



Smart Rock Meets Smart Tamper

— Improved Tamping for Track Durability

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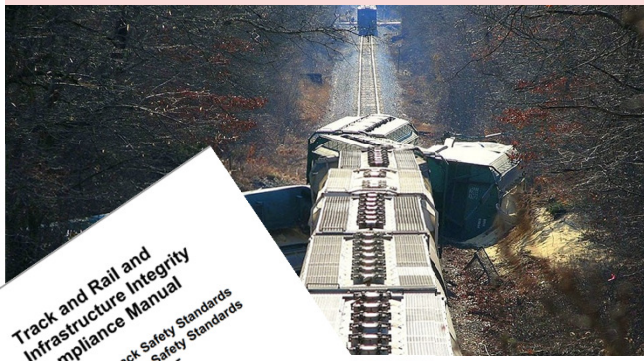
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Why do we tamp the track?



Why is this topic so important?

Safety



Track and Rail and Infrastructure Integrity Compliance Manual
Volume II-Track Safety Standards
Chapter 1 Track Safety Standards
Classes 1 Through 5
January 2017
Office of Railroad Safety

U.S. Department of Transportation
Federal Railroad Administration

Ride Quality



Sustainability



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Track Geometry saves money...

... if a track geometry defect is present, the cumulative MGT “life” of the rail was approximately 30% less than that of a rail defect with no track geometry defect. [1]



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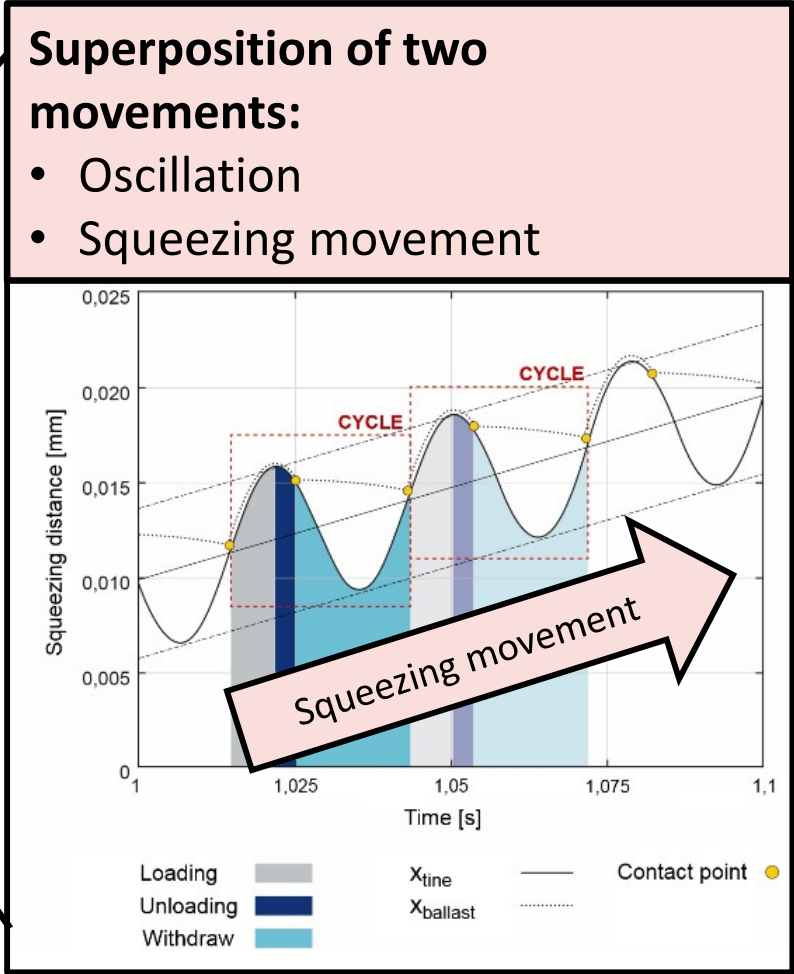
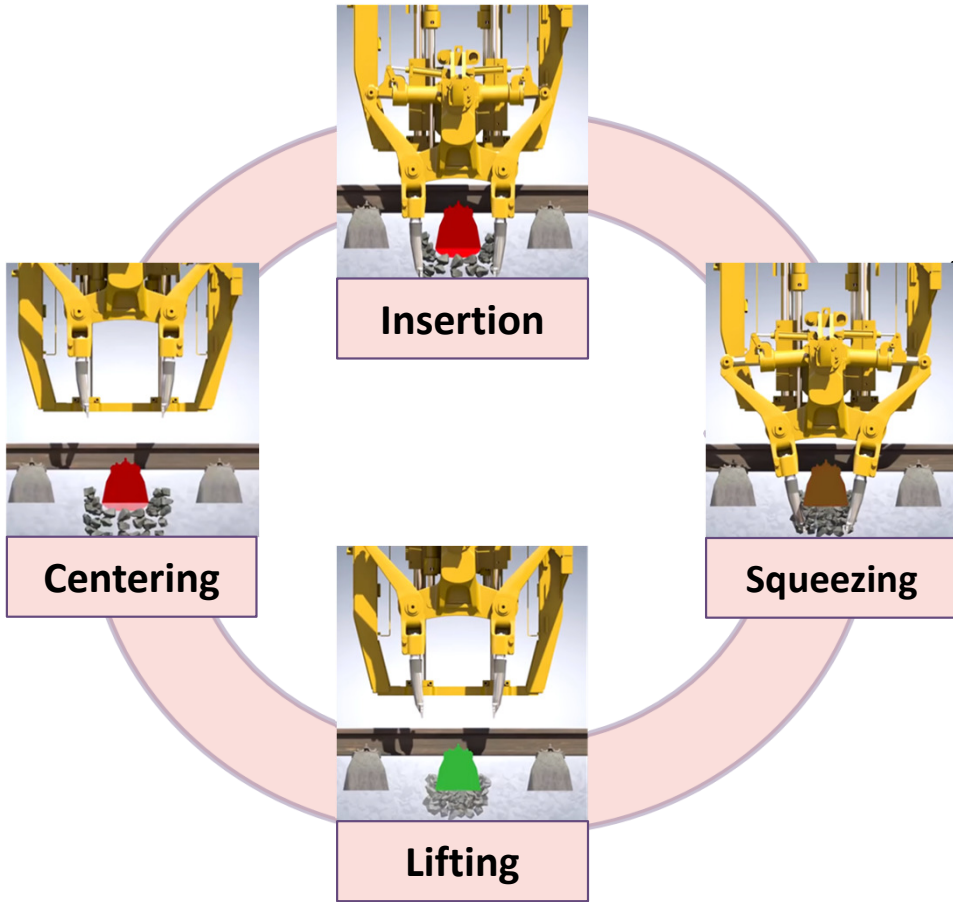
[1] Zarembski, A. M.; Attoh-Okine, N.; Einbinder, D.; Thompson, H.; Sussmann, T. How Track Geometry Defects Affect the Development of Rail Defects. <http://railroadengineering.engr.udel.edu>

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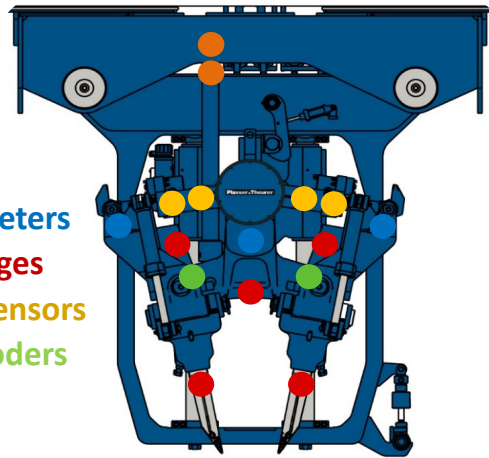
Tamping machines all over the world...

They may look different...

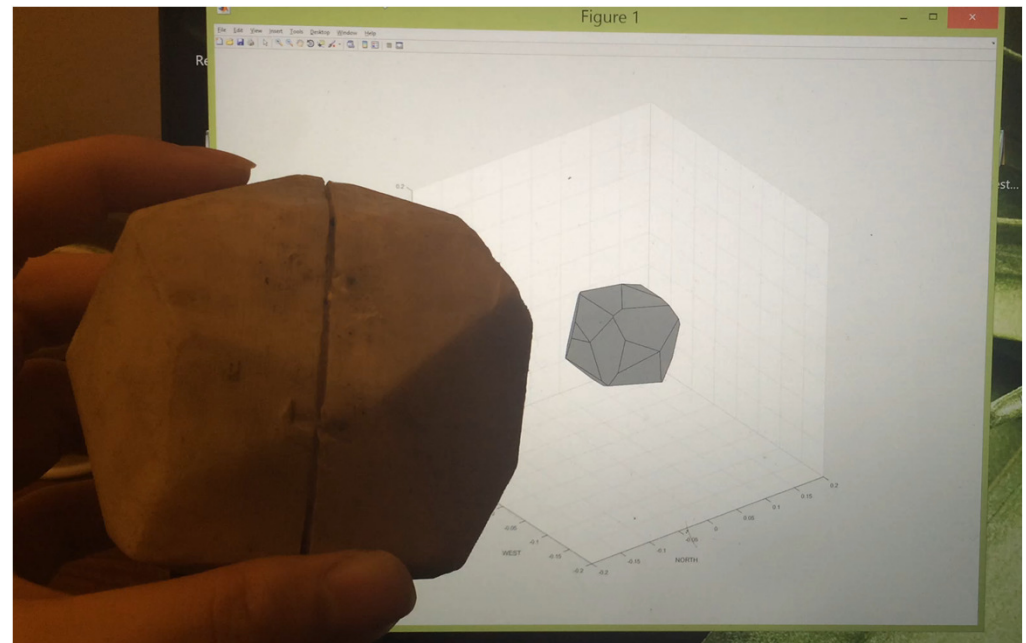
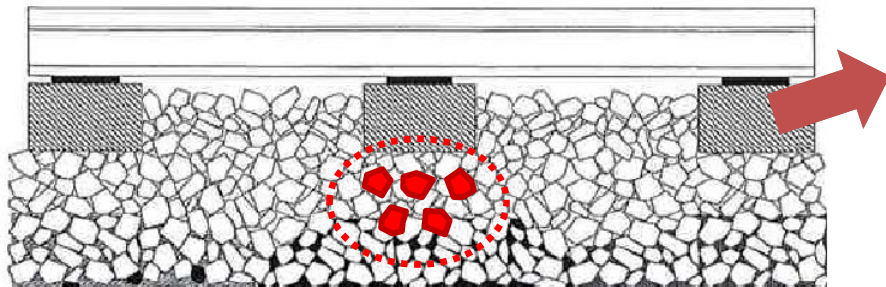




Technology Background



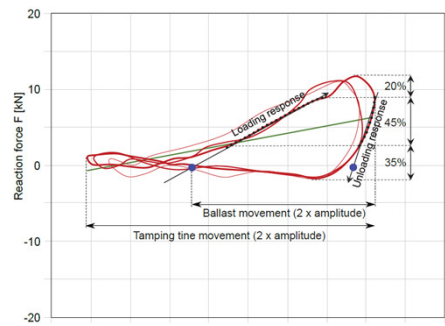
- Accelerometers
- Strain Gauges
- Pressure sensors
- Angle encoders



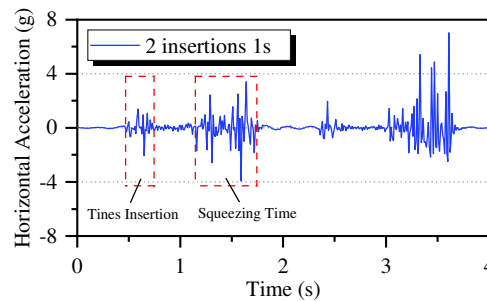
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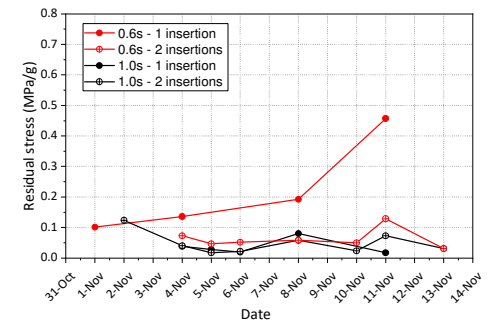
Research Concept



Tamping Parameters
e.g. Squeezing time,
Number of insertions



Ballast Performance
during tamping

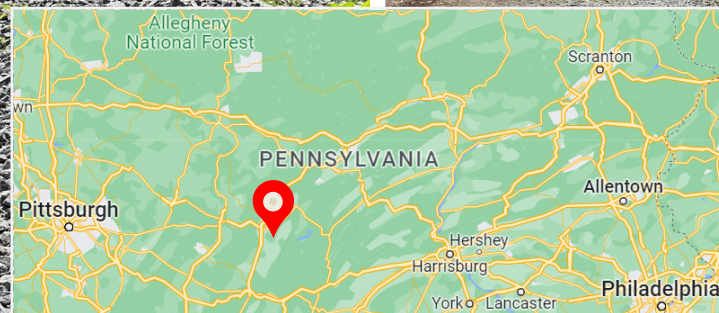
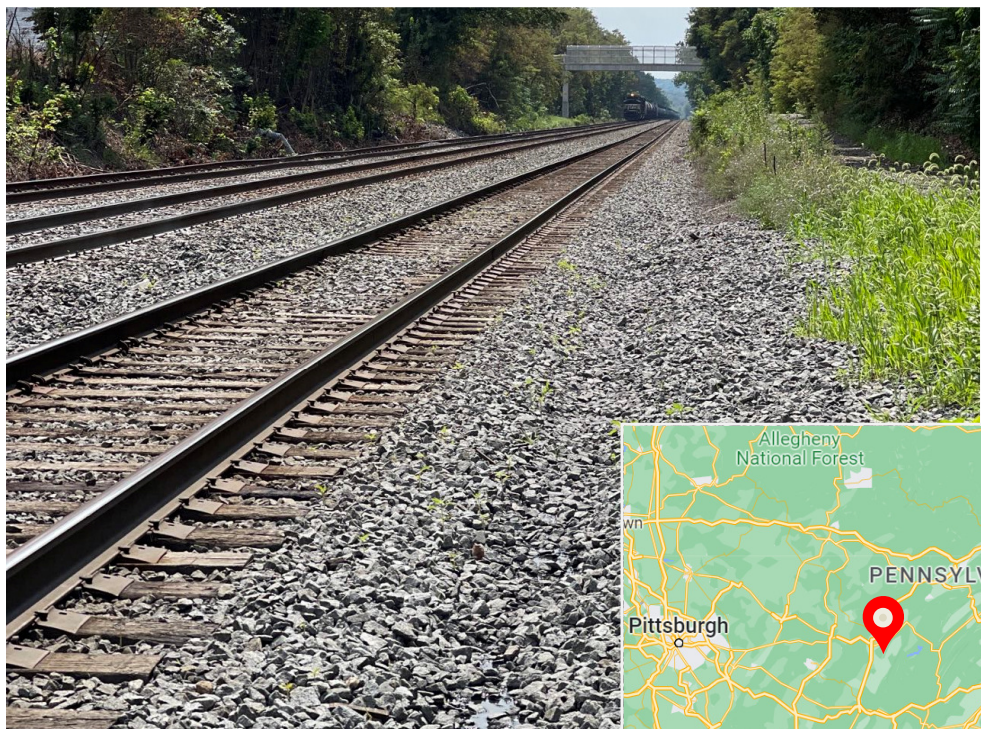


Ballast Performance
after tamping

Establish Direct Link



Testing Sites



Bellwood (clean ballast)

Tunnelhill (fouled ballast)

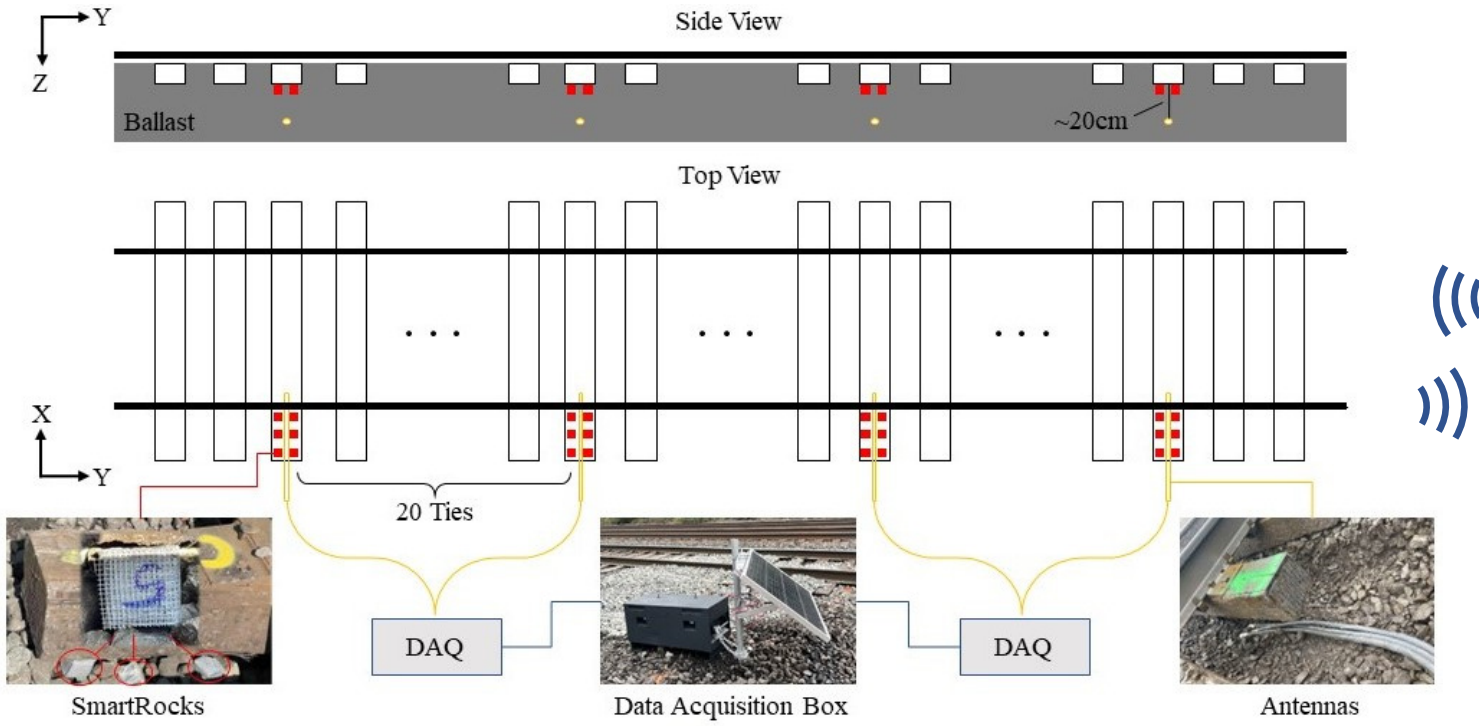


Testing Matrix

Site	Test Scenario	Squeeze time (s)	Number of Insertions	Lifting Value(mm)	Pressure
Bellwood (clean ballast)	#1	0.6	1	25	Const./ 35Hz
	#2	0.6	2		
	#3	1.0	1		
	#4	1.0	2		
Tunnelhill (fouled ballast)	#5	0.6	1		
	#6	0.8	1		
	#7	0.8	2		
	#8	1.2	1		

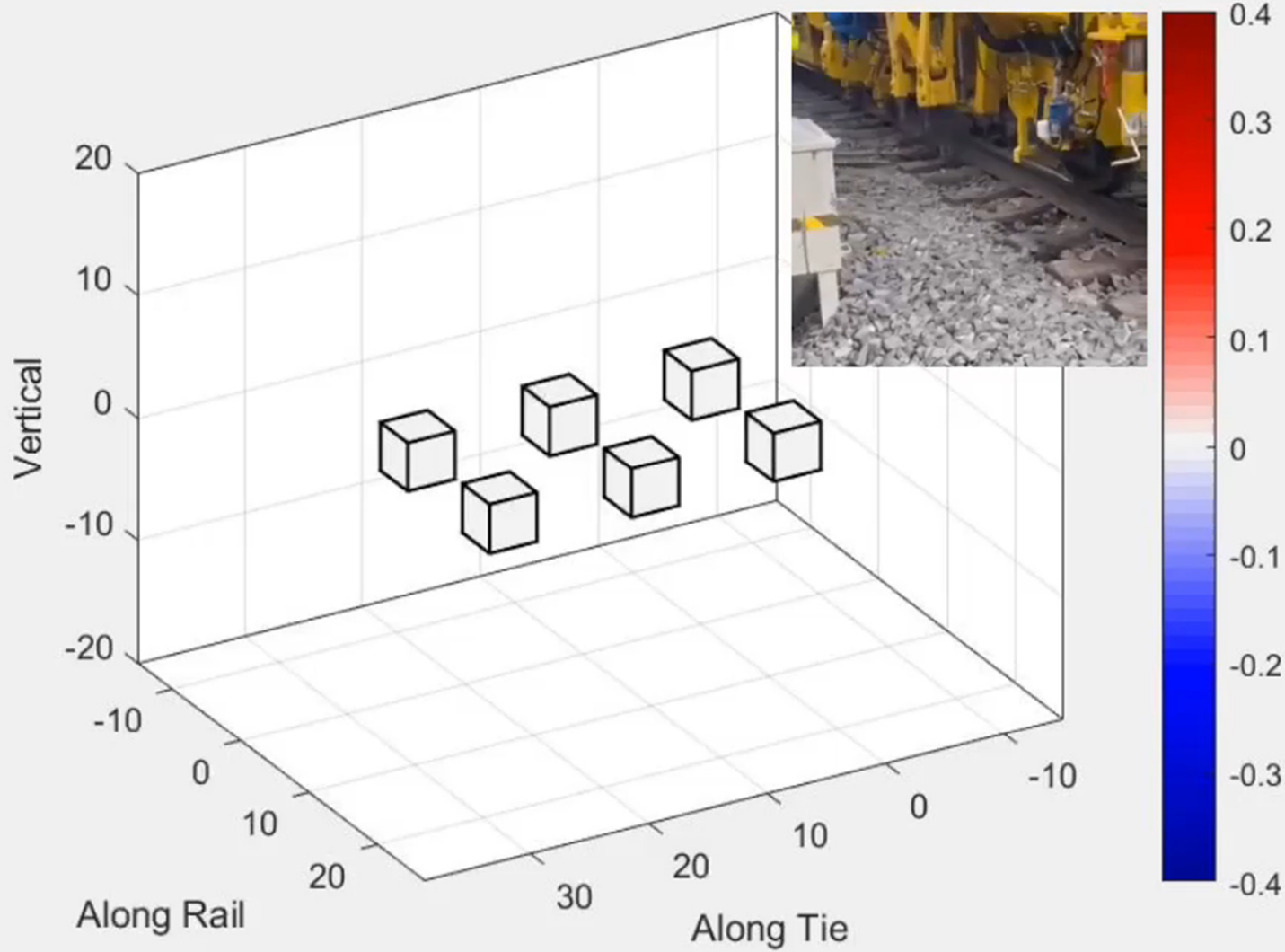


Field Configuration

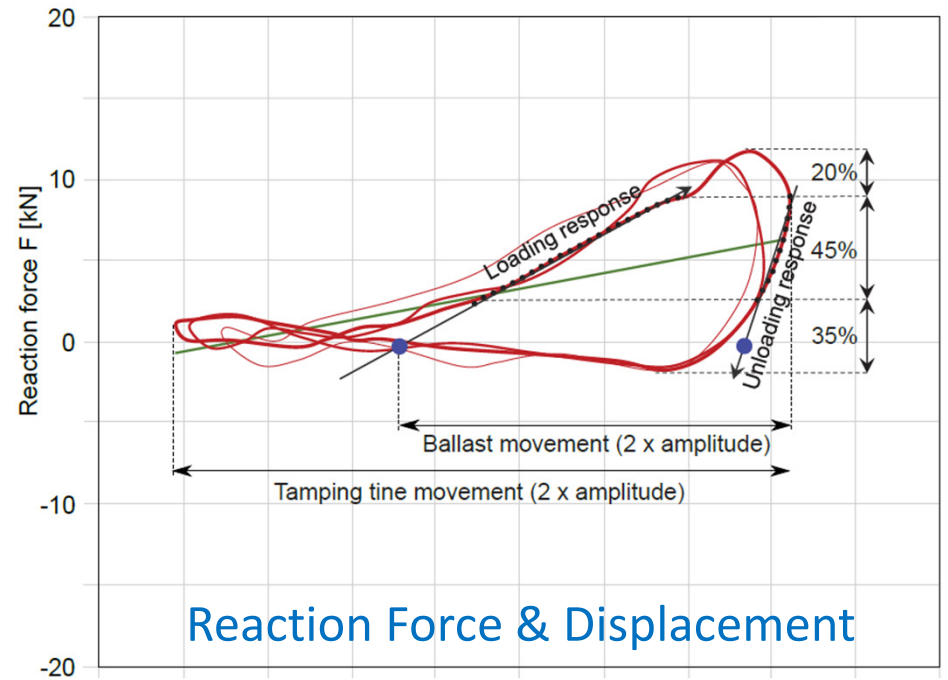
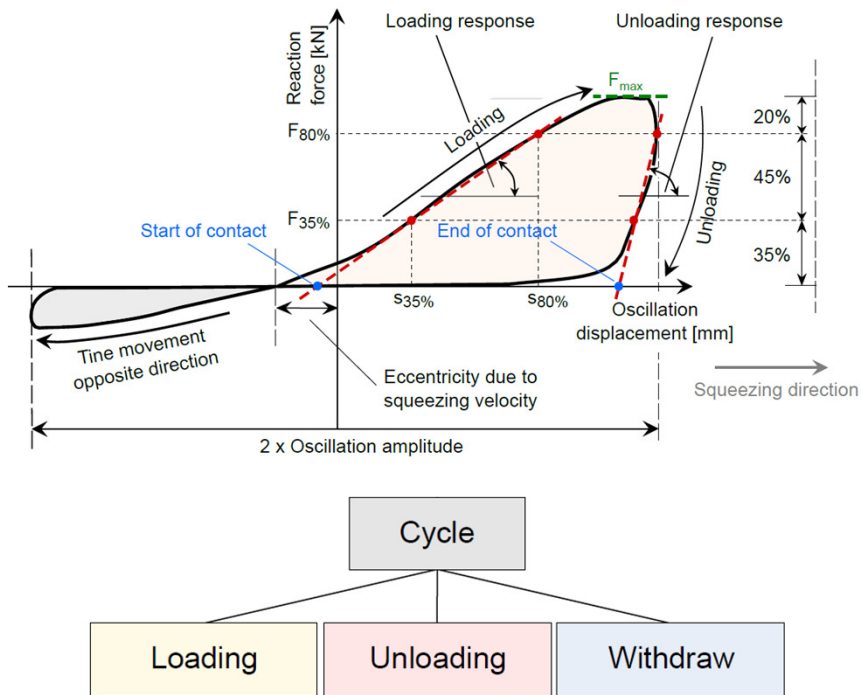


Remote Controller





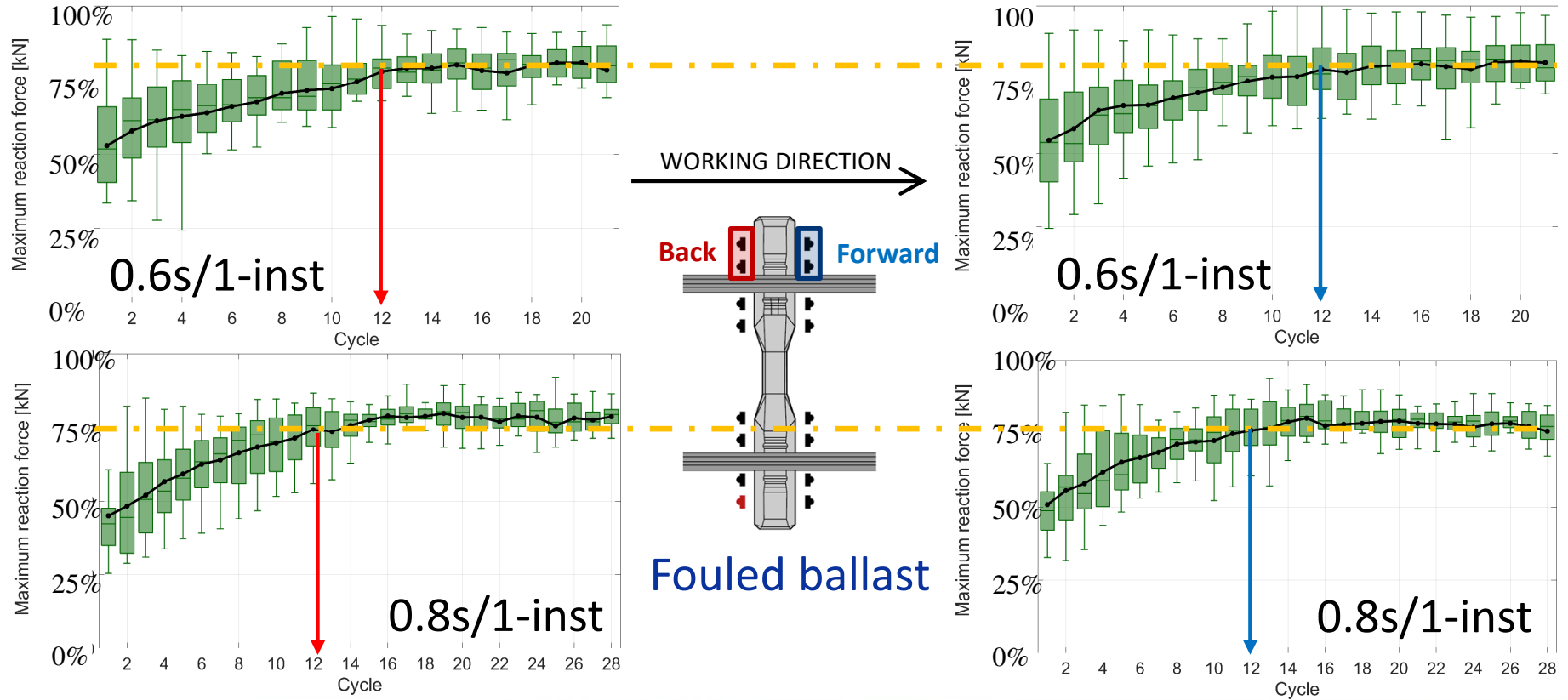
Squeezing Movement and Force From Smart Tamper



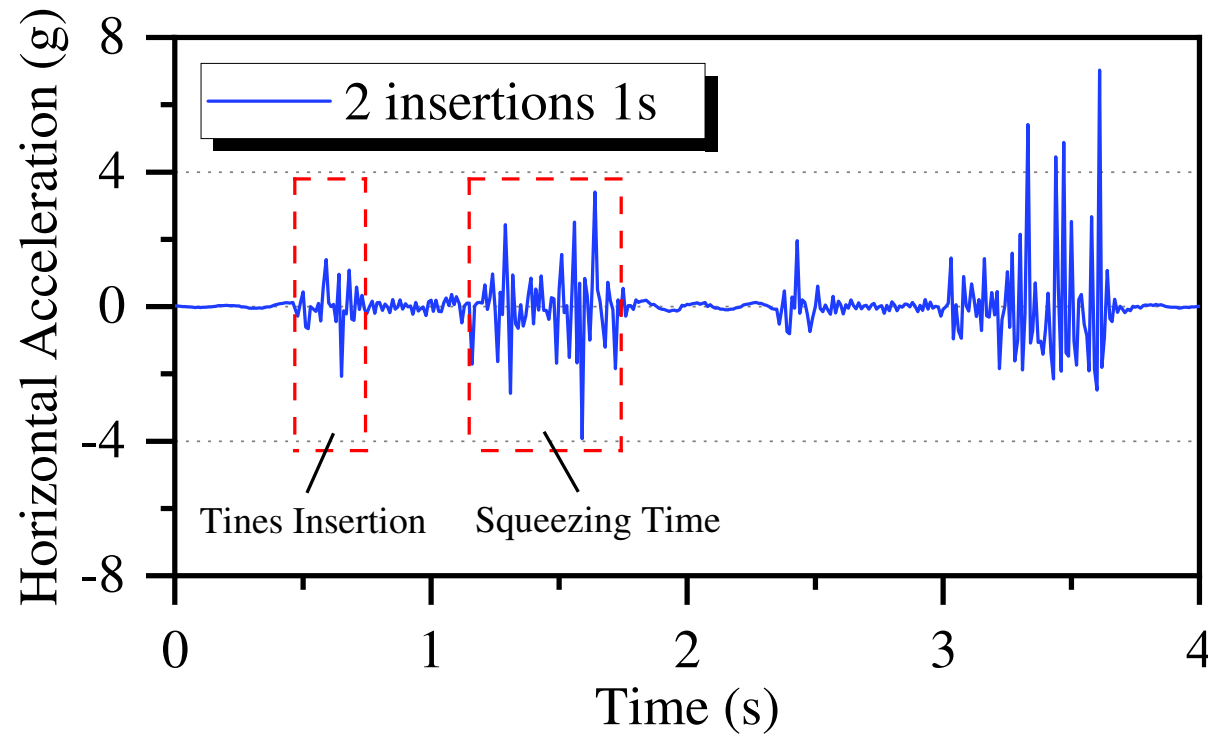
Reaction Force & Displacement



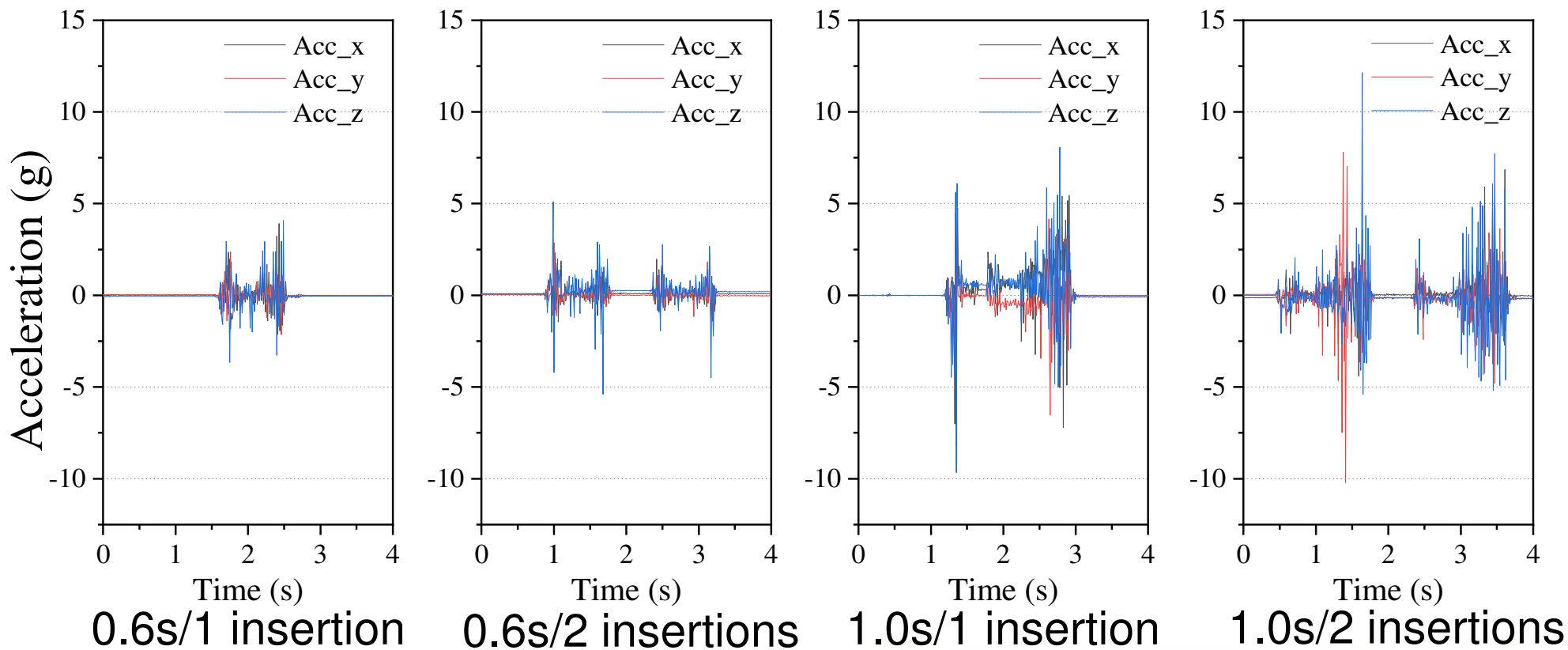
Maximum Reaction Force



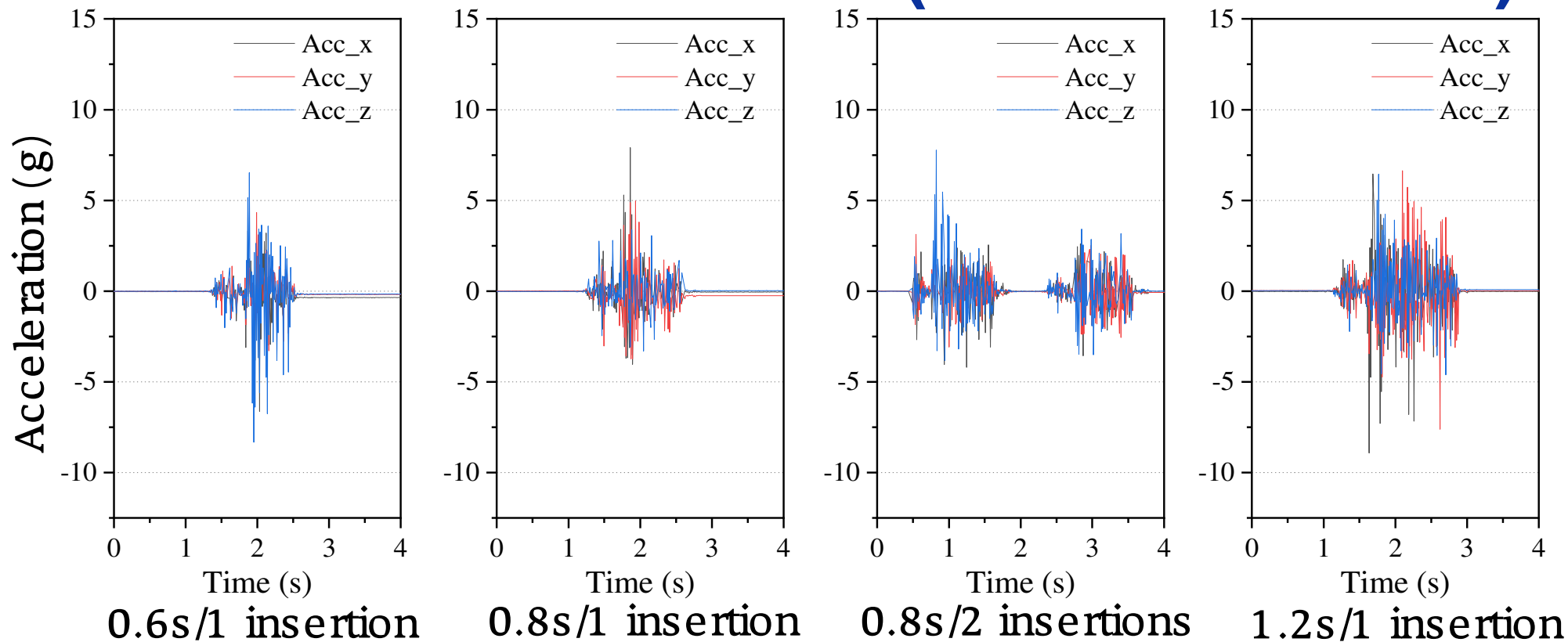
Ballast Acceleration Pattern From SmartRock



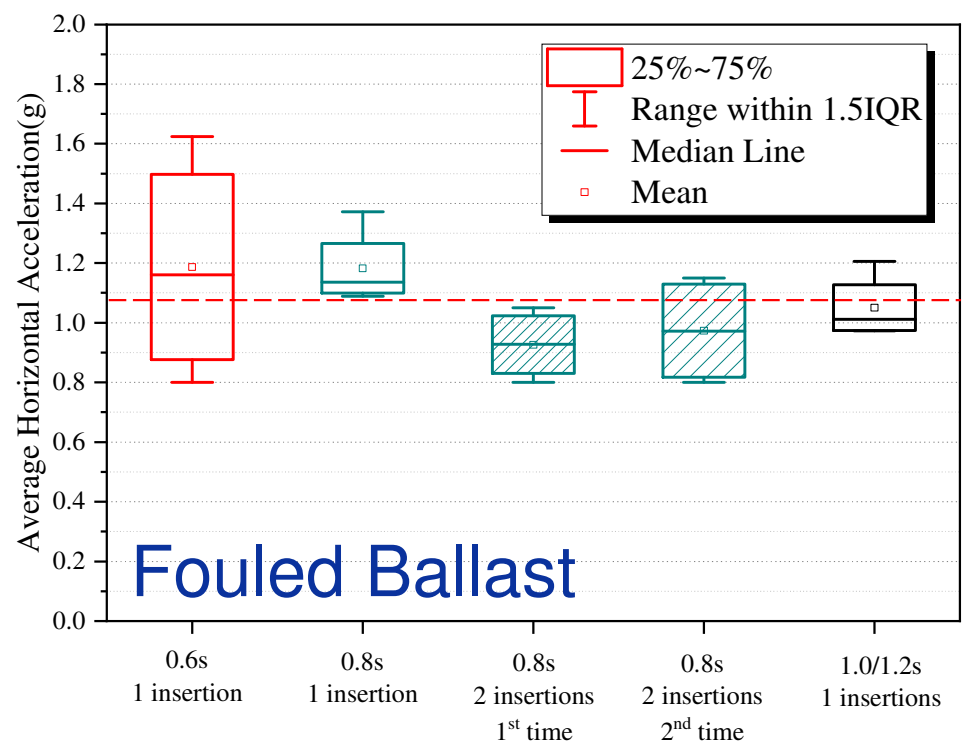
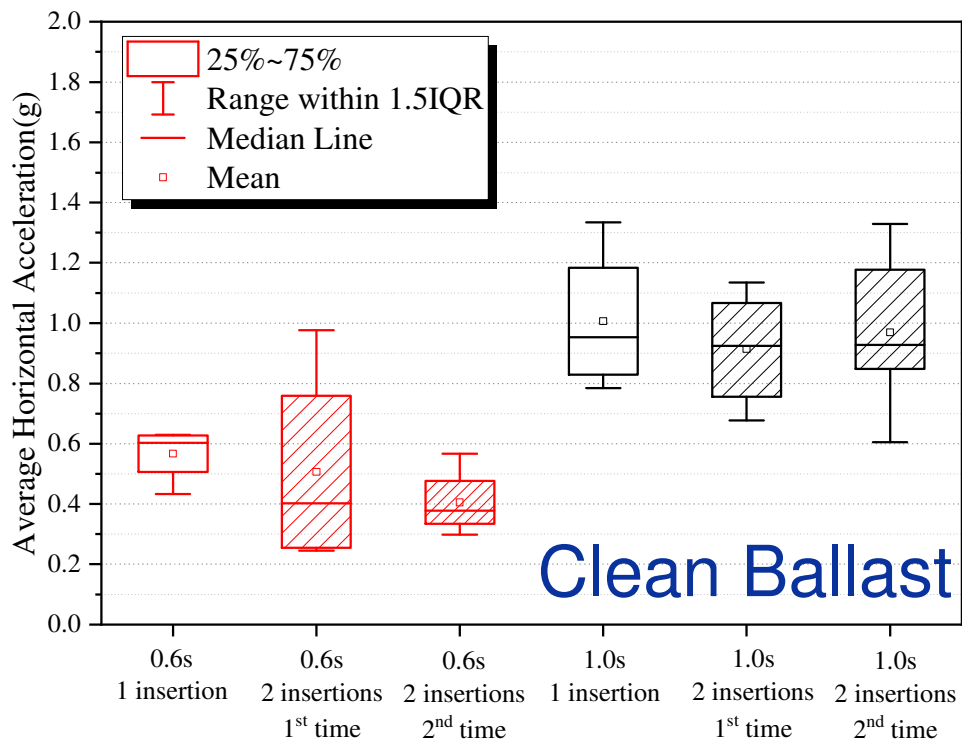
Ballast Acceleration (Clean Ballast)



Ballast Acceleration (Fouled Ballast)

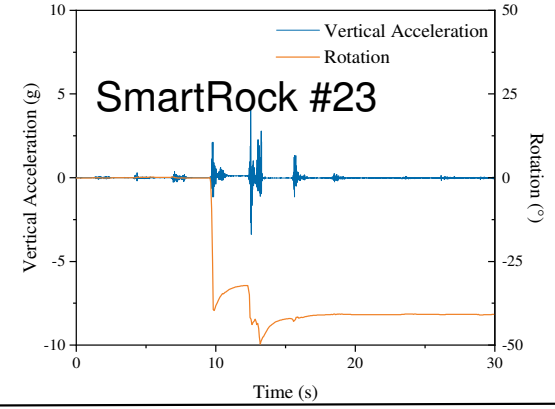
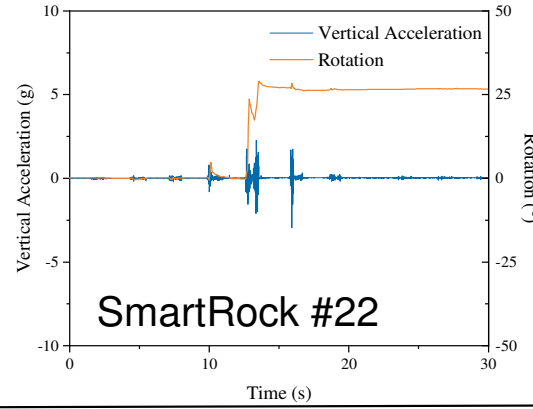
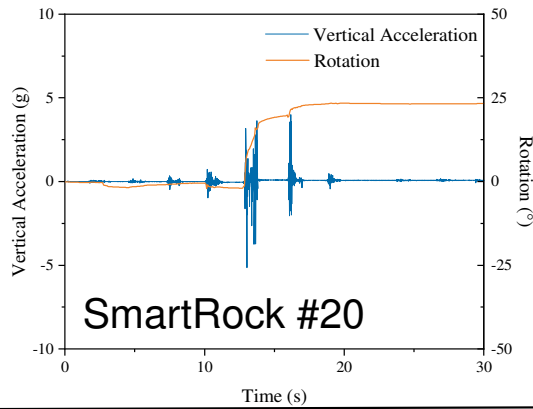


Comparison between Clean and Fouled Ballast

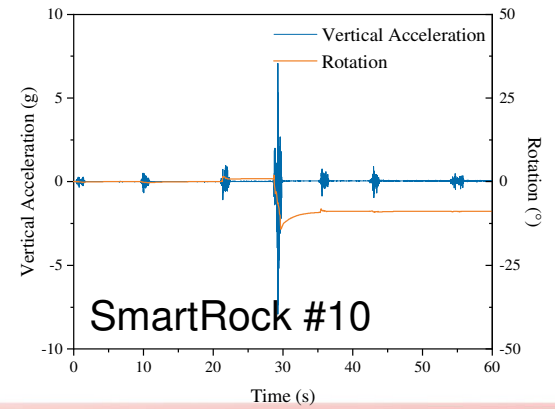
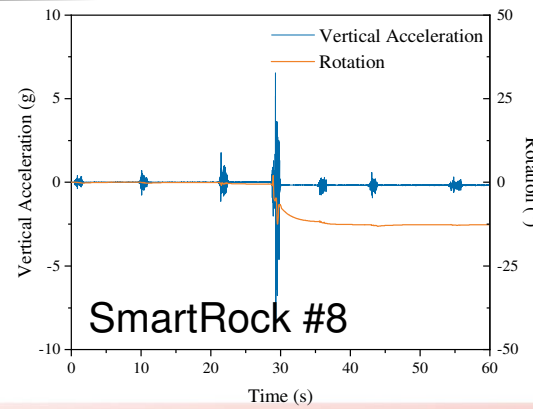
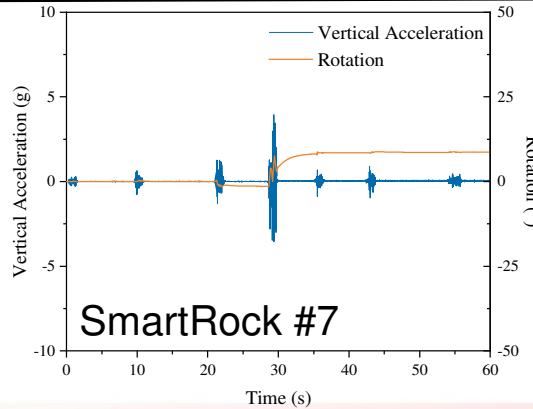


Ballast Rotation

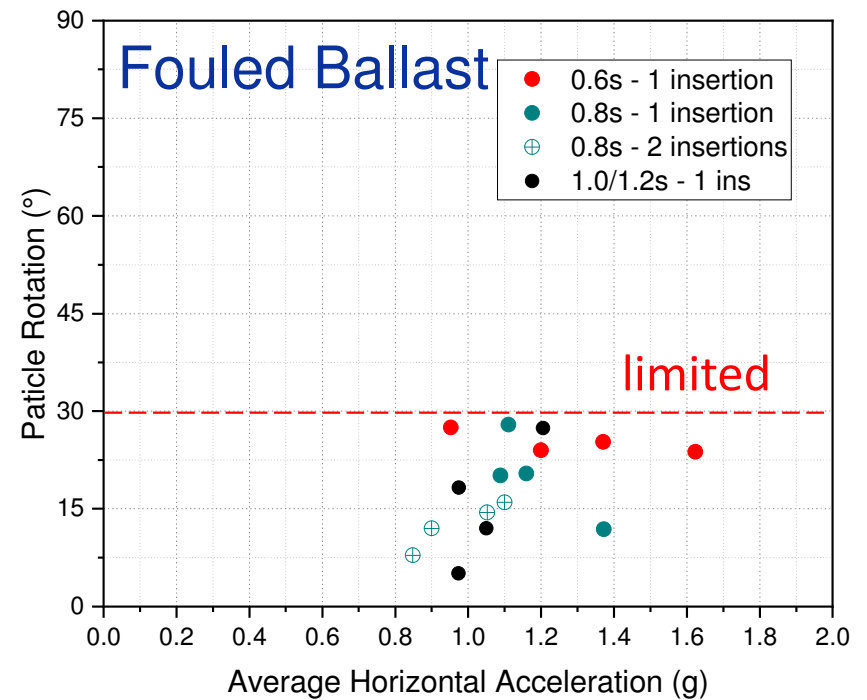
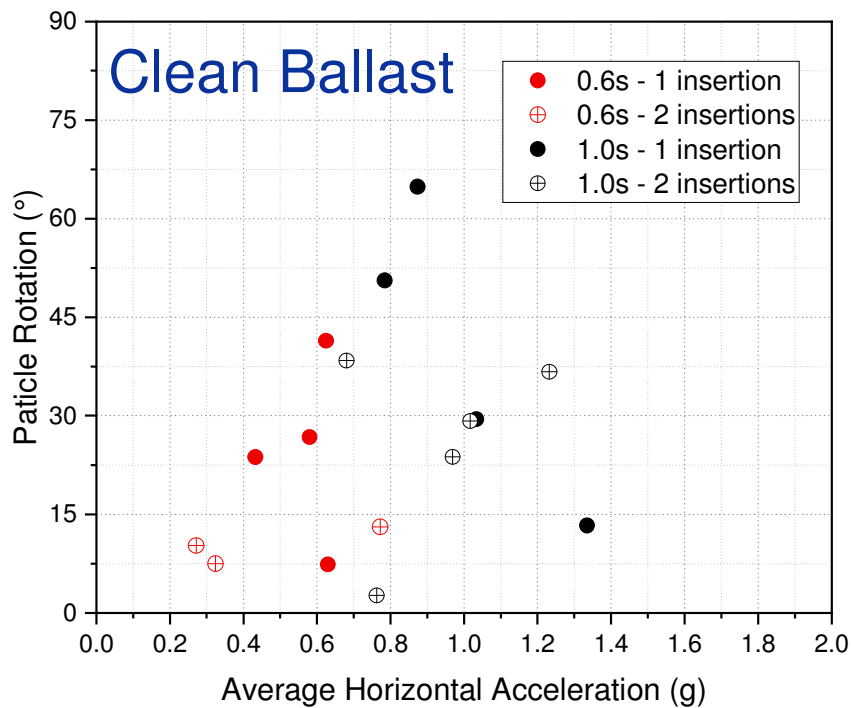
Clean Ballast



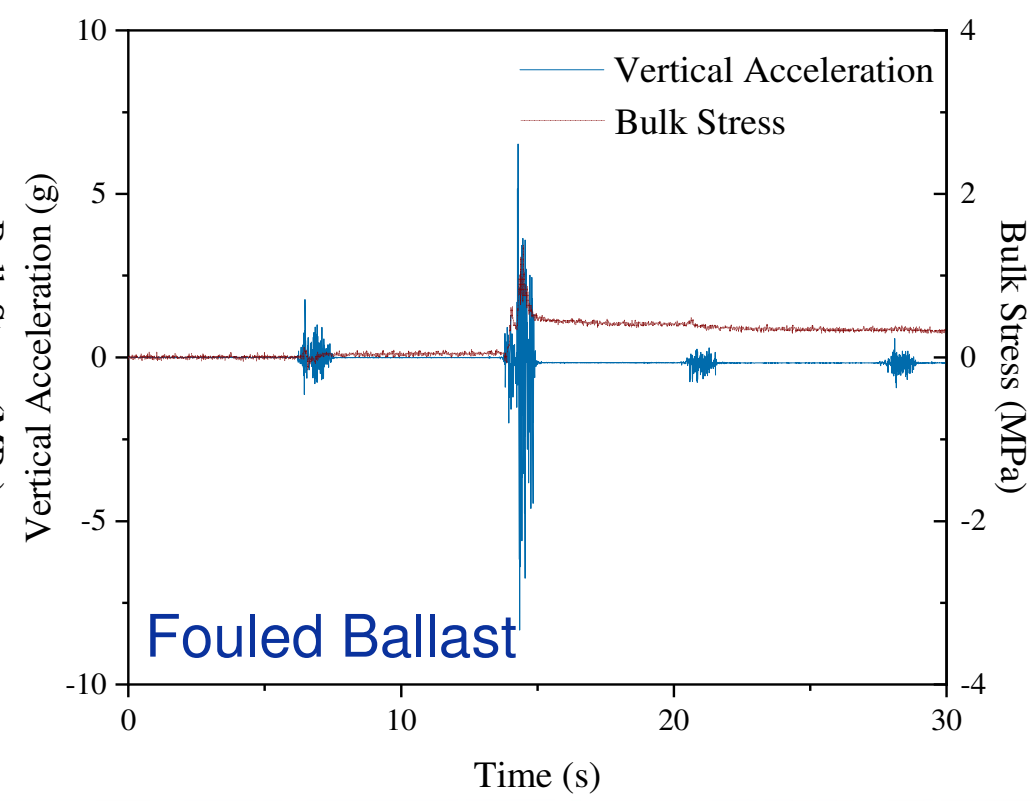
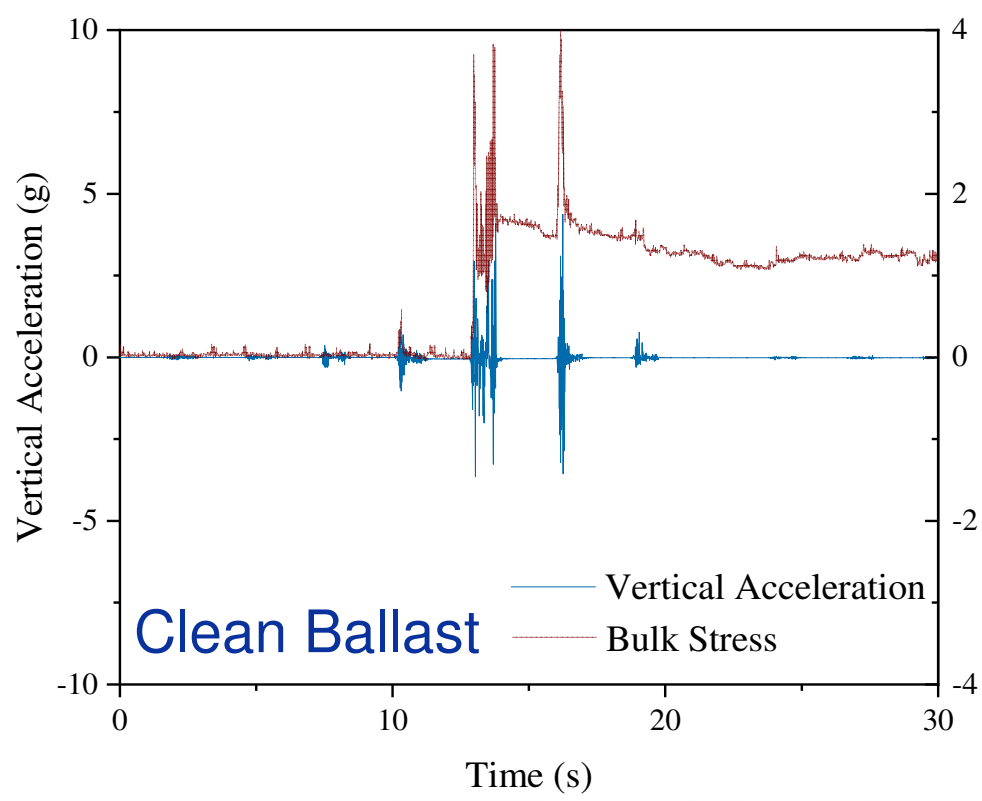
Fouled Ballast



Comparison between Clean and Fouled Ballast

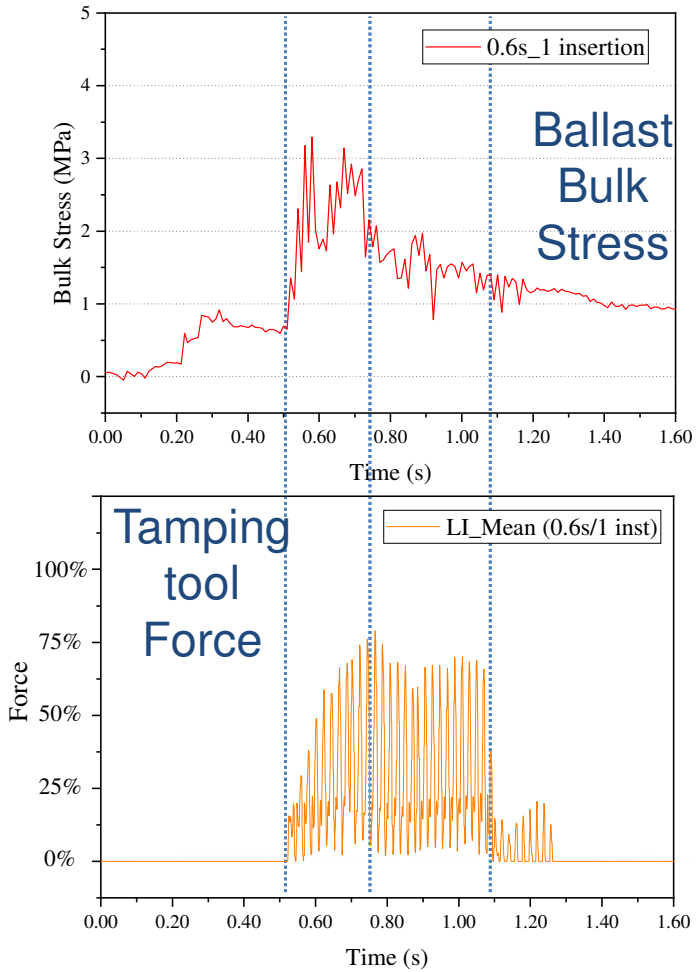


Ballast Contact Stress

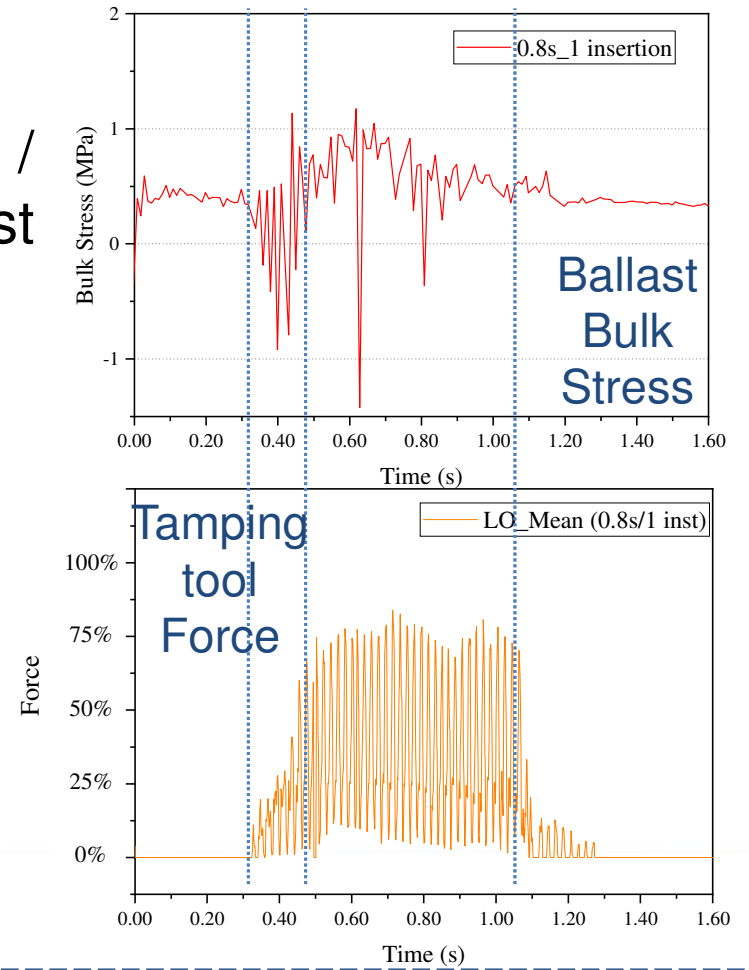


Comparison of signal from ballast and tamper

0.6s /
1 Inst

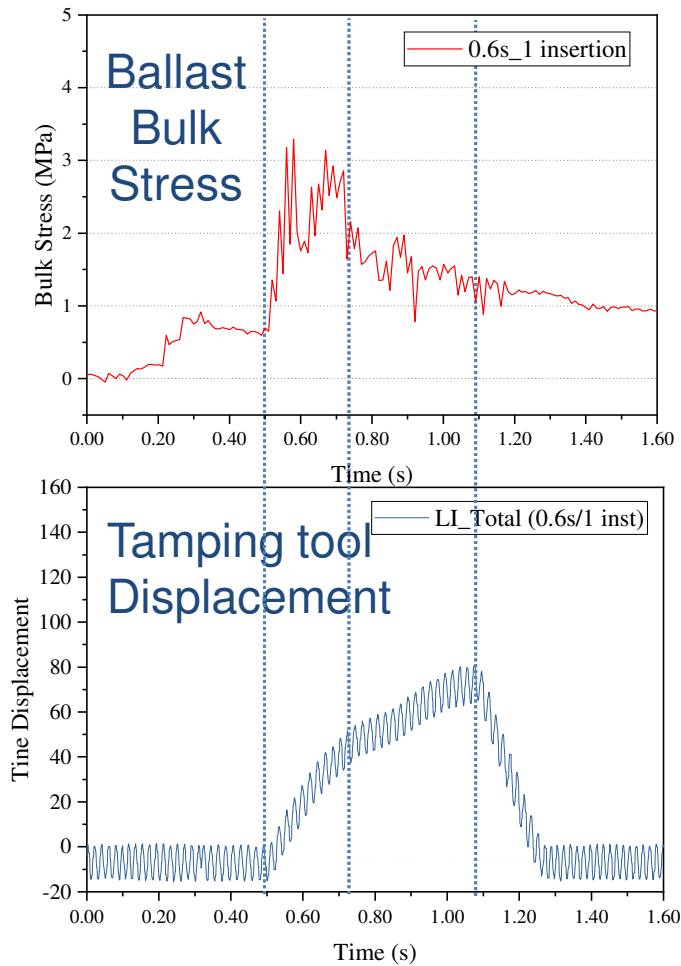


0.8s /
1 Inst

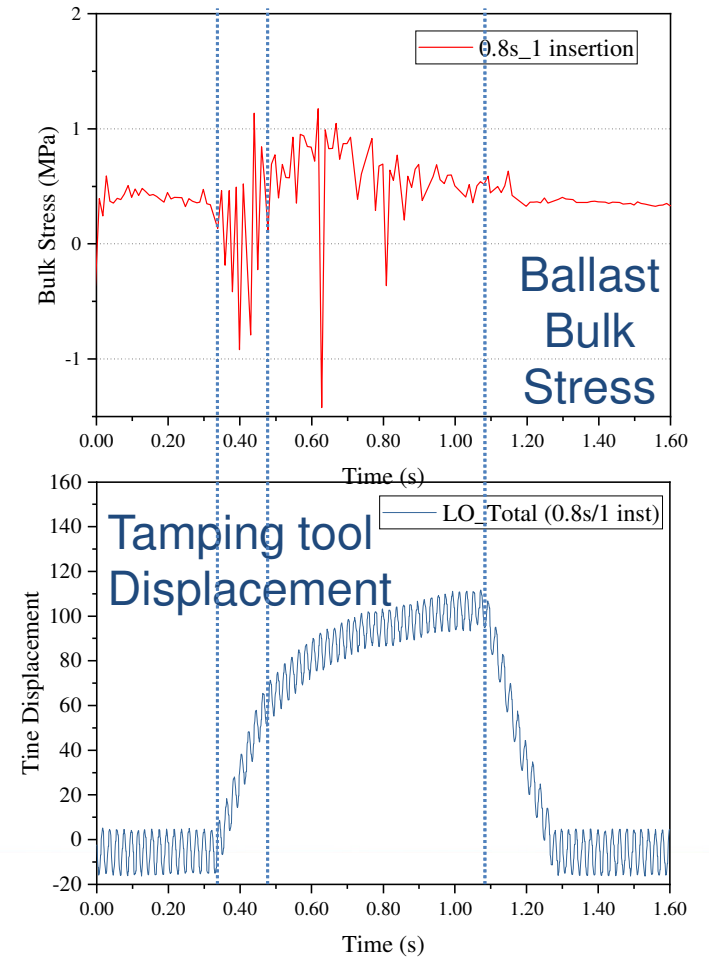


Comparison of signal from ballast and tamper

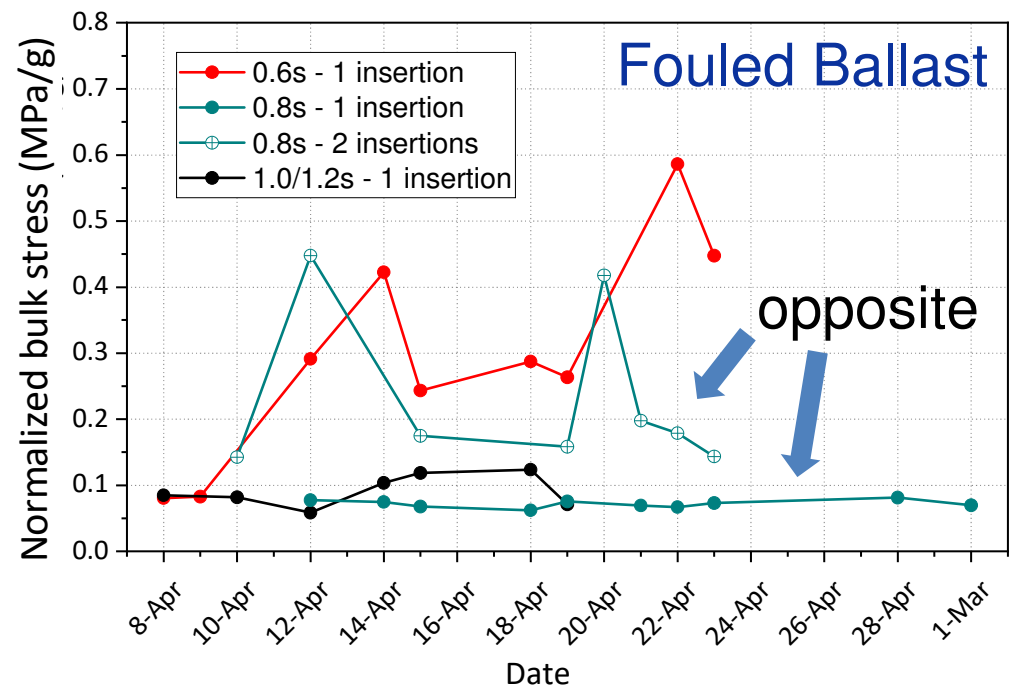
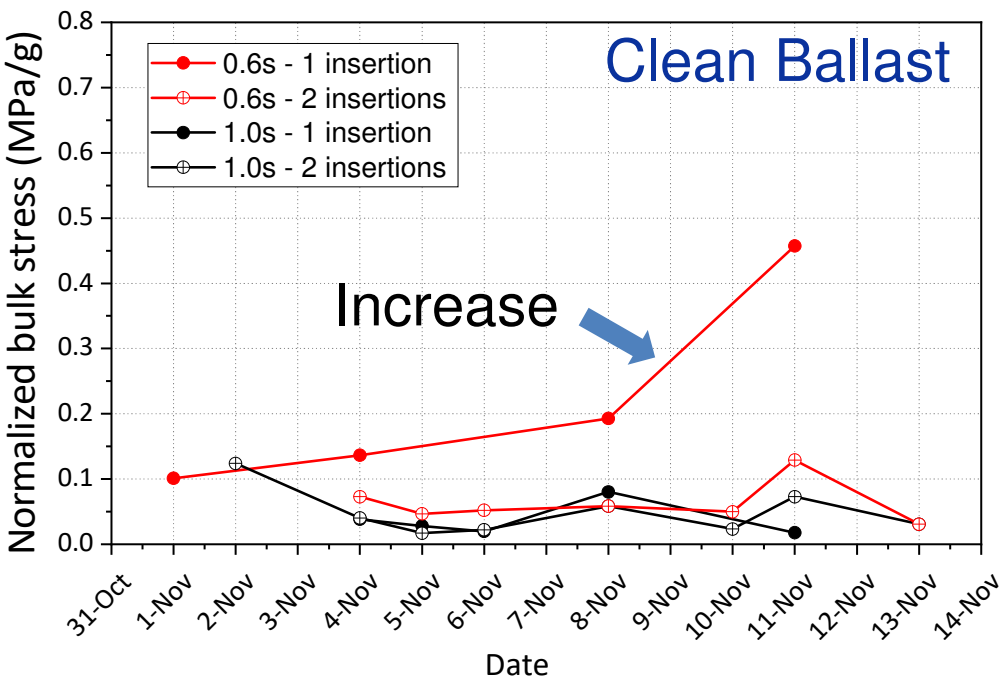
0.6s /
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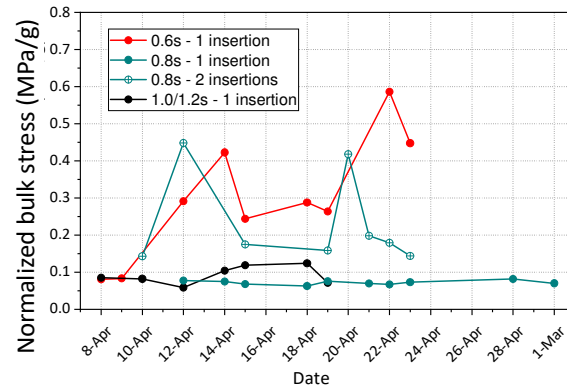
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1 Inst



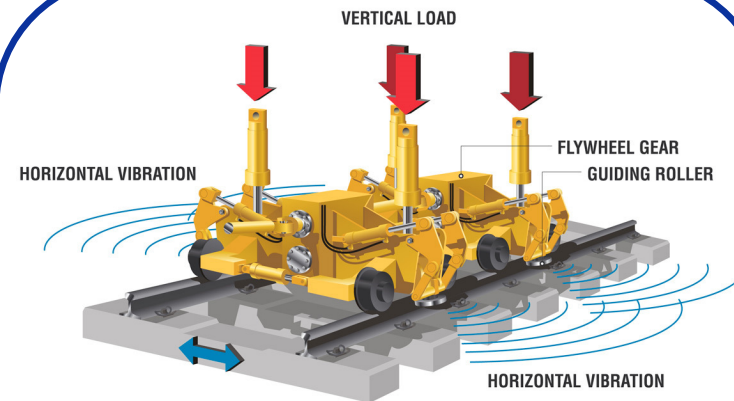
Comparison of Ballast Performance after Tamping



Future Work



Further analysis of data between Tamper and SmartRock is required to explore various ballast conditions.



The findings will be used to investigate the anticipated impact of ballast stabilization.



Conclusion

- ❖ Compared to fouled ballast, clean ballast is more responsive to the specific parameters of tamping. Typically, a squeezing time of 1.0 second yields better results than 0.6 seconds. However, deficiencies in short squeezing time can be rectified by increasing the number of insertions.
- ❖ When it comes to ballast, the tamping process's squeezing phase can be broadly divided into two stages: the initial disruption of structure, and the establishment of "interlocking".



Acknowledgement

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Plasser American

Mr. Hugh B. Thompson II



U.S. Department of Transportation
Federal Railroad Administration



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