Three Integrated Projects to Enhance Non-Contact Rail Inspection Technology for Application to Substructure Health Evaluation on Both Rail and Road Bridges

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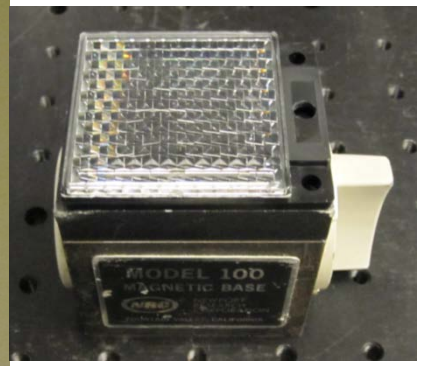
This project extends rail technology to generate an inspection methodology for bridge substructure evaluation.

Technical gap: the identification of sensitive global dynamic property changes resulting from local substructural component damage.



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Outline: Integrated Activities

- Experiment 1: Non-Contact Rail Inspection
- Experiment 2: Bridge Scale Model
- Experiment 3: Full Scale Bridge Test
- Structural Health Monitoring (SHM) Algorithm Development *(throughout project)*
- Finite Element (FE) Modeling *(throughout project)*

Gantt Chart available upon request

Experiment 1: Full Scale Rail

- Build Fall 2012 (completed)
- Test Spring 2013 (in progress)

Standard railway: typical transport rail using common tie-downs

  - Rail: 115 pound/yard A.R.E.A., a medium heavy rail
  - Ground Prep: trench; loose limestone, compaction, repeat
  - Set ties: target central tie has artificial settlement plates
  - Set rail and e-clips

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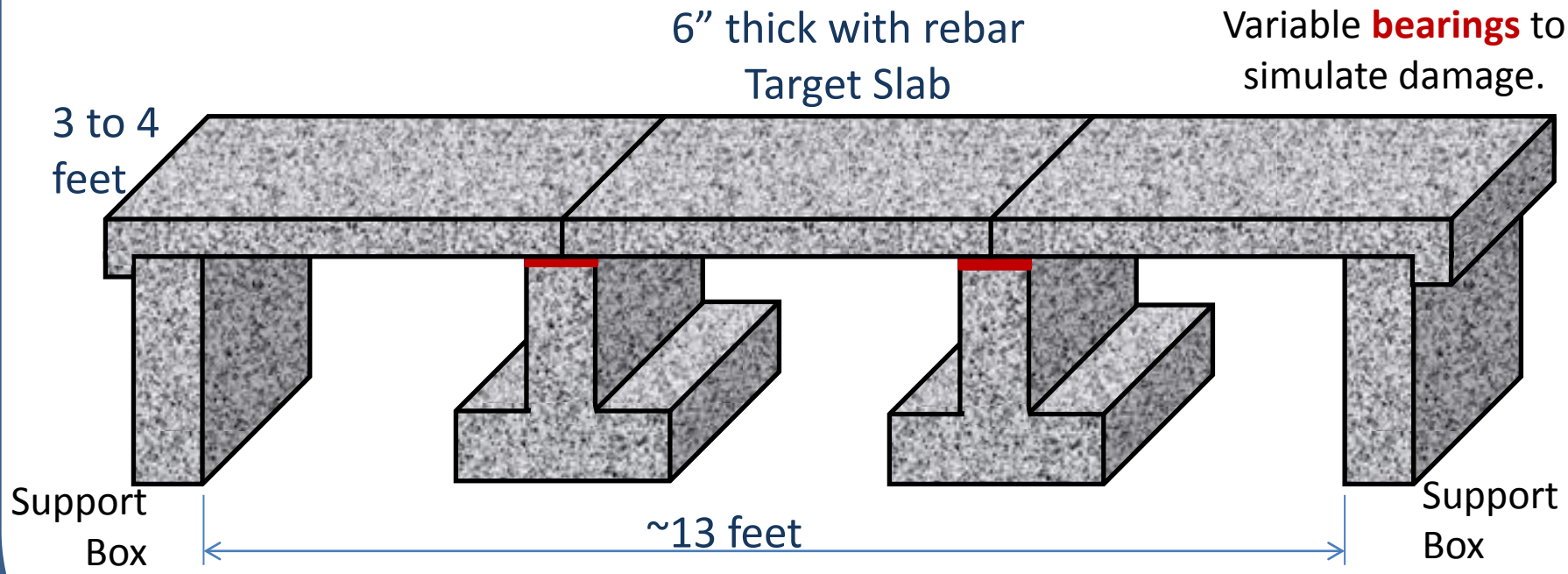
Experiment 2: Scale Model Bridge

- Design Fall 2012 (completed)
- Build Spring 2013 (in progress)
- Test/Analyze Summer to Fall 2013

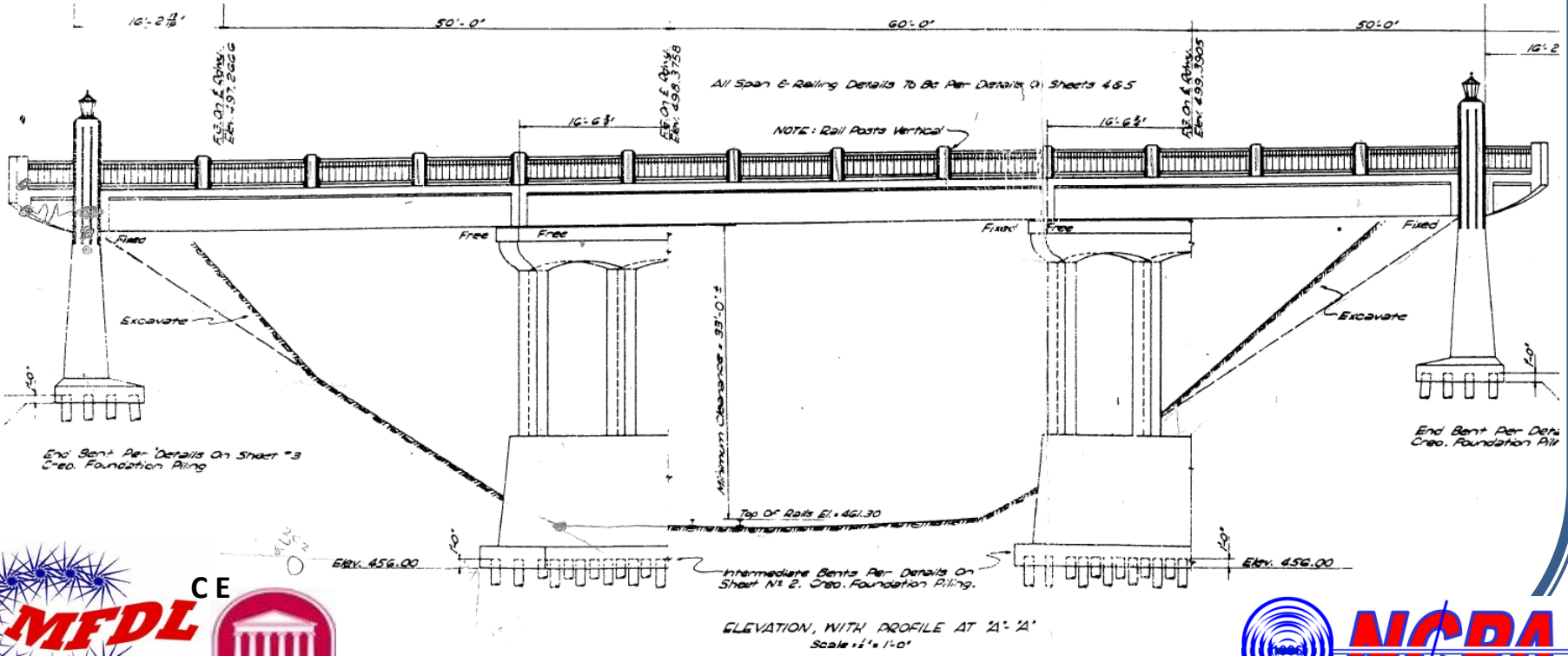


1:12 scale of overall Eastgate Bridge dimensions

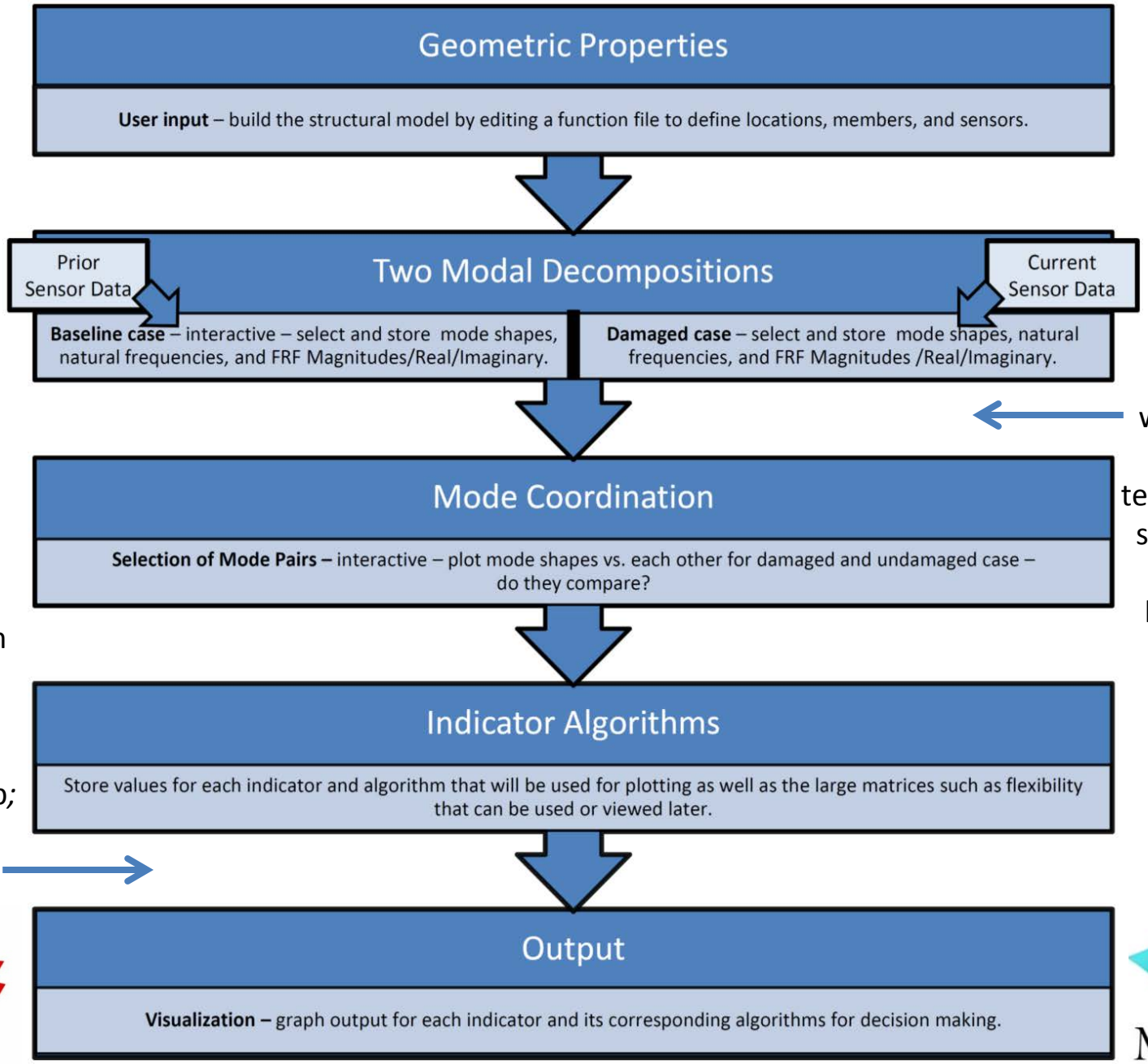
Experiment 3: Full Scale Bridge

- Plan Fall 2012 to Spring 2013 (in progress)
- Test Summer 2013
- Analyze Fall 2013

University Avenue Bridge: Eastgate Bridge (near Ford Center)



Structural Health Monitoring (SHM) Algorithm



Self-written code; testing on student ASCE bridge

"A Comparison of Structural Health Indicators," RAM Workshop; *2nd place presentation.*

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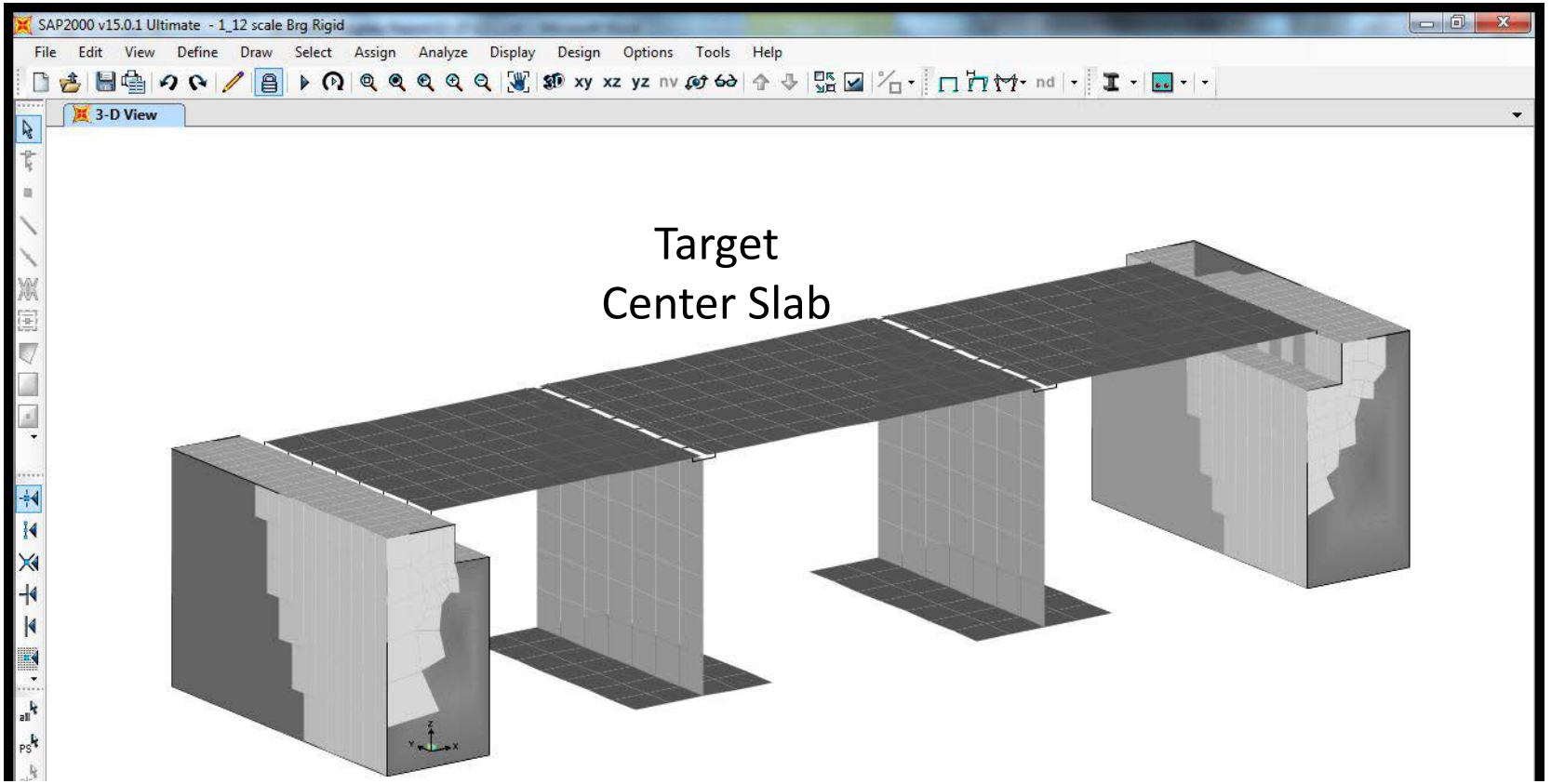
MATLAB

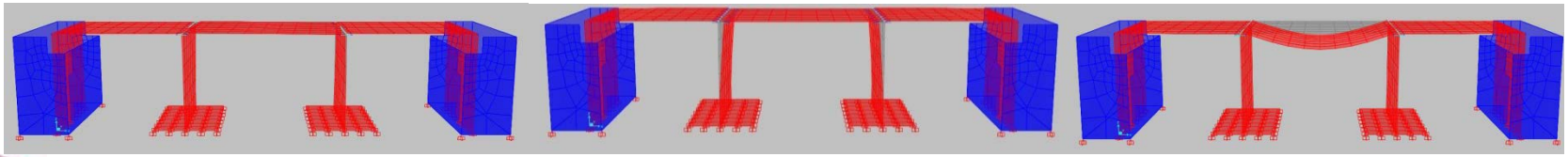
FE Model of 1:12 Scale Bridge Test



Deck Slab Torsion Mode (29.2 Hz)

Support Bending Mode (42.0 Hz)

Deck Slab Bending Mode (109 Hz)



CE

ANSYS: Baseline for Eastgate Bridge

Potential Project Benefits

Unique selling points of our health program include…

- comprehensive analysis for any data/structure,
- comparison of a variety of algorithms, and
- basis for multivariate analysis.

The new integrated inspection technique is expected to be…

- more efficient,
- more cost effective, and
- more accurate than traditional (visual) techniques.

Potential Product: Improved Inspection Technique

- Remaining life estimation could potentially prevent collapse but, at a minimum, will aid decision-making on the bridge's maintenance.
- This project keeps in mind how best to transfer any new technique to field inspectors and/or maintenance workers.