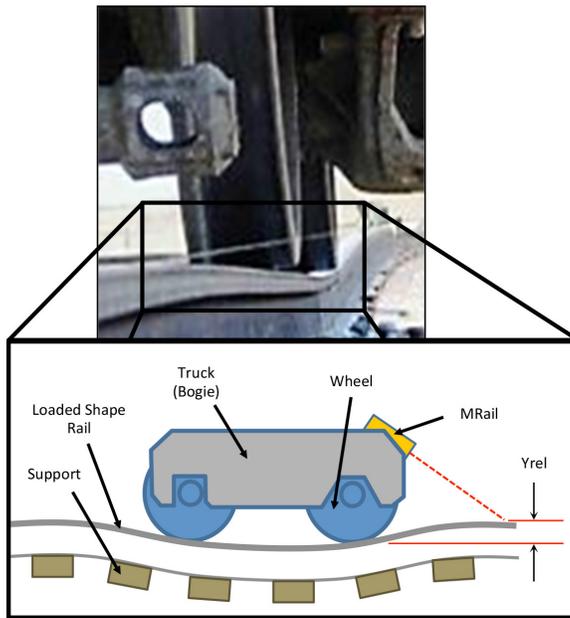


PROTRAN
TECHNOLOGY

A Harsco Rail Company



Photographic and schematic representation of vertical rail deflection

Identifiable Issues:

- Track structural support issues
 - Locations of weak or failing ballast
 - Locations of weak or failing sub-grade
 - Issues with bridge structures
 - Issues with pipes or culverts
 - Transitional support discrepancies
- Broken or weakening ties (sleepers)
- Broken or weakening joints

MRAIL

VERTICAL TRACK DEFLECTION MEASUREMENT SYSTEM

MRAil is the only system available on the market today that measures and records vertical rail deflection

- MRAil measures the vertical difference between the loaded and unloaded rail shape
 - Measurement made relative to wheel/rail contact point
 - This can be transformed into track structure modulus
- Fully autonomous operation
 - Mounts on revenue car
 - Solar powered
- Processed data can help prioritize and direct maintenance activity
 - Can correlate data with locations of track components (bridges, culverts, etc.)

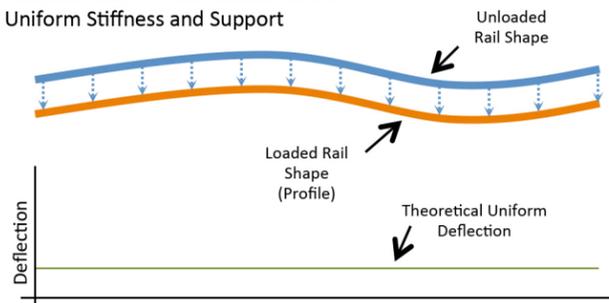
MRAIL - CONCEPT AND ANALYTICS

VERTICAL TRACK DEFLECTION MEASUREMENT SYSTEM

MRAil measures and records the actual vertical difference (rail deflection) between the unloaded and loaded rail states (Shown as the arrows in the below examples).

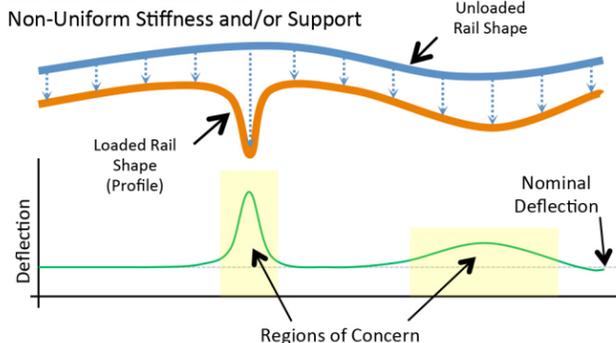
Loaded Rail - Theoretical Case

Uniform Stiffness and Support

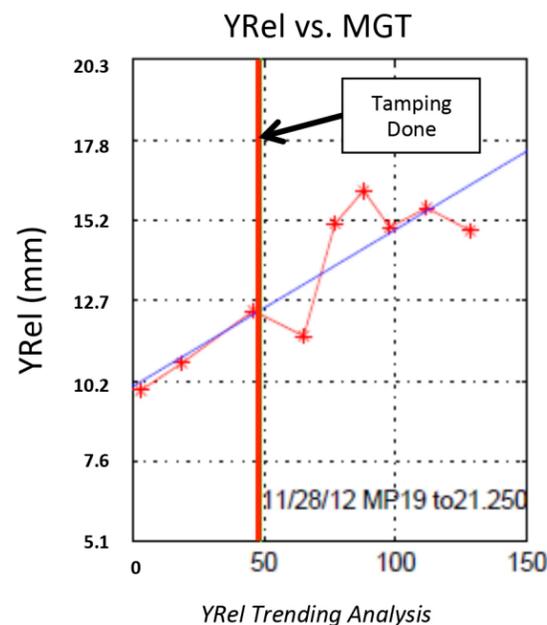


Loaded Rail - Real World Case

Non-Uniform Stiffness and/or Support



- Data comes off car as deflection (YRel) at a location
- This data can be further processed to yield safety and maintenance information
- Analyses include:
 - Threshold analyses
 - Maintenance quality checks
 - Component/location degradation analyses
 - Evaluate effectiveness of:
 - Tamping
 - Track stabilizing
 - Drainage
 - Bridge transitions and support

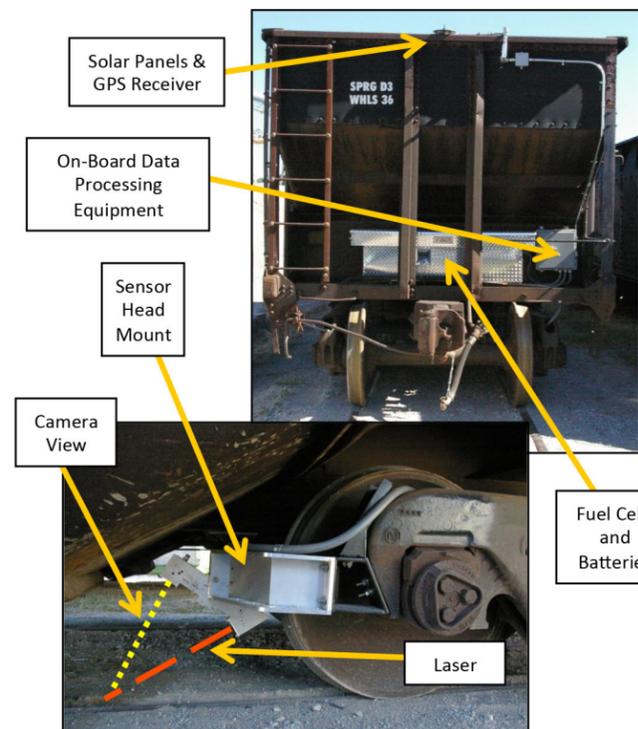
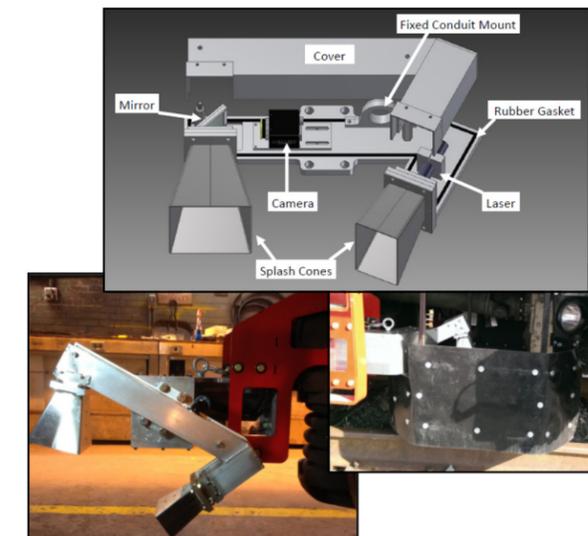


MRAIL - HARDWARE AND MOUNTING

VERTICAL TRACK DEFLECTION MEASUREMENT SYSTEM

MRAil is an autonomous compact laser/camera based measurement system.

- Laser/Camera system
 - Components protected from elements and track particulates
 - Sun glare minimized via blackout sheet
- Ridged mounted system
 - Mounts directly to truck side frame (Bogie)
 - Simple calibration done to dial in deflection measurement



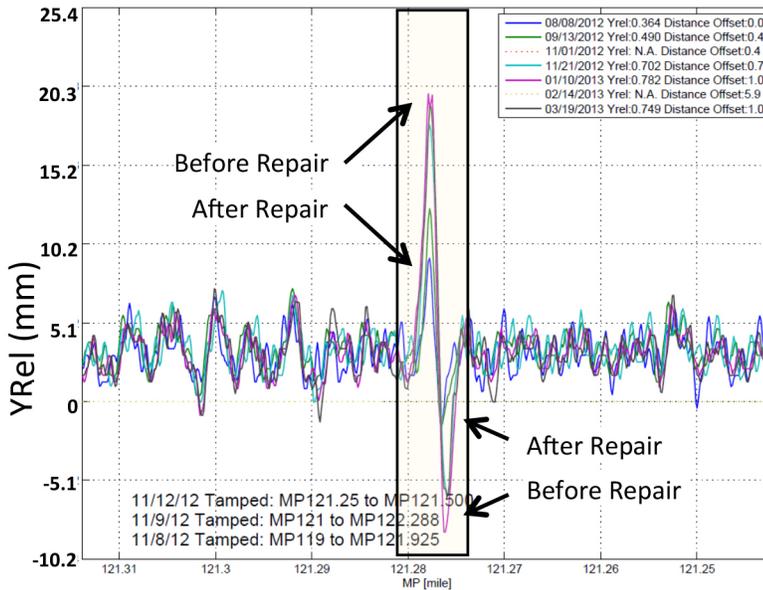
- Mounts on revenue generating car
 - Fully loaded cars give greatest results
 - Sun glare minimized via blackout sheet
- Uses solar panels with battery energy storage for power
- Computer system mounted for data processing
- Data transmitted via cell modem
- Sensor head aimed 1.2m (4 ft) from nearest axle

MRAil mounted on a revenue rail car

MRAIL

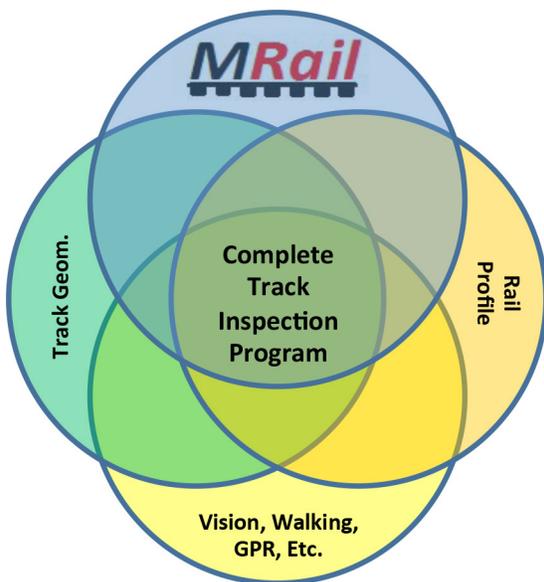
VERTICAL TRACK DEFLECTION MEASUREMENT SYSTEM

Example Exception Identification – Culvert Damage



- A culvert was identified by MRail for having high vertical rail deflection
- Tamping was repeatedly attempted to address deflection - No change In YRel
- Culvert was repaired due to collapsed/broken support collar
- Subsequent measurements confirmed successful repair

Augmenting Existing Inspection Processes



- MRail adds critical information about the track structure that is difficult and time consuming to measure using other techniques
- Adds information that track walkers and hy-rails cannot see

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