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Introduction to Track, Components, and Geometry in Railroad Engineering



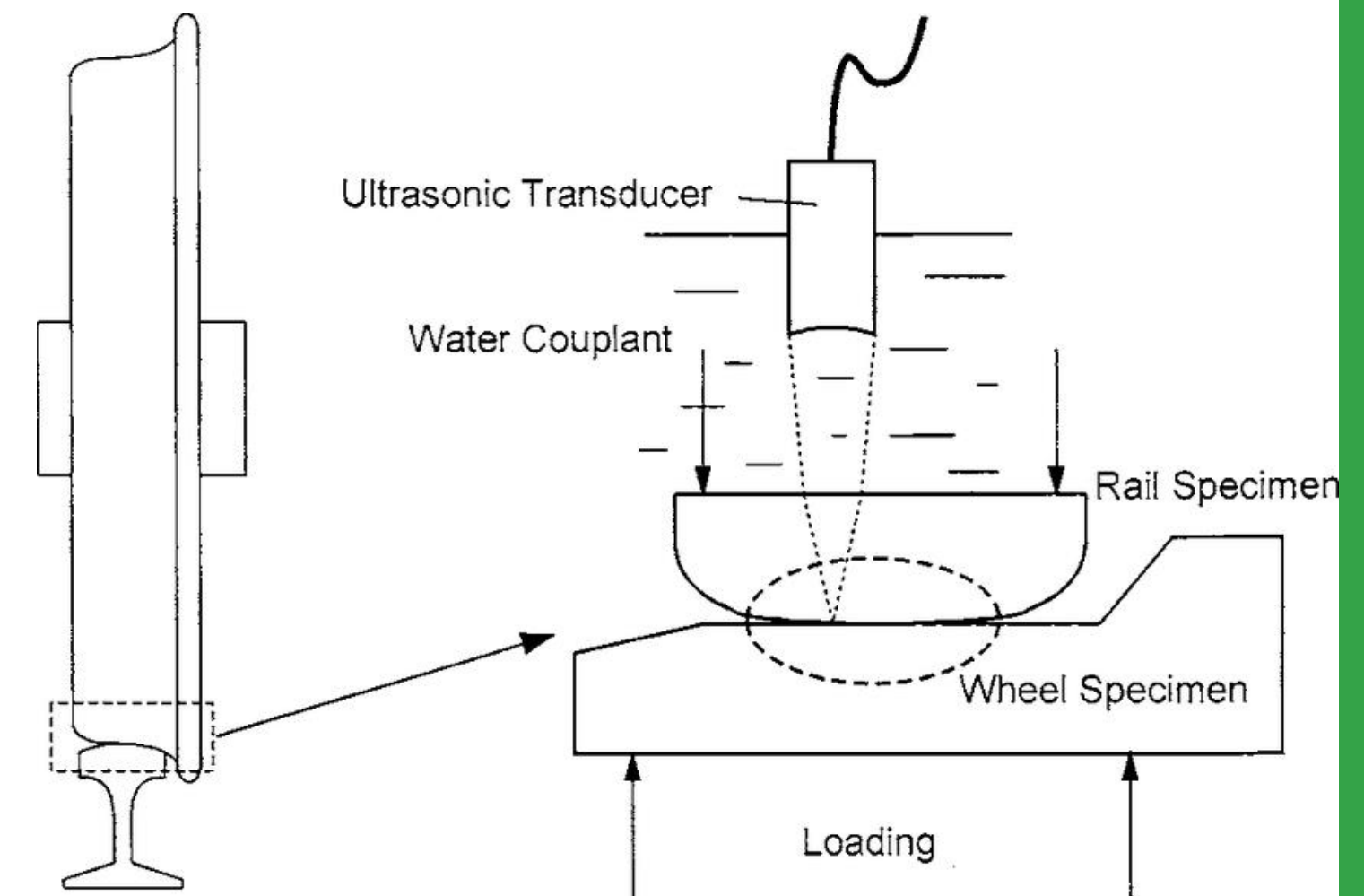
PRINCIPLES COURSE

Why Track Matters

The track structure directly impacts:

- Wheel-rail interaction
- Safety & stability
- Energy efficiency & ride quality

Foundation of reliable transit operations



August 26-28,
2025

SEATTLE, WA

WRI2025RT

Structure of Presentation

PRINCIPLES COURSE

1. Track Structure Overview
2. Key Track Components
3. Track Geometry Fundamentals
4. Design & Maintenance Considerations
5. Summary & Takeaways

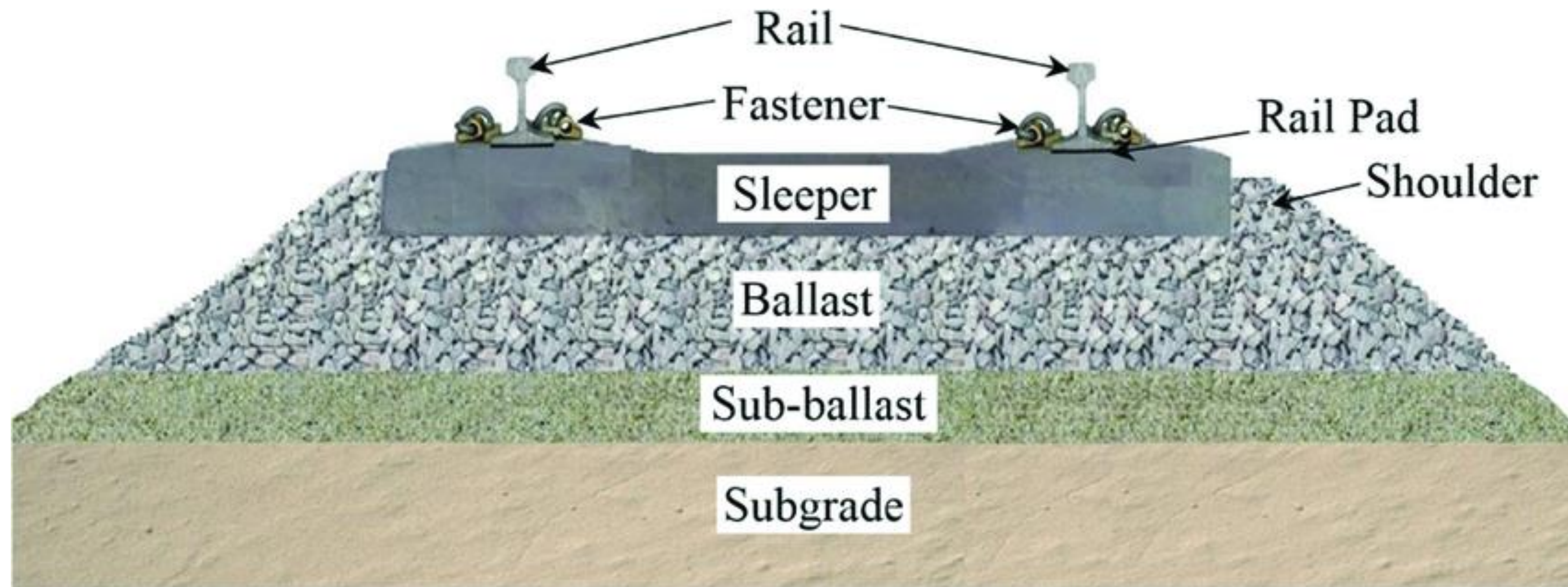


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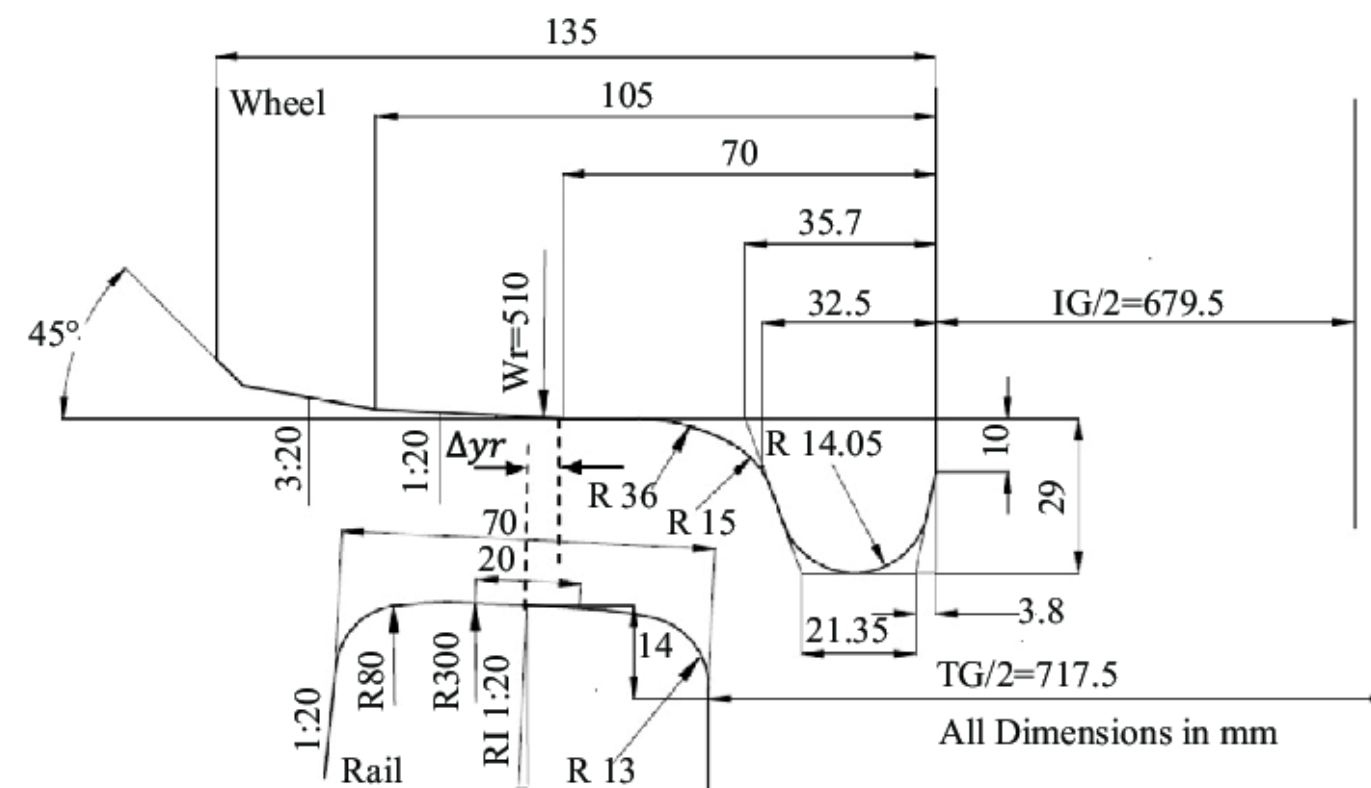
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Track Structure Overview

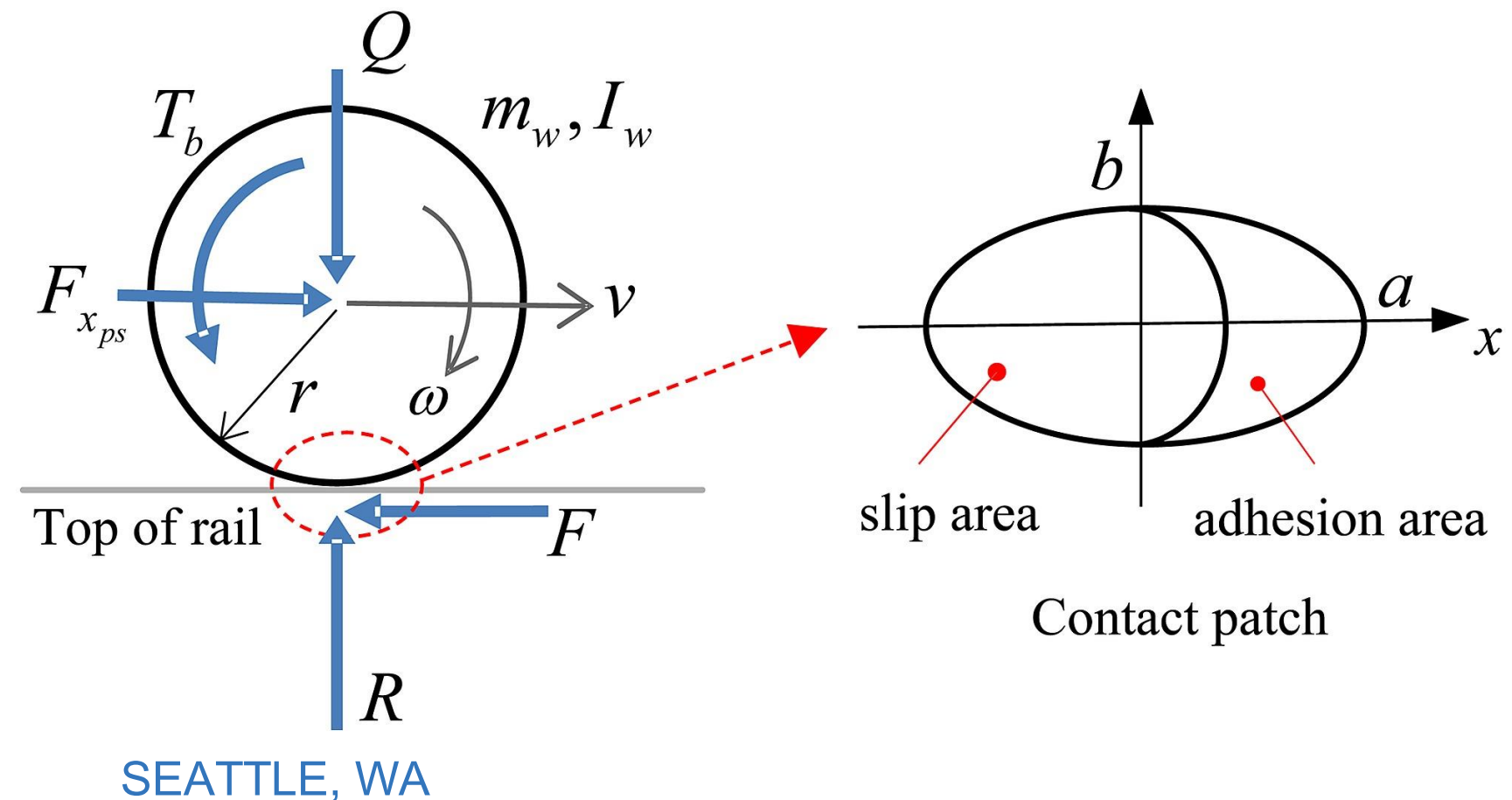


- Types: AREMA 115RE, 136RE
- Function: Guide vehicle, carry loads
- Key properties: hardness, profile, wear resistance
- Importance of profile matching with wheel



Sleepers and Fasteners

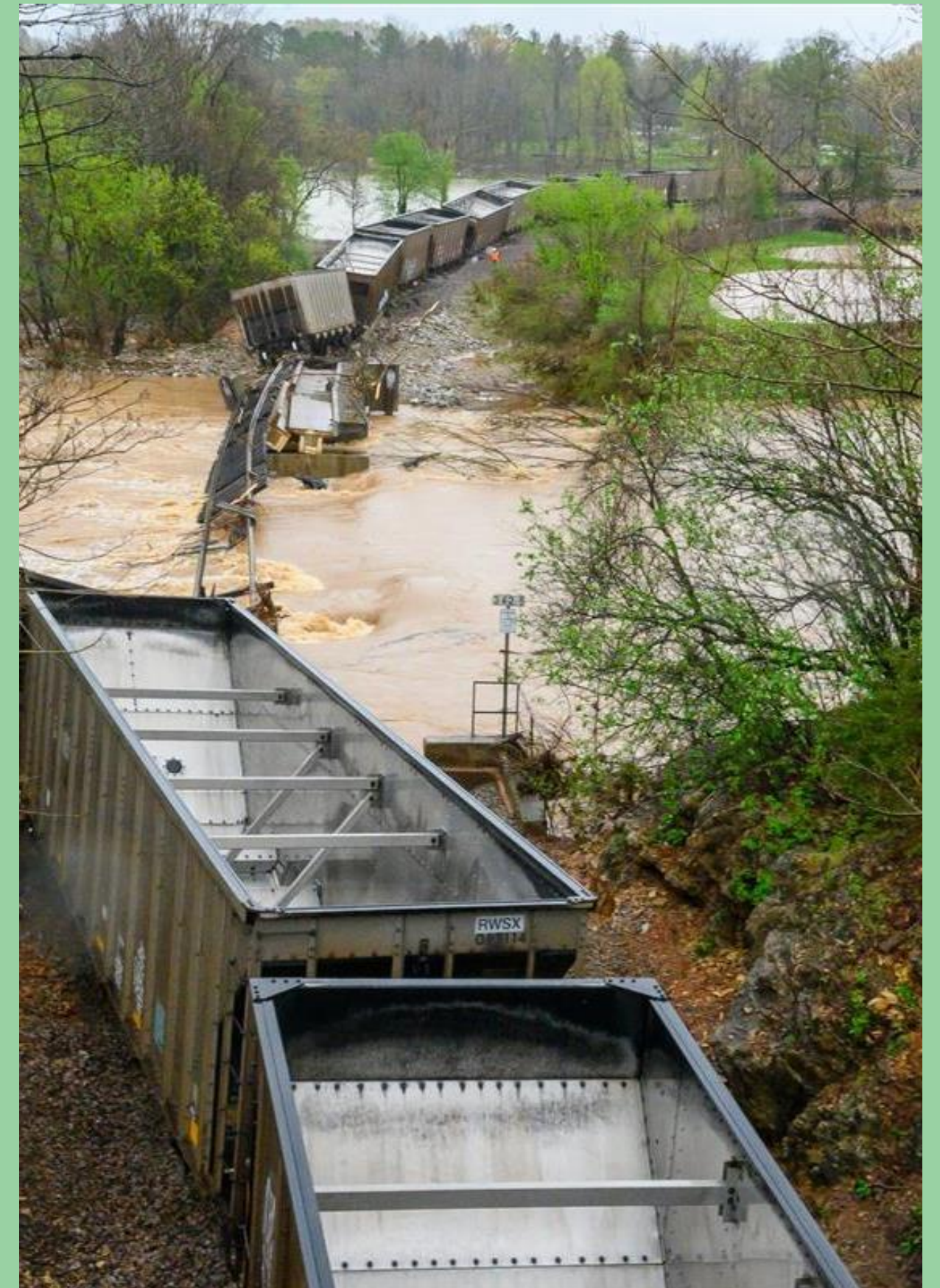
- Sleepers: Wood, concrete, plastic composites
- Function: Maintain gauge, distribute load
- Fasteners: Clips, anchors, baseplates
- Performance: Durability, noise & vibration mitigation





Ballast and Subgrade

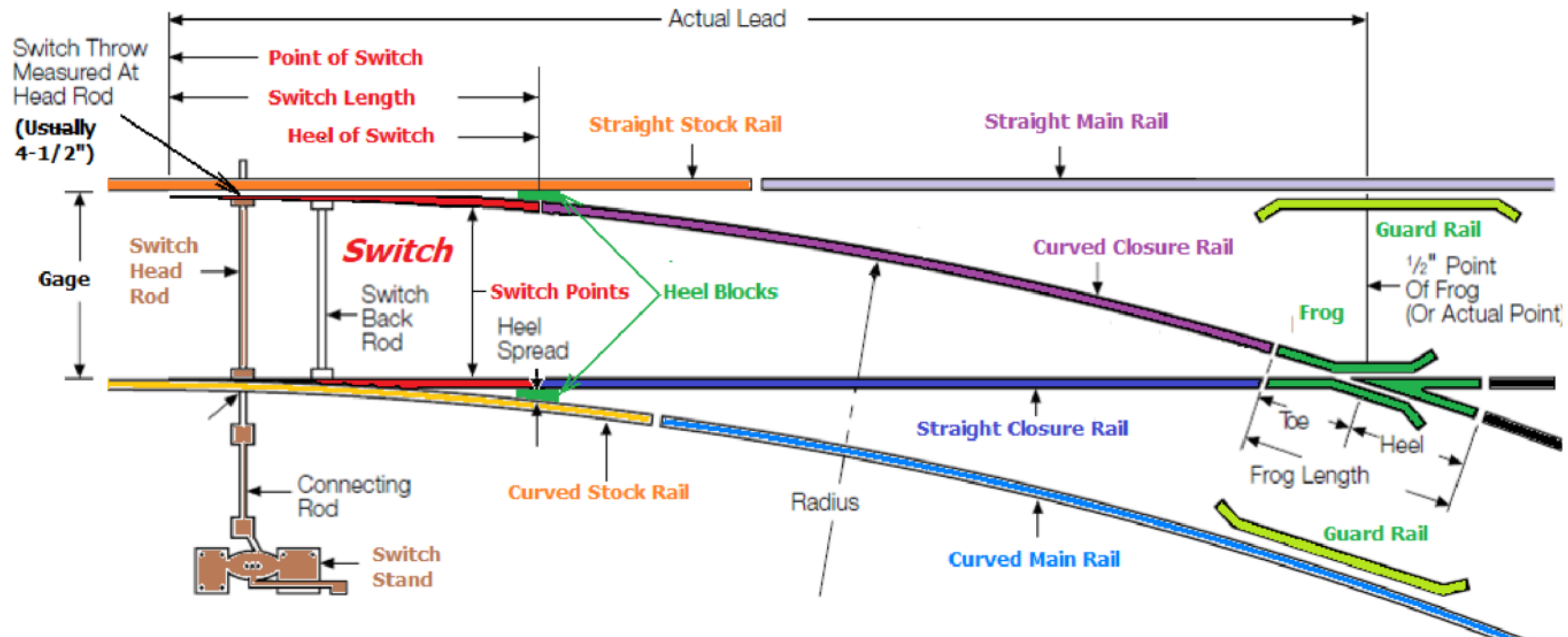
- Ballast: Provides stability, drainage, shock absorption
- Subgrade: Long-term support layer
- Failure causes: Water, fouling, insufficient compaction



BNSF's main track (Thayer South sub) April 2025

Special Trackwork

- Turnouts, crossovers, crossings
- Require precise design & maintenance
- High wear zones, stress concentrations



Transition to Geometry

- From components to spatial layout
- Track geometry shapes performance, wear, safety



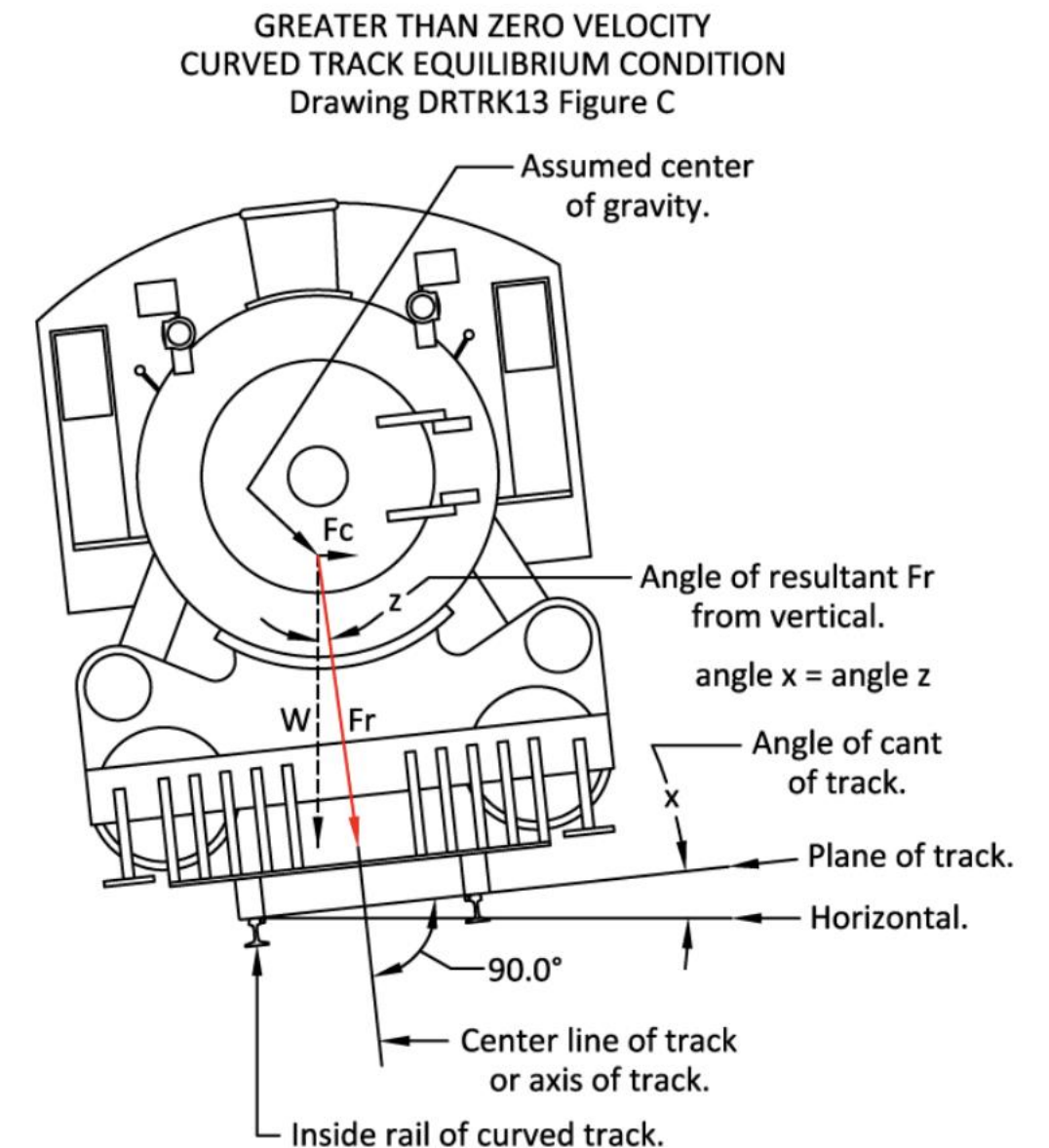
Chicago CTA RPM





What is Track Geometry?

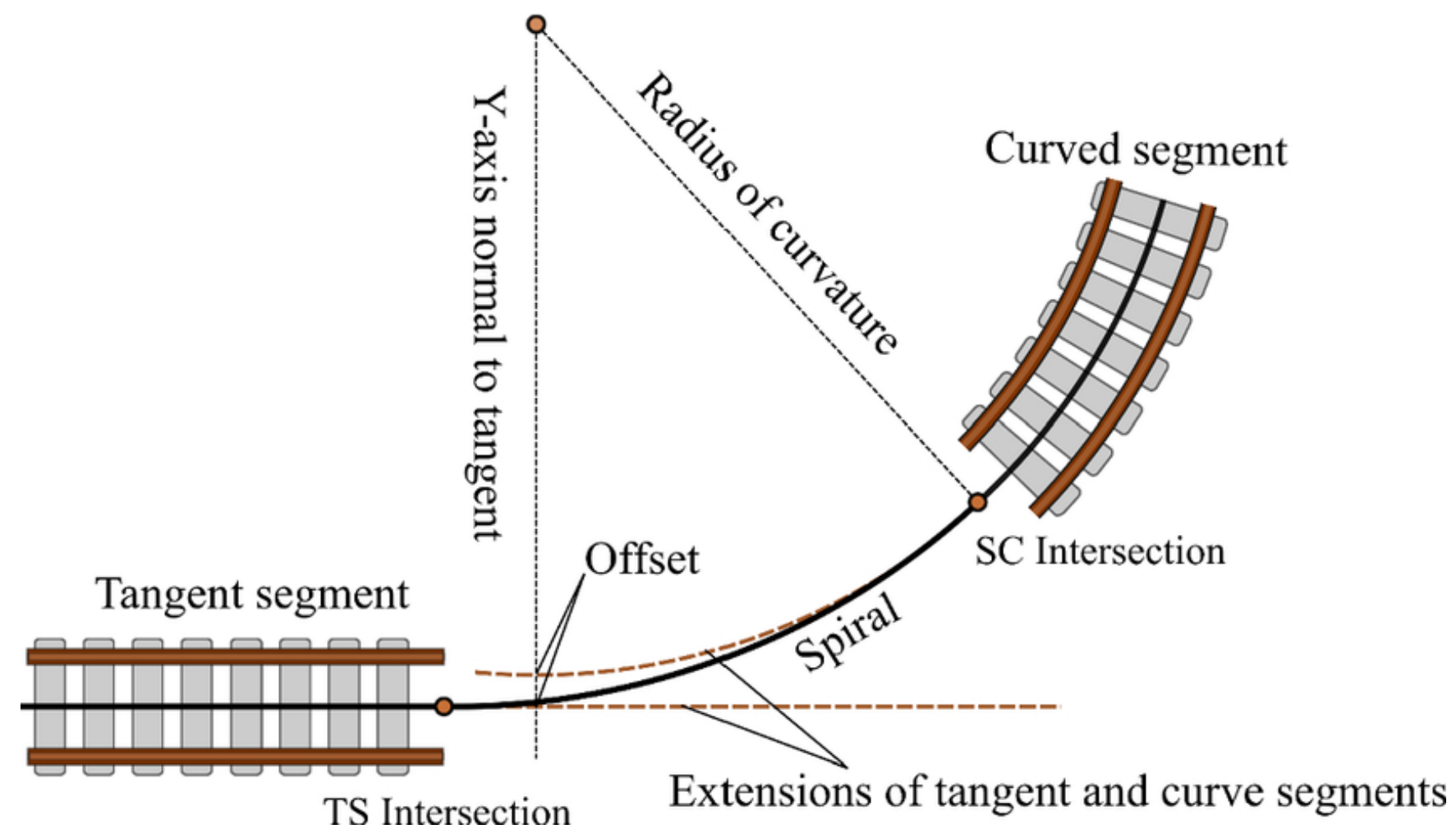
- Horizontal alignment (curves, tangents)
- Vertical alignment (grades, profiles)
- Cross-level and superelevation
- Gauge, cant deficiency, conicity





Design Parameters (TCRP 155)

- Degree of curve, minimum radius
- Superelevation and transition lengths



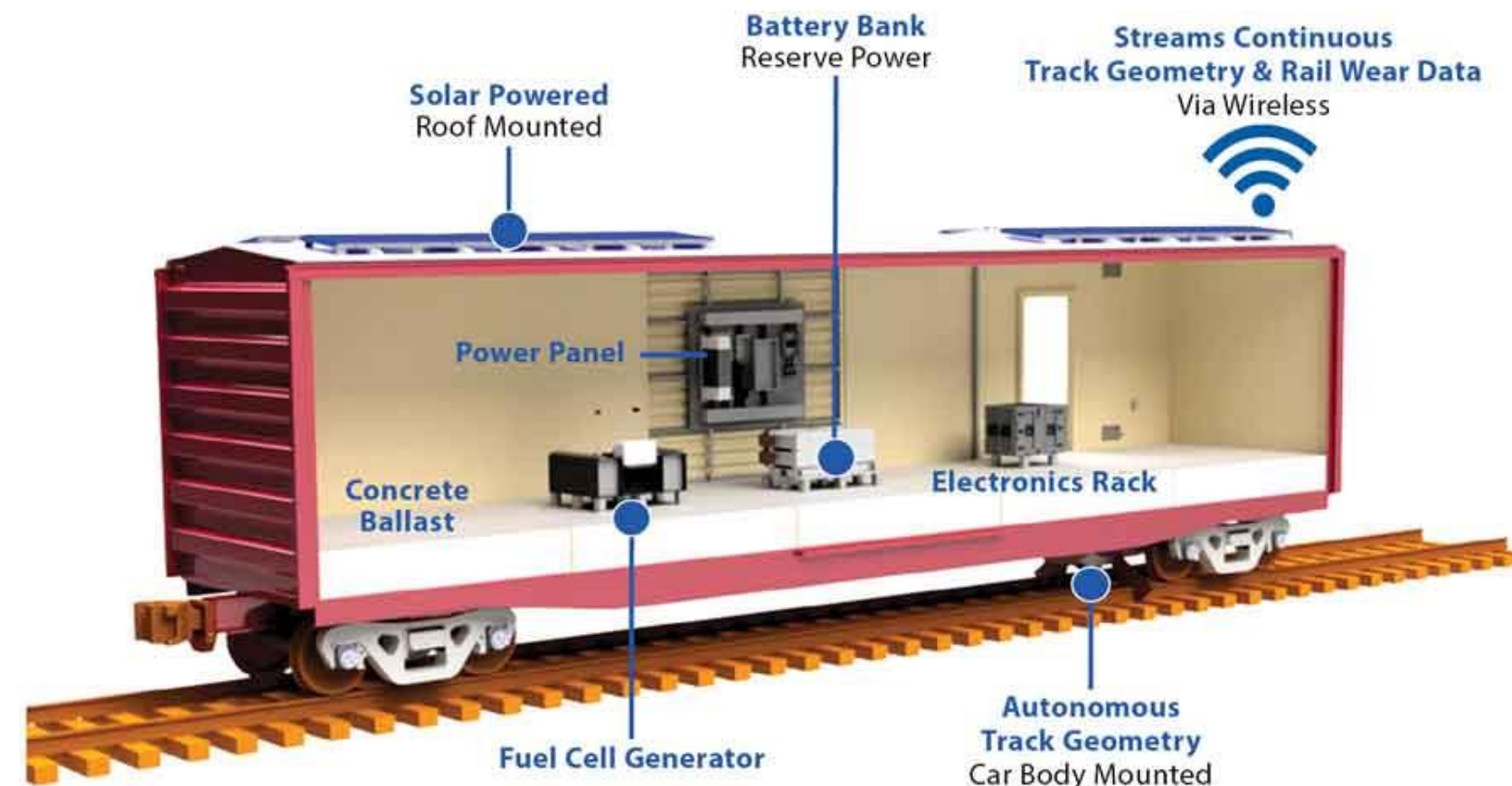
Impacts of Geometry

- Vehicle dynamics
- Ride comfort
- Wheel/rail wear
- Derailment risk
- Misalignment = Maintenance burden



Monitoring & Standards

- Measurement tools: geometry cars, onboard sensors
- TRC data, Kalman filter models (emerging)
- Standards: FRA, AREMA, TCRP



Maintenance & Lifecycle

- Ballast tamping, tie replacement, realignment
- Preventive vs reactive strategies
- Track geometry degradation over time



Key Takeaways

- Track = structure + components + geometry
- Good geometry = safety + performance
- TCRP 155, APTA, and/or AREMA are key resources
- Interface = where track engineering and vehicle behavior meet



Questions & Discussion

Thank you!

