Outline

• Program-Level Update (Tie Program)
• Project-Level Update (FRA BAA)
  – Overall Status
  – Budget Review
  – Final Report Planning
  – Path Forward
  – Future Meetings
  – 2014 Symposium
• Questions
• Discussion
Program Vision

Investigate real-world engineering challenges related to concrete crossties and fastening systems, serving the railroad industry and University, while developing strong leaders
Program Objectives

• Solve real-world design and performance challenges associated with concrete crossties and fastening systems
  – Projects - and the resulting experiments and models - should be traceable to specific failure modes in the field
  – Strive for a healthy balance of materials, component, and system-level research and testing projects

• Meet railroad industry and University objectives (which can be divergent in nature)
  – Strive to have more “basic” projects on the applied → basic research continuum

• Foster student interest in the subject, training future leaders in the fundamentals of railway engineering
Research Progression Pyramid

- Identify Problem
  (Literature Reviews, Field Visits, Surveys, Expert Opinion, Industry Experience)
- Development of Research Project / Hypothesis
- Laboratory Testing and Analytical Modeling
- Field and Laboratory Testing
- Analyze Lab and Field Results
- Recommended Practices
- Prototype Field Testing
- Revenue Service

- Literature Review
- Materials Study
- Component Study
Concrete Crosstie and Fastener Research Levels (and Examples)
Research Sponsors

- Federal Railroad Administration (FRA) (Fastening System Design, Performance, Wear, Fatigue, Cracking, Environmental, etc.)
- Amsted RPS / Amsted Rail, Inc. (Fastening System Wear and Fatigue)
- Association of American Railroads (AAR) Technology Scanning Program (RSD and Fastening System Wear and Fatigue)
- Kansas City Southern (KCS) and GIC Ingeniería y Construcción (Crosstie Design)
- NEXTRANS Region 5 Transportation Center (RSD)
- National University Rail (NURail) (Fastening System Wear and Fatigue)
- CN Fellowship in Rail Engineering (RSD)
Research Program Timeline

2008 August – Hired First Graduate Research Assistant (John Zeman)
2008 October – Attendance at First AREMA C-30 Meeting in Savannah, GA
2009 January – First Research Project (CN and AAR funding)
2009 August – Hired Second Graduate Research Assistant (Mauricio Gutierrez)
2009 October – Second Research Project (Amsted RPS funding)
2010 August – Hired Third Graduate Student (Ryan Kernes)
2011 January – Hired Full-Time Research Engineer (Marcus Dersch)
2011 January – Third Research Project (NEXTRANS Co-Funding)
2011 June – Begin Improved FRA Tie and Fastener BAA (Hired Graduate Research Assistants (Sihang Wei, George Chen, Justin Grasse, and Brandon Van Dyk)
2011 Summer – Hired Graduate Research Assistants for Amsted RPS and NEXTRANS Projects (Chris Rapp and Amogh Shurpali)
Research Program Timeline (Cont.)

2012 January – Hired Postdoctoral Researcher (Moochul Shin)

2012 Summer – Hired Second Research Engineer (Ryan Kernes) and Graduate Research Assistants (Thiago Bizarria, Emily Van Dam, and Brent Williams), Two Additional FRA BAA Projects Awarded

2013 Spring – FRA BAA Modification #2 Awarded

2013 Summer – Hired Summer Interns and Graduate Research Assistants for Amsted RPS and FRA Tie and Fastener BAA Projects (Matthew Greve and Kartik Manda)

2013 Fall – Hired Graduate Research Assistant for FRA Tie and Fastener BAA Project (Andrew Scheppe and Matthew Csenge), FRA BAA Modification #3 Awarded
### Papers, Posters, and Presentations

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Conference Accomplishments
(FRA Tie and Fastener BAA Only)

- **TRB 2013** → 1 Spoken Presentations and 1 TRR Publication Accepted
- **IHHA 2013** → 4 Spoken Presentations, 1 Poster, and 5 Technical Papers
- **JRC 2013** → 5 Spoken Presentations and 2 Papers
- **WRI 2013** → 1 Spoken Presentation in Plenary Session
- **AREMA 2013** → 1 Spoken Presentation and 1 Paper
- **WCRR 2013** → 1 Spoken Presentation, 3 Posters, and 4 Technical Papers
- **TRB 2014** → 1 Spoken Presentation (*more potentially to come*)
- **JRC 2014** → 4 Abstracts Submitted
## Journal Articles

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Research Team (May 2013)
Current Tie and Fastener Research Coverage

Load distribution through rail stress analysis
Kartik Manda

Mechanistic behavior of insulator
Brent Williams

Mechanistic behavior of rail pad assembly
Thiago Bizarria

Load quantification
Brandon Van Dyk/Andrew Scheppe

Clip stress analysis/
Crosstie structural analysis
Sihang Wei

Rail seat pressures
Matthew Greve

Other research: Concrete materials (Emily Van Dam),
FE modeling (George Chen and Austin Zhang)
FRA Tie and Fastener BAA Status

- Currently in Month 29 (October 2013) of 43 Months (including modification period of performance extension)
- Financial status through Month 27 (August 2013):
  - Funding Level: $3,129,348 (incl. both financial mods)
  - Expended: $2,167,644
  - Remaining: $961,704 (31%)
- Adherence to Schedule through Month 29 (Oct. 2013):
  - Re-baselined the project in Month 28
  - Critical path items are back on schedule
  - Improved schedule adherence is due to improved coordination between different areas of the project (e.g. modeling and experimental teams)
Cumulative Monthly Expenditures and Budgets

- Labor & Fringe CLIN 1
- Direct Costs CLIN 2
- Fac & Admin CLIN 3
- Travel CLIN 4

Dollars (Thousands)

Jun-11, Aug-11, Oct-11, Dec-11, Feb-12, Apr-12, Jun-12, Aug-12, Oct-12, Dec-12, Feb-13, Apr-13, Jun-13, Aug-13
Actual vs. Projected Cumulative Total Expenditures

Dollars (Thousands)

Projected Expenditures

Actual Expenditures

Final Report Development - Process

1. Chapters Drafted Internally at UIUC by Project Sub-teams (e.g. modeling)
2. Internal Review by Research Engineers and Faculty
3. Internal Revision and Re-review
4. Chapters (1 to 2 at a time) sent to FRA for Technical Review
5. Process repeats until all chapters are reviewed and approved
6. Final report released
## Final Report - Table of Contents *(Working Draft)*

### Executive Summary

**Volume 1**

1. Introduction and Background
2. Laboratory Instrumentation Results
3. Field Instrumentation Results
4. FE Modeling Results and Simplified Design Tool Results
5. Mechanistic Design of Concrete Crossties and Fastening Systems
6. Conclusions

### Volume 2

1. International Survey Results
2. Loading Quantification Document
3. Laboratory Instrumentation Plan
4. Laboratory Instrumentation Results
5. Field Instrumentation
6. Field Instrumentation Results
7. Modeling Methodology and Development
8. Modeling Results (Parametric Analyses) and Conclusions
9. Simplified Analytical Model Development and Capabilities
10. References
11. Abbreviations and Acronyms
Final Report – Status *(October 2013)*

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**KEY**

- Future
- In Progress
- Final Review
- Complete
Key Highlights Since Tampa (Fall 2012)

- Multiple trips to TTCI including completion of 2nd major field experiment focusing on lateral load path
- Design and construction of full-scale setup
- FE Model advancement and capabilities update
- Establishing dates for and expanding the 2nd International Crosstie and Fastening System Symposium
- Chapters for final report drafted/developed
- Strong Conference and Journal Participation (Papers, Posters, and Presentations)
- Students graduated and entering industry
Current Focus and Immediate Path Forward

• Complete processing of May 2013 field data from TTC
• Complete construction and shakedown of full scale laboratory experimental loading frame
• Continue to integrate experimental and modeling efforts
• Complete development and validation of initial multi-tie model utilizing laboratory and field experimentation data
• Document mechanistic design improvements
  – Synthesis of lab and field data
  – Validation of model
  – Review of specifications and identification of gaps
  – Developing vision for path forward
Future Meetings

- AREMA C-30 and Industry Partners Meetings
  - Lake Tahoe, NV → October 2013
  - Pueblo, CO → April 2014
    - Half-day overview (if there is interest)
  - Champaign-Urbana, IL → June 2014
    - Co-located with International Symposium
  - Orlando, FL → October 2014
    - Co-located with C-30 meeting and RTA
- 2nd International Concrete Crosstie and Fastening System Symposium, Urbana, IL → 2014
- Program Review Meetings with FRA
  - (Location and Dates TBD)
2014

International Crosstie and Fastening System Symposium

Rail Transportation and Engineering Center (RailTEC)
University of Illinois at Urbana-Champaign, Newmark Lab, Champaign, IL 61801

3 – 5 June 2014

This three day conference will have presentations, discussions and a technical tour that focus on the state of the art in timber, concrete, steel and composite crosstie and fastening system design, performance, research, modeling, and inspection.
Acknowledgements

FRA Tie and Fastener BAA
Industry Partners:

U.S. Department of Transportation
Federal Railroad Administration

• Funding for this research has been provided by the Federal Railroad Administration (FRA)
• Industry Partnership and support has been provided by
  – Union Pacific Railroad
  – BNSF Railway
  – National Railway Passenger Corporation (Amtrak)
  – Amsted RPS / Amsted Rail, Inc.
  – GIC Ingeniería y Construcción
  – Hanson Professional Services, Inc.
  – CXT Concrete Ties, Inc., LB Foster Company
  – TTX Company
• Specific Acknowledgement of the entire team at UIUC, including the Co-Pis, Research Engineers, and Students
Questions?

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