

State of the Program Address

RailTEC Crosstie and Fastening System Research Program



FRA Tie and Fastener BAA Industry Partners Meeting
2 April 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
- Successes
- Current Areas of Focus
- Key Meetings and Future Events
- Questions and Comments

Crosstie and Fastener Research Team

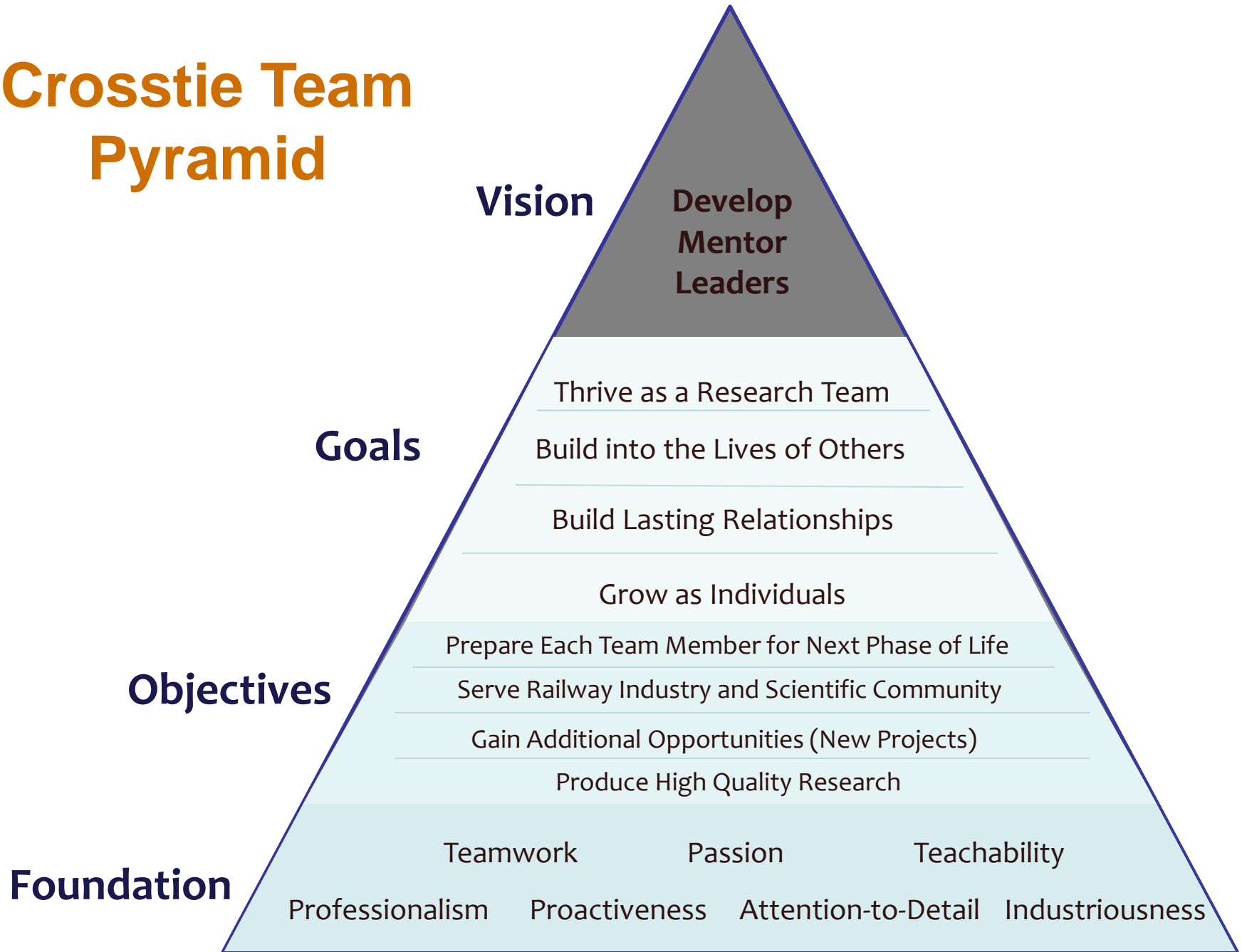
May 2013



Crosstie Program Vision

Investigate real-world engineering challenges related to concrete crossties and fastening 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

Crosstie Research Program Levels and Deployment Locations

Location	Materials	Components	System
Laboratory	Abrasion Resistance Comparison - Small Scale Testing for Abrasion Resistance (SSTAR)	Crosstie Flexural Capacity Experiments – Static Tie Tester (STT)	AREMA Test 6 - Wear/Deterioration Test - Pulsating Load Testing Machine (PLTM)
Field	N/A	N/A	FRA Field Experimentation at Transportation Technology Center (TTC)
Analytical	Statistical Model of Wear Depth	<i>Model of Transfer Length Based on Wire Pattern – Kansas State University (KSU)</i>	Full-Scale FEA Modeling and Model Iterations

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), GIC Ingeniería y Construcción, and IntegriCo (Crosstie Design)
- NEXTRANS Region 5 Transportation Center (RSD)
- National University Rail (NURail) (Fastening System Wear and Fatigue)
- CN Fellowship in Rail Engineering (RSD)



U.S. Department of Transportation
Federal Railroad Administration

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)

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 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, **IntegriCo Project and FRA RSD Projects Awarded**

Papers, Posters, and Presentations

Year	Conference/Meeting	Papers	Presentations	Posters
2009	AREMA	1	1	
	IHHA	1	1	0
2010	TRB	1	1	0
	AARTR Research Review			1
	JRC	1	2	0
	AREMA	2	2	
2011	TRB	1	0	1
	IHHA	3	0	2
	AARTR Research Review			1
	JRC	0	2	0
	WCRR	2	0	2
	AREMA	1	1	
2012	TRB	1	1	1
	AARTR 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
	AARTR Research Review			4
	JRC	3	8	0
	WRI		1	
	AREMA	1	1	
	WCRR	4	1	3
2014	TRB	4	3	1
	JRC	4	8	
Total		42	50	19

FRA Tie and Fastener BAA Status

- Currently in Month 35 (April 2014) of 43 (December 2014)
- Financial status through Month 33 (February 2014):
 - Funding Level: \$3,129,348 (*includes all financial mods*)
 - Expended: \$2,708,006 (87%)
 - Remaining: \$421,342
- Major Efforts Between Now and End of Project (Month 43)
 - Additional Validation and Refinement of the FEM
 - Additional Laboratory Testing (construction and operation of full scale track bed at Schnabel)
 - Coordination of Experimental and Modeling Efforts
 - 2nd International Crosstie and Fastening System Symposium
 - **Development of Mechanistic Design Practices**
 - **I-TRACK Development and Release**
 - **Final Report Completion**

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



U.S. Department of
Transportation
Federal Railroad
Administration

Improved Concrete Crossies 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

Final Report - Table of Contents

Executive Summary

Volume 1

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

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

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

Executive Summary

Volume 1

1. Introduction and Background
2. Laboratory and Field Instrumentation Results
3. Mechanistic Design of Concrete Crossies and Fastening Systems
4. **Conclusions**
5. References
6. 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
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6. Field Instrumentation Results
7. **Modeling Methodology and Development**
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Major Accomplishments

- International Survey
- Loading Quantification Study and Report
- 2012 International Symposium
- Document Depository
- **Papers and Presentations**
- **Lab and Field Experimentation**
 - Lateral load quantification
 - Rail seat pressure measurement
 - Rail seat bending moments for mixed traffic
- **FEA Model Development and Refinement**
- **Full-Scale Track Loading System Design and Construction**
- **Preliminary Development of I-TRACK**

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
 - Completion of first build out of RAIL at UIUC
 - Pursuit of research projects in additional areas:
 - 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

Mechanistic Design Framework

Literature Review

Load Path Analysis

International Standards

Current Industry Practices

AREMA Chapter 30

I – TRACK

Statistical Analysis
from FEM

Free Body Diagram
Analysis

Probabilistic
Loading

Finite Element Model

Laboratory Experimentation

Field Experimentation

Parametric Analyses

Future Meetings and Key Events

- AREMA C-30 and Industry Partners Meetings
 - 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 → 3-5 June 2014

Hosting 2014 International Crosstie and Fastening System Symposium

- Co-organized by: **AREMA Committee 30 (Ties)**, Railway Tie Association (RTA)
- *Three day conference with presentations, discussions, and a technical tour*
- **Focus** → state of the art in timber, concrete, and composite crosstie and fastening system design, performance, research, modeling, and inspection
- **3 - 5 June 2014** – Sessions on UIUC campus
4 June 2014 – Technical tour to UIUC Research and Innovation Laboratory (Rail) and voestalpine Nortrak facility in Decatur, IL
- Strong domestic and international participation; addressing topics including:
 - *Laboratory and Field Testing*
 - *Component and System Modeling*
 - *Automated Inspection Technologies*



RAILTEC

2014 International
Crosstie & Fastening System
Symposium

3-5 June 2014



Rail Transportation and Engineering Center (RailTEC)
University of Illinois at Urbana-Champaign (UIUC)
Newmark Civil Engineering Lab
205 N. Mathews Avenue
Urbana, IL 61801

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U.S. Department of Transportation
Federal Railroad Administration



An Amsted Rail Company



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FRA Tie and Fastener BAA Industry Partners:



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Other Supporting Organizations



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CANADIAN PACIFIC RAILWAY



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Questions and Comments?



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