Remaining Life Prediction for Rail Vehicles

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Why Evaluate Remaining Life?

- Prolong Fleet Retirement

- Consider Overhaul Alternatives

- Avoid Cost of New Fleet Procurement

Steps to an Effective Evaluation

- Documentaion Review

- Inspection

- Structural Analysis

- Instrumentation
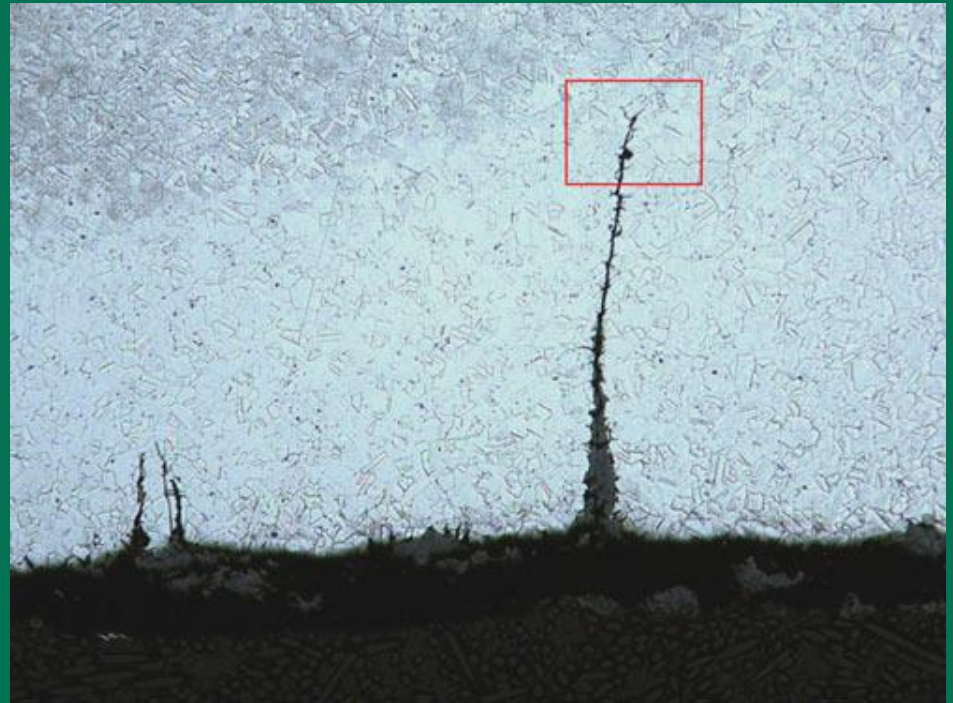
- Testing

- Analysis

Potential NDE Findings

- Undocumented or Unknown Damage

- Fatigue / Cracks in Structure

- Corrosion

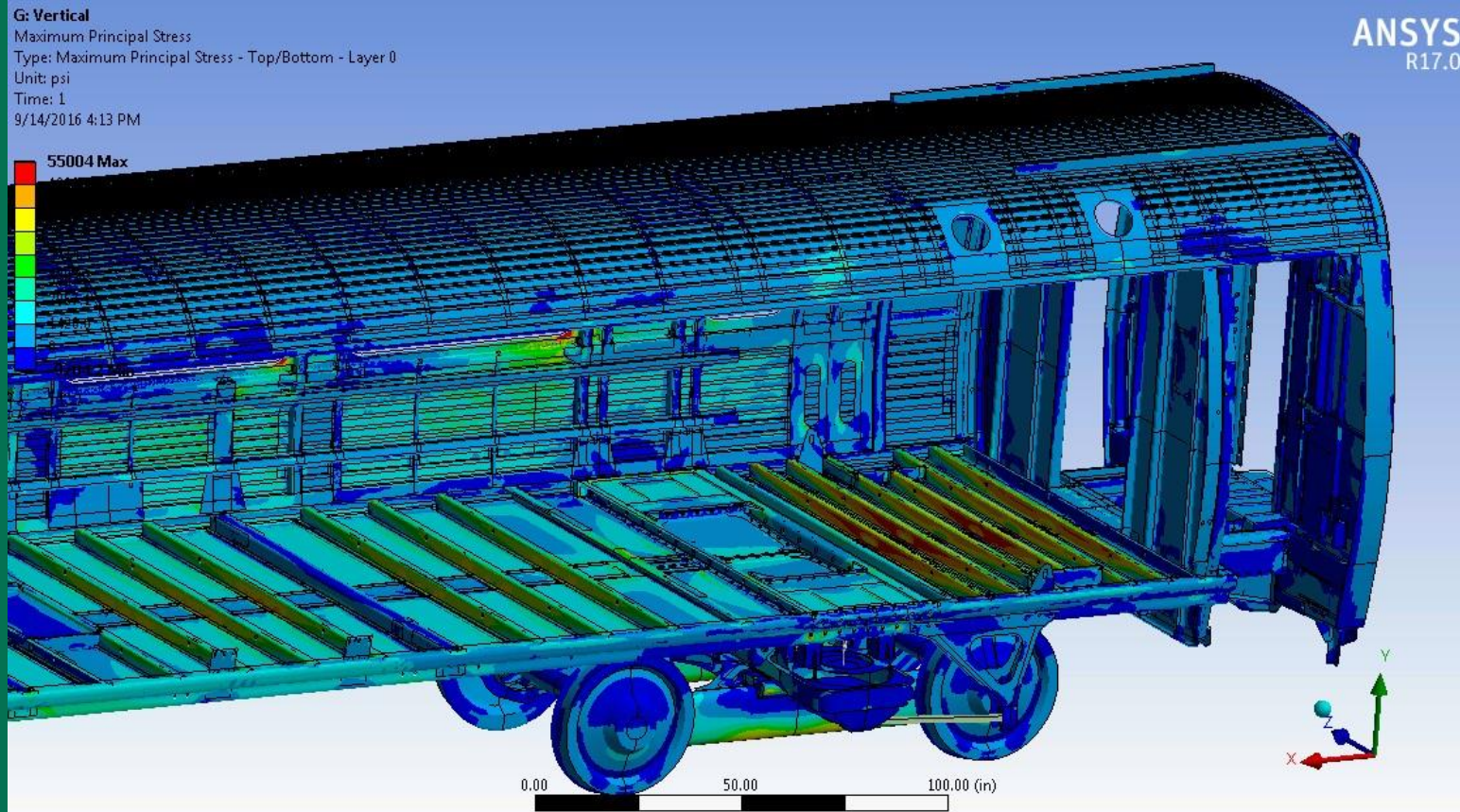# Sample Finding - Corrosion

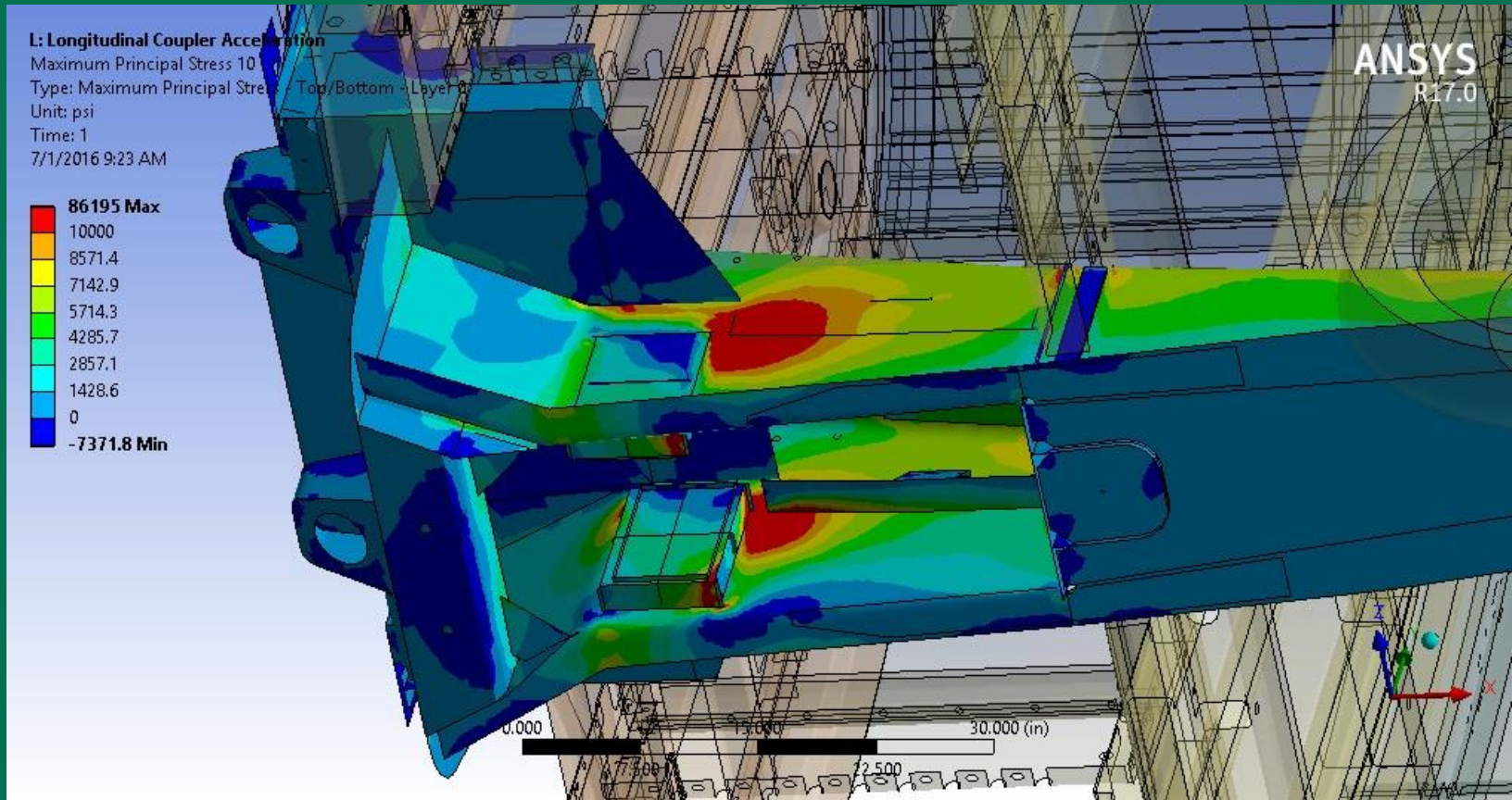# Sample Finding - Corrosion

Structural Analysis

- Drawing Review

- Hand Calculation

- 3-D Finite Element Model

Vertical Load: Principal stress (Front end shown)
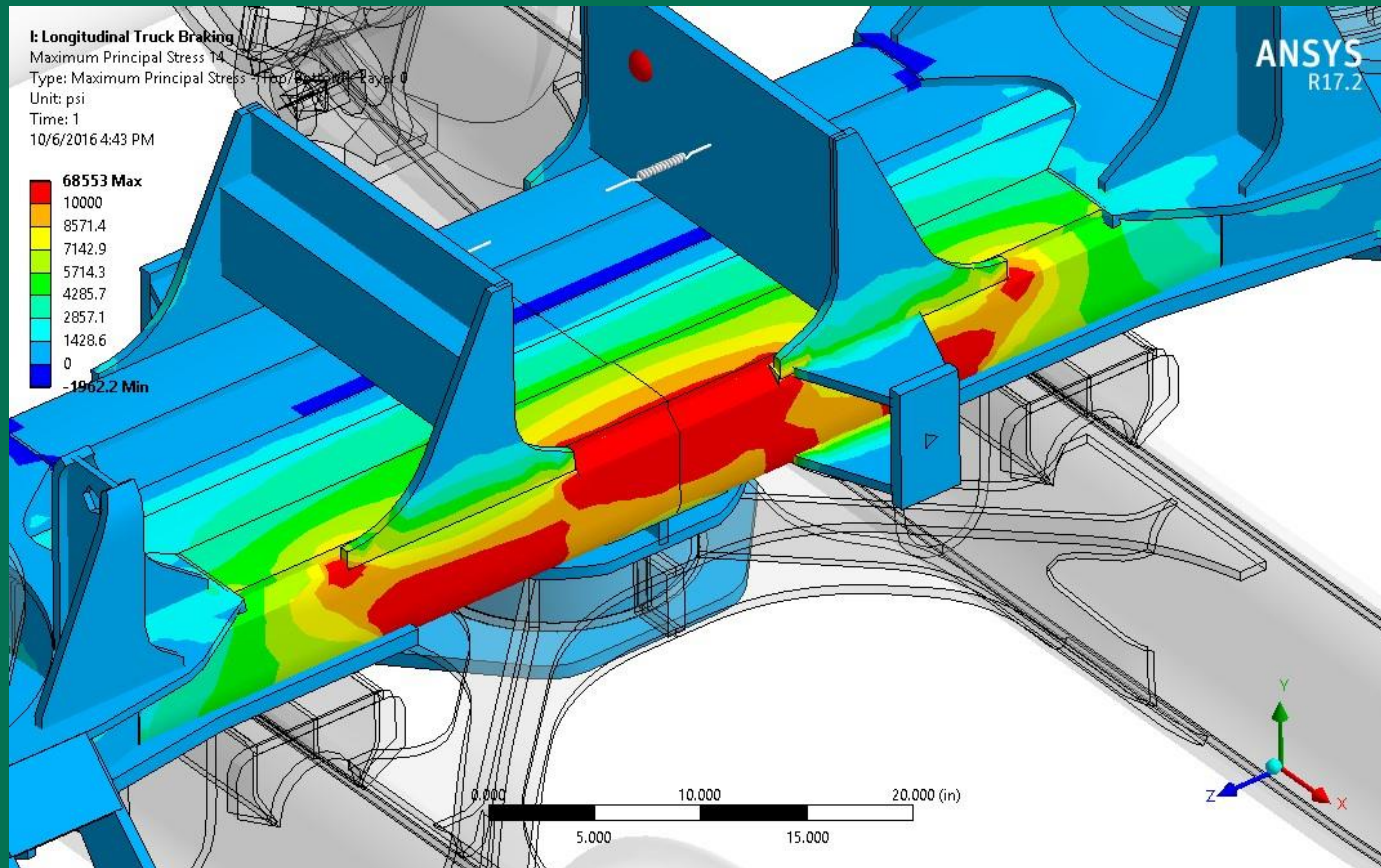
Tensile Principal Stress Around Coupler Pocket
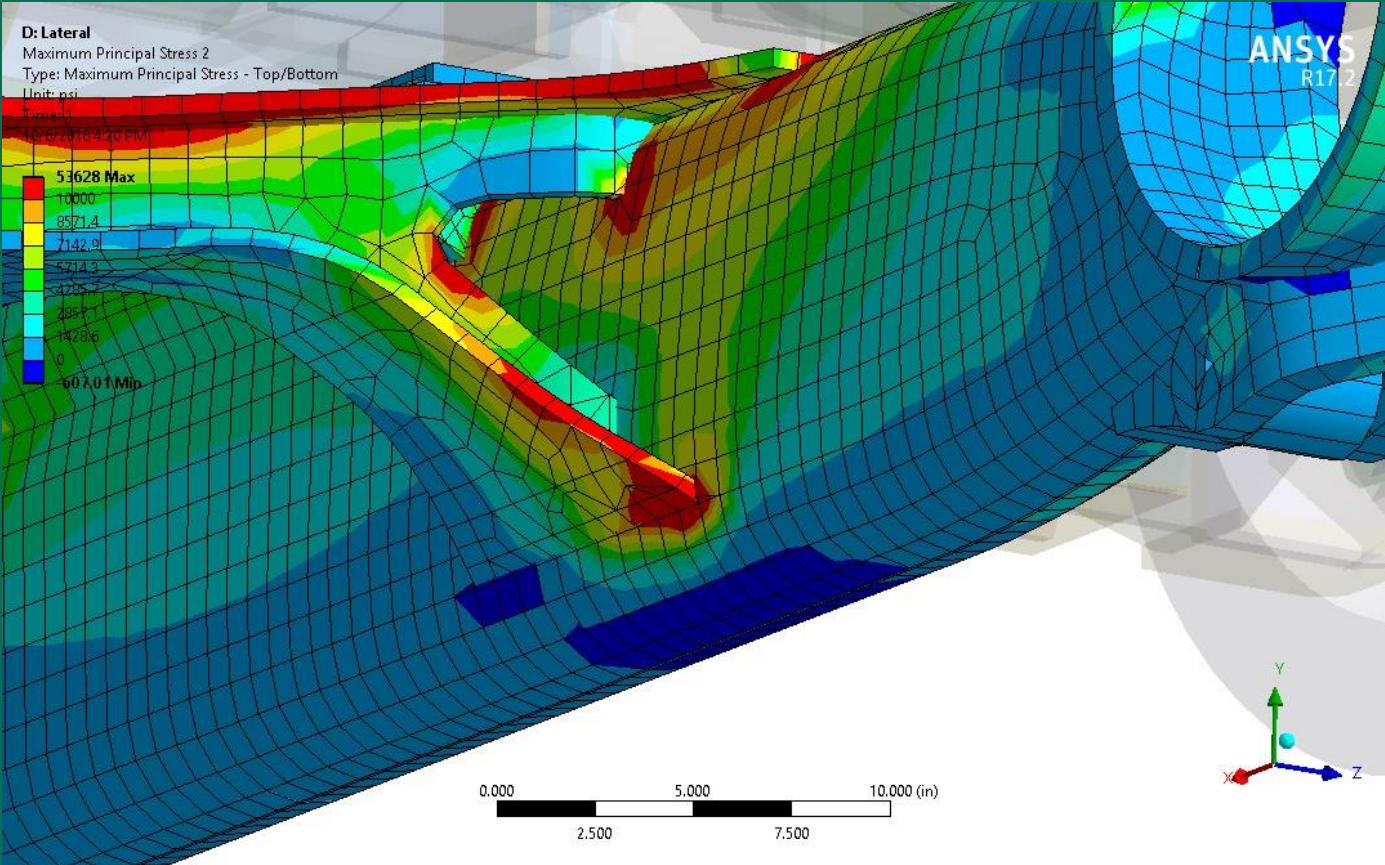
Finite Element Model

- Accurate Load Path Determination

- Identify High Stress Areas

- Accurate Strain Gage Placement

- Effective Analysis of Potential Repairs

Bolster FEA Loading For Braking Case

Side Frame FEA Loading for Lateral Loading

Testing

- Strain Gage & Accelerometer

- Test Over Representative Revenue Route

- Sample Vehicle(s)

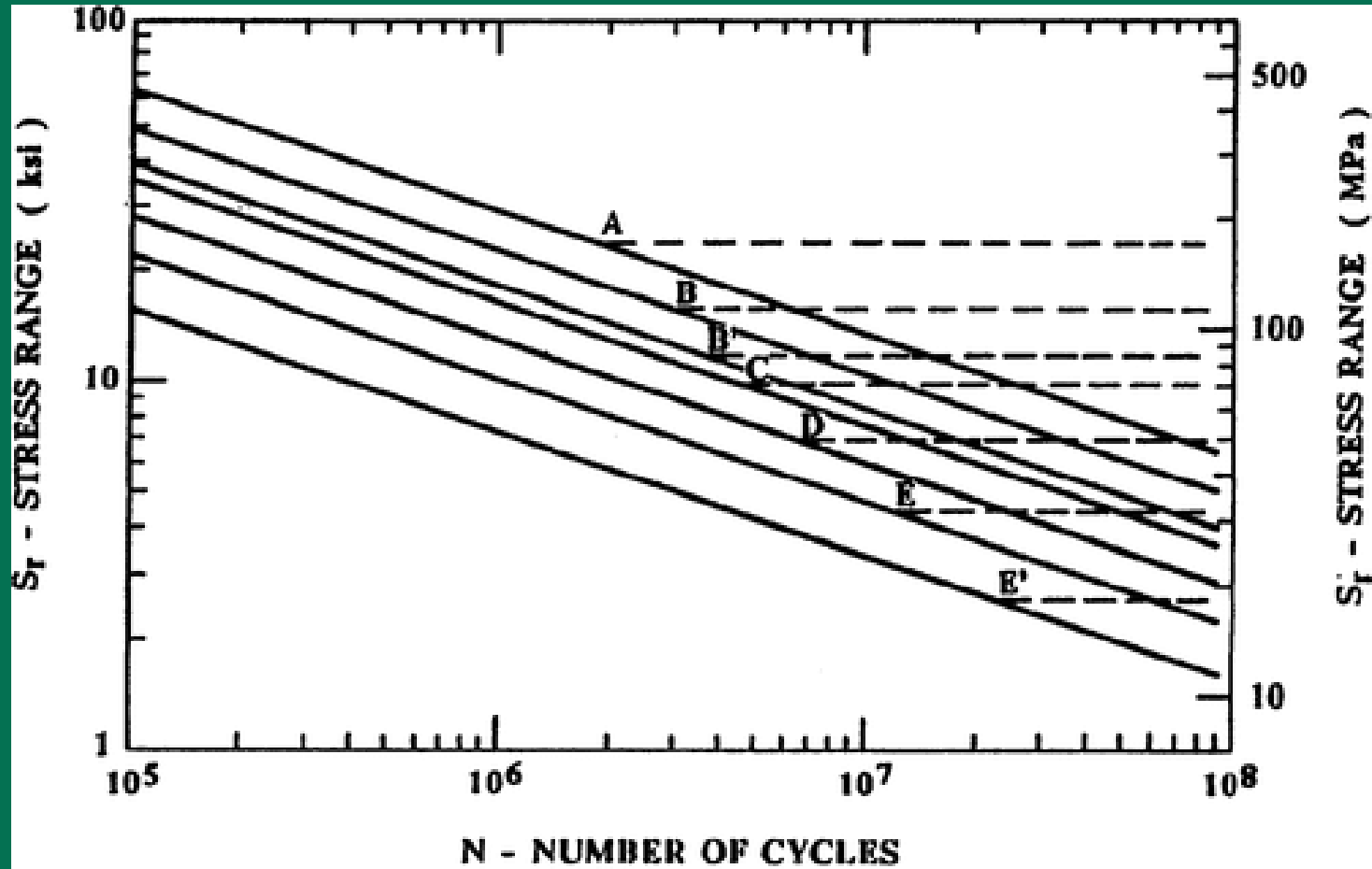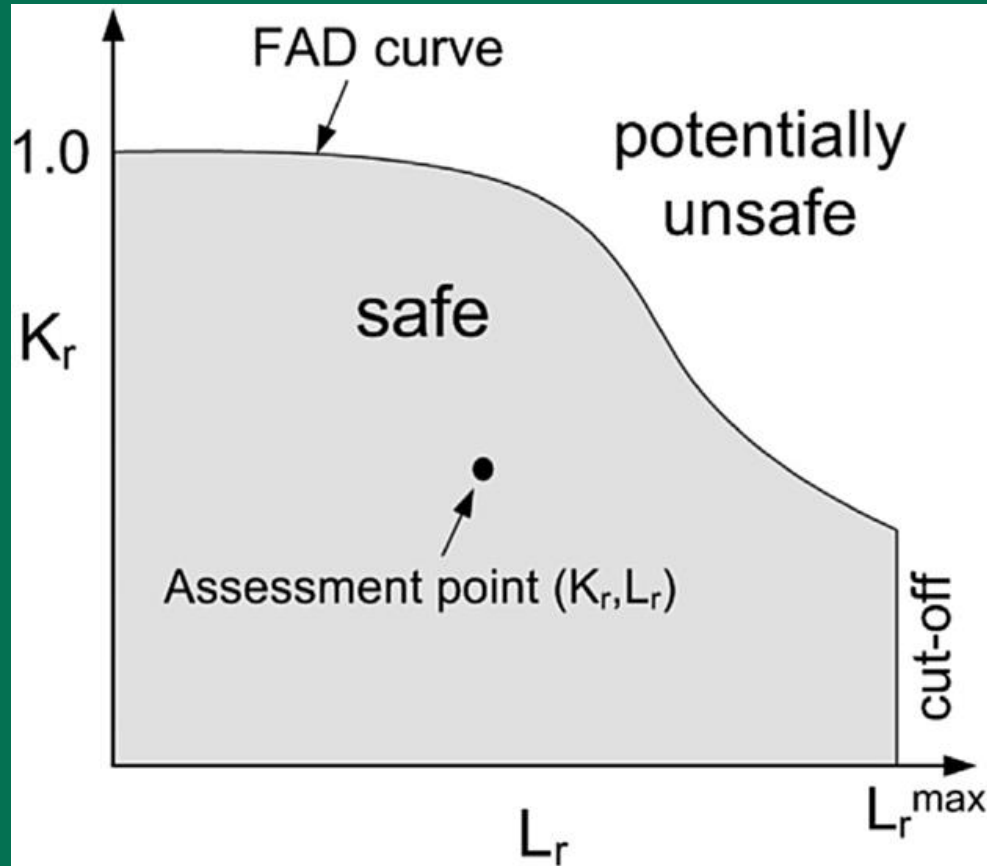- Actual Car Loading & Track Condition

Analysis of Results

- Data Collection

- Rainflow Analysis

- Fatigue Curves
  - S-N Curve
  - FAD Curves / Crack Growth

S-N Fatigue Curve

FAD Fatigue Curve

Remaining Life Prediction

- Interpretation of Results
- Impact of Damaged Areas
  - Potential Repair Life Span
- Determination of Options
  - Operate As-Is
  - Emergent/Interim Repairs
  - Overhaul
  - Replace