

Remaining fatigue life assessment of bridge decks based upon a numerical-experimental SYSCOM SYStem-COMponent-Material-based approach.

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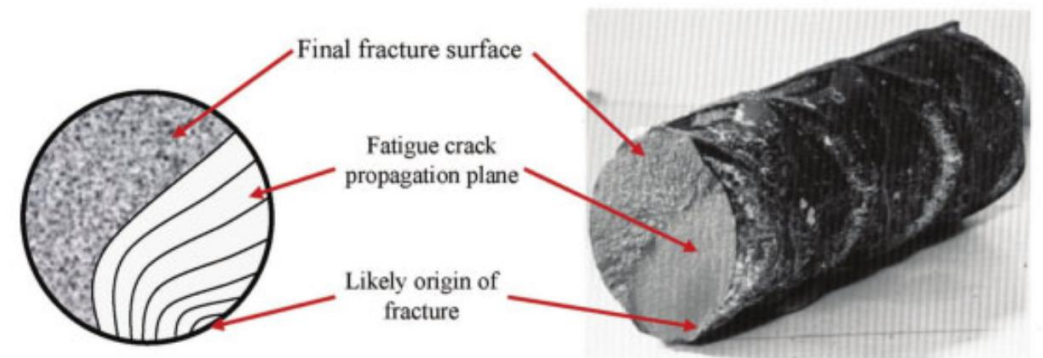
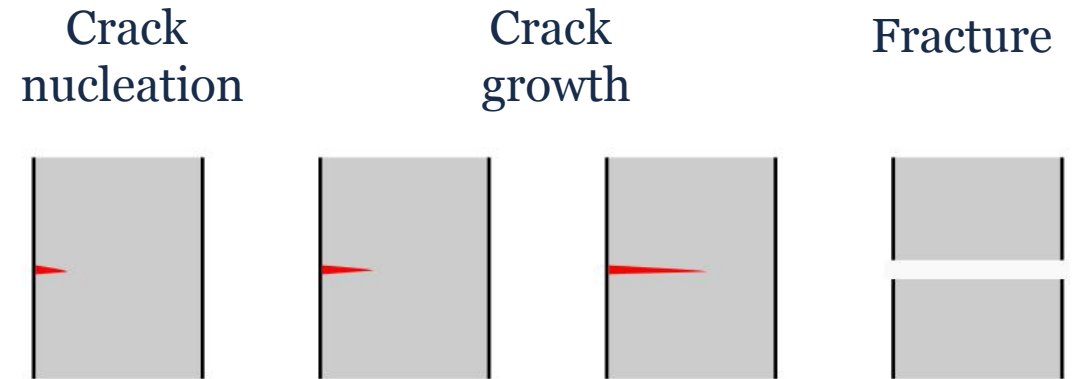
Co-PI: Machel Morrison

Outline

- Background
- Motivation
- Objective
- Methodology
- Conclusion

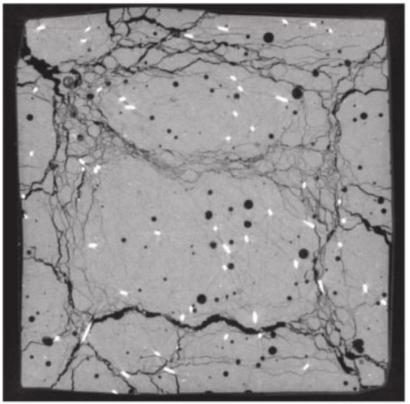
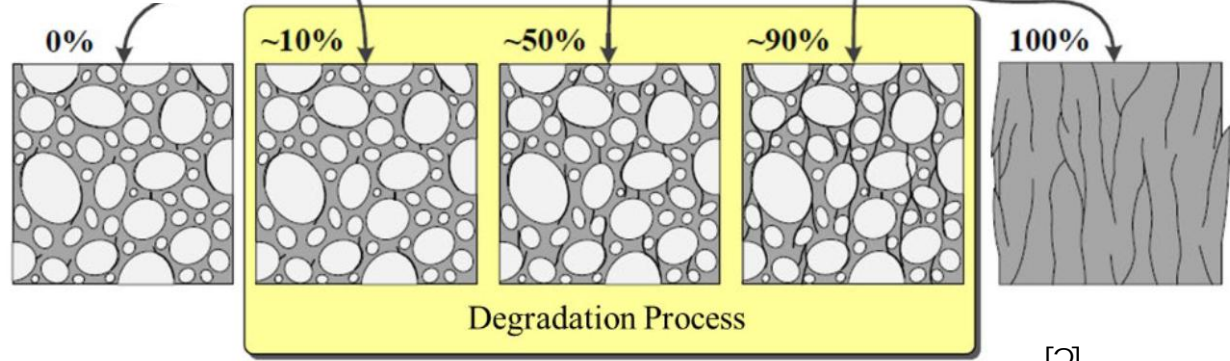
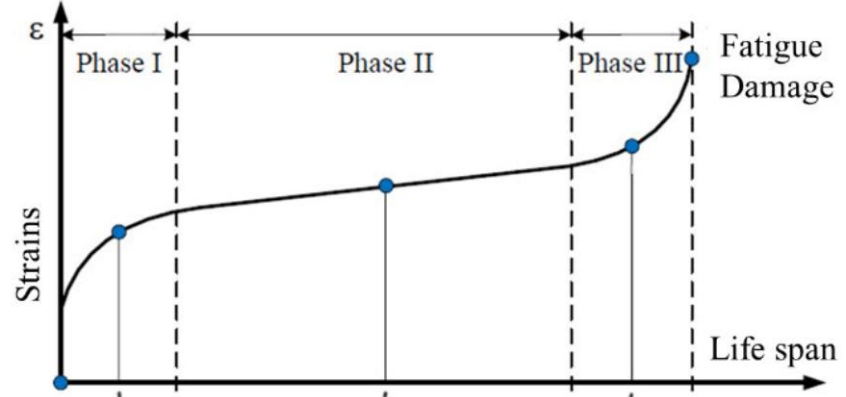
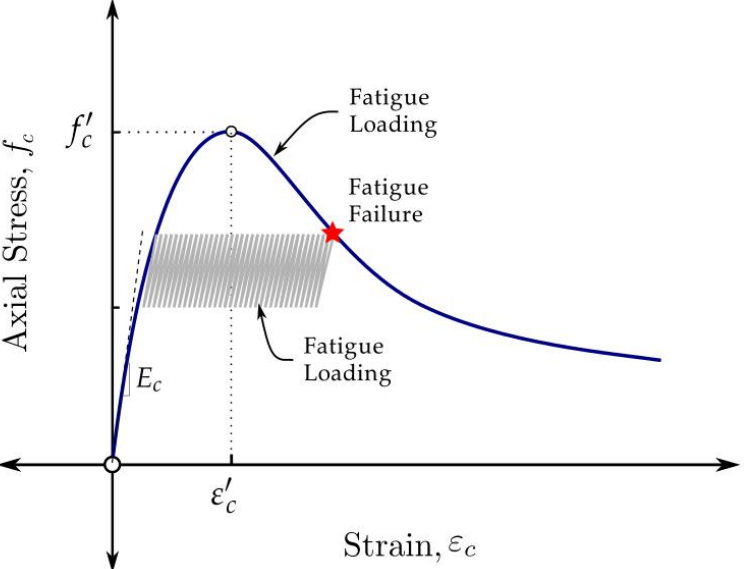
Background

- The **fatigue** process consist essentially of the **progressive crack initiation and propagation** until the remaining cohesive forces are overcome.



[1]

Background



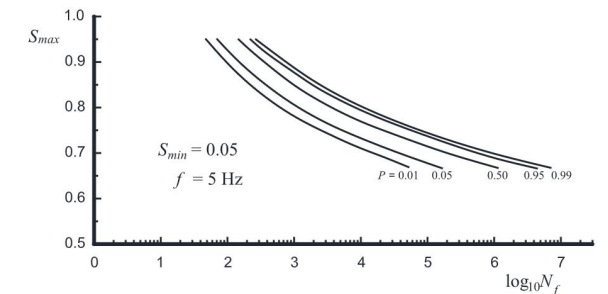
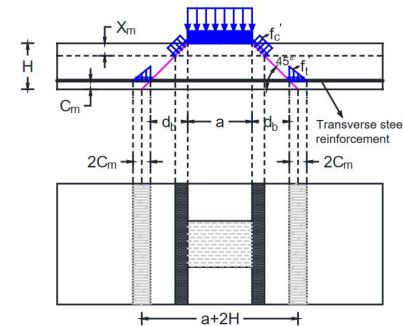
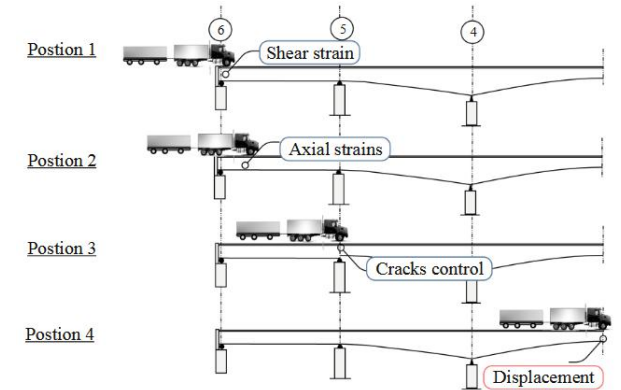
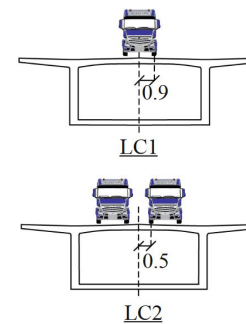
[1]

[2]

Background

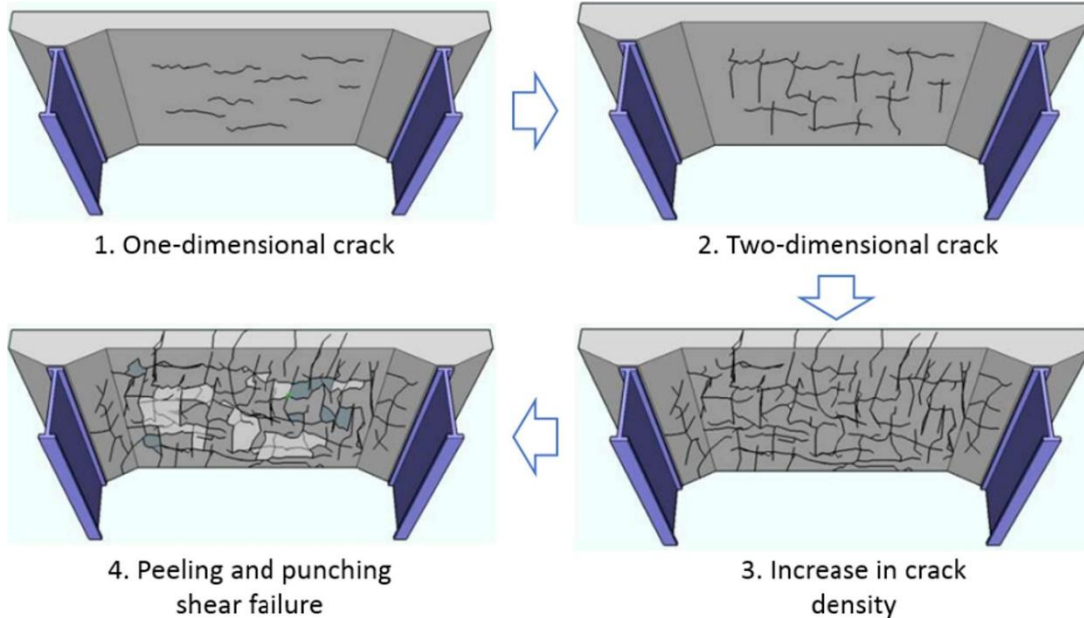
Estimating the fatigue life of bridge involves:

- Assessing the **loads** causing the **fatigue**.
- Identifying the **fatigue-critical details** or “**hot spots**” in the bridge deck.
- Determining the design **stresses** and comparing to **residual strength**



[3,4]

Motivation



[5]

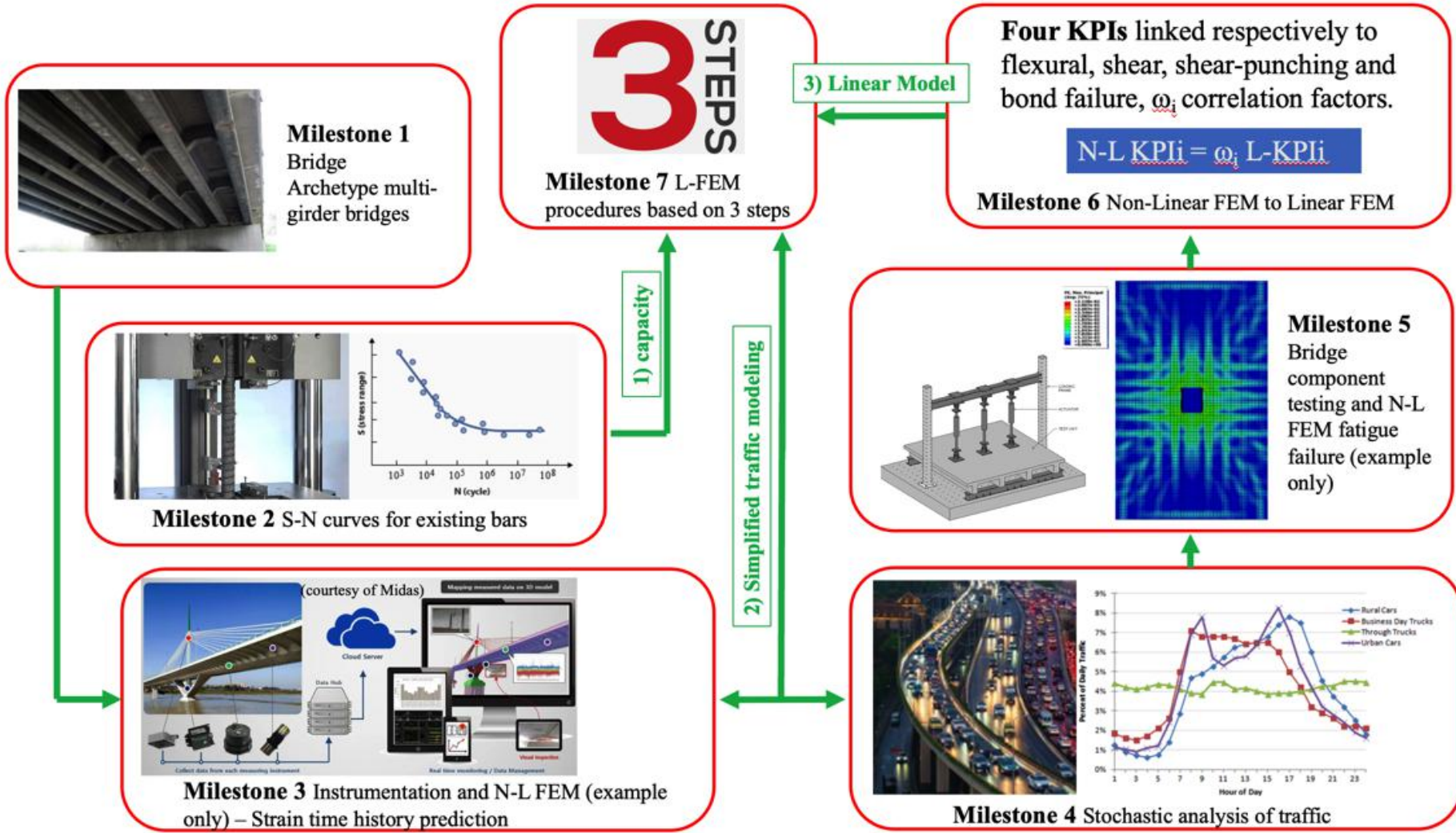
- Increasing traffic loads
- New structures requires **key performance indicators (KPIs)** in design.
- Analytical tools and a performance-based approach, aligning with modern needs **for maintenance, repair, and renewal** are required to **ensure reliability**.

Objective

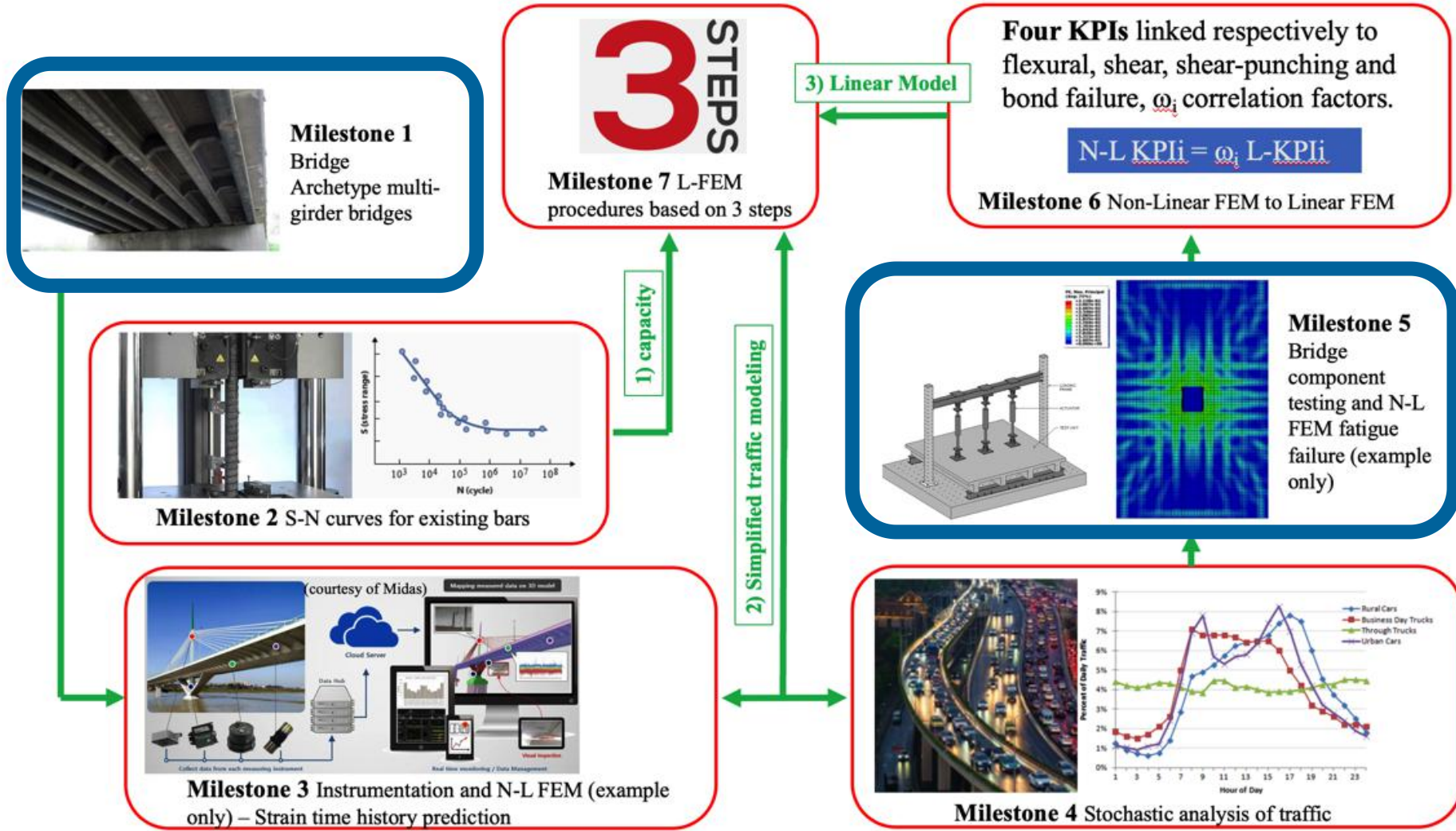
Formulate a practical design procedure implementing Linear FEM for estimating the fatigue life of RC bridge decks

$$K P I_i^{NL} \approx \omega_i K P I_i^L$$

Methodology



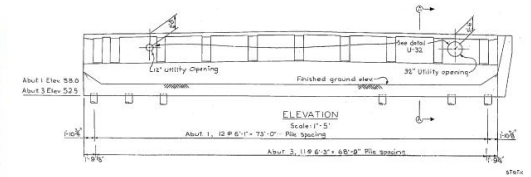
Methodology



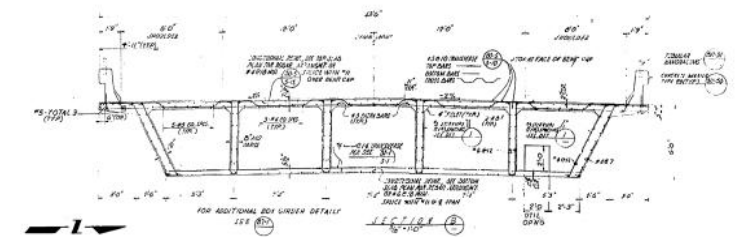
Archetype bridge selection



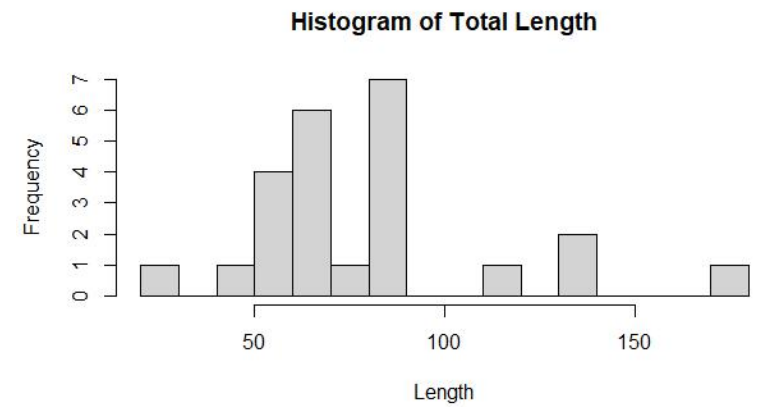
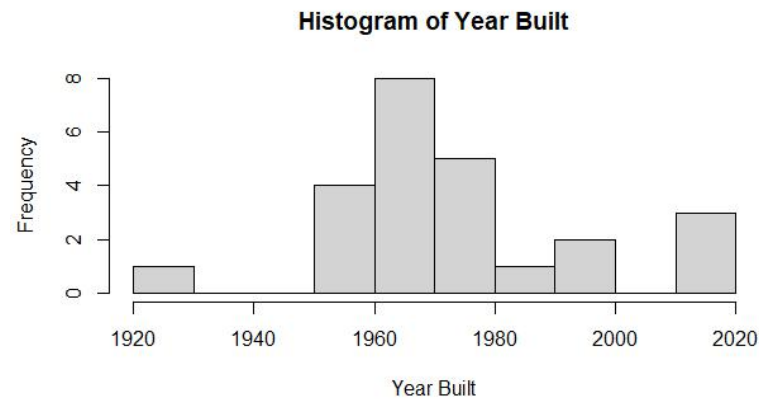
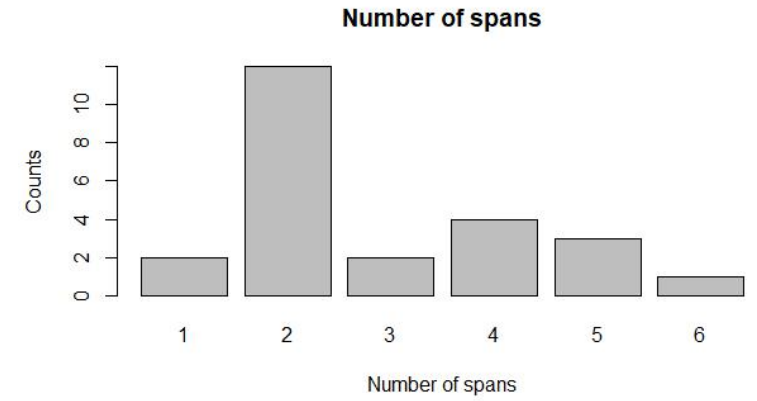
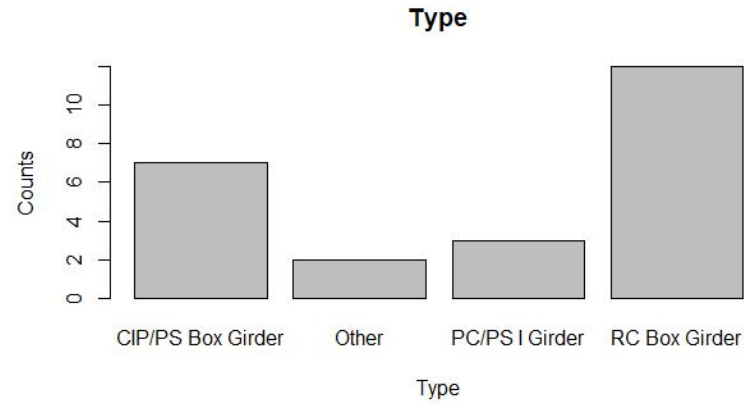
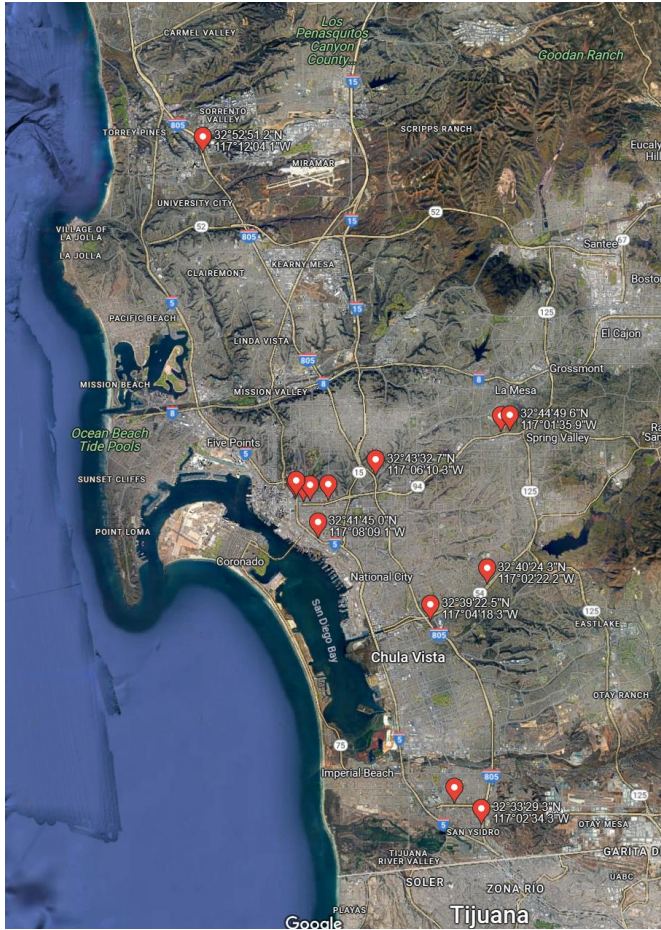
Los Carneros Rd OC (1 9 6 8)



Tejon Highway OC (1970) RC Box Girder

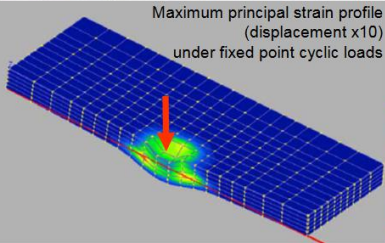


Archetype bridge selection

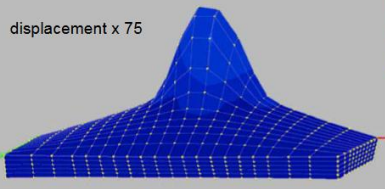


Component Testing and NL-FEM Validation (Next)

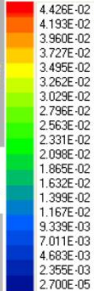
Fixed



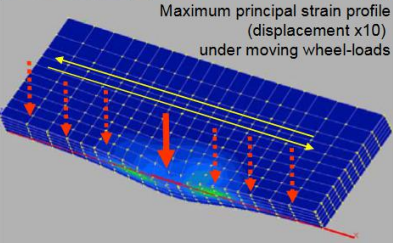
Damage and corresponding deformation are *localized* around the load point after many pulsating.



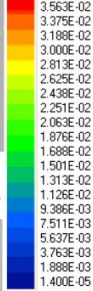
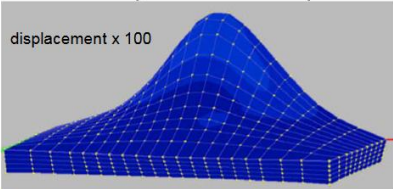
Magnified vertical displacement of the bottom face of the slab (upside down drawing)



Moving

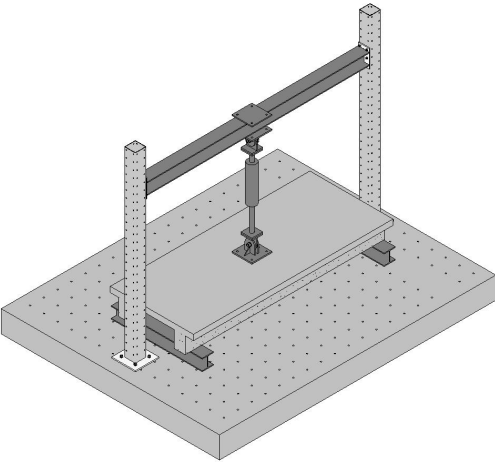


Damage and corresponding deformation are *dispersed* along the slab axis after many passages.

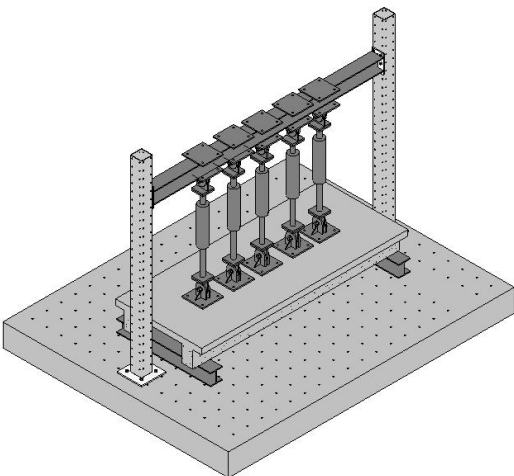


[5]

Typical test setup

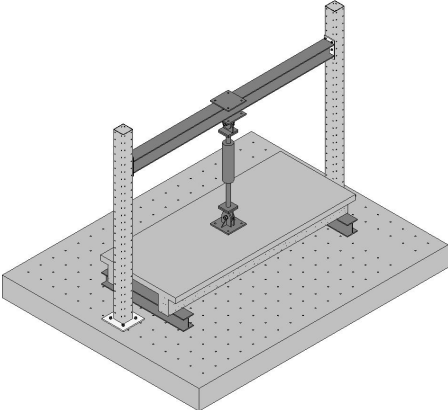
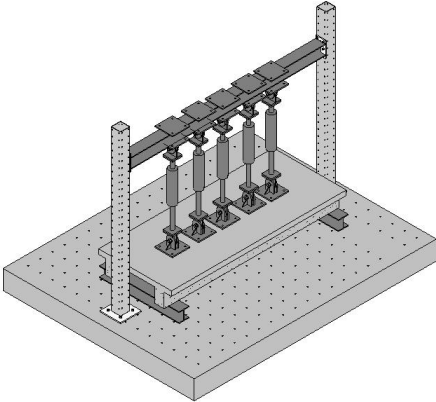


Modified test setup

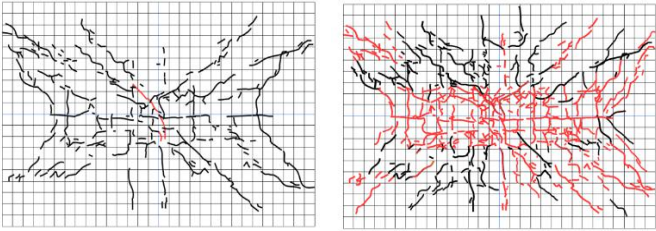
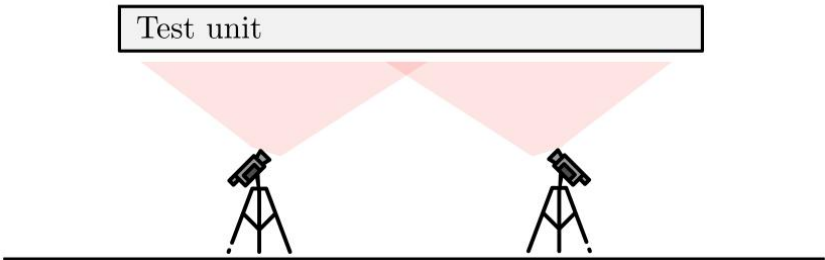


Component Testing and NL-FEM Validation and (Next)

- Test Setup



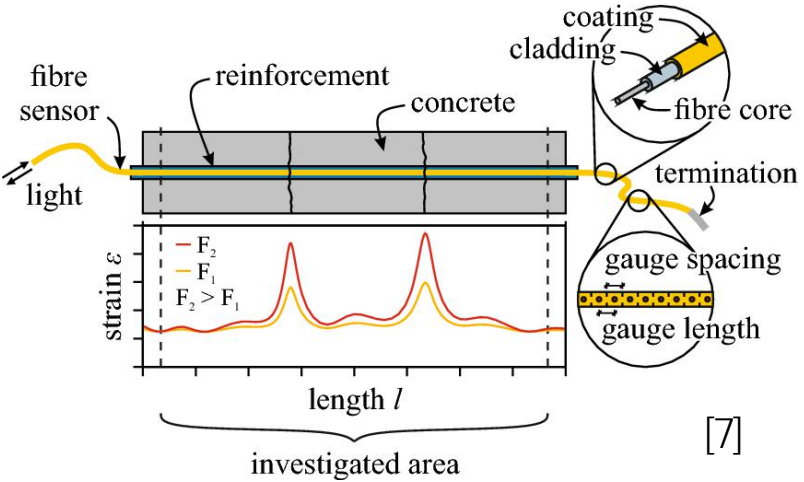
- Digital image correlation and crack pattern



[6]

Accurate crack width measurements

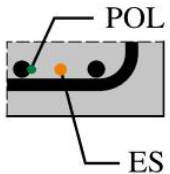
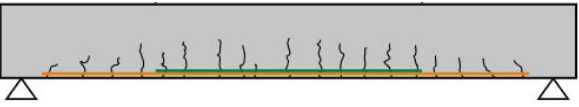
- Fiber optics sensors



[7]

General view

Detail DFOS



Continuous strain measurements

Summary

- This research aims to offer a comprehensive approach for assessing the remaining fatigue life of bridge decks, taking into account realistic bridge-traffic loads and in-situ data.
- Detailed experimental data using Digital Image Correlation and fiber optic sensors aim to provide new insights and assess both nonlinear and linear finite element analyses.
- These advancements will improve maintenance strategies for existing bridge decks and the design of new ones.

Questions?

Bibliography

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