NMSU Bridge Engineering Program

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Past, Present, and Future Work

- Inspection and Rating of Highway and Railroad Bridges
- Higher Level Evaluation of R/C Slab, Steel Girder, and P/C Girder Bridges
- Bridge Retrofit using CFRP Materials
- Riveted Connections of Steel Arch Bridges
- Fatigue Evaluation of Railroad Bridges
- UHPC for P/C Bridge Applications
- Masonry Arch Bridge Evaluation using Photogrammetry
- Bridge Stability during Demolition

Bridge Inspection Program at NMSU

- Only one if its kind in the US
- Two teams
  - One professional engineer
  - Two co-op students (6 months)
- Inspection and documentation of ~400 bridges per year
  - Fracture-critical steel bridges ~ NSTM
  - On or over the Interstate
- Bridge Inspection Schools
  - Comprehensive / Refresher inspection school
  - Training of NMSU and NMDOT personnel

Inspection of Highway Bridges

- Inspection Teams
  - Professional Engineers
  - Co-op Undergraduate & Grad Students

- Sponsoring Agencies
  - New Mexico Department of Transportation / Federal Highway Admin.
  - Los Alamos National Laboratory
  - United States Army Corp of Engineers
  - Private Companies

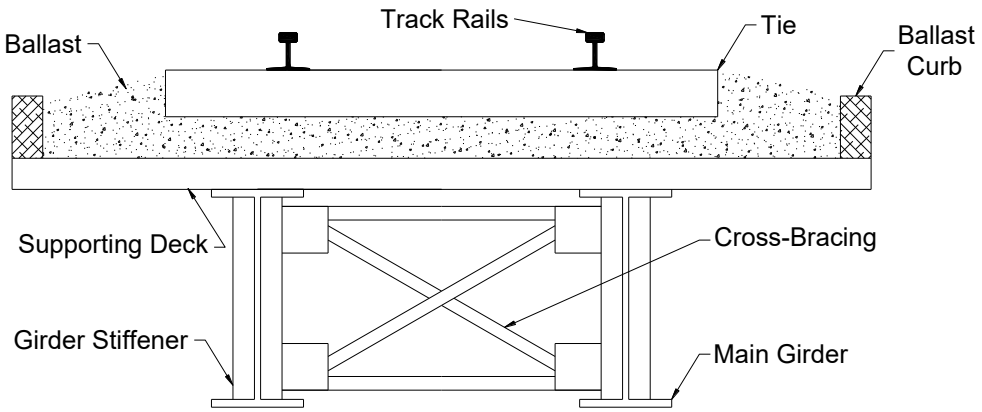
Inspection of Highway Bridges (cont.)

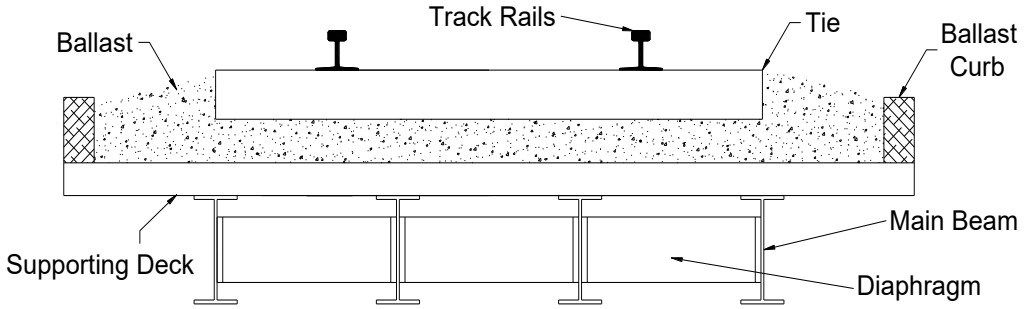
Inspection of Highway Bridges (cont.)

Load Rating of Railroad Bridges

- Develop a general procedure for the load rating of railroad bridges based on the American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
- Utilize the AASHTOWare software to perform the structural analysis of the bridges.
- Compute load ratings for two rating levels and for flexure and shear limit states.
- Create a New Mexico railroad bridge database.

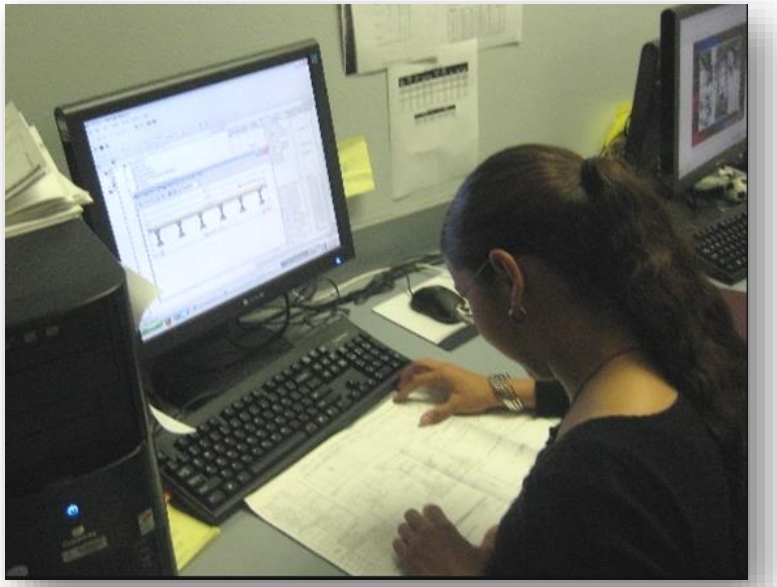
Types of Railroad Bridges





Load Rating Process

- undergraduate seniors and MS students
- two-member teams under PE supervision
- load rating of numerous bridges per year



Bridge Education Outcomes

- Interpretation of design plans
- Understanding of inspection and rating procedures
- Appreciation for the importance of quality control
- Preparation of structural calculations
- Collaborating and building a partnership
- Creation of opportunities for decision making
- Provides practical experience and opportunities.
- NMDOT and private consultants have benefited by hiring engineering interns ready to produce
- Leads to evaluation of bridges using advanced techniques developed through research

Bridge Retrofit using CFRP Materials

- Performance Issues
  - → *Significant early cracking*
  - → *Deficient bottom mat reinf.*

Desired Repair: increase load capacity of bridge, preferably w/o deck replacement

- Considered Options
  1. *Saw cut deck, install reinf.*
  2. *Use support beams*
  3. *Thicken the deck*
  4. *Total deck replacement*
  5. *Carbon fiber reinforcement*

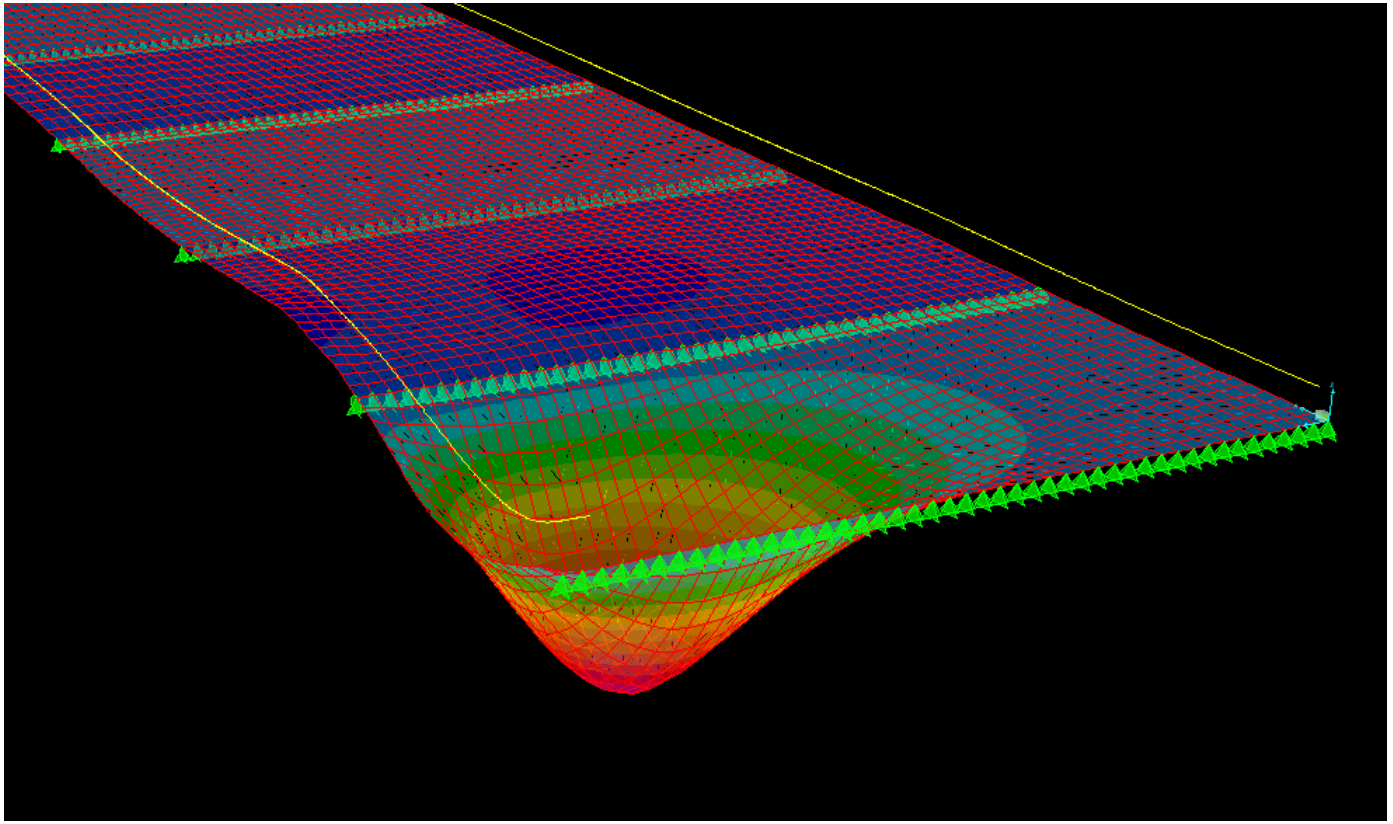
Bridge Retrofit using CFRP Materials (cont.)

- CFRP Advantages
  - → *Previous use (beams, columns)*
  - → *Least intrusive option*
  - → *Fastest installation*
  - → *Lowest cost*

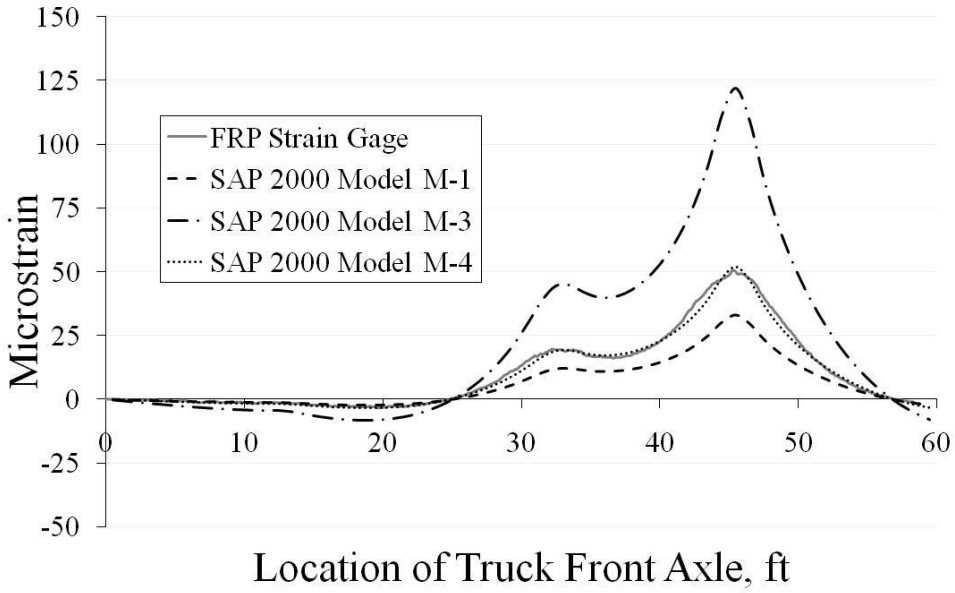
- Installation Process
  1. *Surface preparation*
  2. *CFRP strip preparation*
  3. *Adhesive application*
  4. *CFRP strip installation*

Bridge Retrofit using CFRP Materials (cont.)

Bridge Retrofit using CFRP Materials (cont.)



Bridge Retrofit using CFRP Materials (cont.)



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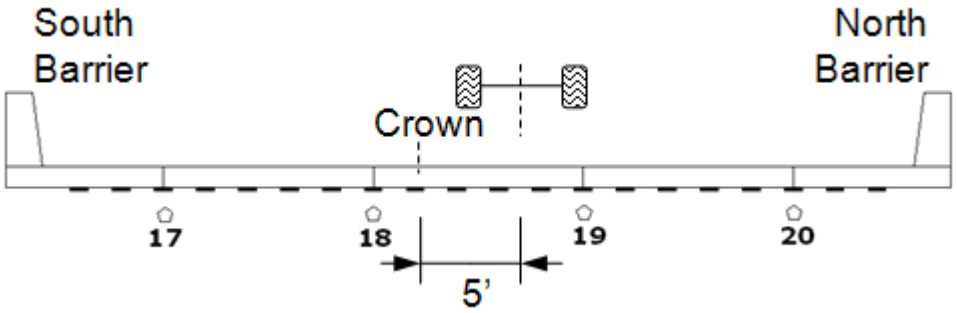
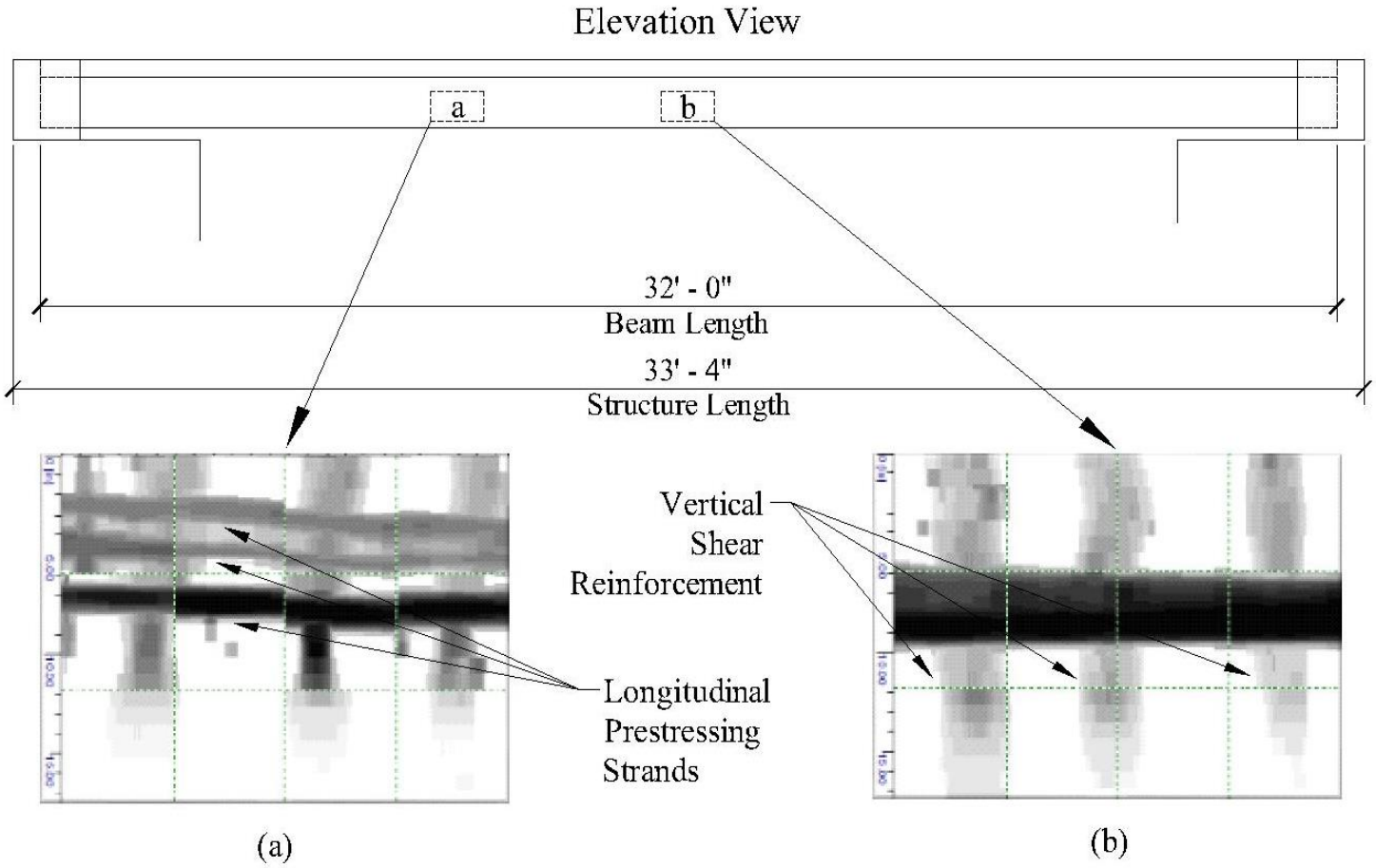


Load Rating of Planless Concrete Bridges

- Bridges without design plans are an issue as many exist within New Mexico and throughout the U.S.
  - Most are older, off-system (city or county owned) bridges
  - This presents a challenge for load rating concrete bridges
- A project was conducted for the New Mexico Department of Transportation (NMDOT) to develop a procedure to better determine bridge ratings and posting loads for concrete bridges without plans

Load Rating of Planless Concrete Bridges (cont)

Load Rating of Planless Concrete Bridges (cont)



Load Rating of Planless Concrete Bridges (cont)

Load Rating of Planless Concrete Bridges

- The literature review and AASHTO Bridge Evaluation Manual provided minimal guidance for testing bridges without plans
- The Ferroscan was effective in verifying the estimate of prestressing strands found from the Magnel diagram
- Conducting the load test based on serviceability was necessary to ensure the bridge remained uncracked
- The diagnostic test was helpful in planning the proof test; the monitoring of strain was effective in controlling the proof test
- The load testing exposed the true behavior of the bridge; the original load ratings were overestimated; consequently, the bridge was load posted by the NMDOT
- The four-step process is an effective approach for load rating prestressed concrete bridges without plans

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Structural Health Monitoring

Structural Health Monitoring (cont)

- 3- Additional Bridges
  - Sensors installed up to 20 years ago
- Durability of Sensor Systems
- Long Term Monitoring
- Future of Bridge Inspection
- Interpretation of data
- Data plan


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