Understanding the Transition Behavior of Railroad Track at Level Crossings on US High Speed Rail Shared Corridors

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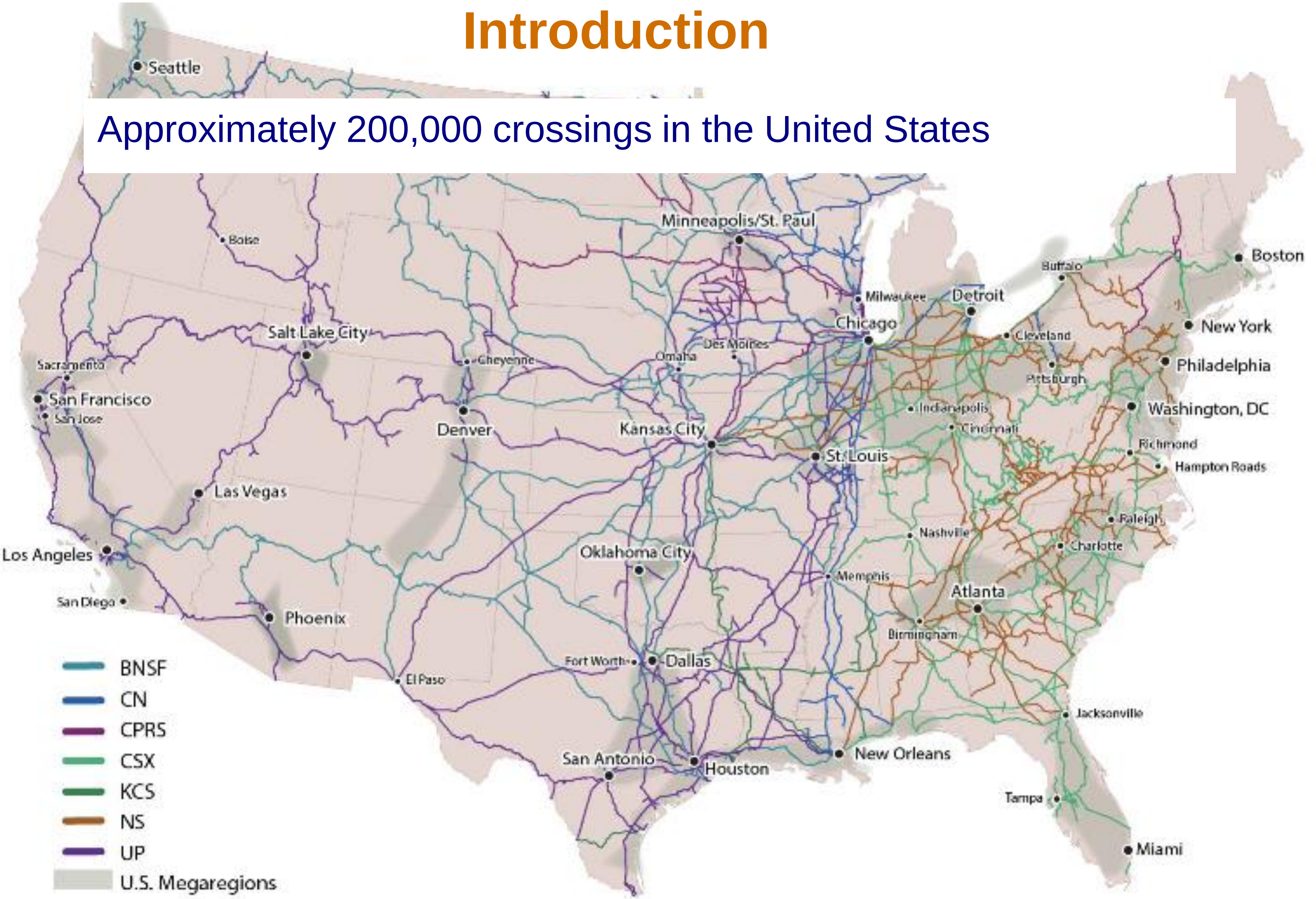
Outline

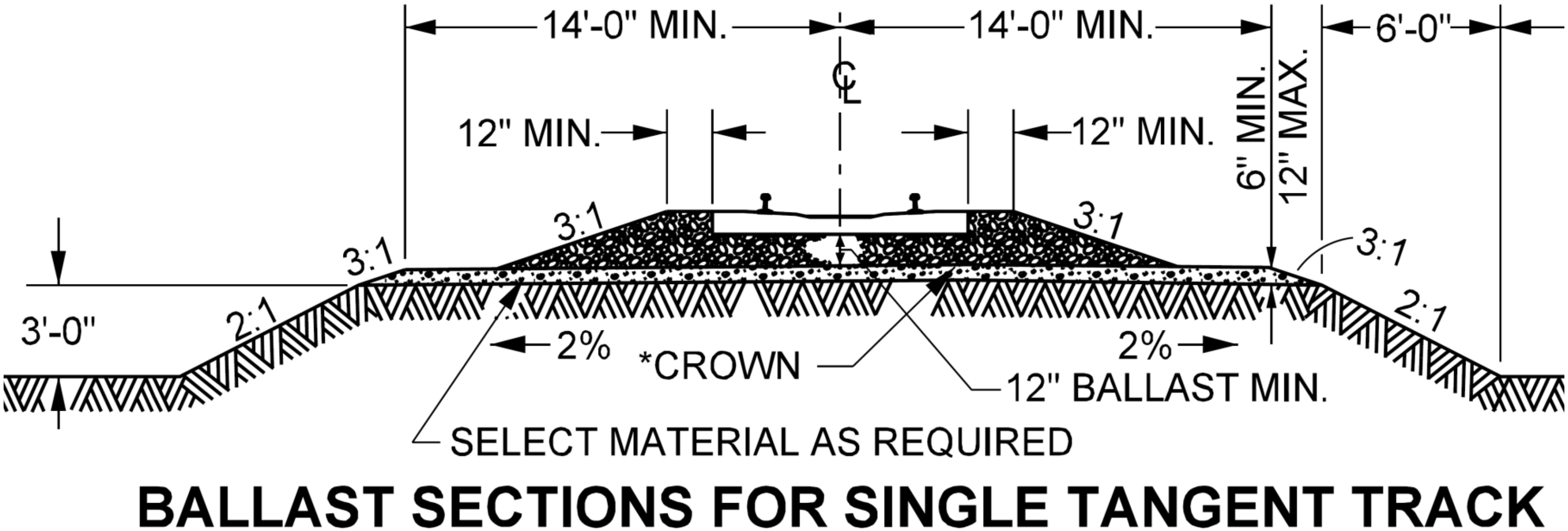
- Introduction
- Transition zones
- Why study grade crossings?
- Grade crossings and US high speed rail
- Summary

Introduction

Approximately 200,000 crossings in the United States

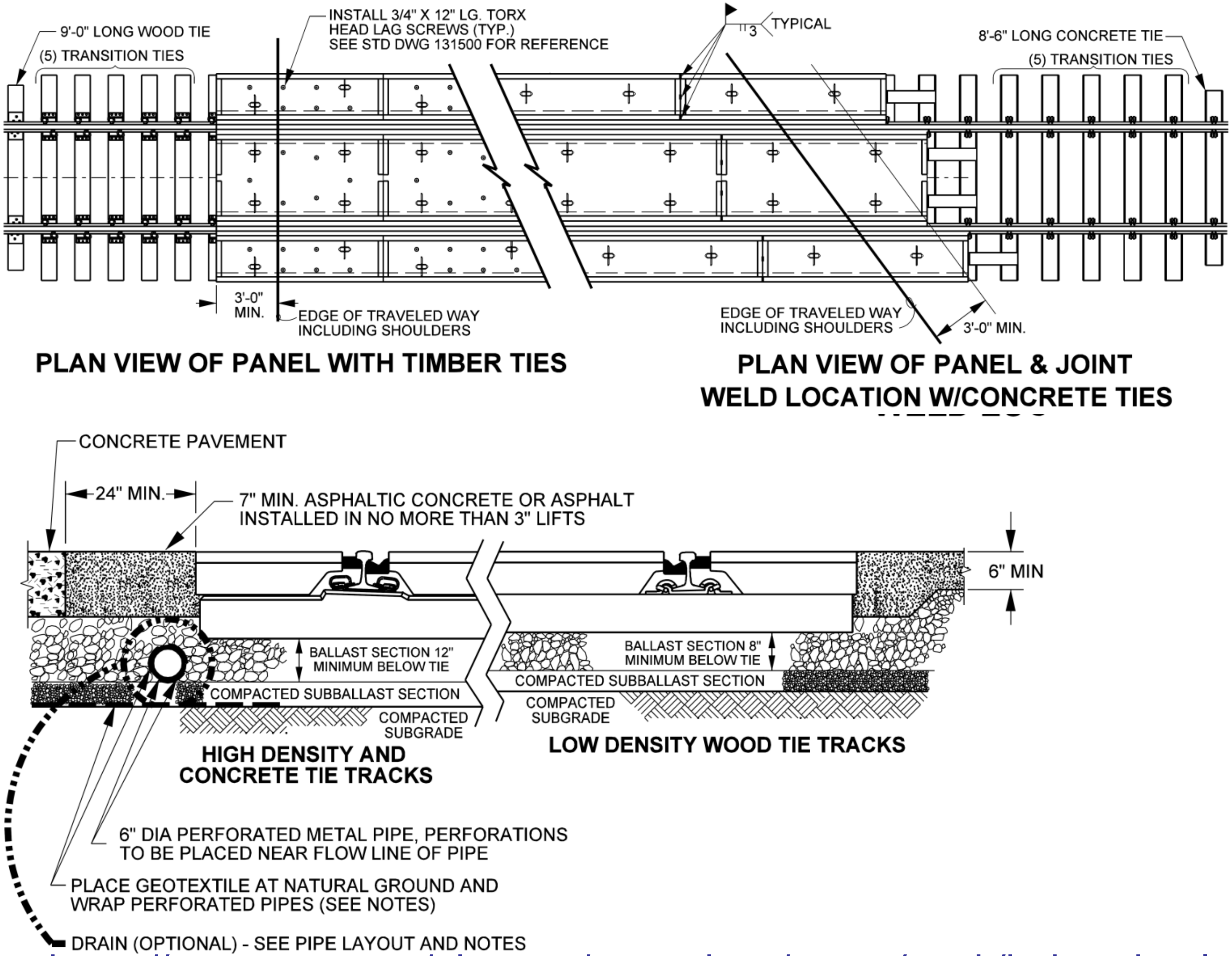


Typical Embanked Section



https://www.uprr.com/aboutup/operations/specs/track/index.shtml

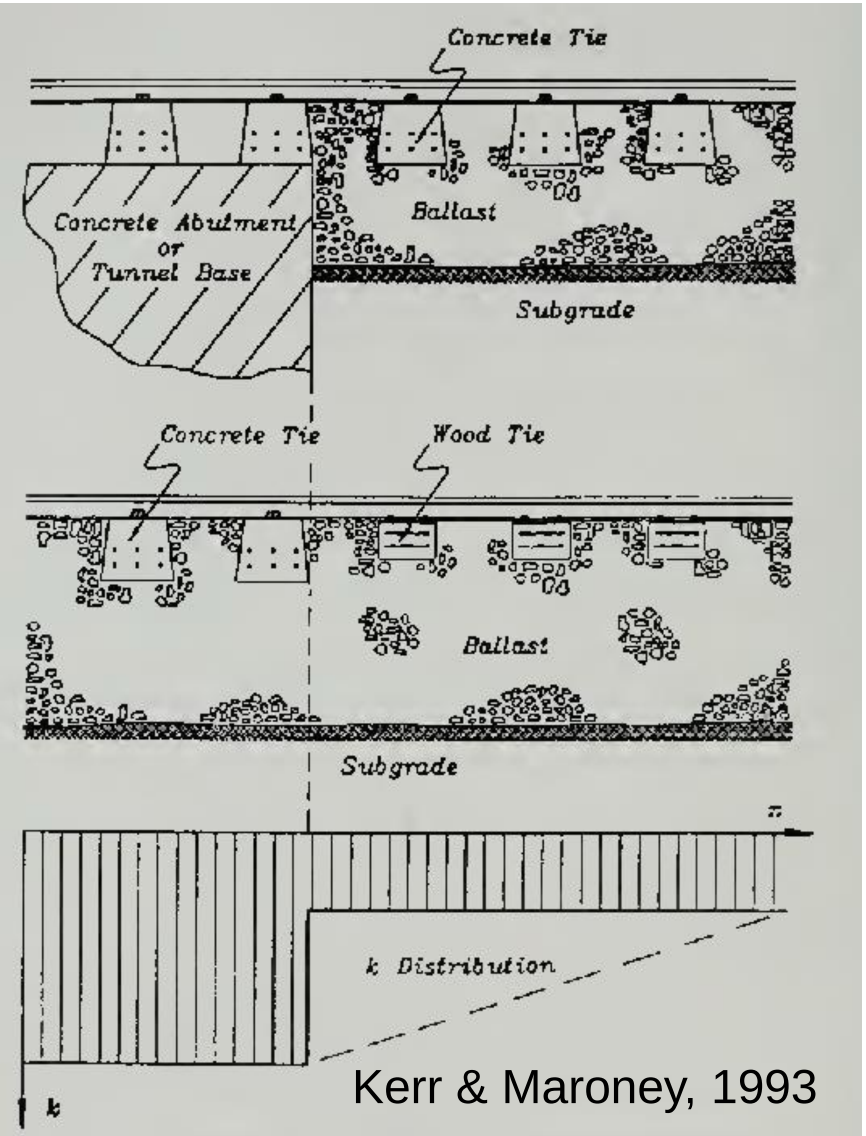
Level Crossing Transition



https://www.uprr.com/aboutup/operations/specs/track/index.shtml

Transition Zone

- A change in the structure of the roadbed
- Different stiffness and deflection behavior of track
- Examples are:
  - Embankment to bridge
  - Tunnel to embankment
  - Embankment to level crossing
- Distribution of stiffness change at transition zones



Kerr & Maroney, 1993

Why Study Transition Zones?

Why Study Transition Zones…
… at Level Crossings?

Why Study Transition Zones?

- Because of the different track stiffness present in a transition zone, differential settlements occur
- One of the areas of major deformation of track (and roadway) surface
- The “bump” experienced on highway bridges and on passenger trains over bridges and other structures in general is the result of the differential settlement
- May cause discomfort and possible damage to rolling stock
- Transition zones are more challenging to maintain compared to other sections of roadway and railroads
- Over $ 200 million per year spent on maintenance of transition zones by railroads

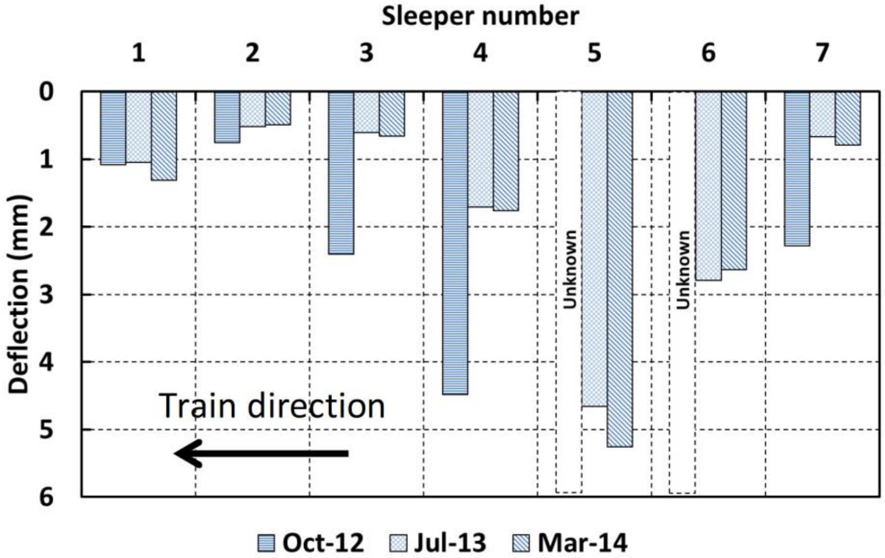
Relevant Work on Transition Zones

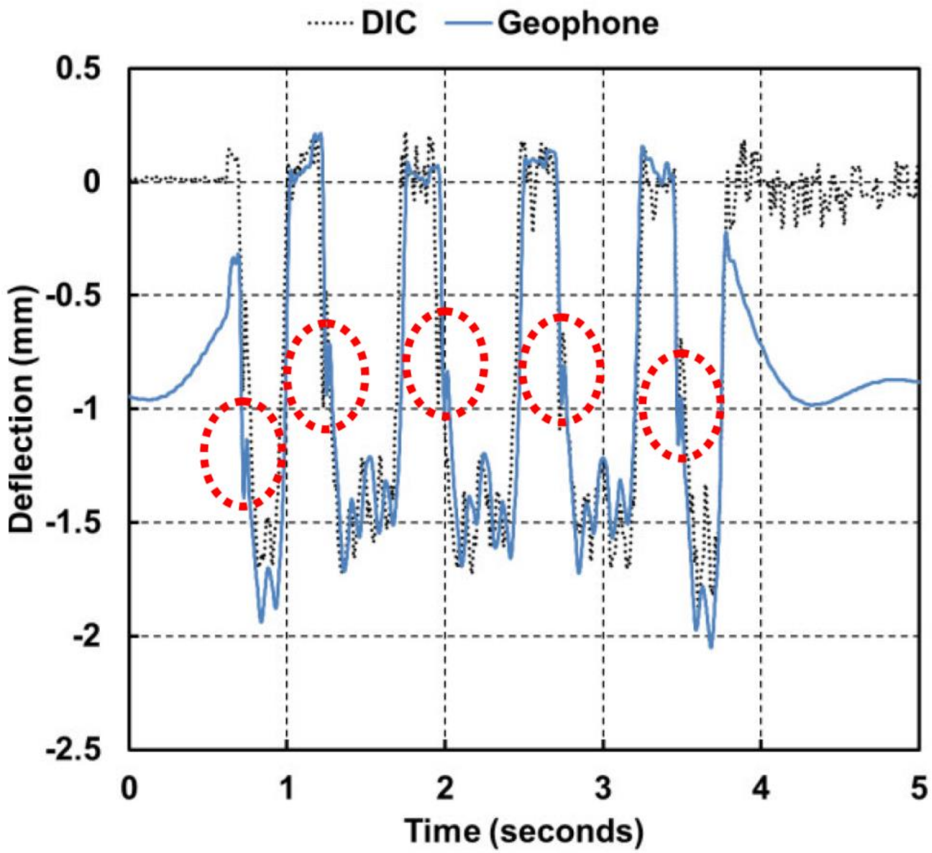
- Bridge approaches and culverts are the substructures that have received much of the attention when studying the behavior of track at such transitions
- Some attention has been given to special trackwork (e.g. turnouts, crossings, diamonds)
- However, little relevant work has been devoted to understand the track behavior near a level crossing
- Le Pen et al (2014) monitored the behavior of a track over crossing in Southern England

Effect of the "Hanging Sleeper"

- The graph on the right shows the behavior of the fourth sleeper away from the level crossing being studied
- Speed of the train: 65 mph (104 km/h)
- Circled in red the effect of the hanging sleeper

DIC: Digital Image Correlation

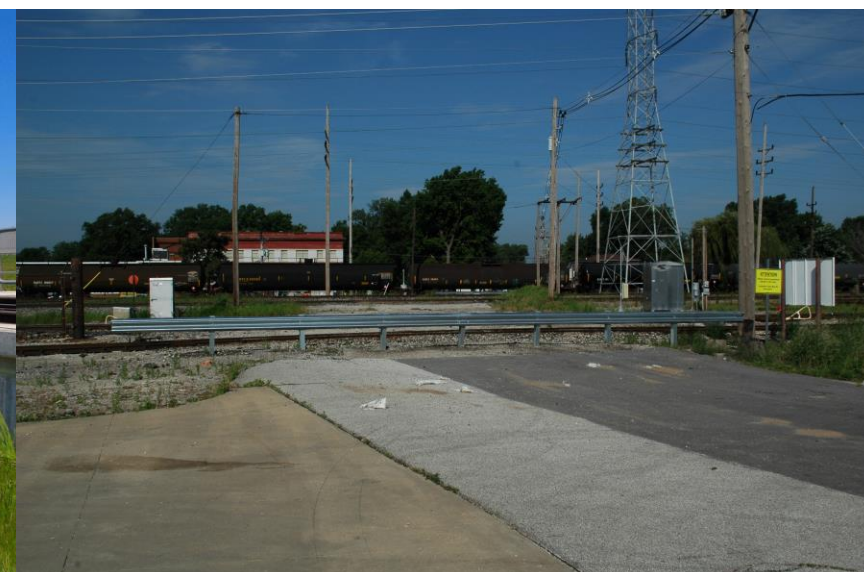




Le Pen et al. 2014

Possible Solutions?

- Close the crossing
- Grade separate the roadway from the railroad
- Understand the mechanisms behind the differential settlement and develop mitigating solutions to optimize the maintenance cost
- Each of the above solutions has its own consequences and challenges



Level Crossings and High(er) Speed Rail in the U.S.

- The Federal Railroad Administration defines nine classes of railroad track
- Classes 1 through 7 are tracks with maximum authorized speeds for passenger trains up to 125 mph (201 km/h) where level crossings are permitted
- Classes 8 and 9 (125 – 200 mph or 201 – 321 km/h) do not allow level crossings to be present
- The majority of passenger service runs at 79 mph (127 km/h)
- Some of the passenger corridors have been upgraded to accommodate higher speed

VISION *for* HIGH-SPEED RAIL *in* AMERICA

Chicago-St. Louis

- One of the projects funded by the Stimulus Plan in 2009
- 240 miles (385 km) of renovated track and structures
- Maximum authorized speed 110 mph (177 km/h)
- 252 level crossings present
- At project completion, maintenance of track will be at class 6

Summary

- Over 200,000 level crossings in the U.S.
- A transition zone
- Not easy to eliminate (by closure or grade separation)
- Some of the passenger corridors in the United States are being upgraded to accommodate higher speeds
- There is a need to understand the track behavior at level crossings in order to optimize the maintenance cost of them

Questions?

Thank You for Your Attention

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