U.S. Department of Transportation
Federal Railroad Administration

OFFICE OF RESEARCH DEVELOPMENT & TECHNOLOGY
FRA OFFICE OF RAILROAD POLICY & DEVELOPMENT

FRA High-Speed Adjustable Perturbation Slab Track

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OFFICE OF RESEARCH, DEVELOPMENT, AND TECHNOLOGY
OFFICE OF RAILROAD POLICY AND DEVELOPMENT

Two Primary FRA Offices

Office of Railroad Safety

- Rulemaking and Enforcement
- Rail Safety Improvement Act (2008)

Two Primary FRA Offices (cont)

Office of Railroad Policy and Development

- Obligation and oversight of grants and loans (Amtrak, RRIF, HSIPR, TIGER, etc.)
- National Rail Plan
- Passenger Rail Investment and Improvement Act (2008)
- Research and Development and Technology

OFFICE OF RESEARCH, DEVELOPMENT, AND TECHNOLOGY

Track Research Division

Equipment and Operating Practices Division

Train Control & Communications Division

Human Factors Research Division

TRACK RESEARCH DIVISION

Track –Train Interaction Program

- Derailment Prevention
- Wheel/Rail Interface
- Modeling/Simulations
- Track geometry

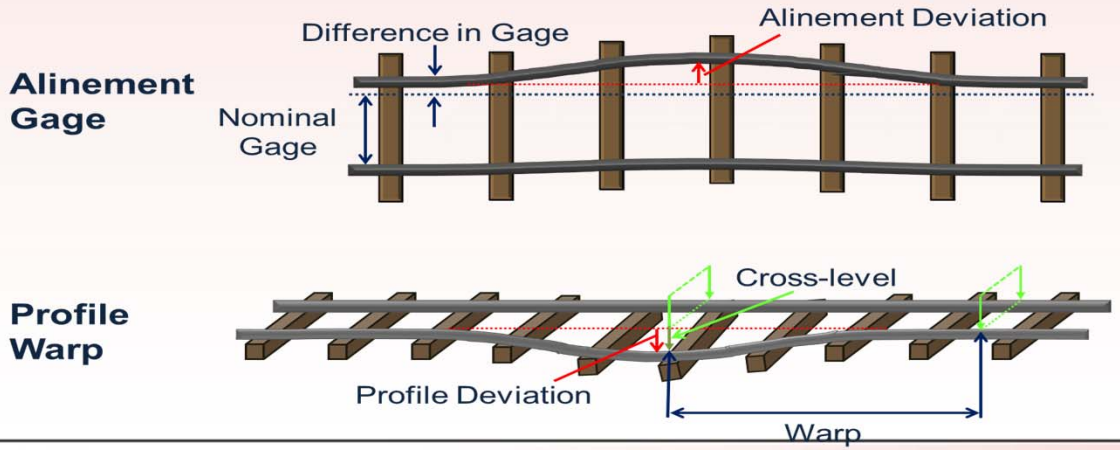
Track and Structure Program

- Rail Integrity
- Tie and Fastener Research
- Ballast and Subgrade Research
- Bridge Research

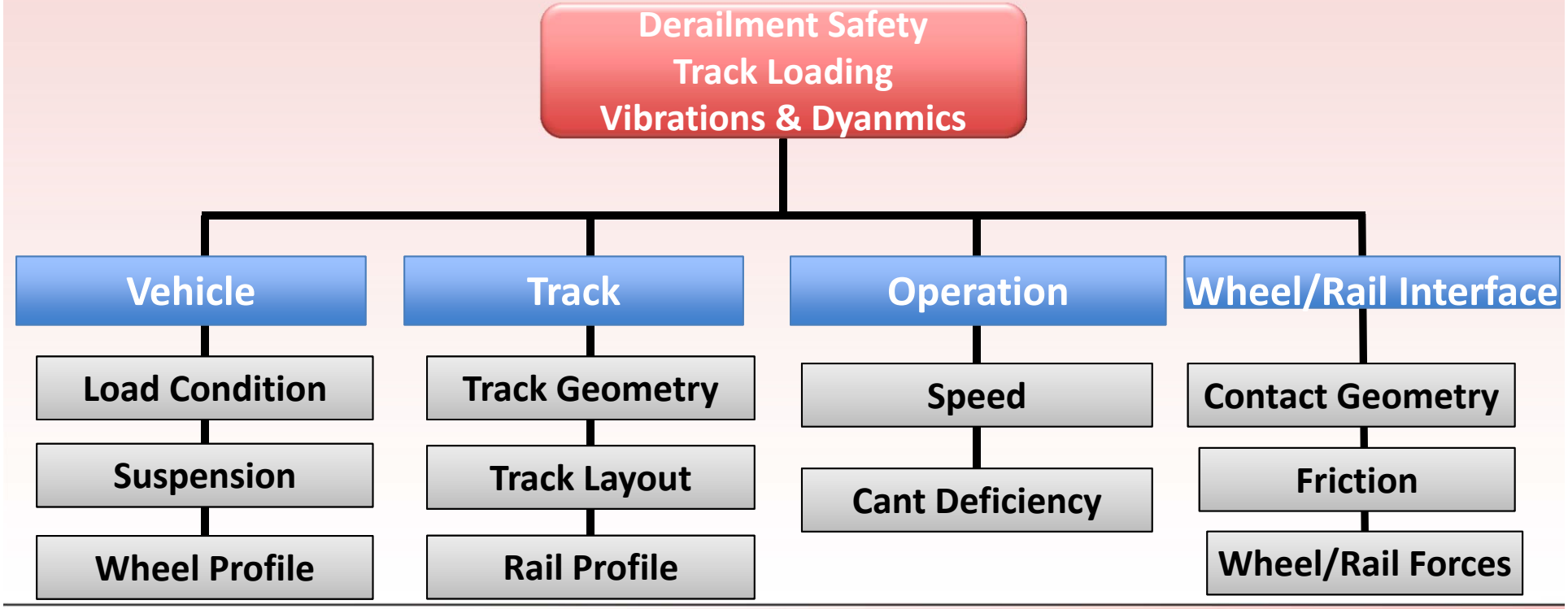
Equipment and Facilities

Vehicle Track Interaction Research

Research in Vehicle/Track Interaction area aims to reduce the risk of derailments and other accidents attributable to the dynamic interaction between the track and the vehicles.



VTI Safety


Derailment Safety
Track Loading
Vibrations & Dyanmics
Vehicle
Load Condition
Suspension
Wheel Profile
Track
Track Geometry
Track Layout
Rail Profile
Operation
Speed
Cant Deficiency
Wheel/Rail Interface
Contact Geometry
Friction
Wheel/Rail Forces

Track-Train Interaction

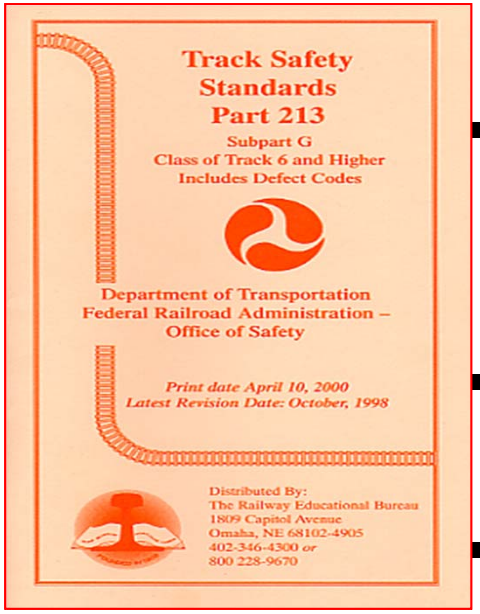
Research Partners:

- Volpe
- Railroads
- Ensco, TTCI, NRC, KLD, Universities, others

Products:

- ATGMS
- Visual Joint Bar Inspection System
- Ride Meter(VTI, ARMS, rMetrix)
- Optimization of Amtrak Wheel/rail Interface
- RCFS

High Speed Track Safety Standards



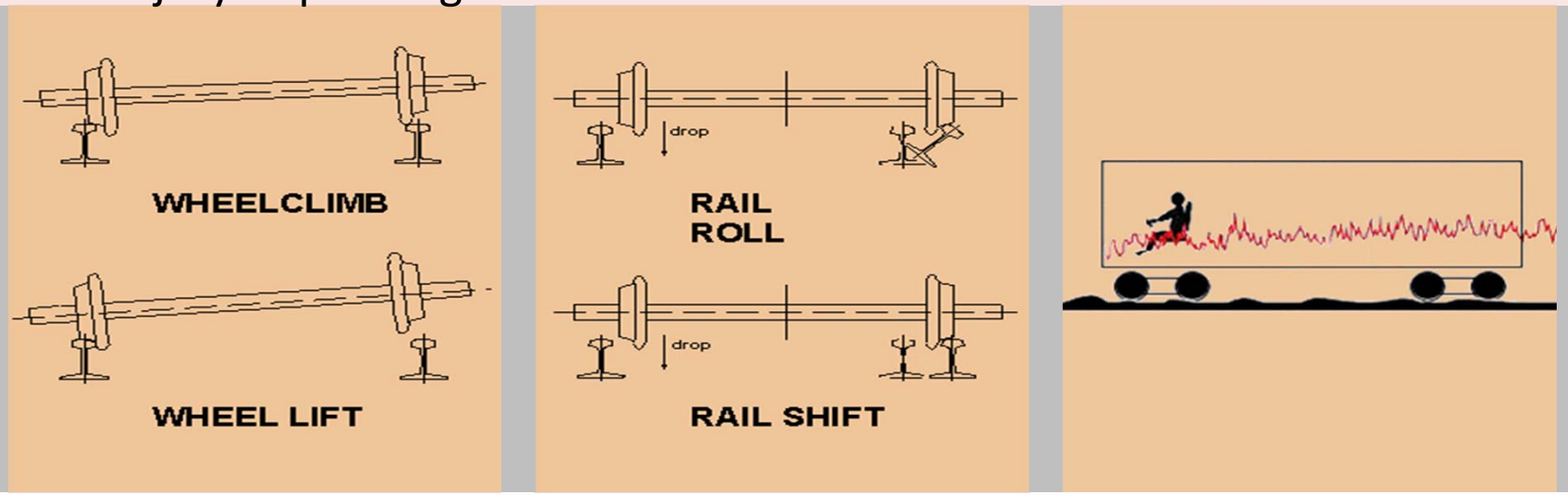
Safe Limits on Track Structure and "Geometry"

Trackworthiness Qualification for high speed and high Cant Deficiency

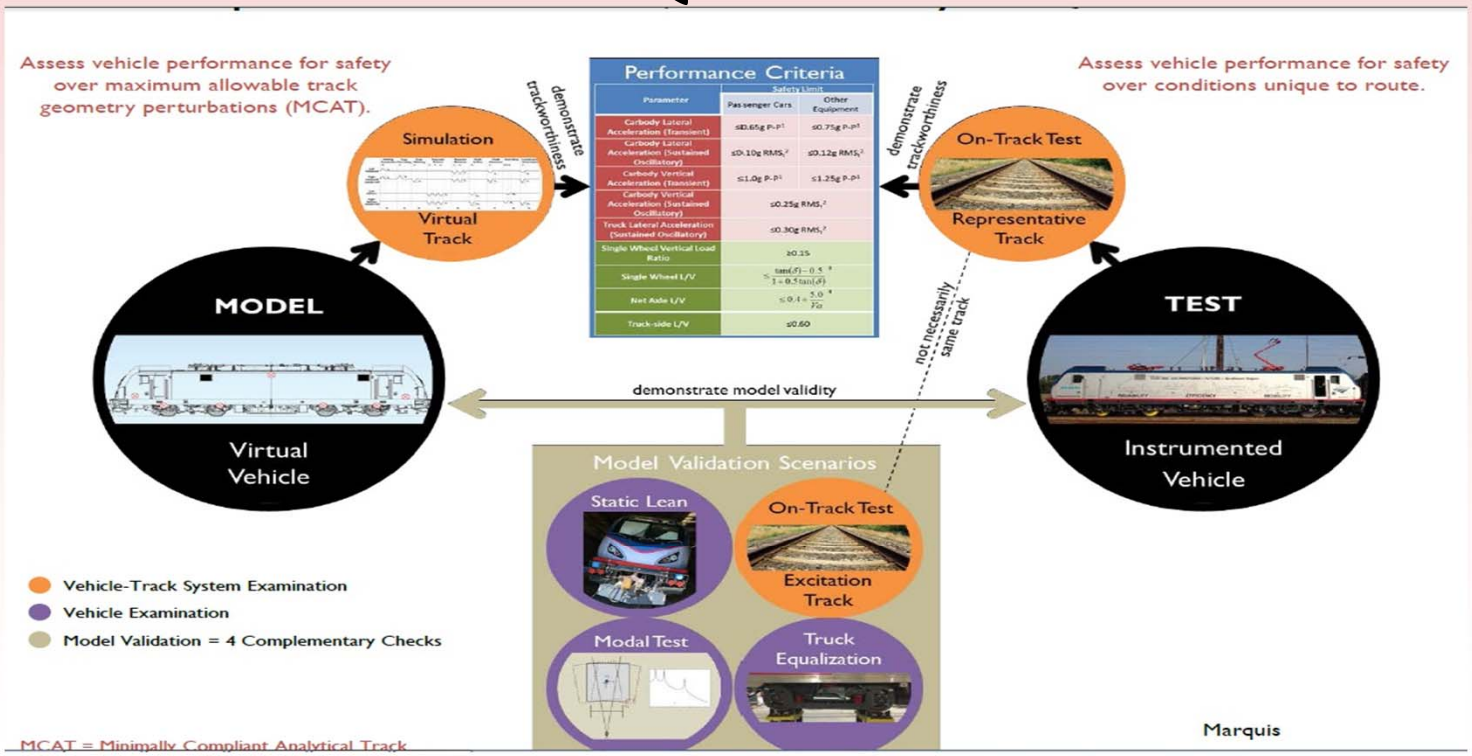
Monitoring and Inspection

VTI Derailment Criteria

Purpose of Criteria: Vehicle dynamics do not overload track, vehicle, or cause injury to passengers



Vehicle Qualification



FRA Cars in Service

High Speed Research Car DOTX216 (T-16)

Only 125 mph operation (NEC)

Track Inspection Car (ATIP) DOTX217 (T-17)

Track Geometry, Ride Quality, Rail Cant, Self propelled capability

Gage Restraint Inspection Car DOTX218 (T-18)

Only Car with GRMS, Testing speed limited to 50 mph, Rail Cant, Track Geometry, 3D Right-of-Way Scanner, Self propelled capability

Track Inspection Car (ATIP) DOTX219 (T-19)

Track Geometry, Ride Quality, Rail Cant, Self propelled capability

Track Inspection Car (ATIP) DOTX220 (T-20)

Track Geometry, Ride Quality, Rail Cant, Towed

Autonomous Track Inspection Car (ATIP) DOTX221 (T-21)

Ride Quality, Track Geometry, Towed

ATIP Support Vehicle DOTX223 (T-23)

Storage, Axle count car

University Support R4

Research Car

High Speed Adjustable Perturbation Test Track

Why Building Test track:

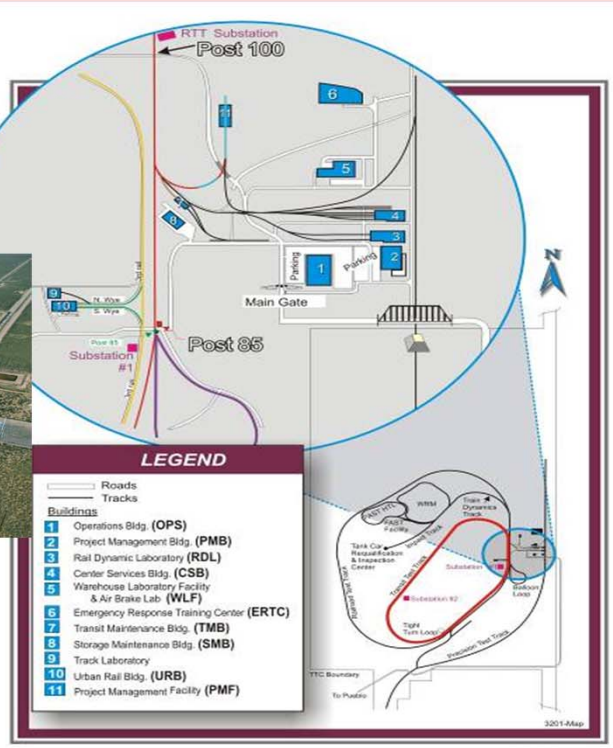
- Need to validate the accuracy of track geometry Measurement systems
  - Current Methods use statistical procedure to evaluate repeatability of measurement system
  - Desired a test facility and procedures to validate the accuracy and repeatability of the system

- Need to provide an utility that can be used for Vehicle model validation with known input.

Asked TTCi to Design and Build the Test Track

FRA ‘s Transportation Technology Center

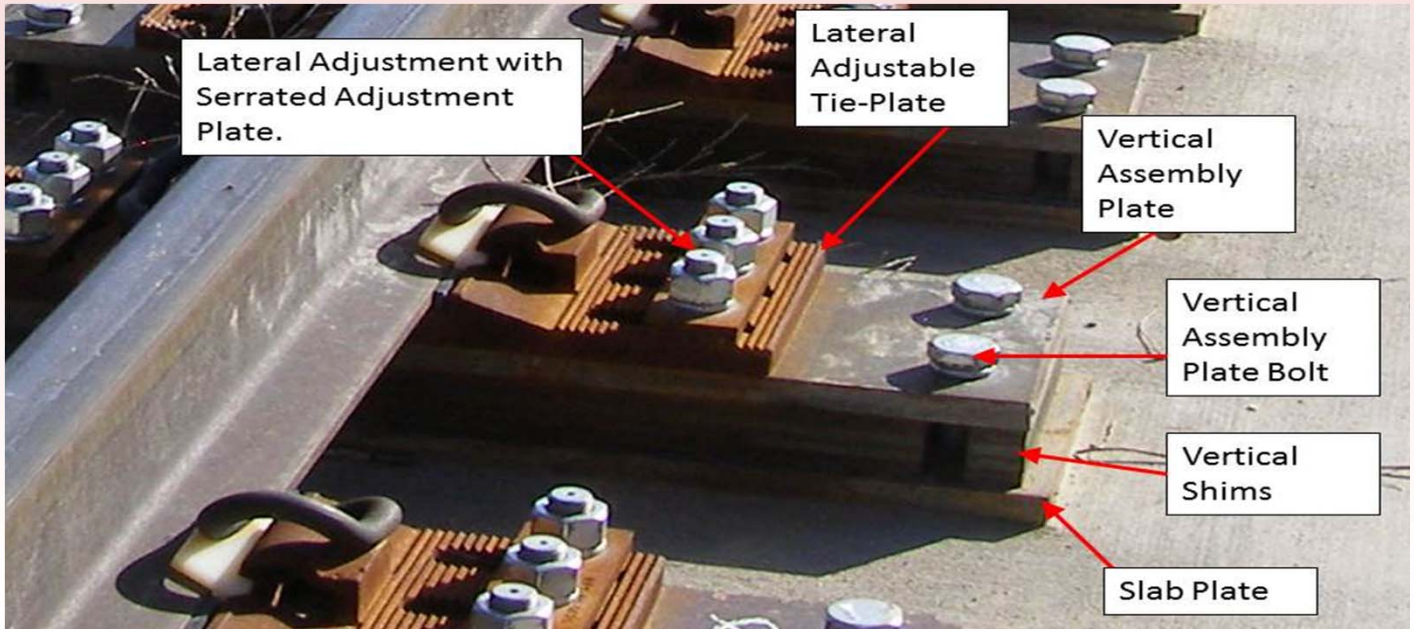
- 52 square miles near Pueblo, CO
- ~50 miles of test track
- Max. testing speed – 165 mph
- Laboratories and workshops
- Association of American Railroads has been the Care, Custody and Control contractor since 1982
- Transportation Technology Center, Inc. took over in 1998



HS-APTT

- The testing facility includes the specially designed tie plates adjustable so that a maximum vertical perturbation of 2 inches can be installed while lateral adjustment of 1.5 inches is possible on either rail.
- Specially designed plates and shims allow track geometry deviations with a resolution or accuracy of 1/8 inch.
- In addition, track properties such as resiliency and damping can be adjusted and controlled.

HS-APTT


Lateral Adjustment with Serrated Adjustment Plate.
Lateral Adjustable Tie-Plate
Vertical Assembly Plate
Vertical Assembly Plate Bolt
Vertical Shims
Slab Plate

Construction

Placement of bottom mat rebar on finished subgrade

Tie plate assemblies in place awaiting rail threading.
End and rear forms for slab in place.

Threading rail onto temporary tie supports prior to attachment of tie plate assemblies to the rail.

Construction

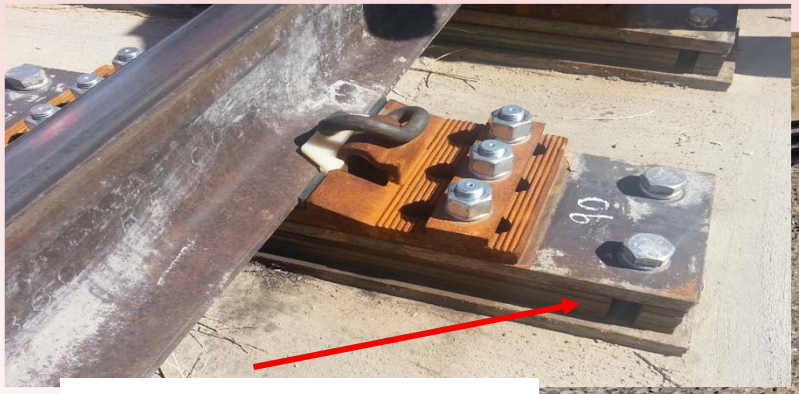
Iron Horse Engineering casting frame supporting rail and tie plate assemblies for concrete casting

Photos showing top rebar mat and coverage of critical components prior to casting of concrete.

Casting of concrete using a pump

Finished Track

Adjustable Tie plates

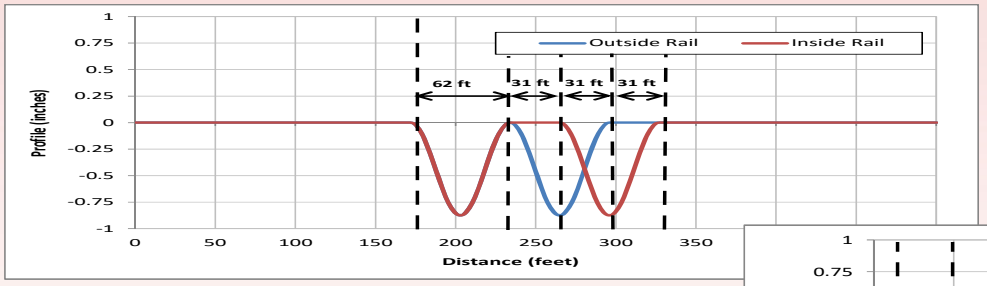


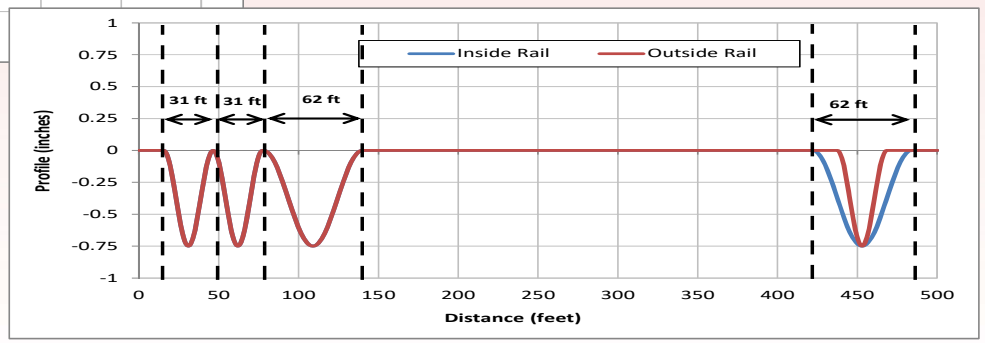
Shims are used to adjust the vertical height of the rail.

Tie plates are moved in and out to introduce lateral deviations.

Wayside Instrumentation

Examples of Vertical Perturbations Installed

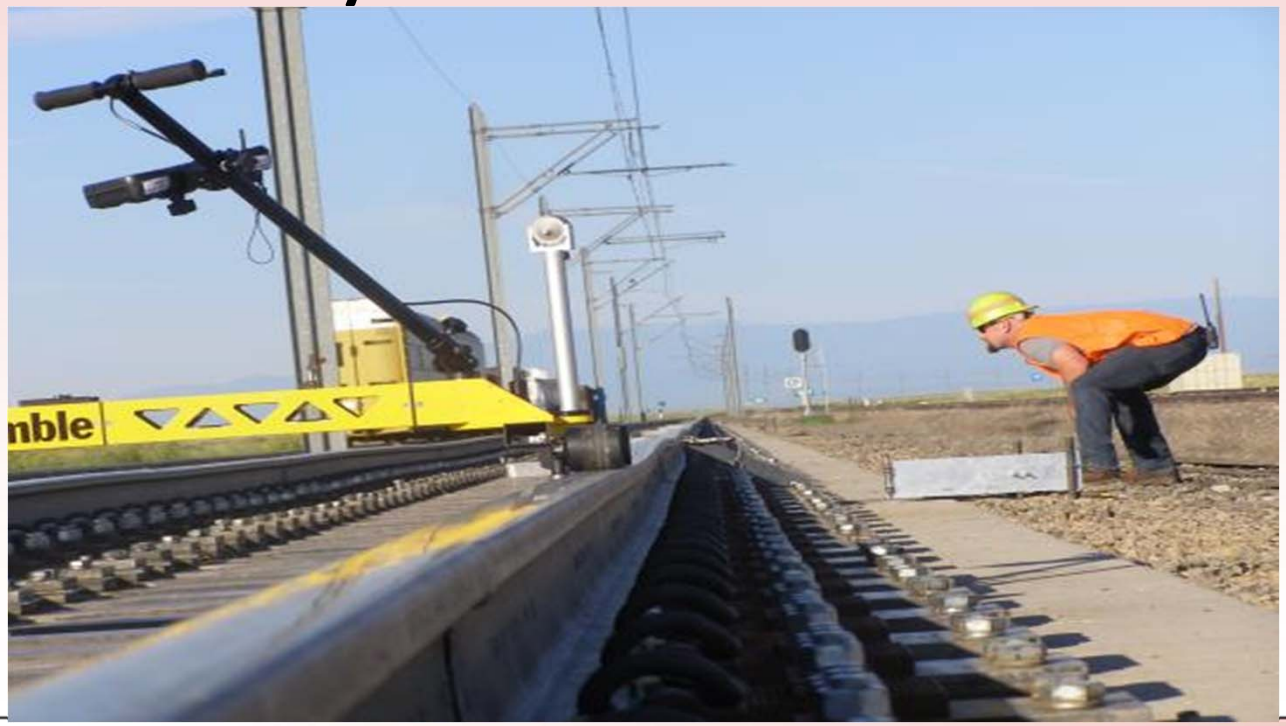




Perturbation Measurements

- Each set of perturbations was measured using a push cart measurement system and traditional survey measurements to provide “ground truth” for comparison to the TGMS measurements.
- The FRA DOTX-216 track geometry test car was operated over the HS-APTT with the introduced deviations.
- Test runs were made at several different speeds from 15 to 100 mph. Each test speed was repeated 3 times, and in both directions of operation to allow comparisons for repeatability.

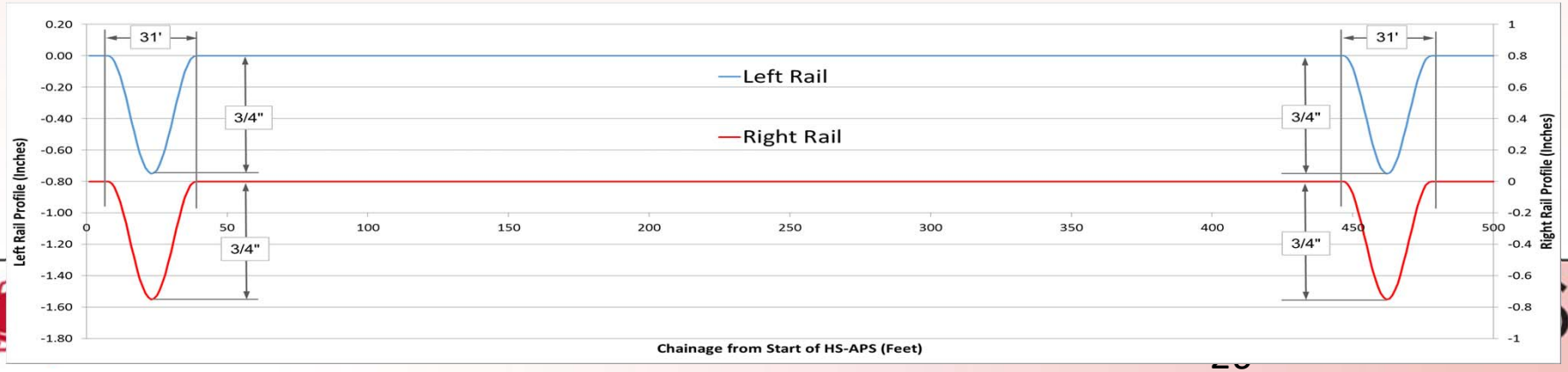
Vertical Perturbations and Push Cart Geometry Measurement at HS-APS



FRA Track Geometry Car Testing

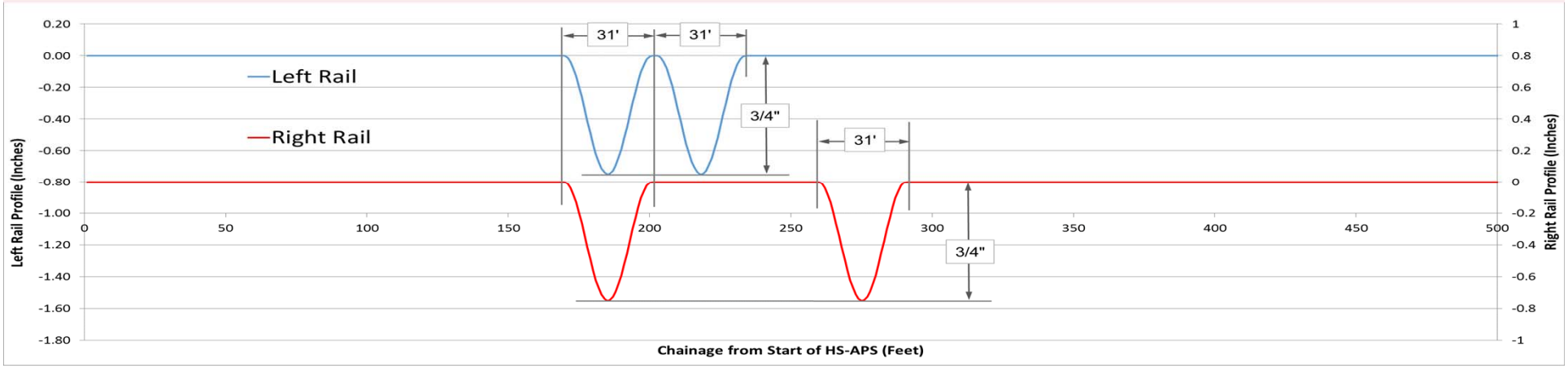
Test Sequence

- Completed four track configurations during initial set of testing:
  - Case 1 – No Deviations
    - 48 runs
    - Included clockwise, counter clockwise, forward and reverse runs
    - Test speeds: 20, 40, 80, and 100 MPH
  - Case 2 - Outside 31’ Profile MCO



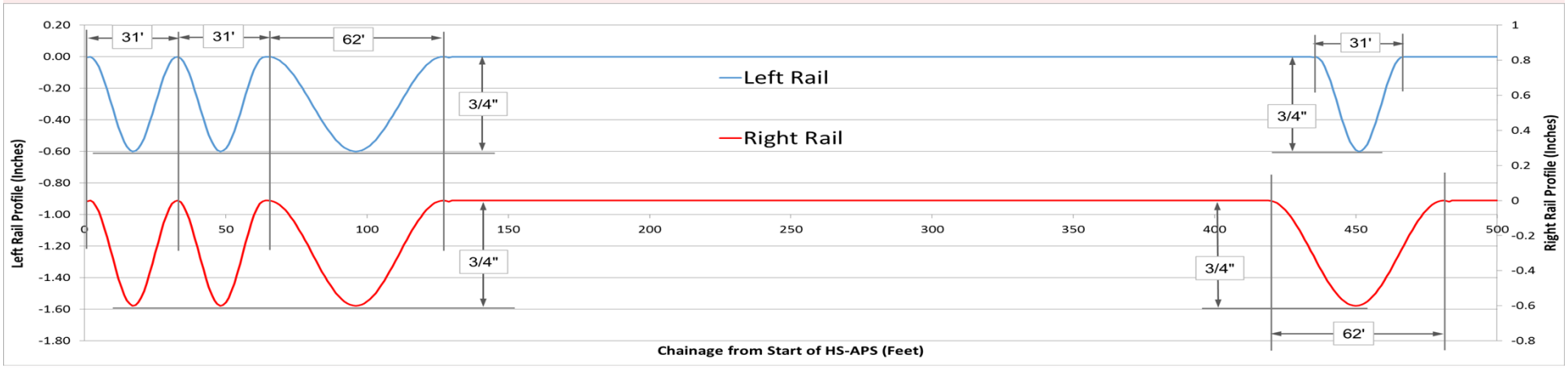
Test Sequence

- Case 3 – Inside 31’ Profile MCO
  - 72 Runs
  - 20, 30, 40, 60, 80, and 100 MPH



Test Sequence

- Case 4 – Blind:
- 72 Runs
  - 20, 30, 40, 60, 80, and 100 MPH



Closing Remarks

- This test track can be used to accurately create different types of track geometry anomalies at different wavelengths, including surface, gage, alignment, and cross level deviations, and combinations of these types.
- It is designed to test the adequacy of track geometry measuring vehicle accuracy
- Also designed for validating vehicle-track interaction modeling simulations.

Closing Remarks

Next Step:

- Finish more tests with DOTx216 to test lateral deviations
- Write a procedure for testing and validating track Geometry Measurement system
- Test FRA's cars Annually to verify the accuracy and calibrate the system
- Continue model validation effort using test track
- Recommend a procedure for Vehicle model validation

Questions?

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