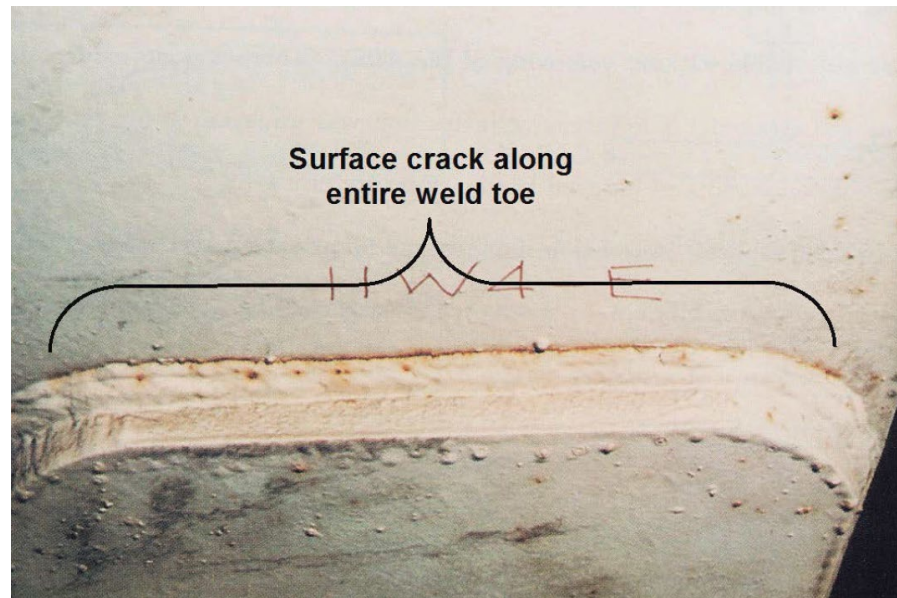
On-the-job training is the key to success!



Fatigue inspection findings

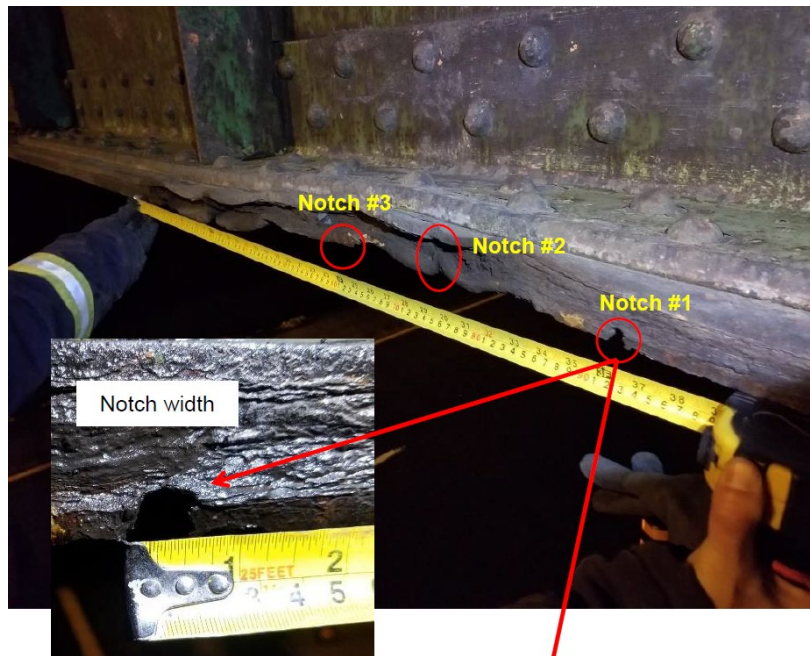


Fatigue inspection findings



Fatigue cracks

Fatigue inspection findings



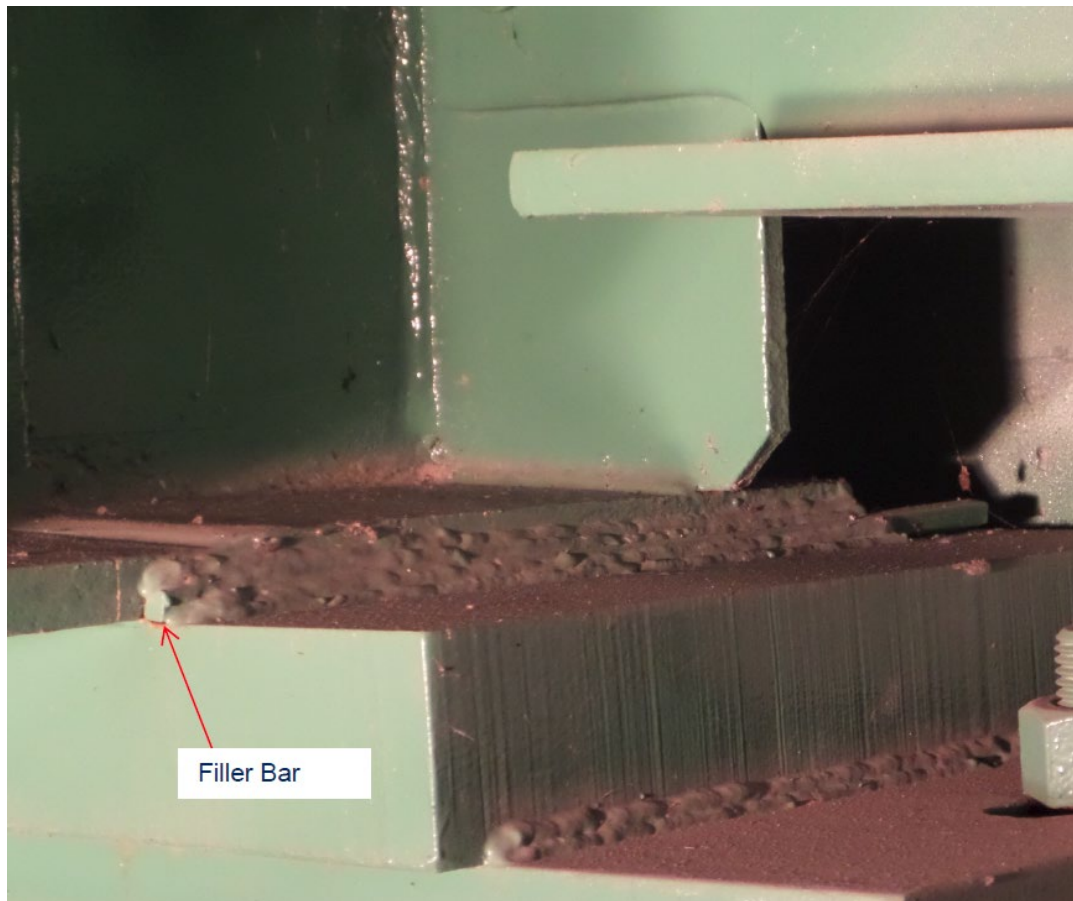
Impact damages by traffic

Fatigue inspection findings



Corrosion

Fatigue inspection findings



Fatigue Inspection and maintenance of bridges save lives!

Teamwork of a P.Eng. and NDT expert is required.

Competency of inspectors to be achieved and verified.



NDT in Canada
NDT*i*C 2022

Canada's NDT Vision - Inspection Excellence

May 17-19

Caesars
Windsor

Windsor,
Ontario

THANK YOU!

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