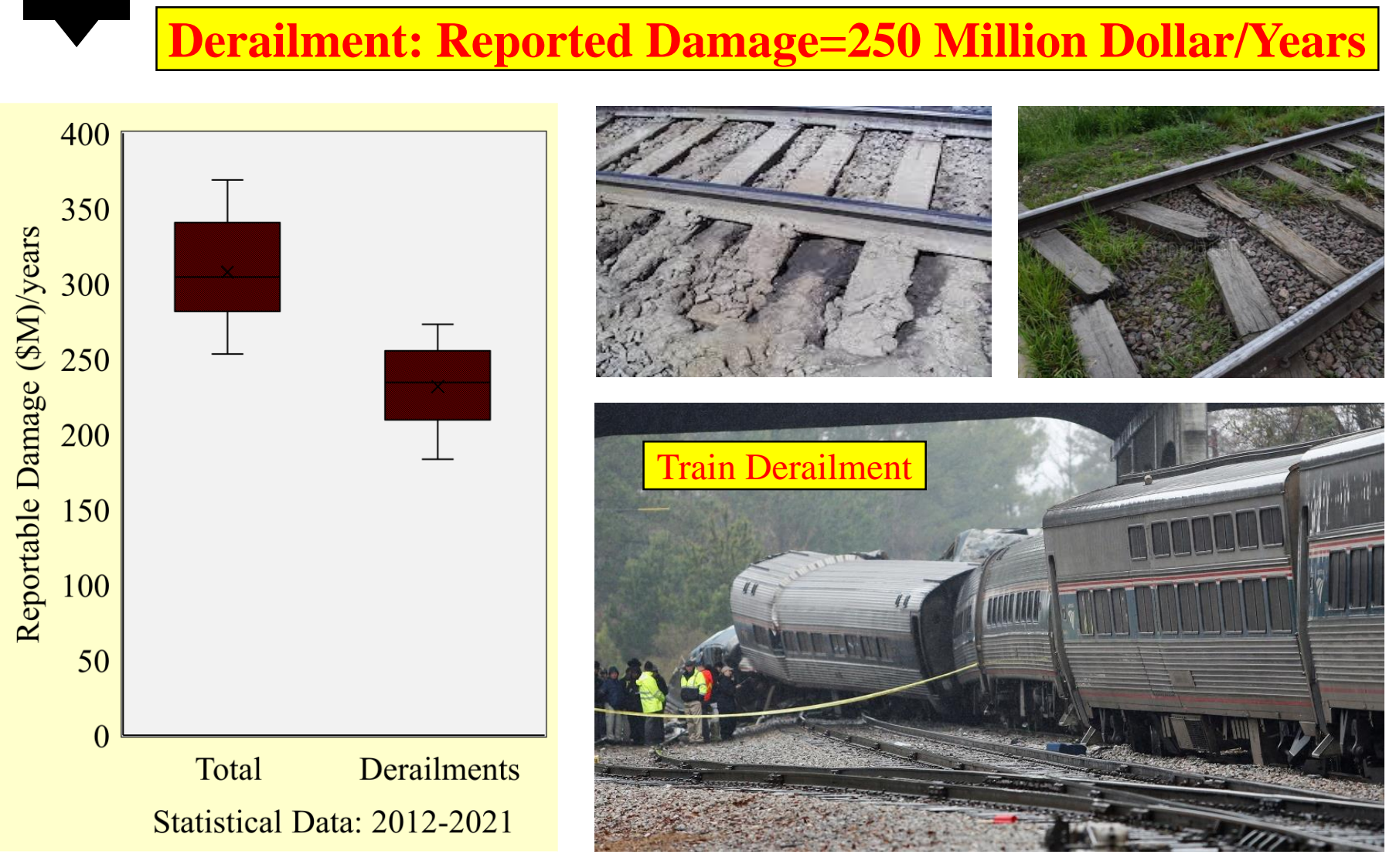
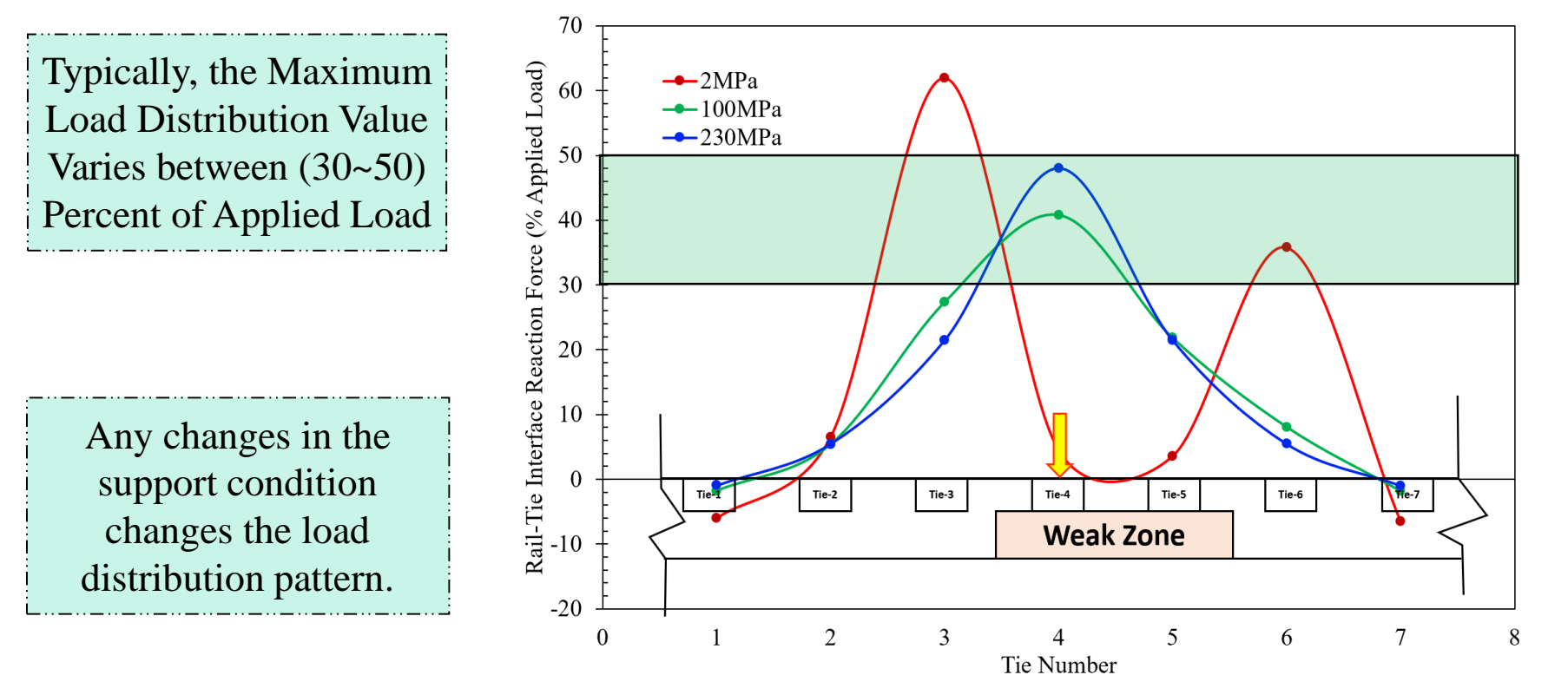


1 Introduction and Motivation



Locations where tie support conditions are not adequate can develop geometry defects, ultimately leading to component failure. Tie reaction force can indicate the load distribution patterns and quality of vertical support along a track.

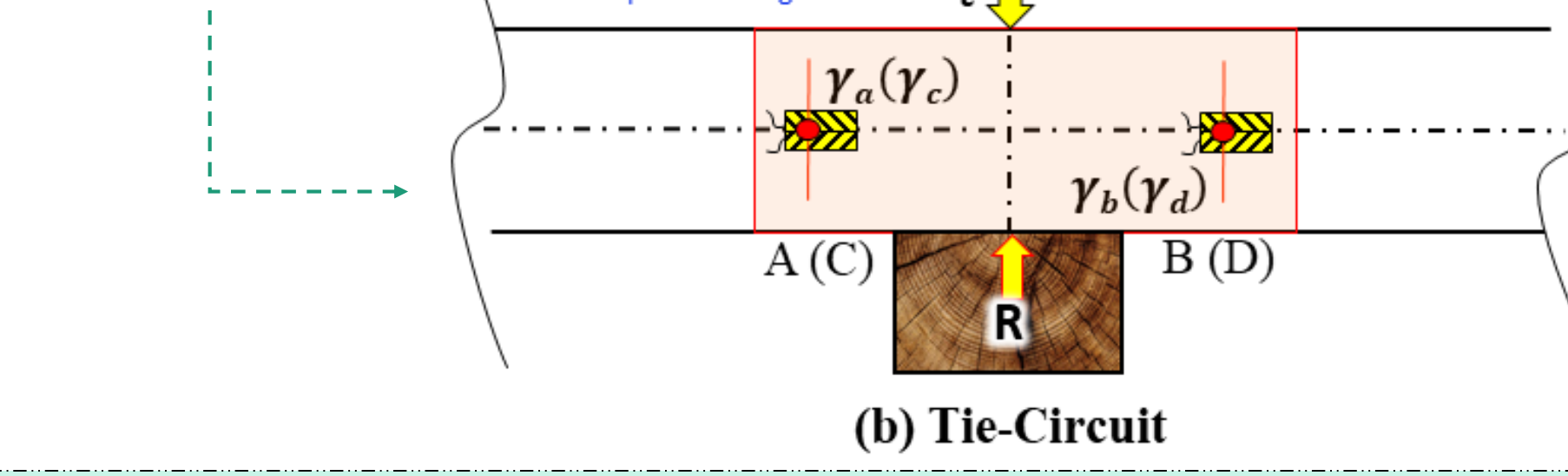
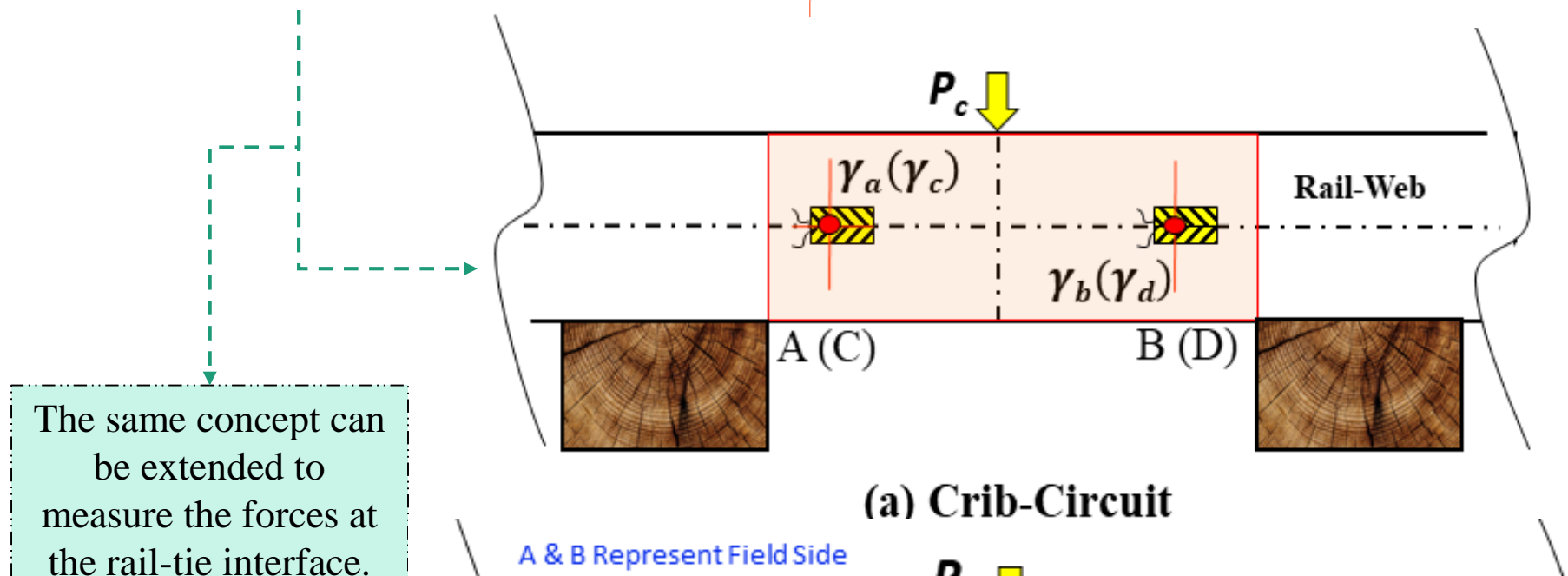


2 Theory and Objective

A strain gauge-based approach using the concept of differential shear strain measurement has been established as a suitable method for wheel load measurements. A common example: Wheel Impact Load Detection (WILD) Systems

Shear Force

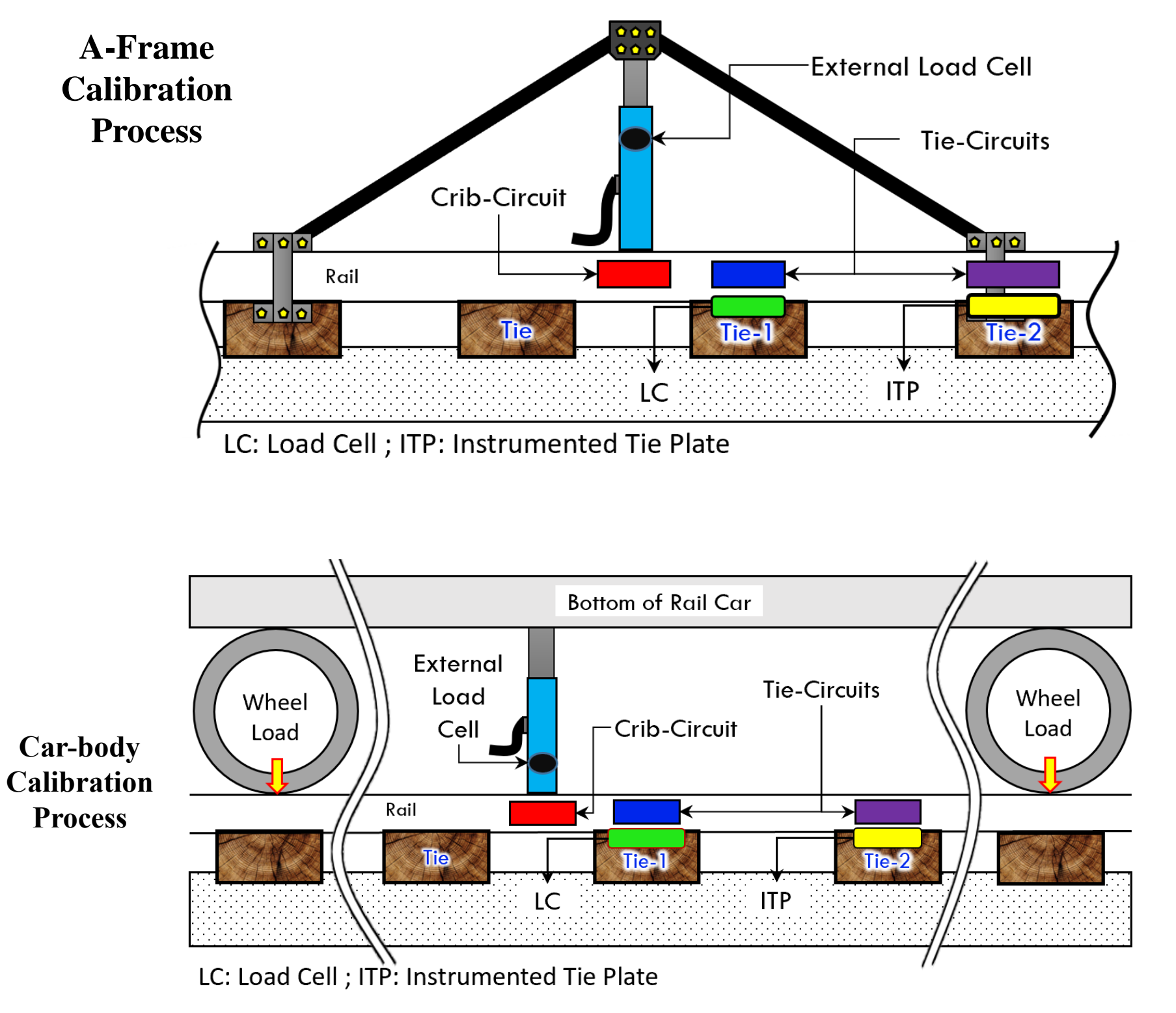
Strain Gauge



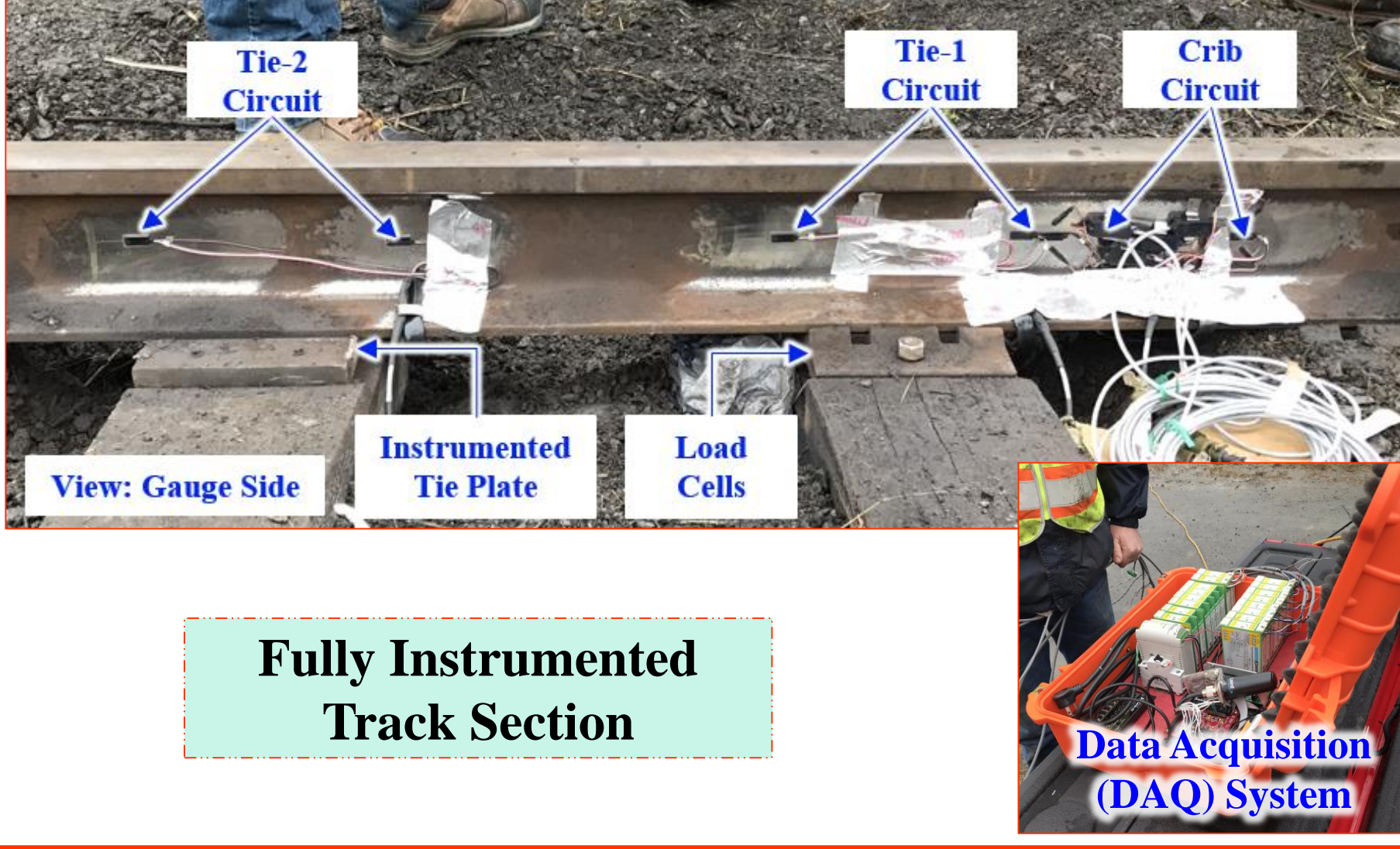
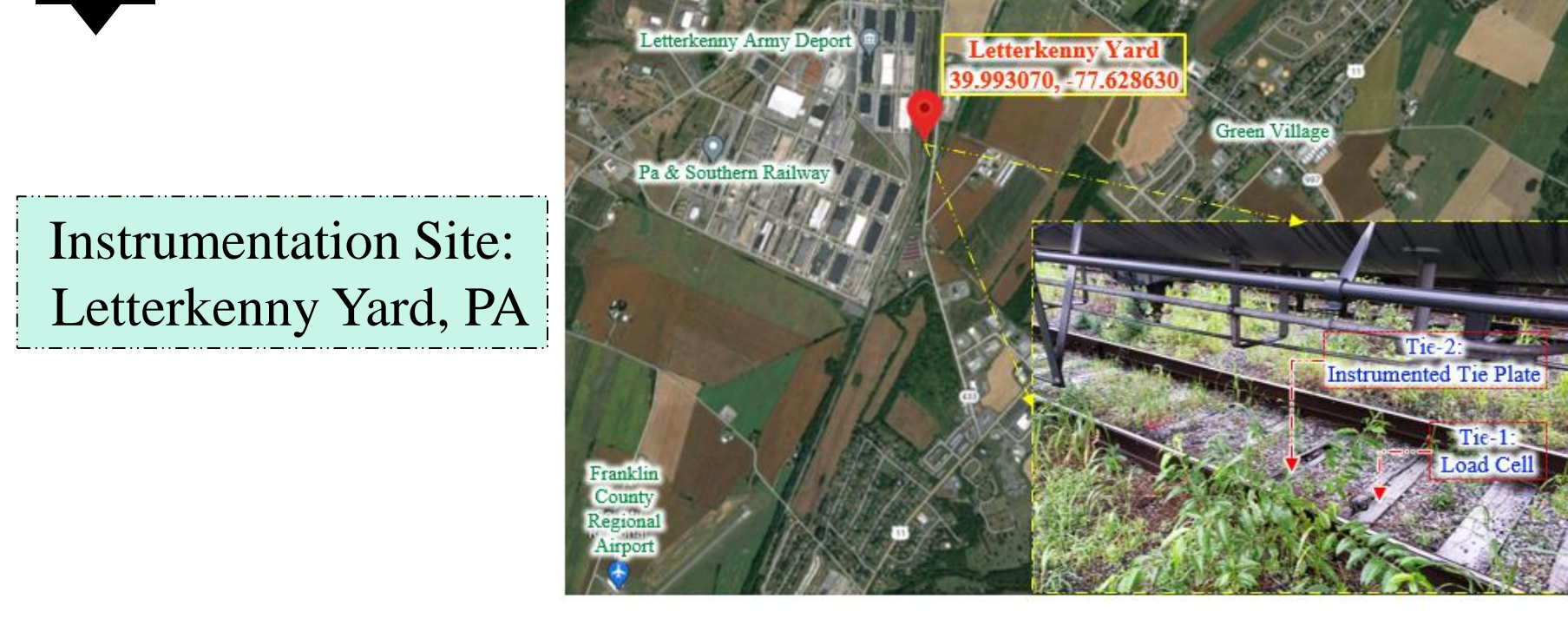
- Motivation:**
- Concerns about strain gauge circuit calibration process.
 - Concerns about accuracy and validity of tie reaction measurement concept.

3 Design: Instrumentation and Calibration

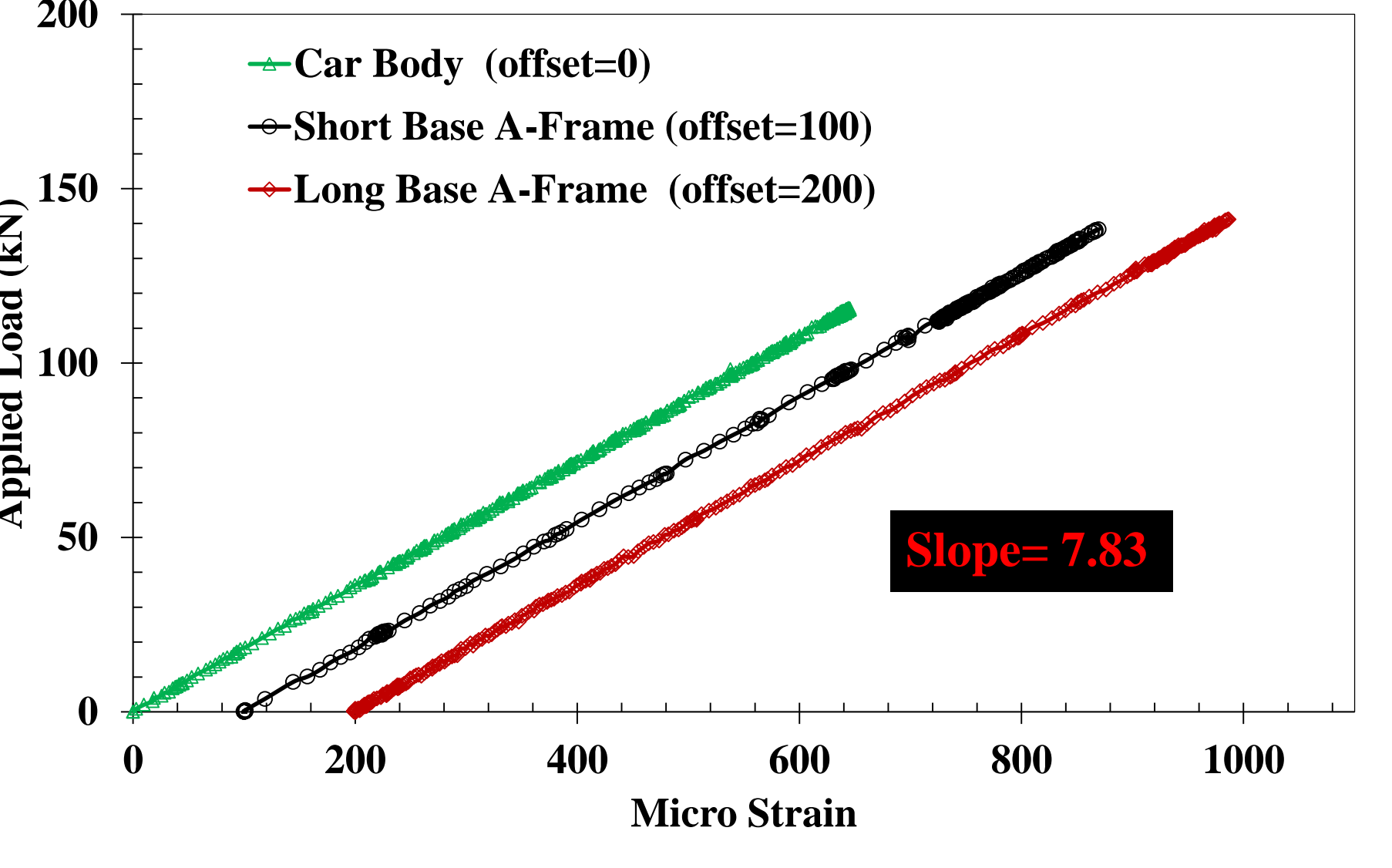
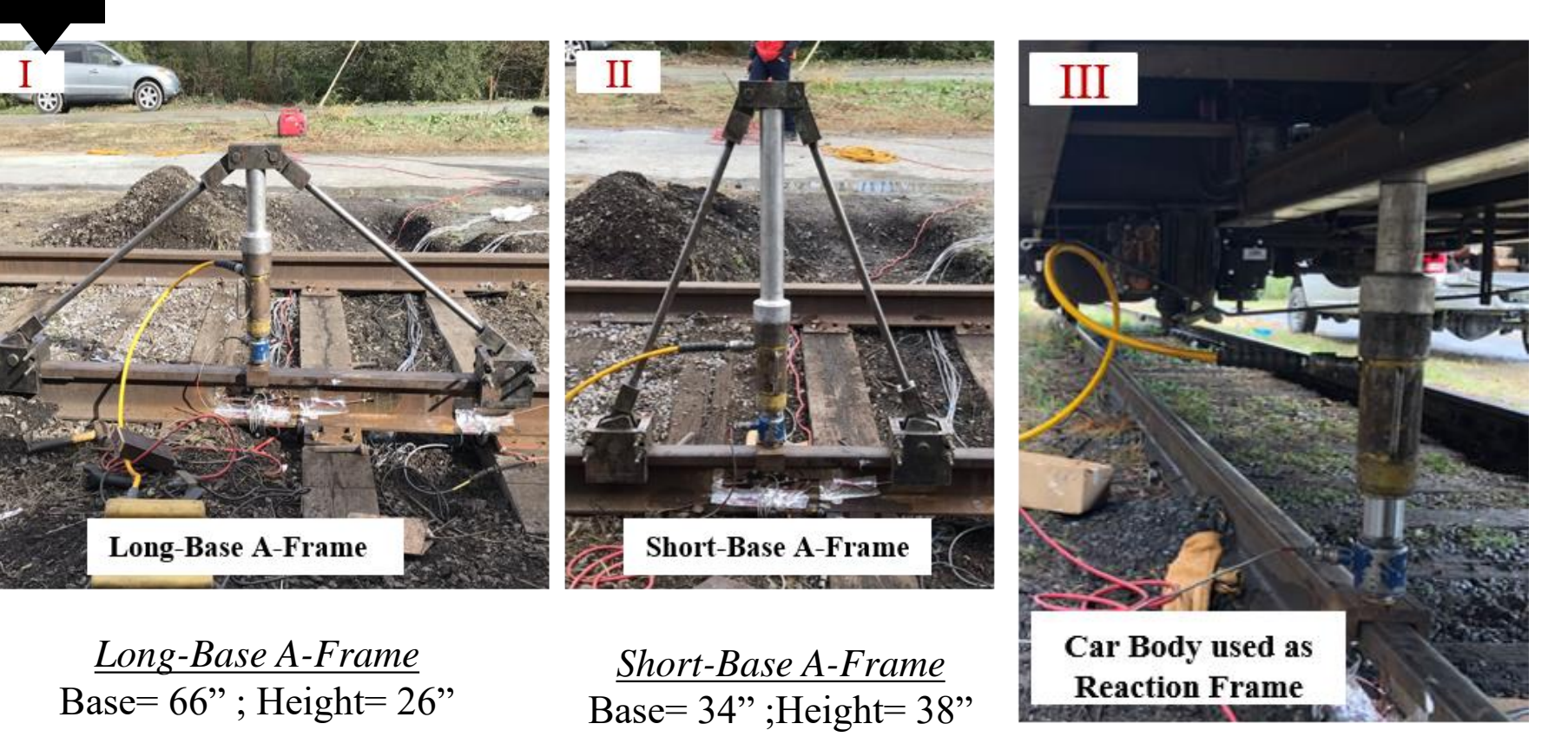
Schematic Representation of Two Different Methods used for Strain Gauge Circuit Calibration: (a) A-Frame; (b) Empty Hopper Car used as Reaction Frame



4 Field Instrumentation

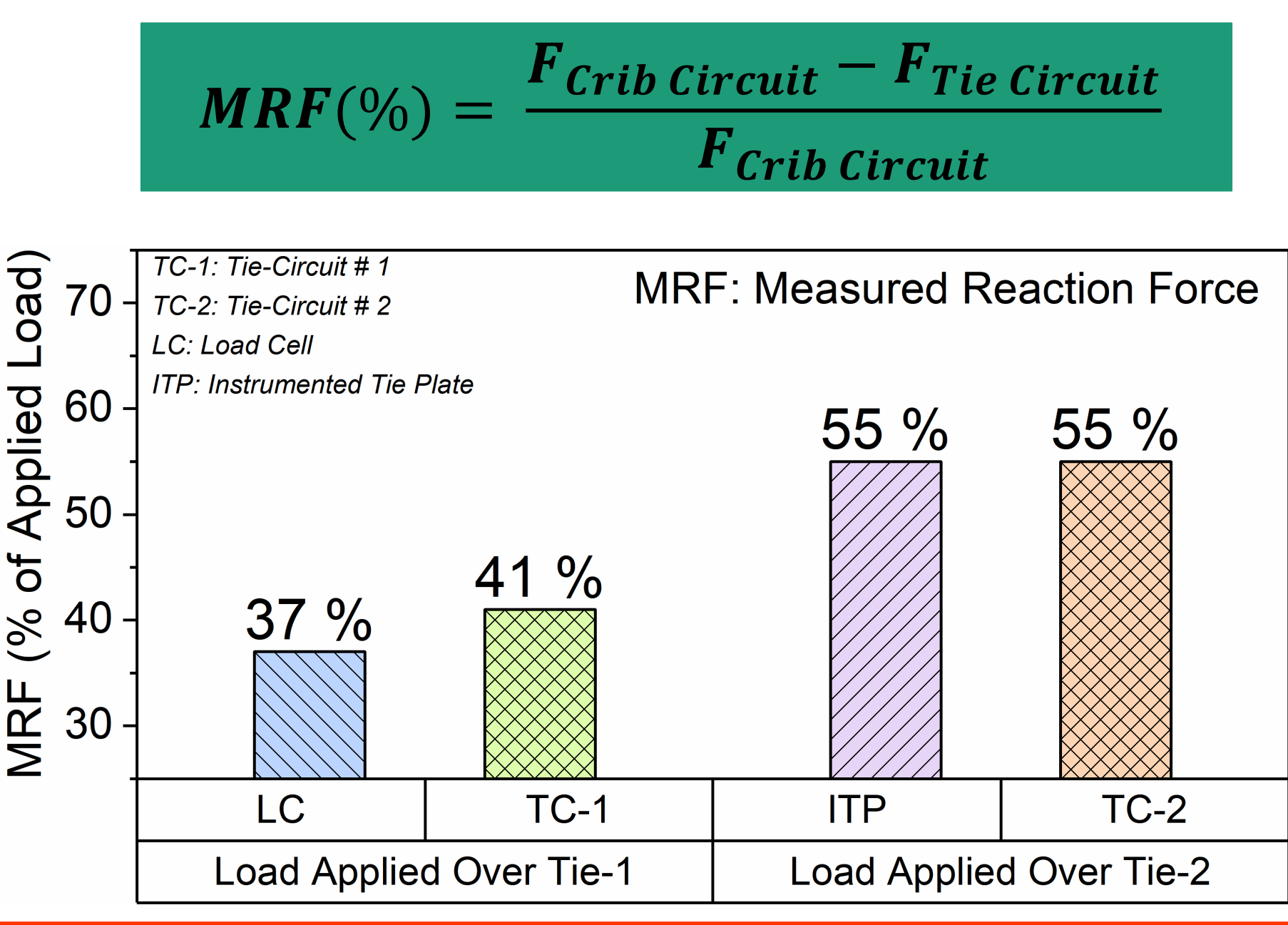
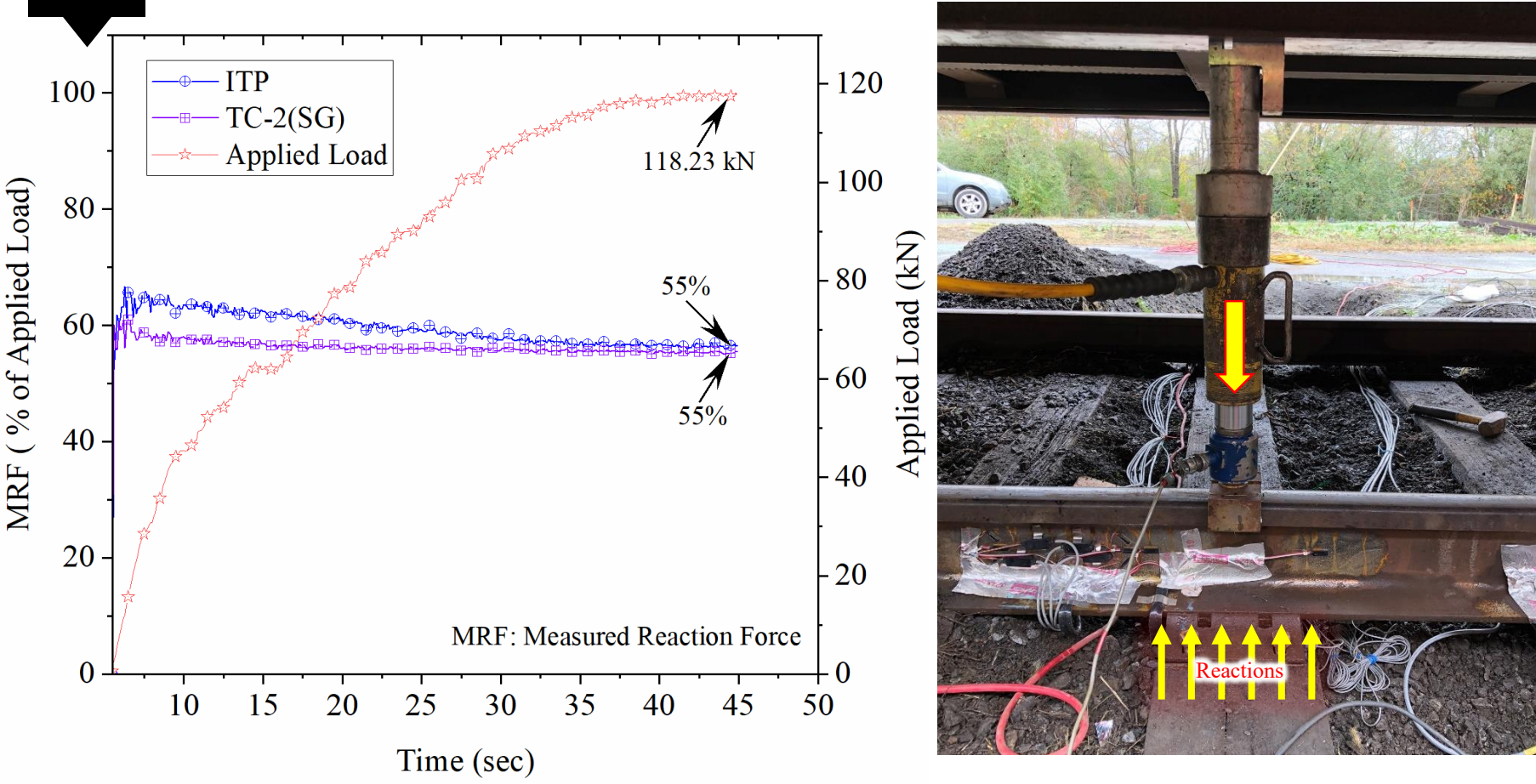


5 Field Calibration of Crib Circuit

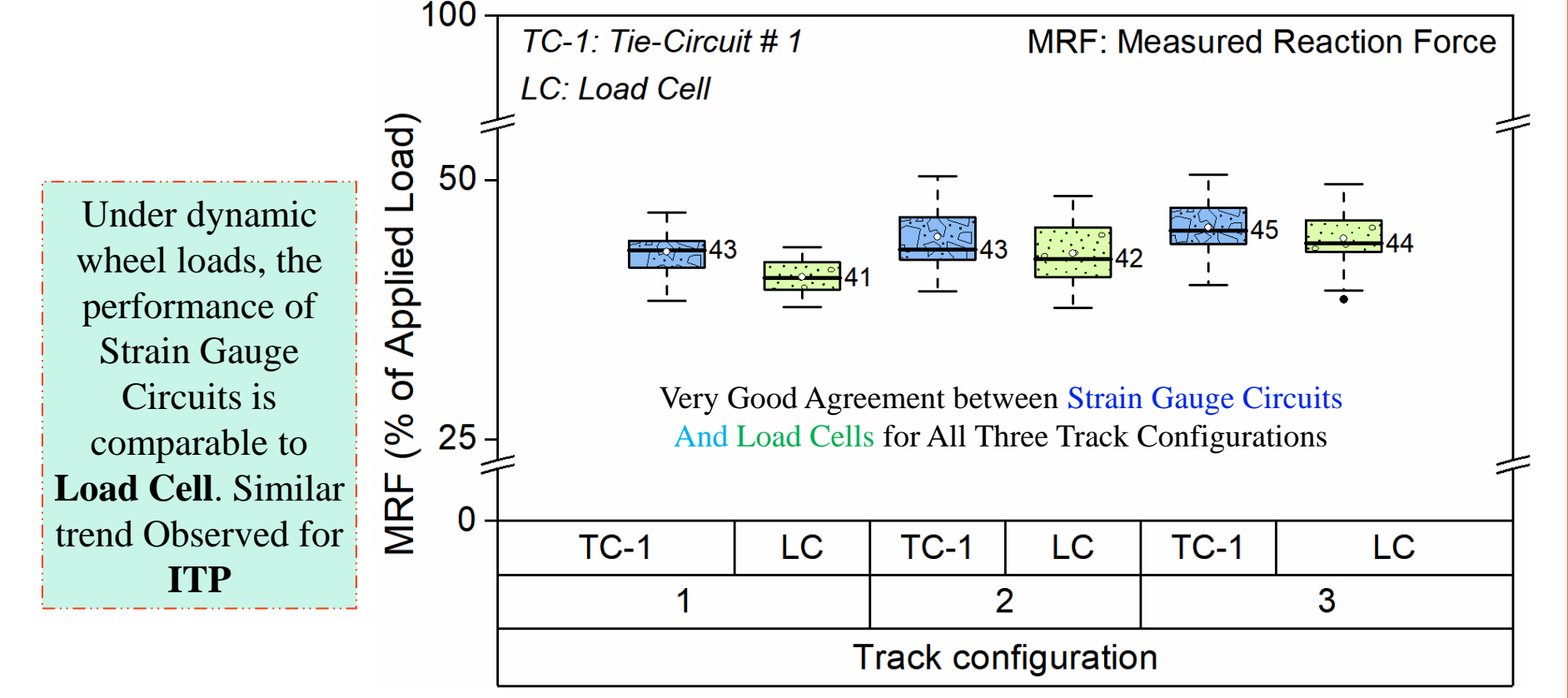
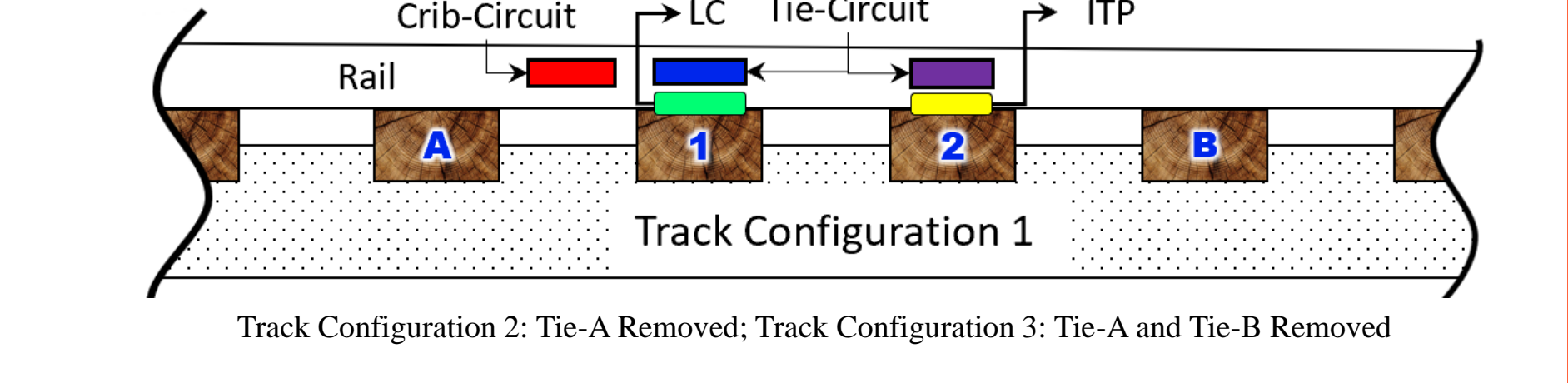
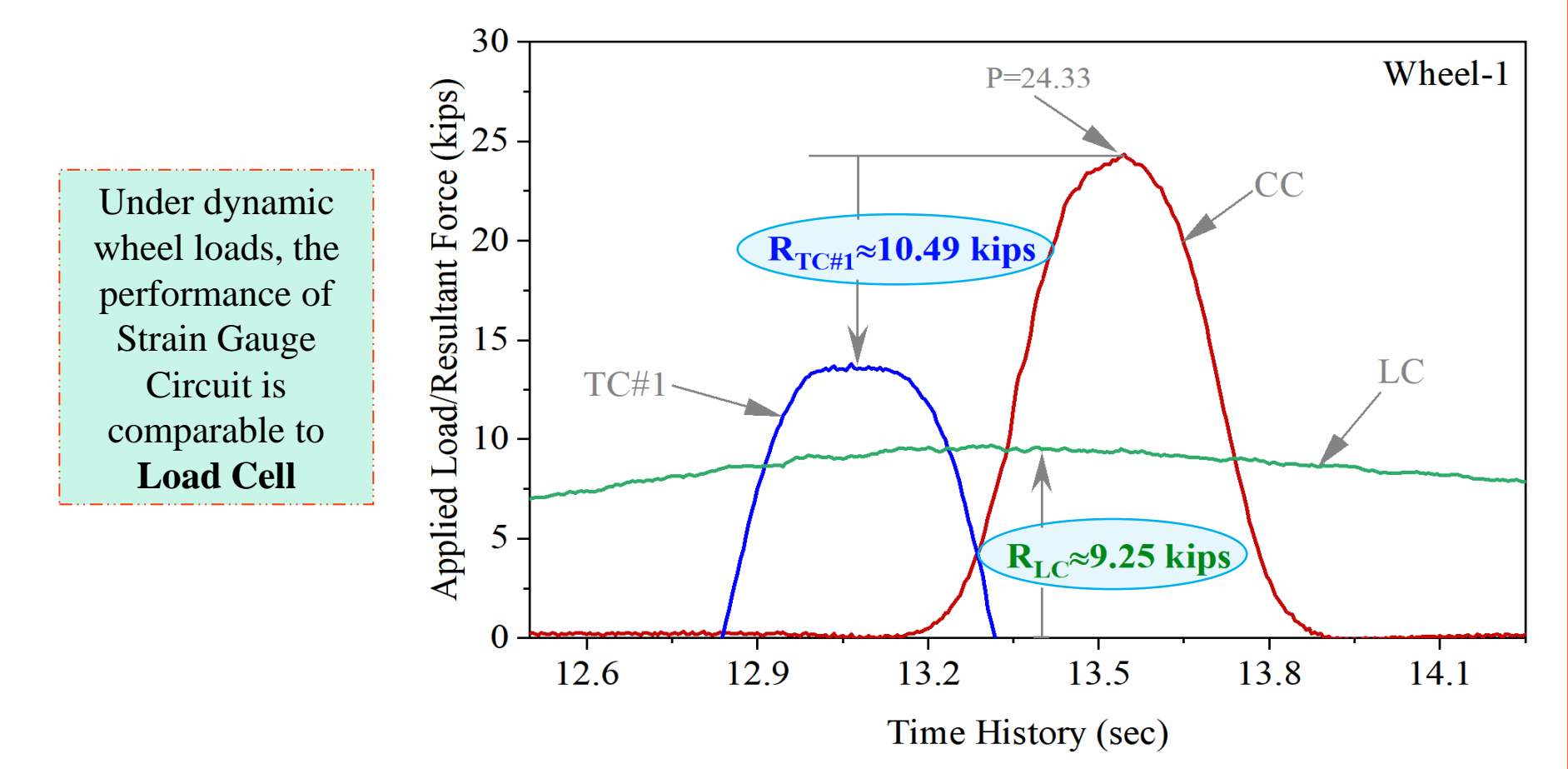
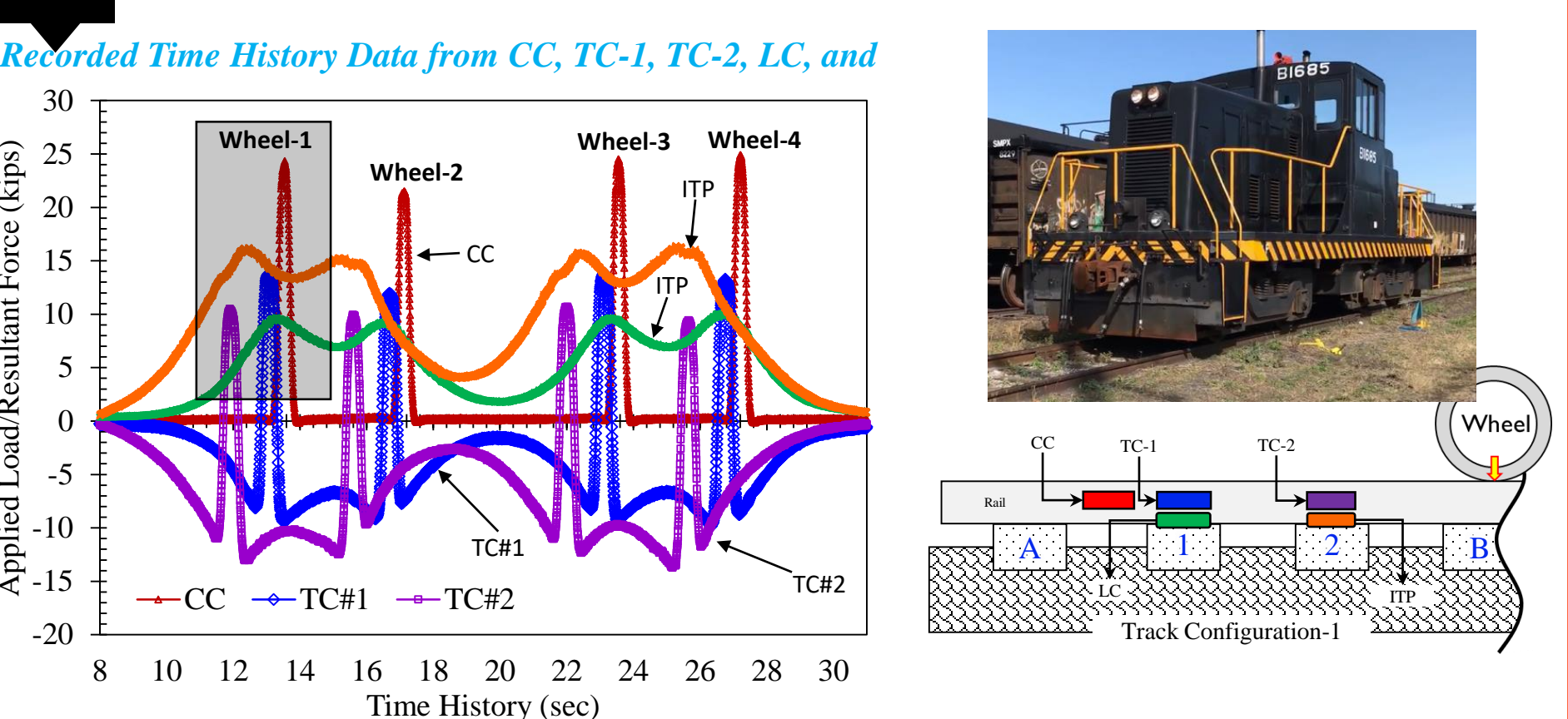


For all calibration cases, a slope value of 7.83 indicates that calibration of the strain gauge circuit does not depend on the geometry of the calibration set-up.

7 Support Condition Assessment



8 Response Under Dynamic Loading



9 Findings

- Data from the field testing proved that the differential shear strain measurement approach can be accurately used to **measure the forces at the rail-tie interface**, which indicates the support condition under the tie.
- Irrespective of how the load is applied, data from the **Strain gauge circuit closely matched** those from the **Load Cells and Instrumented Tie Plate**.
- This method represents a **non-invasive approach** for railroad agencies to study support conditions under problematic ties.

10 Acknowledgements

- Late Mr. Harold Harrison for his technical input.
- Instrumentation Services Inc. helped with the field instrumentation.
- Pennsylvania Southern Railroad accommodated testing on its track and provided rolling stock and track time for testing.