State of the Program Address
RailTEC Infrastructure Research Program

FRA Tie and Fastener BAA Industry Partners Meeting

15 October 2014

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RAILTEC
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Outline

- Introduction
- Vision, Pyramid, and Objectives
- Current Projects, Sponsors, and Team
- Research History Timeline
- Students, Presentations, and Publications
- BAA Program Status
- Qualitative Results of Research Program
- Path Forward
- Questions and Comments

Crosstie and Fastener Research Team

June 2014

Crosstie Program Vision

Investigate real-world engineering challenges related to railway infrastructure components and systems, serving the railroad industry and University, while developing strong mentor leaders

Crosstie Team Pyramid

Crosstie Program Objectives

- Solve real-world design and performance challenges associated with concrete crossties and fastening systems
- Maintain a balanced portfolio of research projects
  - 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
  - Strive for balance of laboratory, field, and analytical (modeling) projects
- Meet railroad industry and University objectives
- Foster student interest in the subject, training future mentor leaders in the fundamentals of railway engineering

Crosstie Program Research Levels (and Examples)

Materials

- Concrete Mix Design
- Rail Seat Surface Treatments
- Pad / Insulator Materials

Components

- Fastener Yield Stress
- Insulator Post Compression
- Concrete Prestress Design

System

- Finite Element Modeling
- Full-Scale Laboratory Experimentation
- Field Experimentation

Current Infrastructure Research Sponsors

- Federal Railroad Administration (FRA) and NURail Center (Crosstie and 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)
- GIC (Improved Concrete Crosstie Design)
- IntegriCo Composites (Improved Composite Crosstie Design)
- Vossloh (Fastening System Load Transfer)
- New York City Transit (NYCT) (Bolted Joint Modeling and Experimentation)

U.S. Department of Transportation
Federal Railroad Administration

ASSOCIATION OF AMERICAN RAILROADS

Amsted RPS
An Amsted Rail Company

GIC

vossloh

National University Rail Center

INTEGRICO COMPOSITES

MTA New York City Transit

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 – FRA Tie and Fastener BAA awarded (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)

2012 January – Hired Postdoctoral Researcher (Moochul Shin)

Research Program Timeline (Cont.)

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 Graduate Research Assistants for Amsted RPS and FRA Tie and Fastener BAA Projects (Matthew Greve and Kartik Manda) and FRA BAA Modification #3 Awarded

2013 Fall – Hired Graduate Research Assistants Matthew Csenge and Andrew Scheppe, GIC Project Awarded

2014 Spring – Hired Graduate Research Assistant Henry Wolf, Marcus Dersch Promoted to Senior Research Engineer, IntegriCo Project and FRA RSD Projects Awarded

2014 Summer – Hired Graduate Research Assistants Bosco Munyaneza and Donovan Holder

2014 Fall – Hired Graduate Research Assistants Kaijun Zhu and Josue Bastos, Hired Research Engineer Yu Qian, *NYCT and Vossloh Projects Awarded*

Infrastructure Program Students/Staff

#	Last Name	First Name	MS/PhD	2007 Fall	2008 Spring	2008 Fall	2009 Spring	2009 Fall	2010 Spring	2010 Fall	2011 Spring	2011 Fall	2012 Spring	2012 Fall	2013 Spring	2013 Fall	2014 Spring	2014 Fall	2015 Spring	2015 Fall	2016 Spring	2016 Fall
1	**Sawadisavi**	Steven	MS																			
2	**Zeman**	John	MS																			
3	**Schlake**	Bryan	MS																			
4	**Rickett**	Tristan	MS																			
5	**Gutierrez**	Mauricio	MS																			
6	**Molina**	Luis Fernando	MS																			
7	**Kernes**	Ryan	MS/Staff											Research Engineer								
	Dersch	Marcus	Staff							Research Engineer							Senior Research Engineer					
8	**Shurpali**	Amogh	MS																			
9	**Rapp**	Chris	MS																			
	Grasse	Justin	MS									Lange Advisee										
	Wei	Sihang	PhD									Kuchma Advisee										
	Chen	George	PhD									Andrawes Advisee										
10	**Van Dyk**	Brandon	MS																			
	Shin	Moochul	PostDoc										Andrawes Advisee - Post Doc									
11	**Bizarria**	Thiago	MS																			
12	**Williams**	Brent	MS		Machine Vision																	
	Manda	Kartik	MS		Crossties and Fastening Systems									Lange Advisee								
13	**Scheppe**	Andrew	MS		Crossties and Fastening Systems (Not Advised Formally)																	
	Zhang	Austin	MS													Andrawes Advisee						
14	**Greve**	Matthew	MS																			
15	**Csenge**	Matthew	MS																			
16	**Wolf**	Henry	MS																			
17	**Holder**	Donovan	MS																			
18	**Munyaneza**	Bosco	MS																			
19	**Kaijun**	Zhu	MS																			
20	**Bastos**	Josue	MS																			
	Quan	Yu	Staff															Research Engineer					

- Continuing to educate a significant number of students…
- Progression of students into industry → Examples of students that are already in the industry and making an impact

Papers, Posters, and Presentations

Year	Conference / Meeting	Papers	Presentations	Posters
2009	AREMA	1	1	
	IHHA	1	1	0
2010	TRB	1	1	0
	AAR Research Review			1
	JRC	1	2	0
	AREMA	2	2	
2011	TRB	1	0	1
	IHHA	3	0	2
	AAR Research Review			1
	JRC	0	2	0
	WCRR	2	0	2
	AREMA	1	1	
2012	TRB	1	1	1
	AAR Research Review			1
	JRC	2	6	0
	WRI		1	
	PCI	1	1	0
	AREMA	1	1	
	ACerS Concrete Conference	0	0	1
2013	TRB	2	2	0
	IHHA	6	6	1
	AAR Research Review			4
	JRC	3	8	0
	WRI		1	
	AREMA	1	1	
	WCRR	4	1	3
2014	TRB	4	3	1
	JRC	4	8	
	AREMA	1	1	
2015	TRB	4	TBD	TBD
	JRC	3	6	
	IHHA	TBD	TBD	TBD
	Total	**50**	**57**	**19**

Crosstie Team Journal Articles

Year	Journal	Topic	Lead Author	Status
2012	American Concrete Institute (ACI) Materials	RSD Mechanisms	Zeman	In Press
2013	Tranportation Research Record (TRR)	Rail Seat Pressures	Rapp	In Press
2013	ASCE Journal of Transportation Engineering (JTE)	Rail Seat Pressures	Shurpali	In Press
2013	ASTM Advances in Civil Engineering Materials (ACEM)	SSART Abrasion	Shurpali	Final Review
2013	Journal of Rail and Rapid Transit (JRRT)	SSART and LSART	Kernes	Final Version Submitted
2013	Electronic Journal of Structural Engineering (EJSE)	Field Testing	Grasse	Under Development
2013	Journal of Rail and Rapid Transit (JRRT)	Modeling	Shin/Chen	Final Version Submitted
2013	ASCE Journal of Transportation Engineering (JTE)	Modeling	Shin/Chen	Draft Submitted
2014	Engineering Failure Analysis	Modeling	Shin/Chen	Accepted
2014	Journal of Rail and Rapid Transit (JRRT)	Loading Quantification	Scheppe	Under Revision

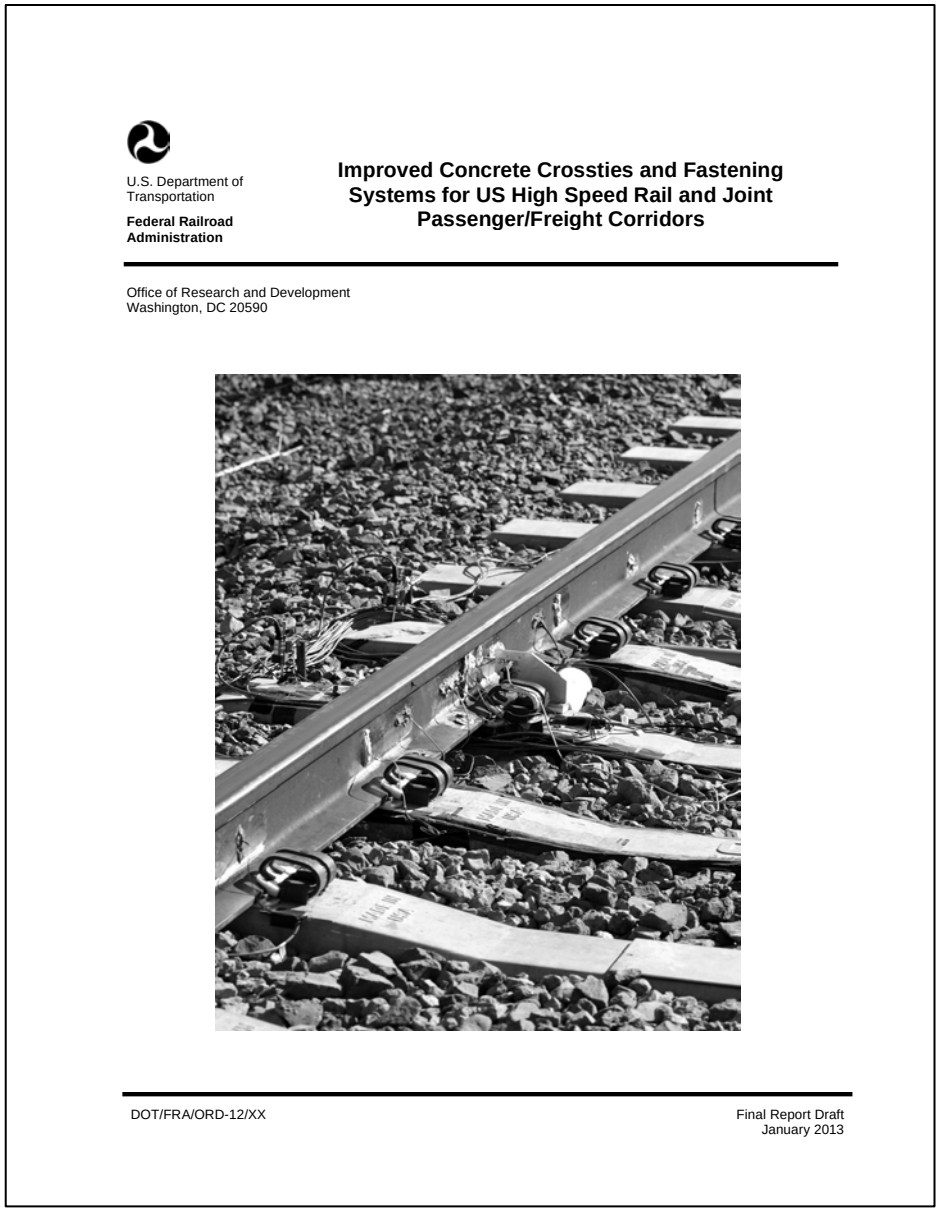
- High acceptance percentage (over 50%)
- Relationship to sustainable research program and academic expectations
- Importance of taking conference proceedings seriously → quickly developing them into journal papers

FRA Tie and Fastener BAA Status

- Currently in Month 41 (October 2014) of 43
- Financial status through Month 37 (June 2014):
  - Funding Level: $3,129,348
  - Expended: $3,096,132 (99%)
- Major Efforts Between Now and Month 43:
  - **Development of Mechanistic Design Practices**
  - **Final Report Completion**

Final Report Development - Update

- Status:
  - Most chapters are drafted
  - 90% Completion
  - Scheduled to be completed within 1-2 months



U.S. Department of Transportation

Federal Railroad Administration

Improved Concrete Crossties and Fastening Systems for US High Speed Rail and Joint Passenger/Freight Corridors

Office of Research and Development
Washington, DC 20590

DOT/FRA/ORD-12/XX

Final Report Draft
January 2013

Website: http://railtec.illinois.edu/CEE/Crossties/FRA_Final_Report.php

Final Report - Table of Contents

Final Report - Table of Contents - *(Progress)*

Executive Summary

Volume 1

1. Introduction and Background
2. Mechanistic Design of Concrete Crossties and Fastening Systems
3. Results and Conclusions
4. References
5. Abbreviations and Acronyms

KEY
Future
Under Development
Under Review
Complete

Volume 2

1. International Survey Results
2. Loading Quantification Document
3. Laboratory Instrumentation Plan
4. Laboratory Instrumentation Results
5. Field Instrumentation Plan
6. Field Instrumentation Results
7. Modeling Methodology and Development
8. Modeling Results (Parametric Analyses) and Conclusions
9. Analytical Model (I-TRACK) Development and Capabilities
10. References
11. Abbreviations and Acronyms

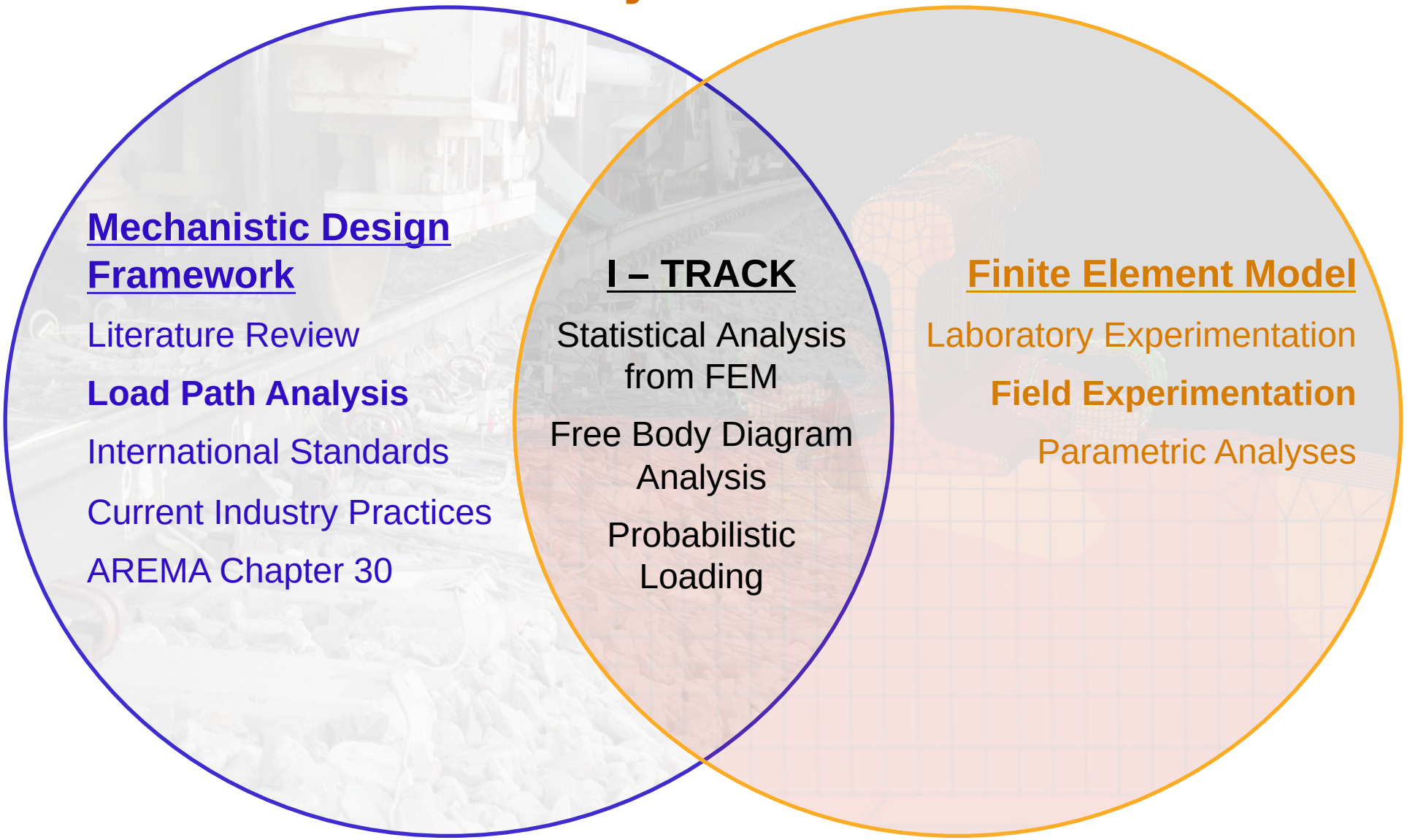
Qualitative Results and Impact

- Key Findings:
  - Quantification of the lateral load path through the development of a novel lateral load measurement device
  - Development of a validated multi-crosstie and fastening system 3D FE model
  - Improved understanding of the pressure distribution at the rail seat
  - Development of a full-scale laboratory track loading system
- Students Educated:
  - Bachelors: MANY undergraduates
  - Masters: Grasse, Rapp, Van Dyk, Bizarria, Manda, Williams
  - PhD: Shin, Chen, and Wei

Where are we going?

- **Current and Near-Term Focus:**
  - Continue to serve key research sponsors (Amsted Rail, etc.)
  - Finish strong on current FRA Tie and Fastener BAA
  - Continue use of RAIL at UIUC
  - New FRA-funded research
  - Pursuit of research projects in additional areas:
    - Bolted and Insulated Joints (IJs)
    - Under Sleeper Pads (USPs)
    - Composite Crossties
- **Long-Term Vision:**
  - Balanced research funding from private and public sectors
  - **Balanced approach with laboratory experimentation, field experimentation, and modeling**

FRA Crosstie and Fastening System Program Overall Project Deliverables



Acknowledgements

Research Sponsors:

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INTEGRICO COMPOSITES

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FRA Tie and Fastener BAA Industry Partners:

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Amsted RPS
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LB Foster
CXT Concrete Ties

AMTRAK®

HANSON

TTX®

Other Supporting Organizations

BNSF Railway

Union Pacific Building America

Amtrak

Norfolk Southern

CSX

CN

Canadian Pacific Railway

U.S. Department of Transportation
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Amsted RPS
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GIC
GIC Ingeniería y Construcción S.A. de C.V.

LB Foster
CXT Concrete Ties

Hanson

Nortrak

BASF
The Chemical Company

Pandrol
Track Systems
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TTCI
Transportation Technology Center, Inc.

Questions and Comments?

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