



CENTER FOR RESEARCH & EDUCATION IN
ADVANCED TRANSPORTATION ENGINEERING SYSTEMS

HVS Evaluation of thin Asphalt Overlays on Composite Pavements

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In this presentation...

- What is CREATEs?
- Motivation for this study
- Goals & Objectives
- Research Approach
- Preliminary Results
- Other CREATEs Projects
- Questions





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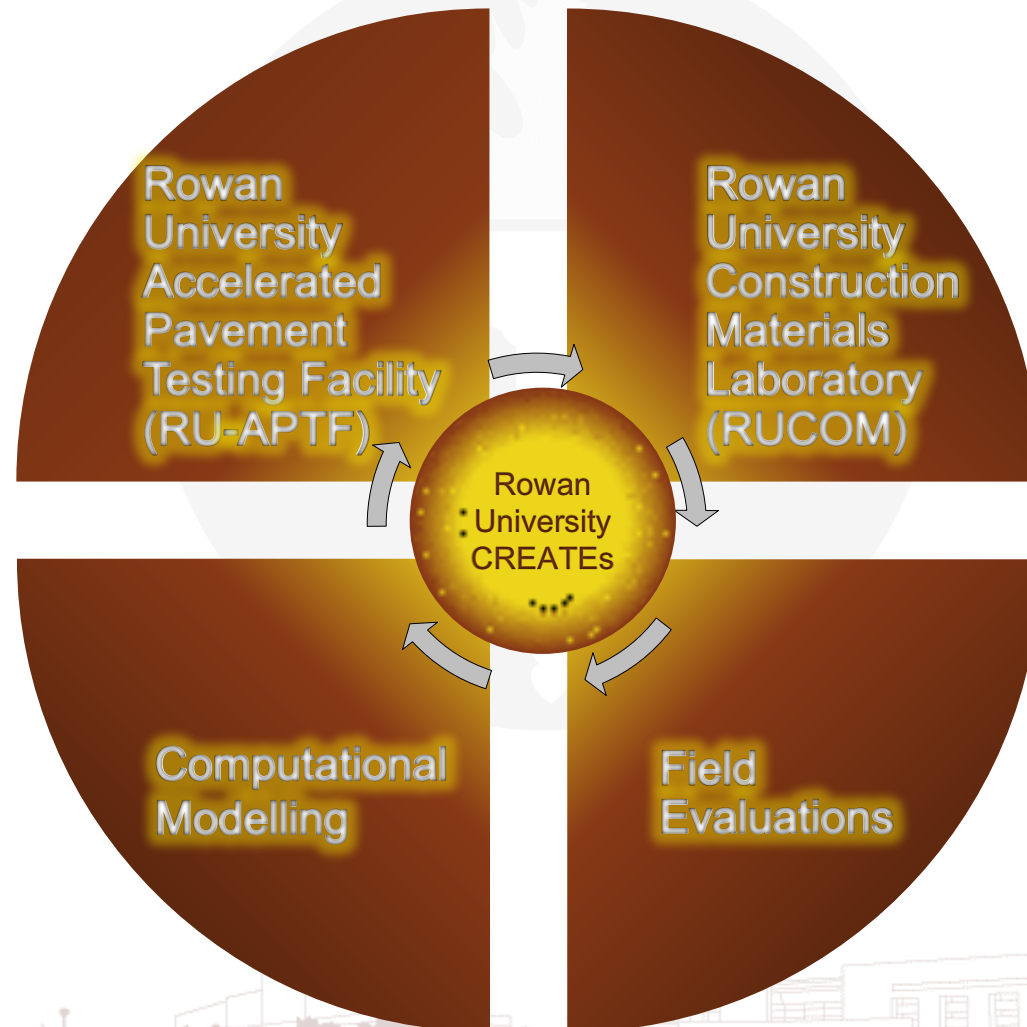


Rowan CREATES



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Rowan CREATEs



CREATEs HVS

- ❑ Rowan University acquired HVS (Mark IV model) from the United States Army Corps of Engineers (USACE).
- ❑ Typically used to evaluate flexible (asphalt) and rigid (cement) pavements.
- ❑ Apply uni- and bi-directional loading along with advanced temperature control ([heating and cooling systems](#)).



CREATEs APTF (Infrastructure)



CREATEs HVS

Rowan's HVS



CREATEs HVS (Heating Unit)



CREATEs HVS (Cooling Unit)



CREATEs





Why Asphalt Overlays?

Thin Asphalt Overlays (Need)

- Around 50% of NJDOT's roads are PCC pavements.
- These roads are generally in poor condition.
- Thin overlays are typically utilized to extend the life of these pavements.
- However, these overlays have been performing poorly in the field.



Thin Asphalt Overlays (Goal)

- ❑ Conduct accelerated full-scale pavement testing to predict the expected life of four thin asphalt overlay treatments used on Portland Cement Concrete (PCC) pavements.





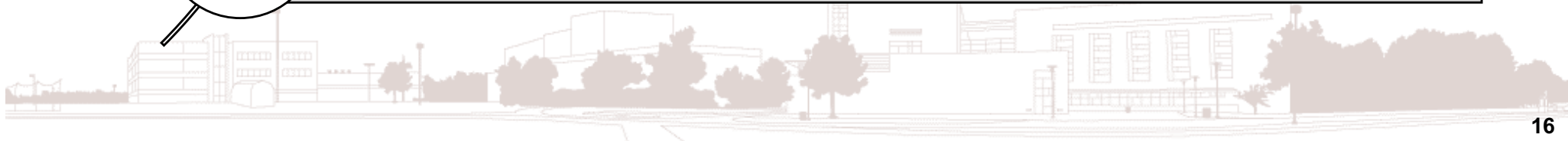
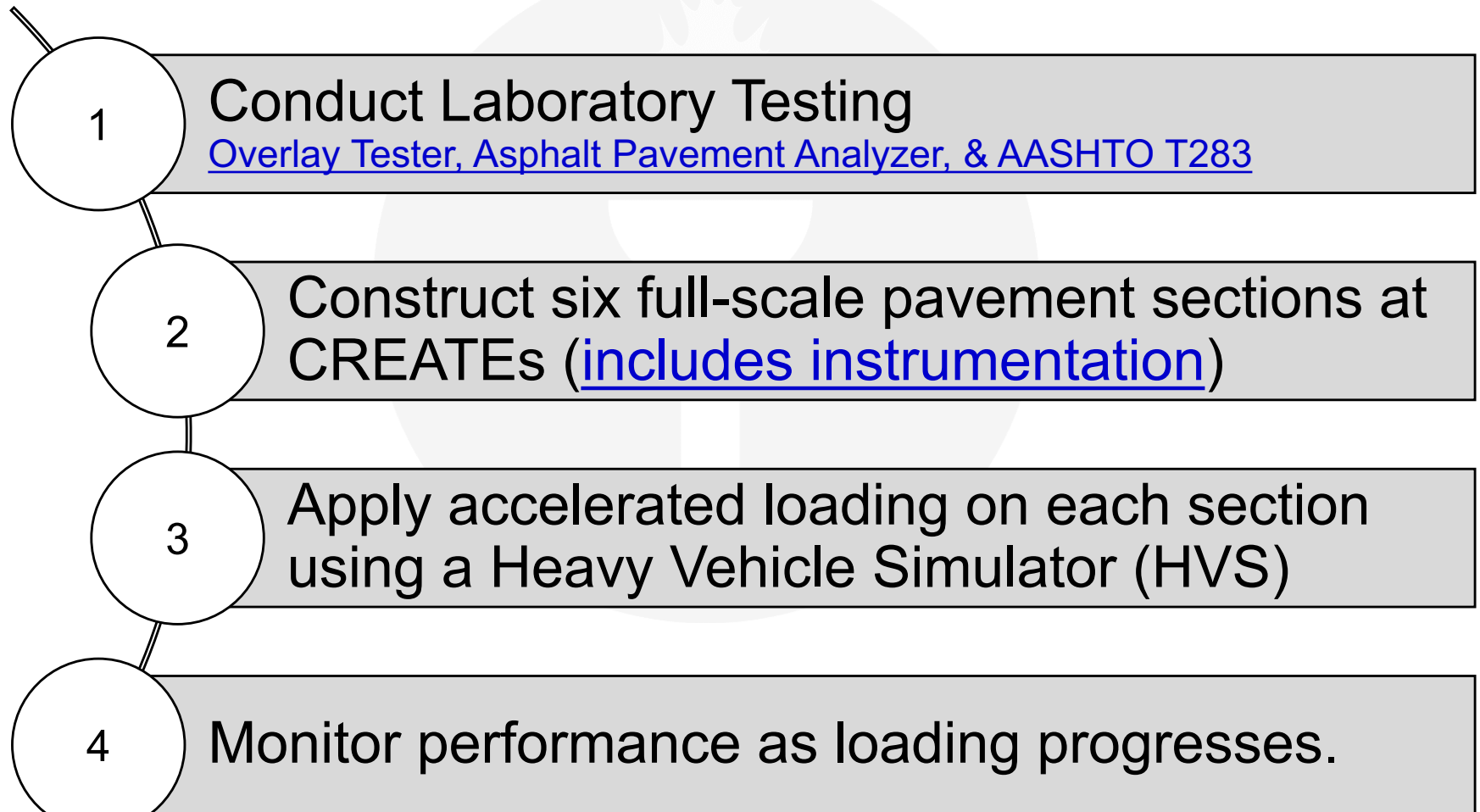
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Research Approach



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Research Approach



Overlays Considered

A

9.5 mm. NMAS Superpave Mix ([Control](#))

B

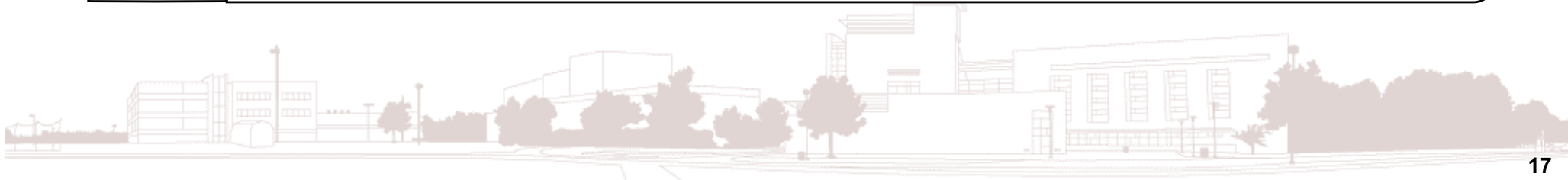
12.5 mm. NMAS Stone Matrix Asphalt (SMA)

C

High Performance Thin Overlay (HPTO)

D

Binder Rich Intermediate Course (BRIC)



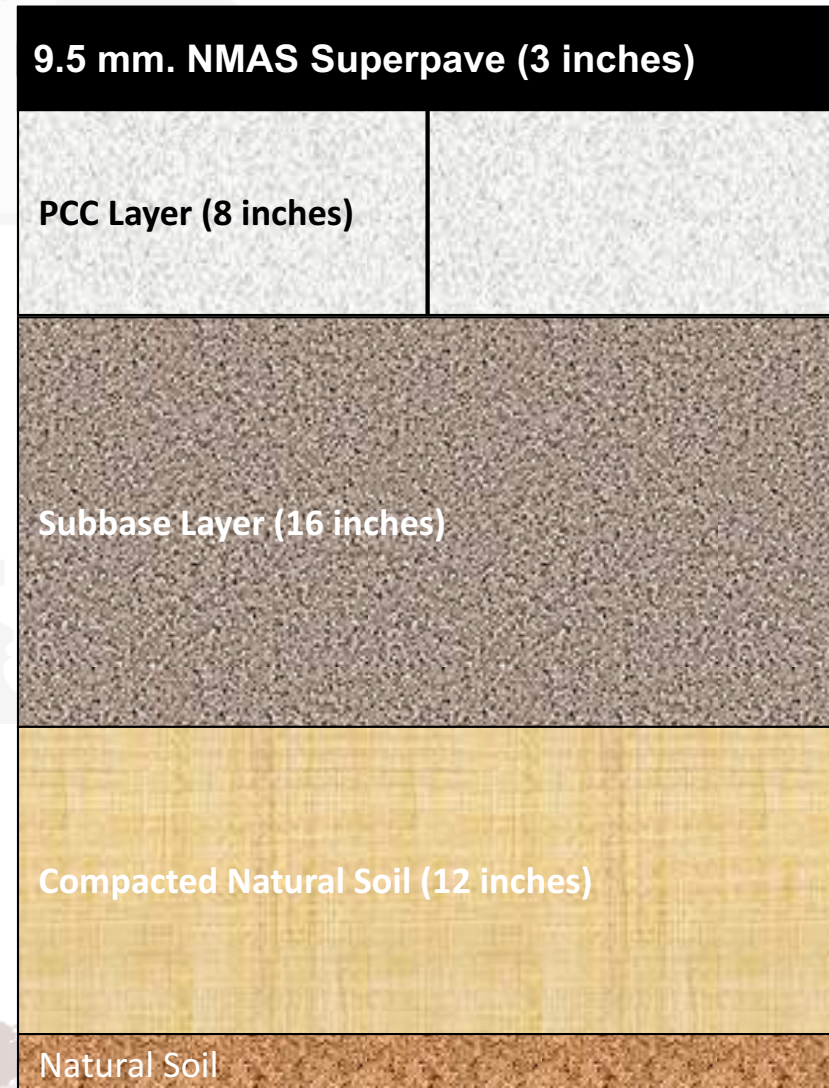
Sections Constructed

- ❑ A total of six sections were constructed at CREATEs accelerated pavement testing facility.
- ❑ Combinations of the four overlays with varying thicknesses.
- ❑ The supporting PCC pavement structure was similar for all sections.
- ❑ The sections were instrumented using: asphalt strain gauge, thermocouples, compression gauges, LVDTs, and pressure cells.

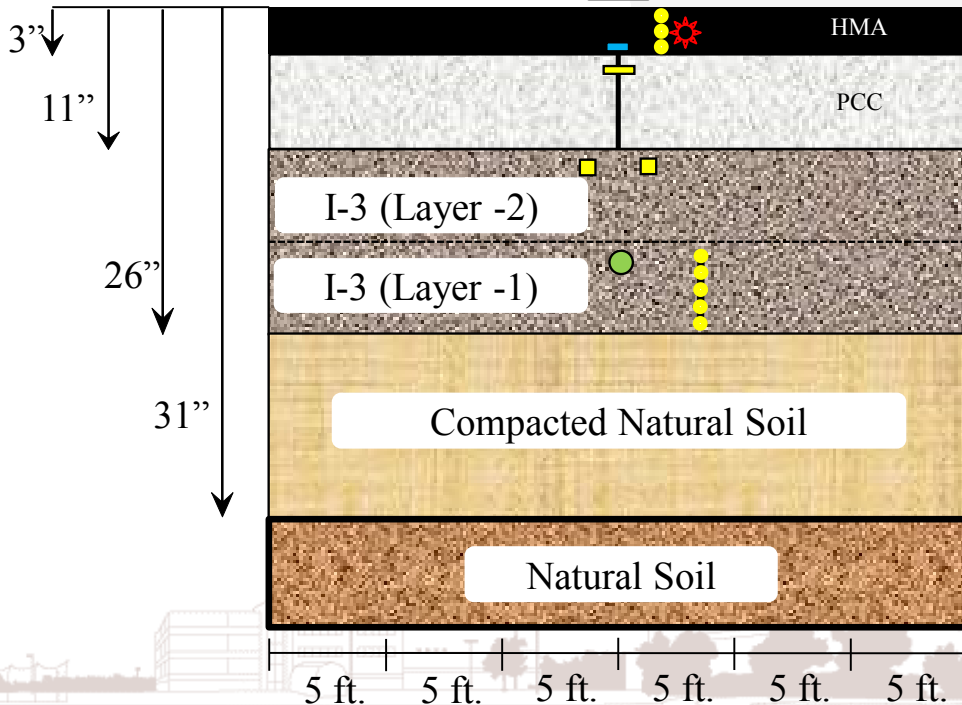
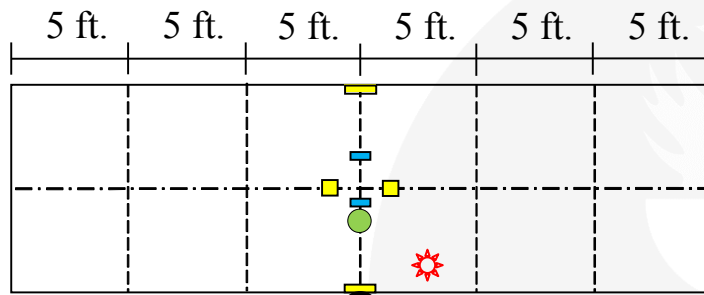
Sections Constructed







Section No. 1:

- 9.5 mm. NMAS Superpave Overlay
- PCC Intermediate Course (BRIC) Overlay mix
- BRIC is a Specialty NJDOT Overlay mix



Sections Constructed



-  Longitudinal Asphalt Strain Gauge (Total: 2)
-  Pressure Cell (Total: 1)
-  LVDT (Total: 2)
-  Soil Compression Gauge (Total: 2)
-  HMA Temperature Sensor (Total: 3 T-type Thermocouples)
-  Type T thermocouples will be used for temperature measurements.

Construction/Sensor Installation



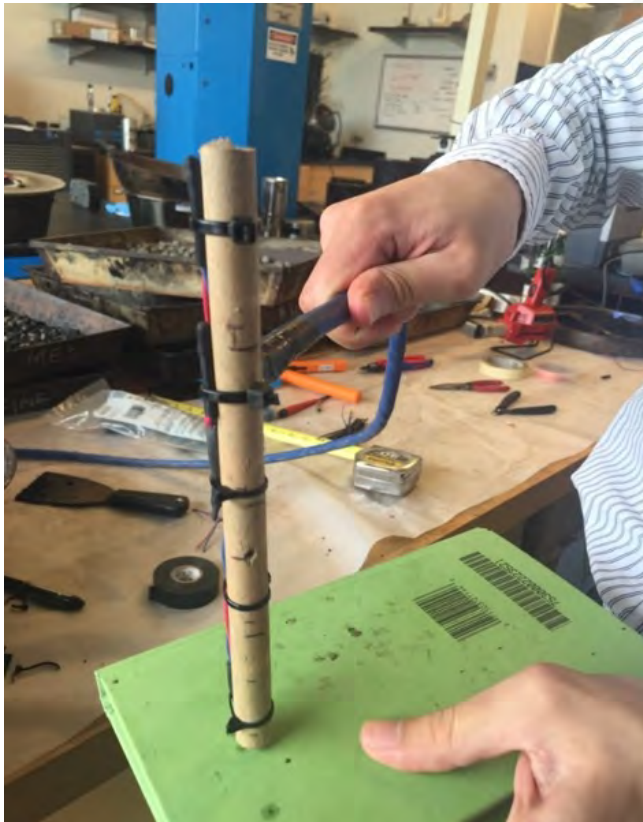
Construction/Sensor Installation



Construction/Sensor Installation



Construction/Sensor Installation



Construction/Sensor Installation



Construction/Sensor Installation



Construction/Sensor Installation



Construction/Sensor Installation



Construction/Sensor Installation



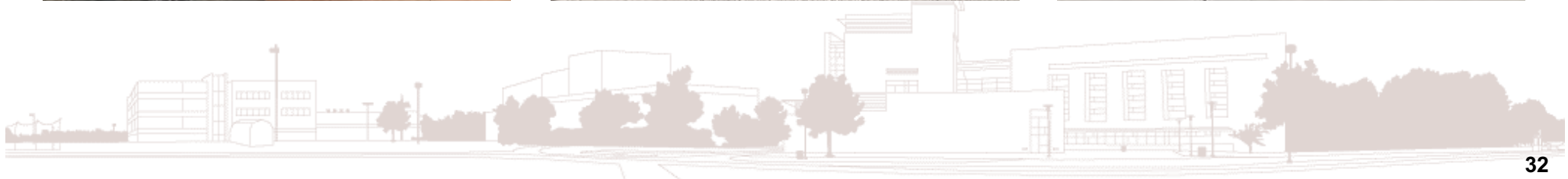
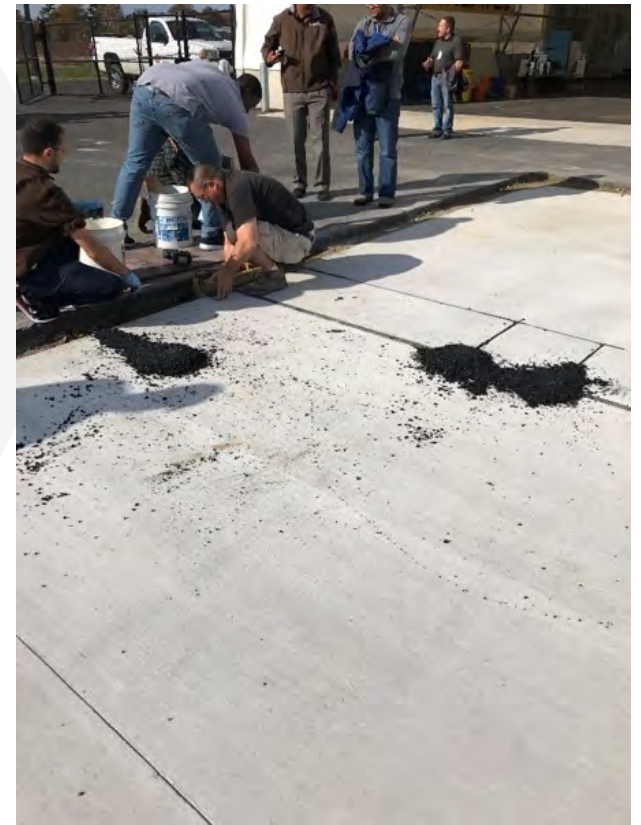
Construction/Sensor Installation



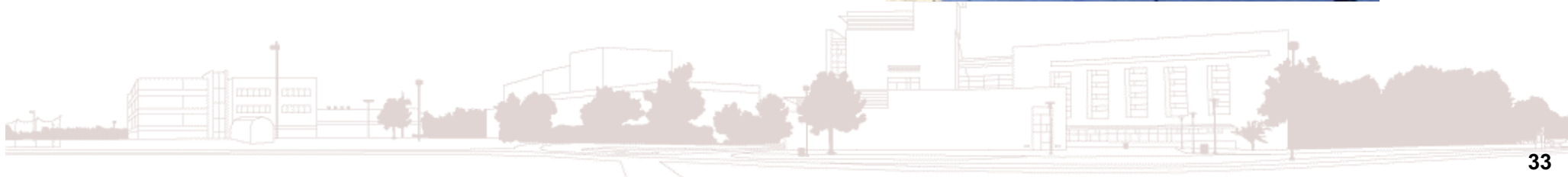
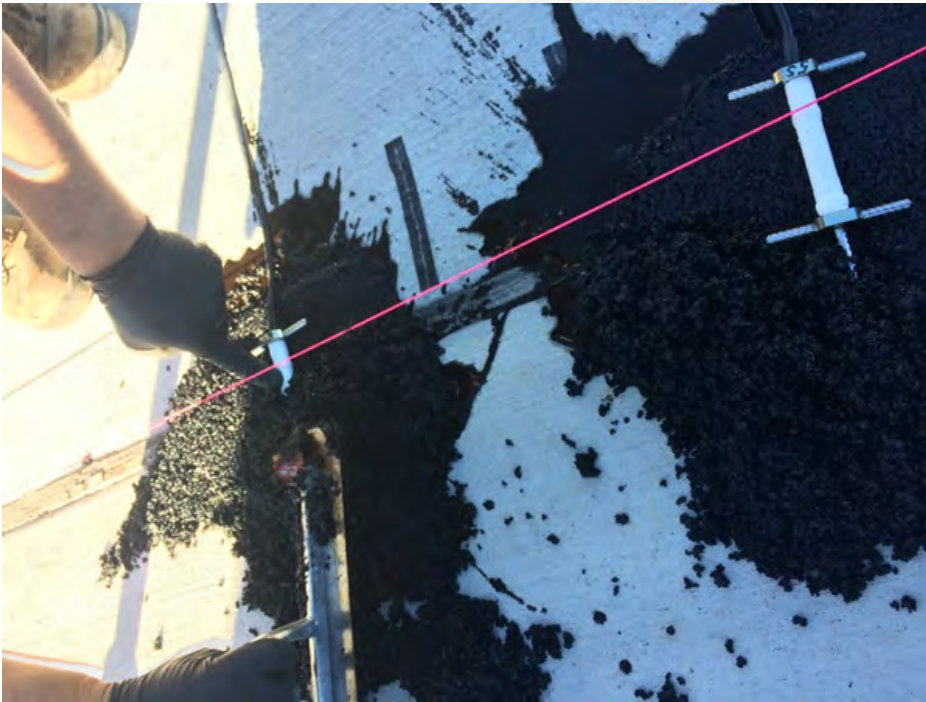
Construction/Sensor Installation



Construction/Sensor Installation



Construction/Sensor Installation



Construction/Sensor Installation



Construction/Sensor Installation





Full-Scale Testing Protocols

HVS Full-Scale Loading

- ❑ One section, out of the six, will be subjected to loading using the HVS until failure (i.e., failing one section at a time or a total of 300K passes).
- ❑ Air Temp. around section is controlled using CREATEs Cooling/Heating System (25°C).
- ❑ Therefore, HVS loading will be conducted in the following sequence: Section 1 loaded until failure, followed by Section 2, followed by Section 3, and so on.

9.5ME	SMA	HPTO	95/BRIC	SMA/BRIC	HPTO/BRIC
Section 1	Section 2	Section 3	Section 4	Section 5	Section 6



HVS Full-Scale Loading

- ❑ Loading will commence by applying, a 25 kN wheel load in a uni-directional mode at a speed of 5 mph for 40,000 passes.
- ❑ Load magnitude will then be increased from 25 kN to 40 kN while all other test parameters remain the same for another 40,000 passes.
- ❑ Finally, load magnitude will be increased from 40 kN to 60 kN after 80,000 passes.
- ❑ Each section will be loaded 22 hours a day; two hours for maintaining the HVS.

HVS Instrumentation Sampling

- The CREATEs cDAQ system was utilized to collect data from all sensors after the application of the following load passes:

Data Sampling Frequency

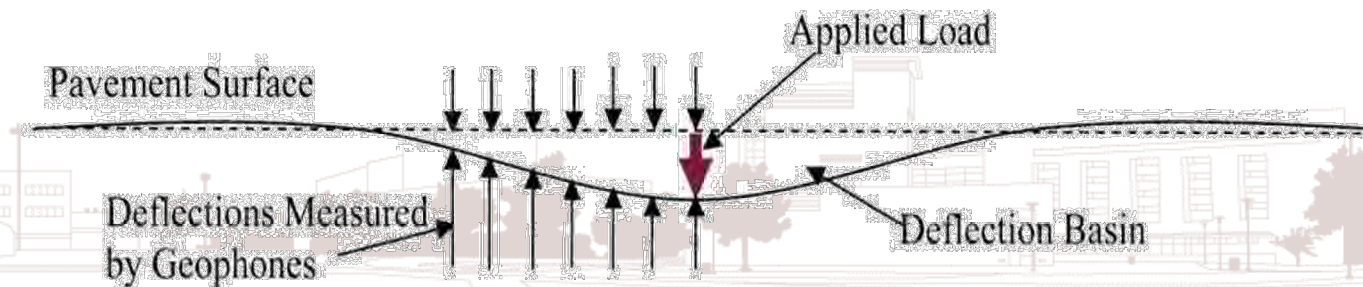
1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150, 175, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000, 2500, 3000, 3500, 4000, 4500, 5000, 6000, 7000, 8000, 9000, 10000, ...

Incremented by
5,000 after 10k
Incremented by
20,000 after 100k

Incremented by
10,000 after 40k
Incremented by
40,000 after 200k

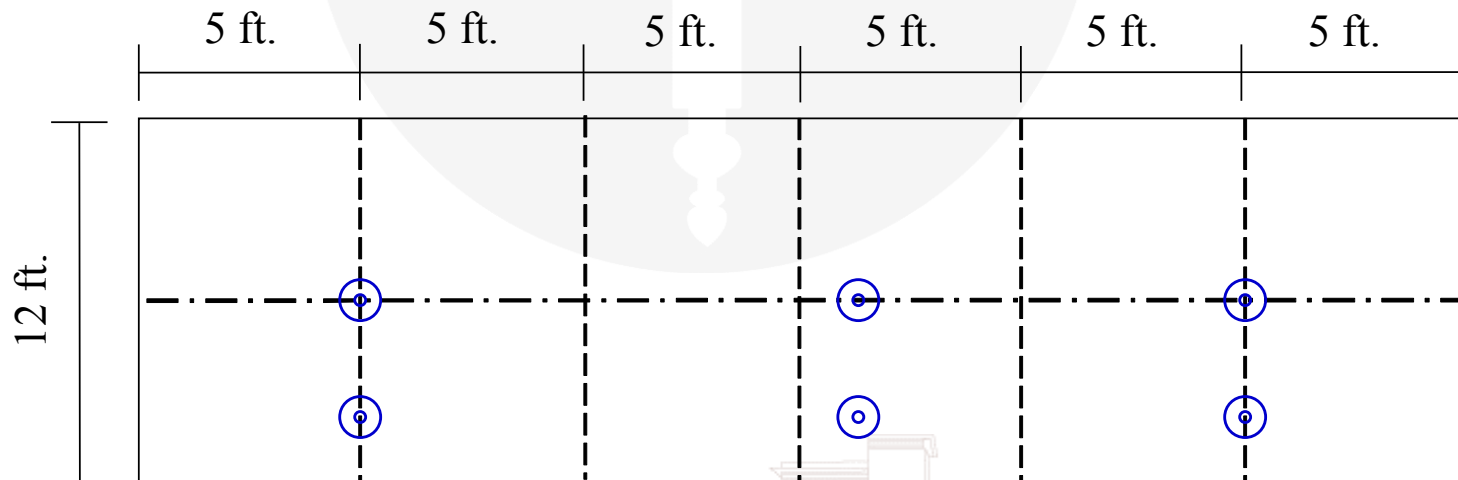
HWD Testing

- ❑ A field test that is typically conducted to evaluate the structural integrity of pavements.
- ❑ The HWD “drops” (freefall) a weight on a particular location.
- ❑ Geophones (seven) are used to measure deflections at various locations: Forming a Deflection Basin.



HWD Testing

- ❑ Heavy Weight Deflectometer (HWD) testing will be conducted before loading is applied and at “failure”.
- ❑ Six locations will be tested on each section.





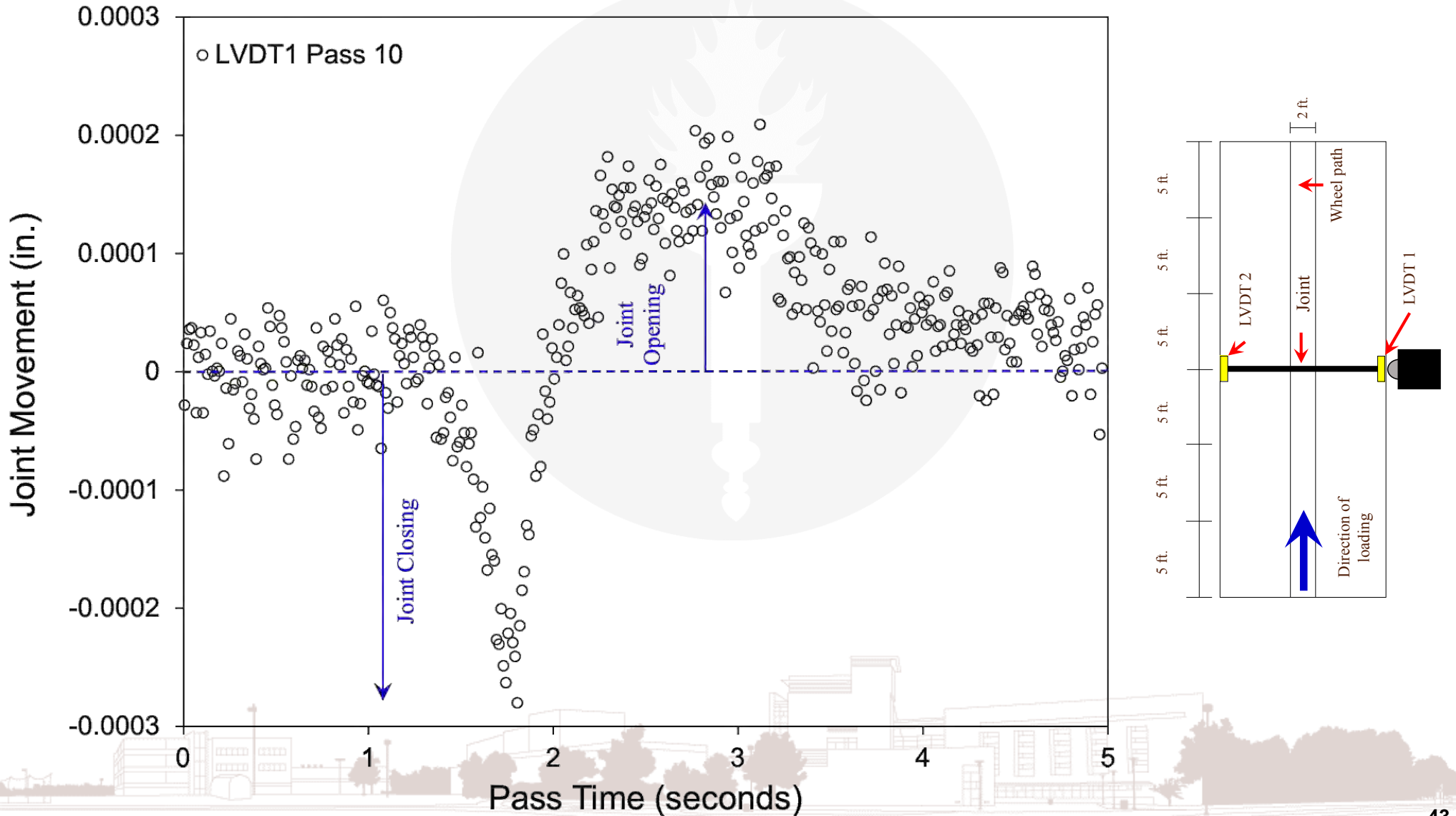
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Preliminary Results

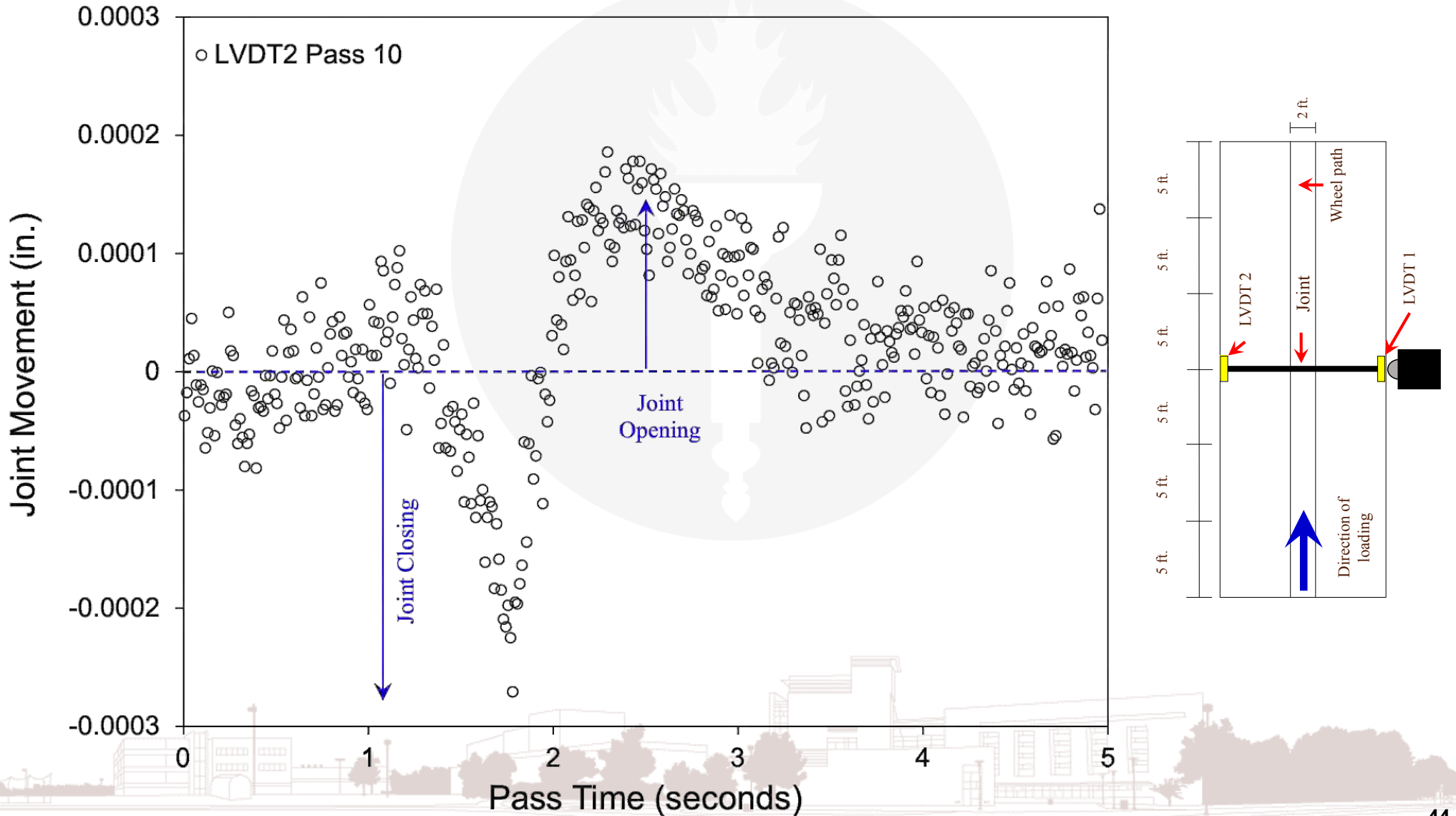


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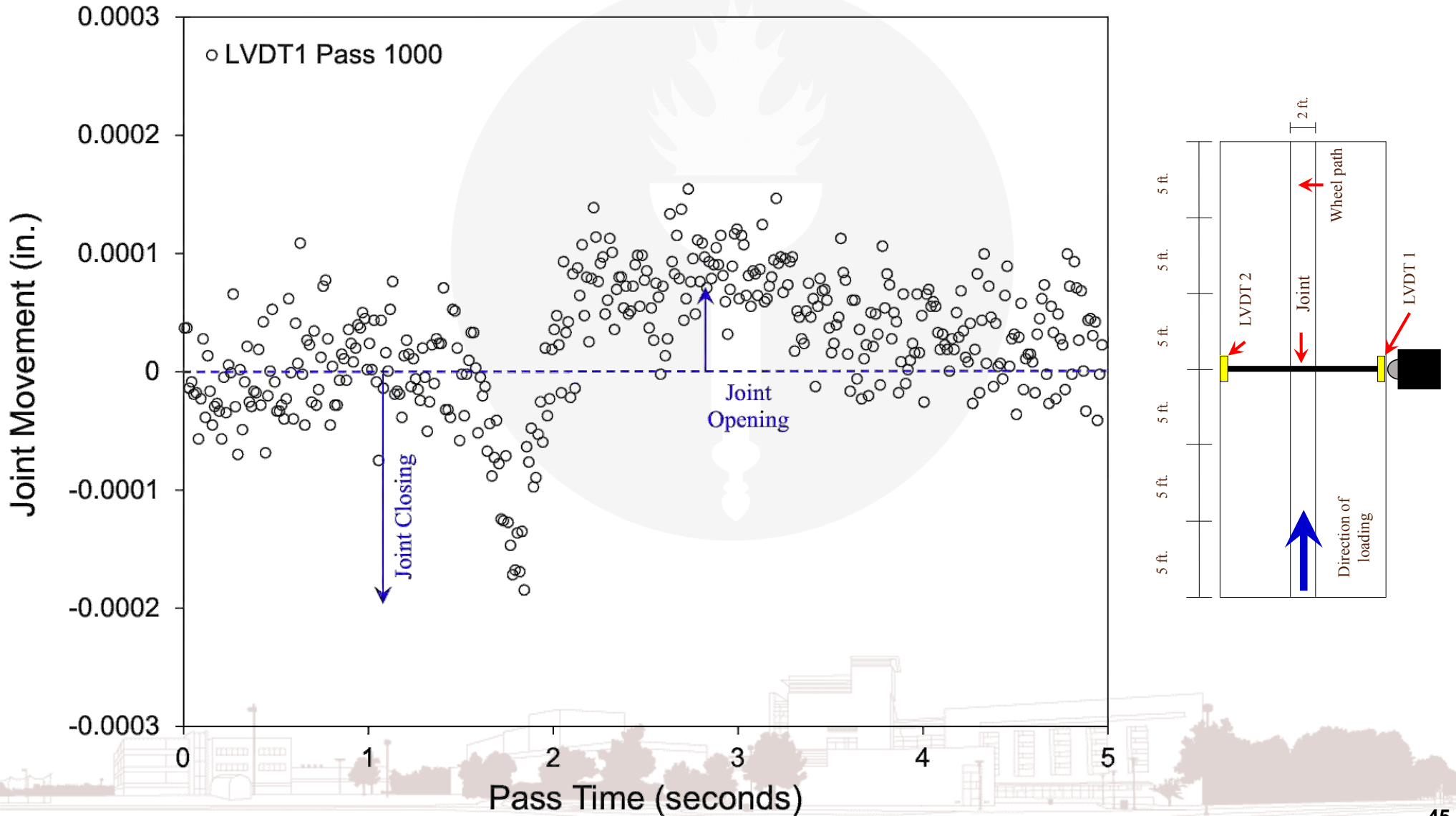
Test Section 1 (Joint Behavior)



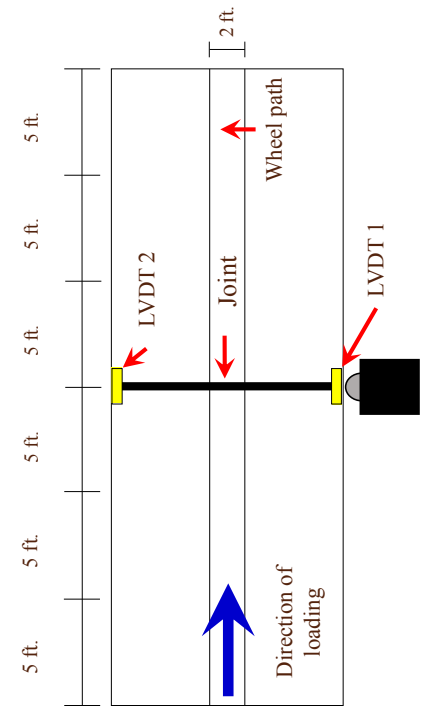
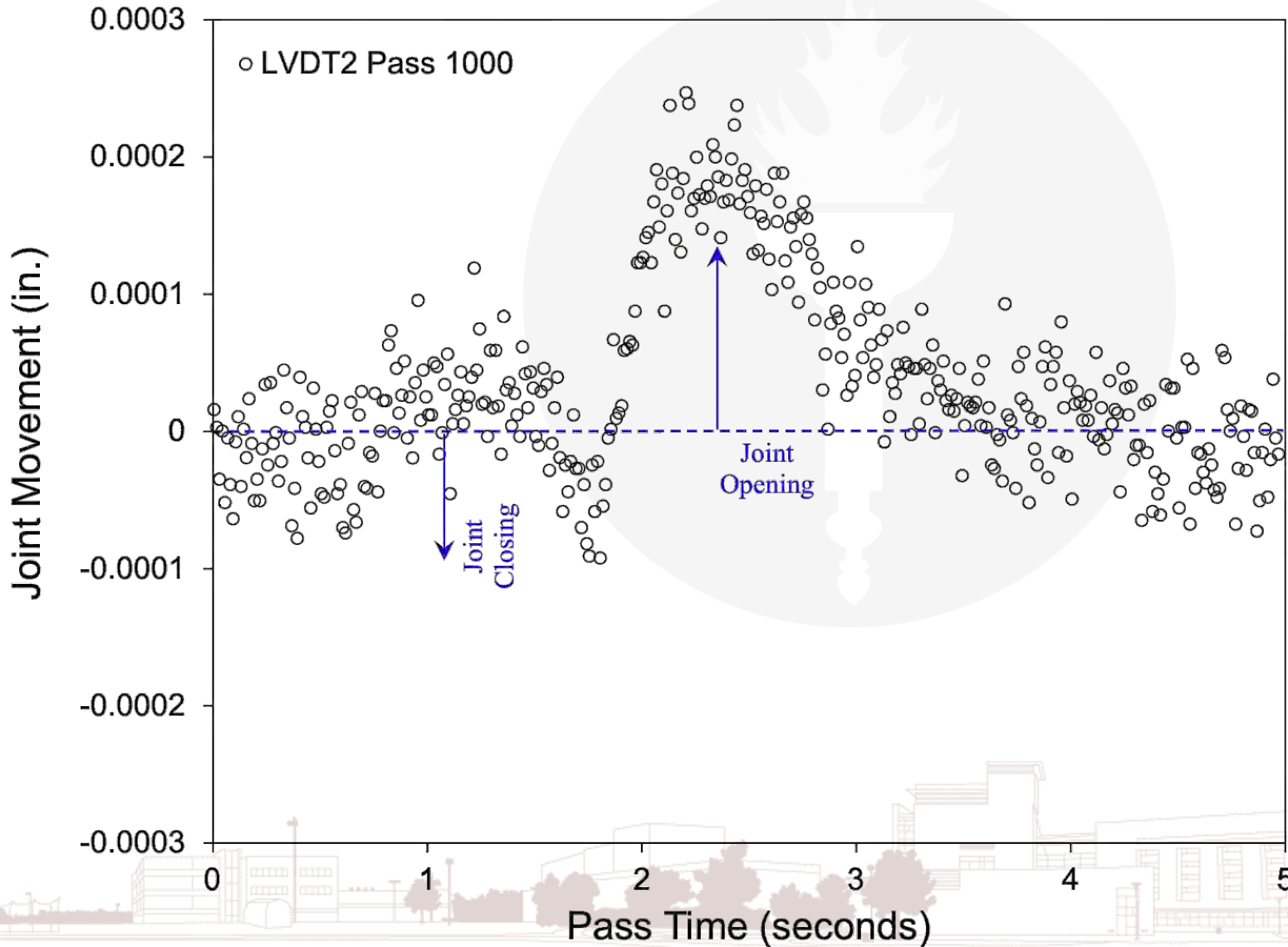
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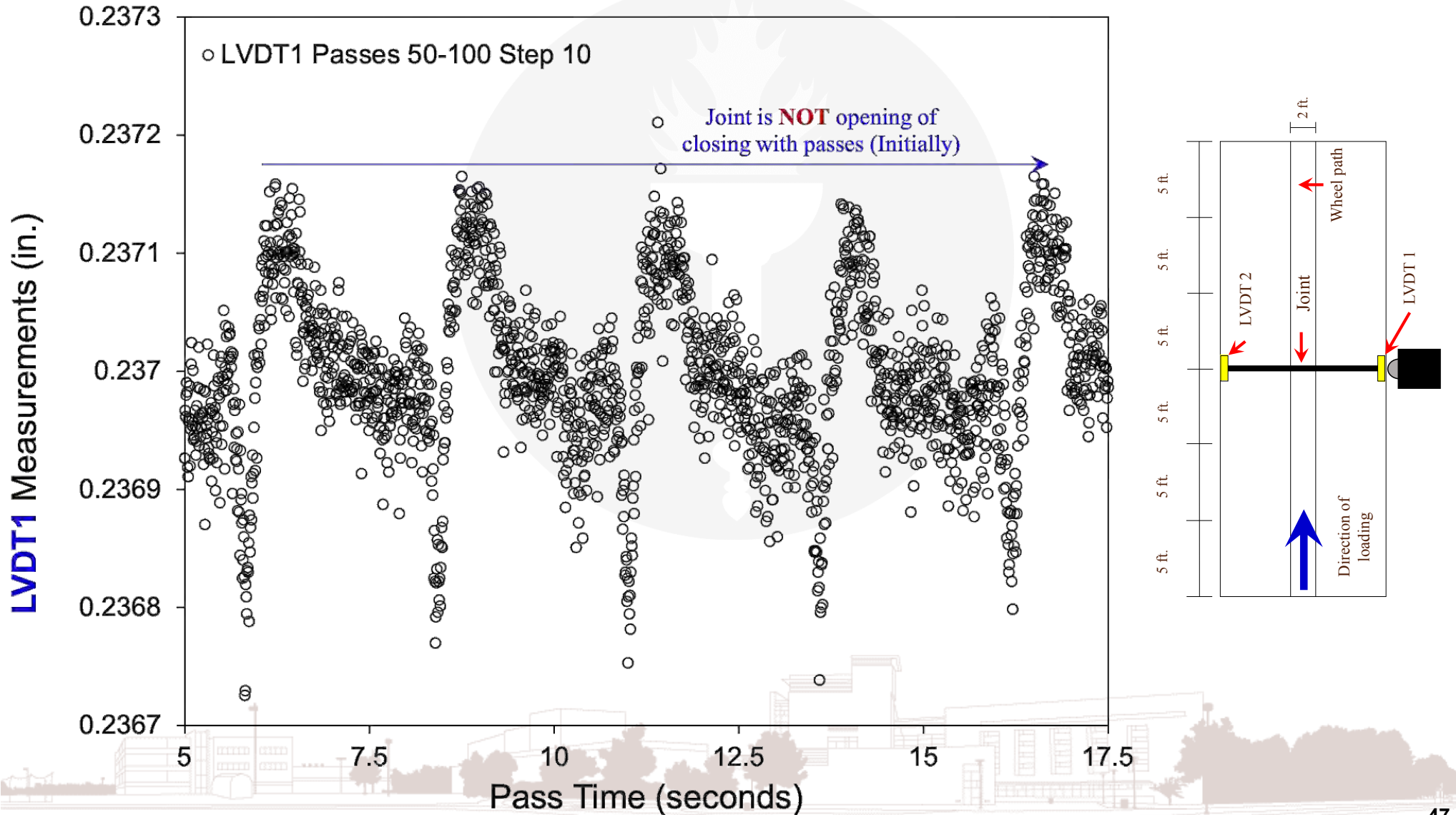
Test Section 1 (Joint Behavior)



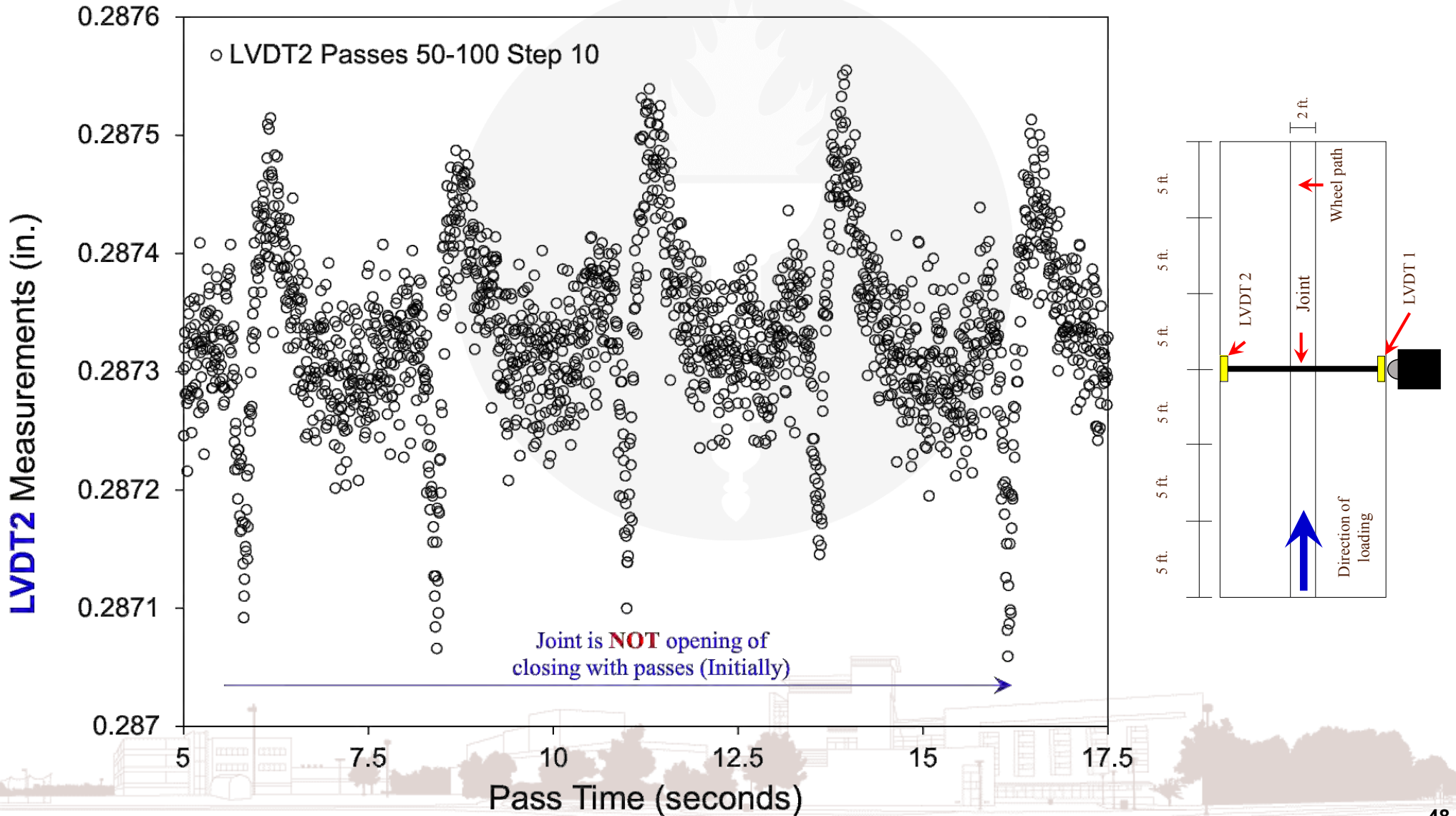
Test Section 1 (Joint Behavior)



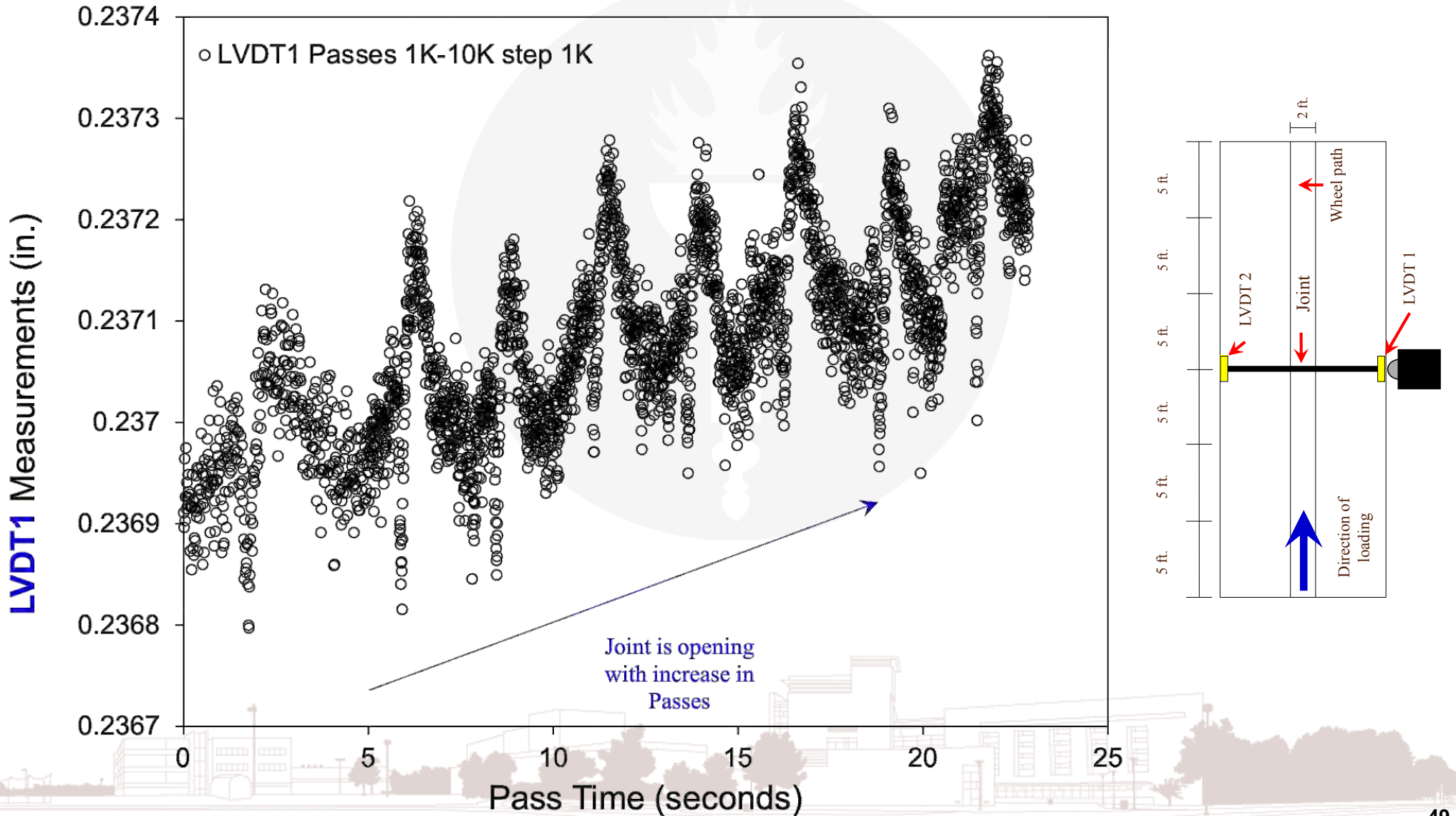
Test Section 1 (Slab Movement)



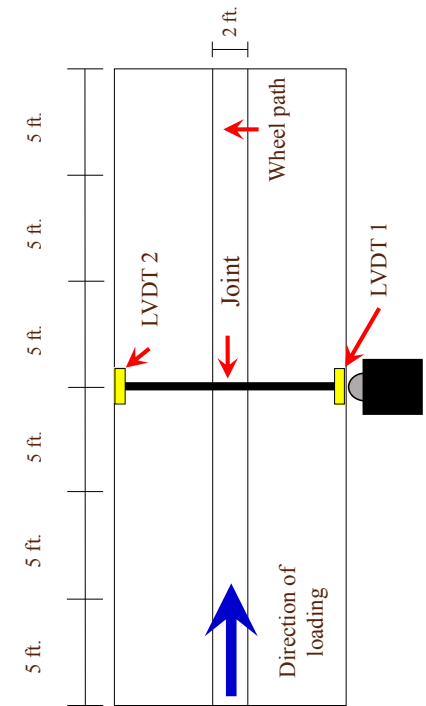
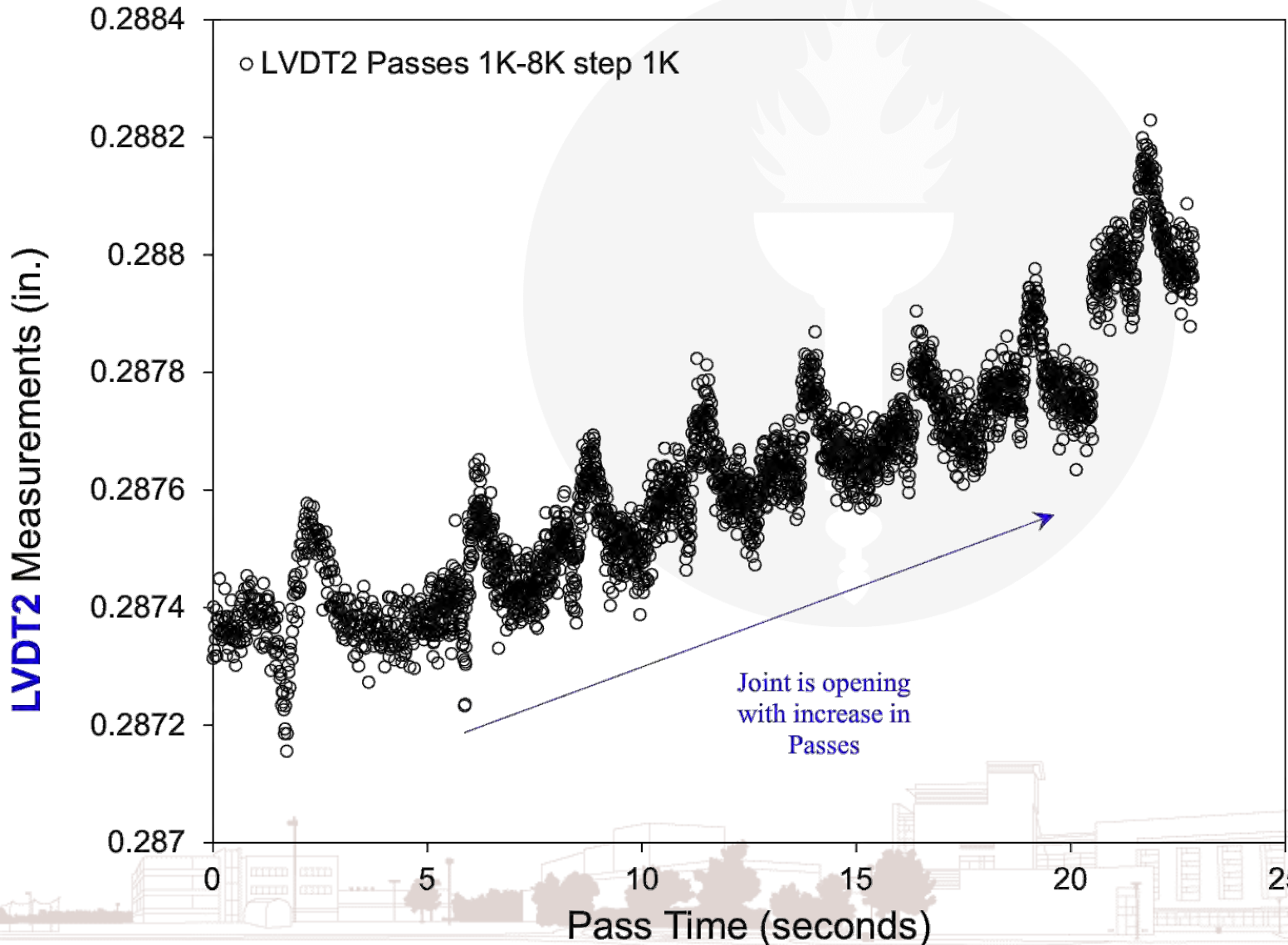
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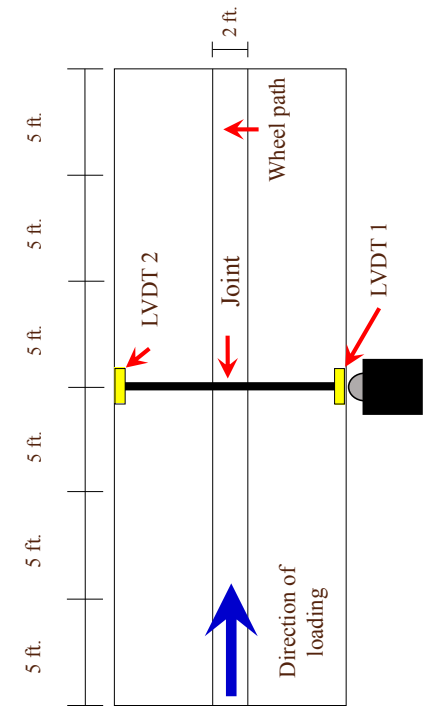
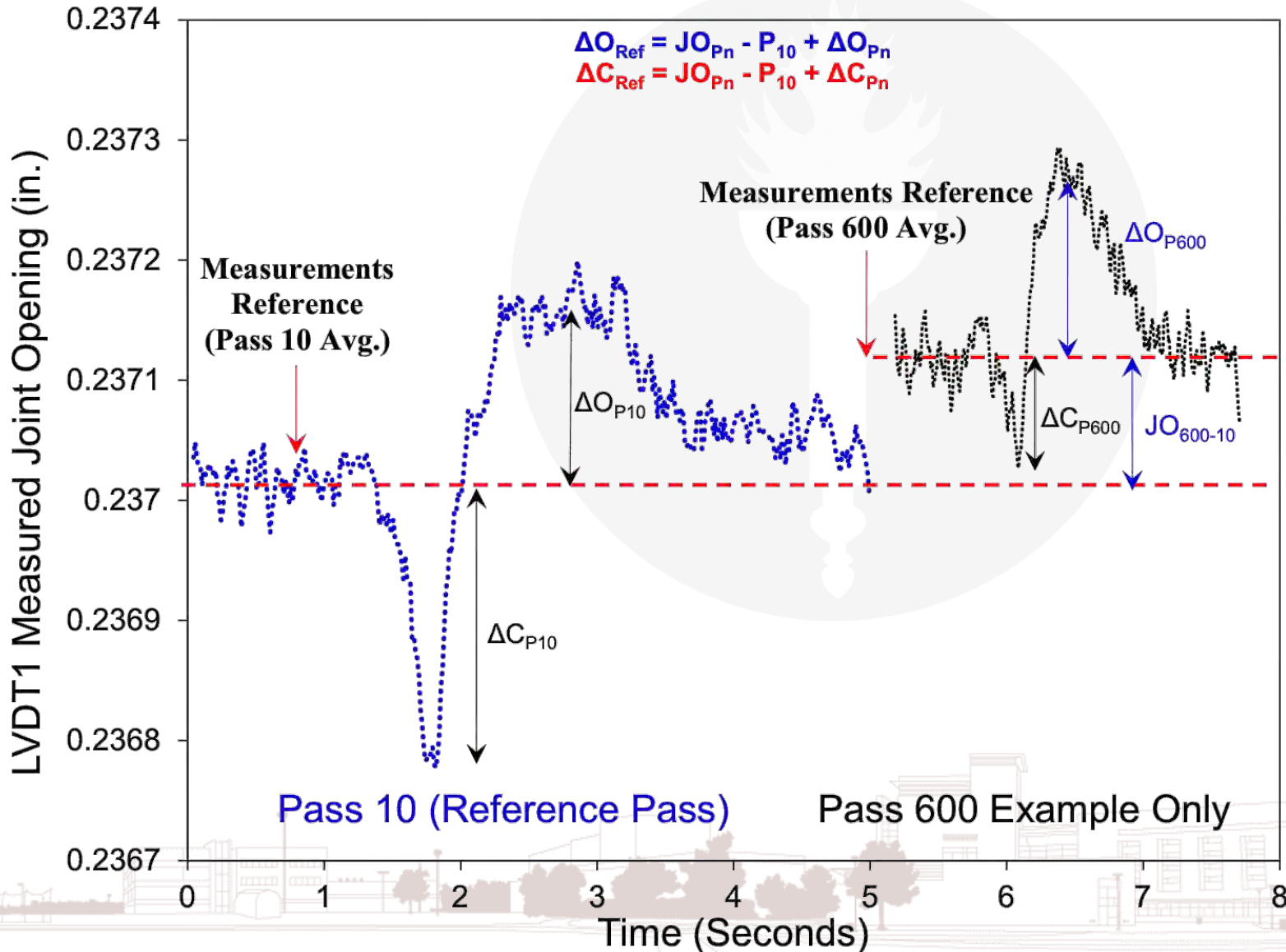
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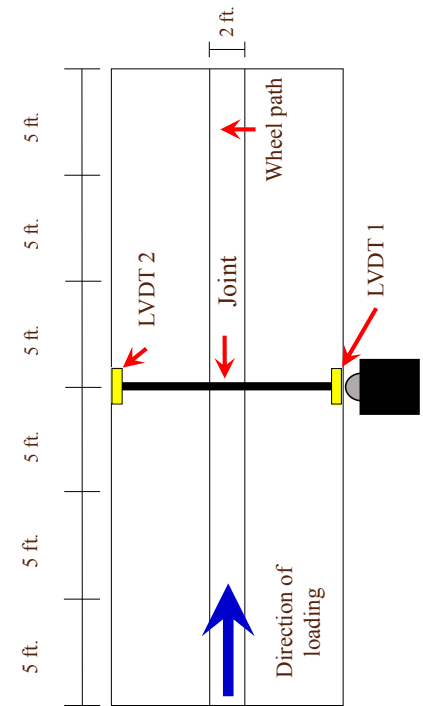
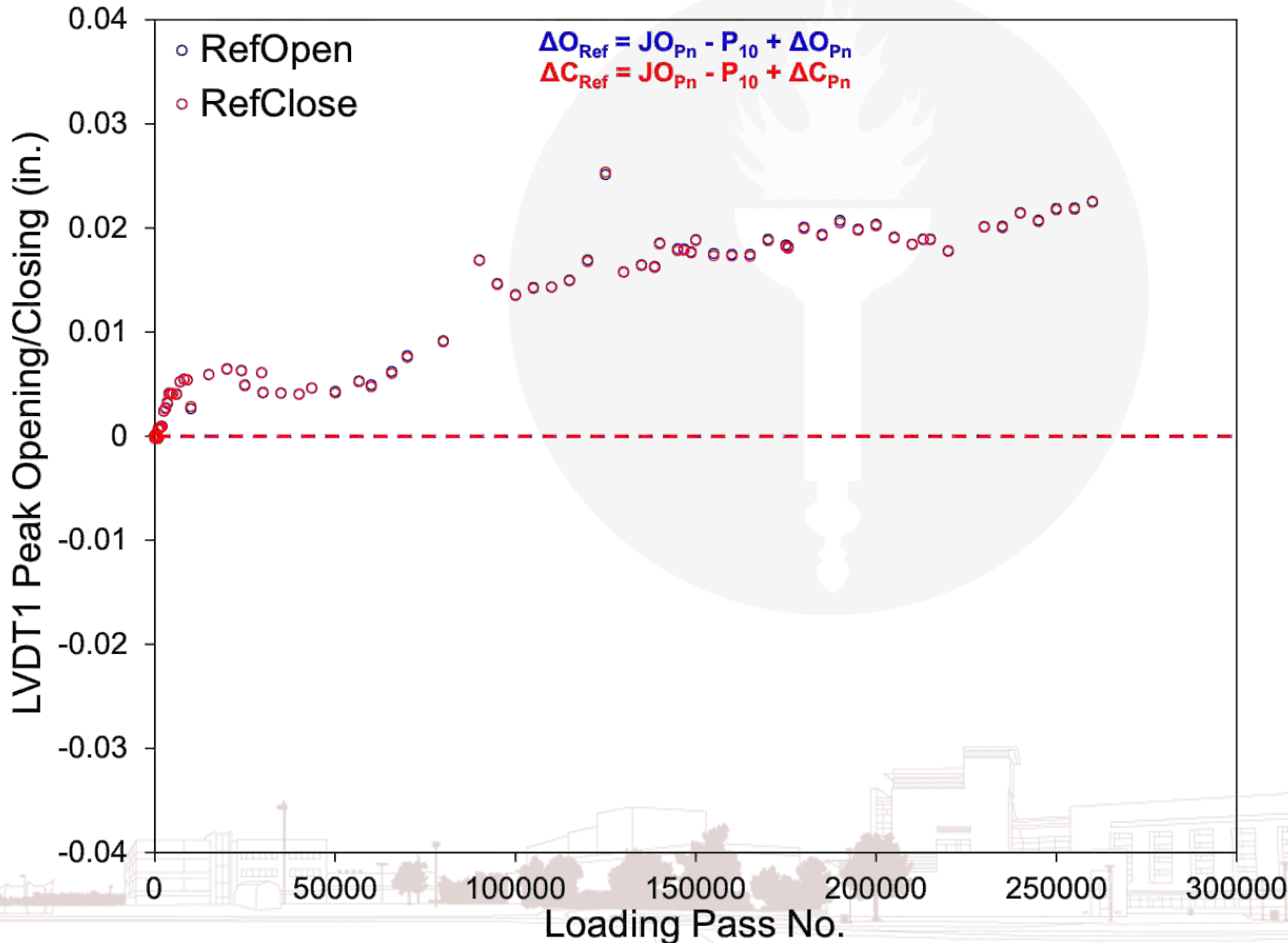
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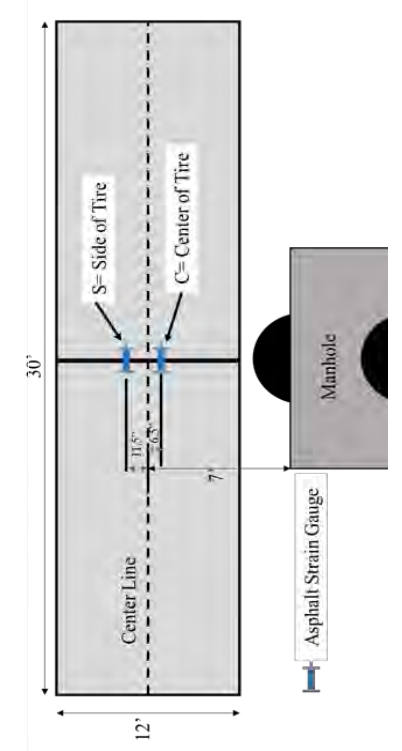
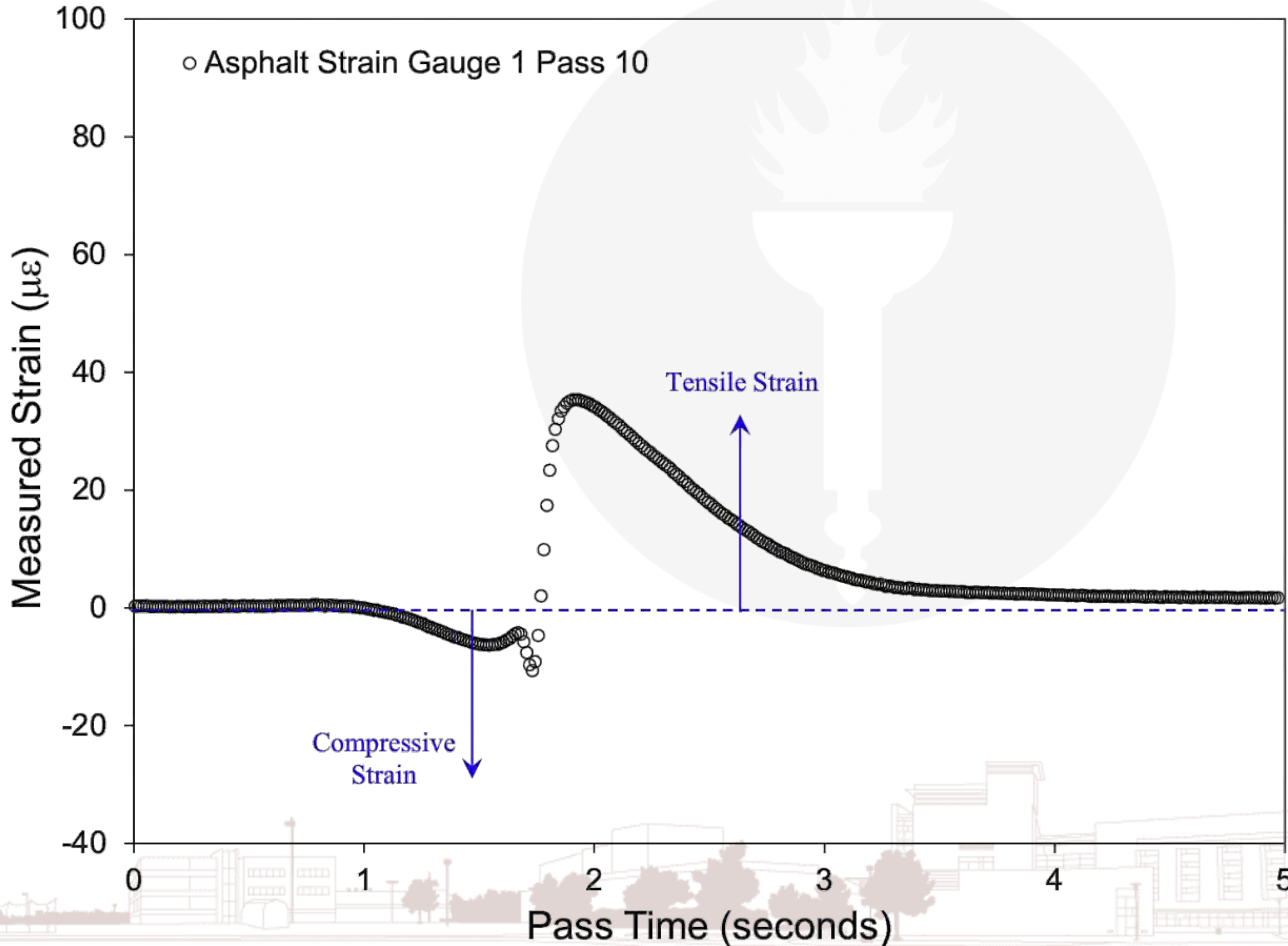
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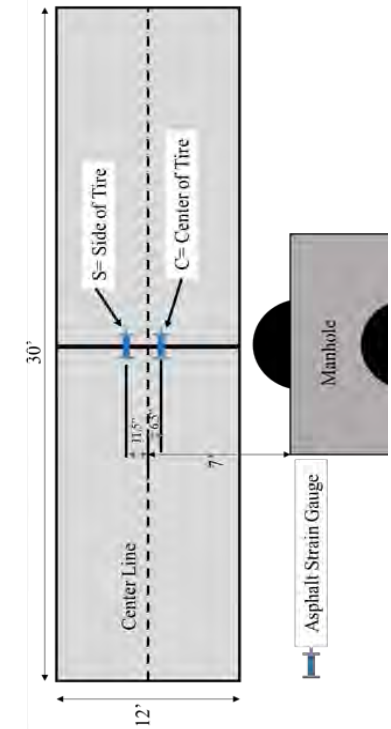
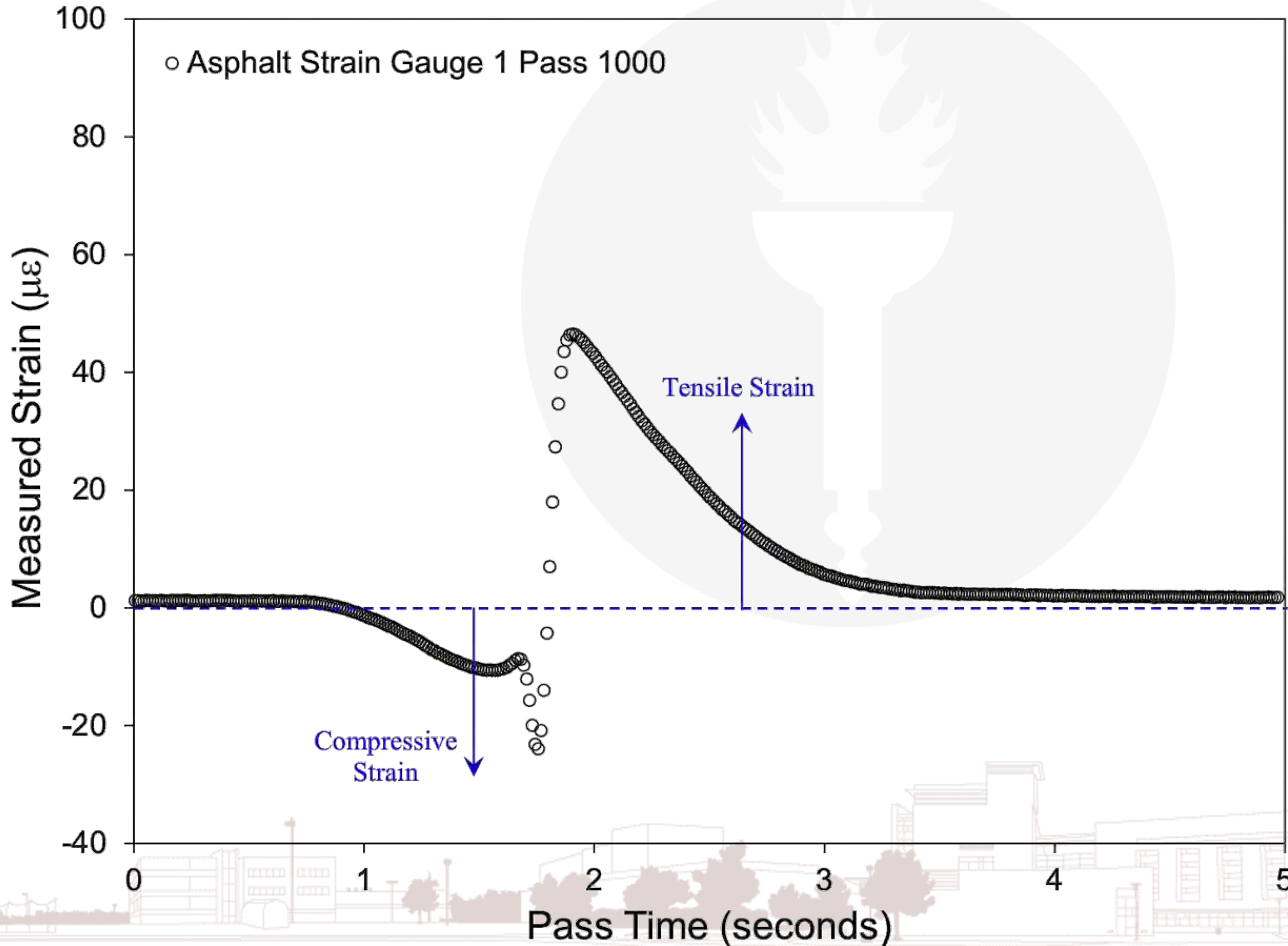
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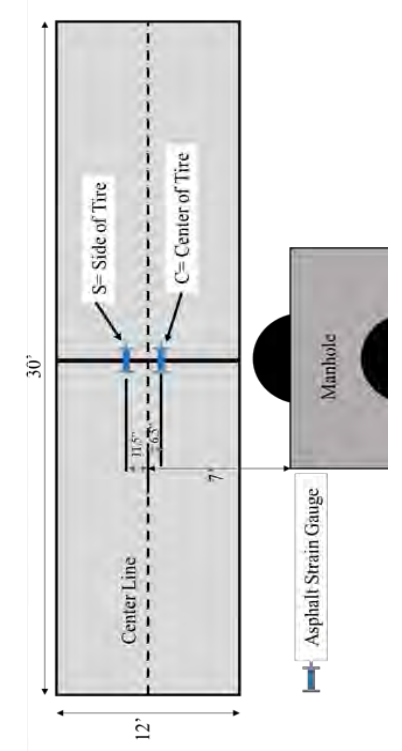
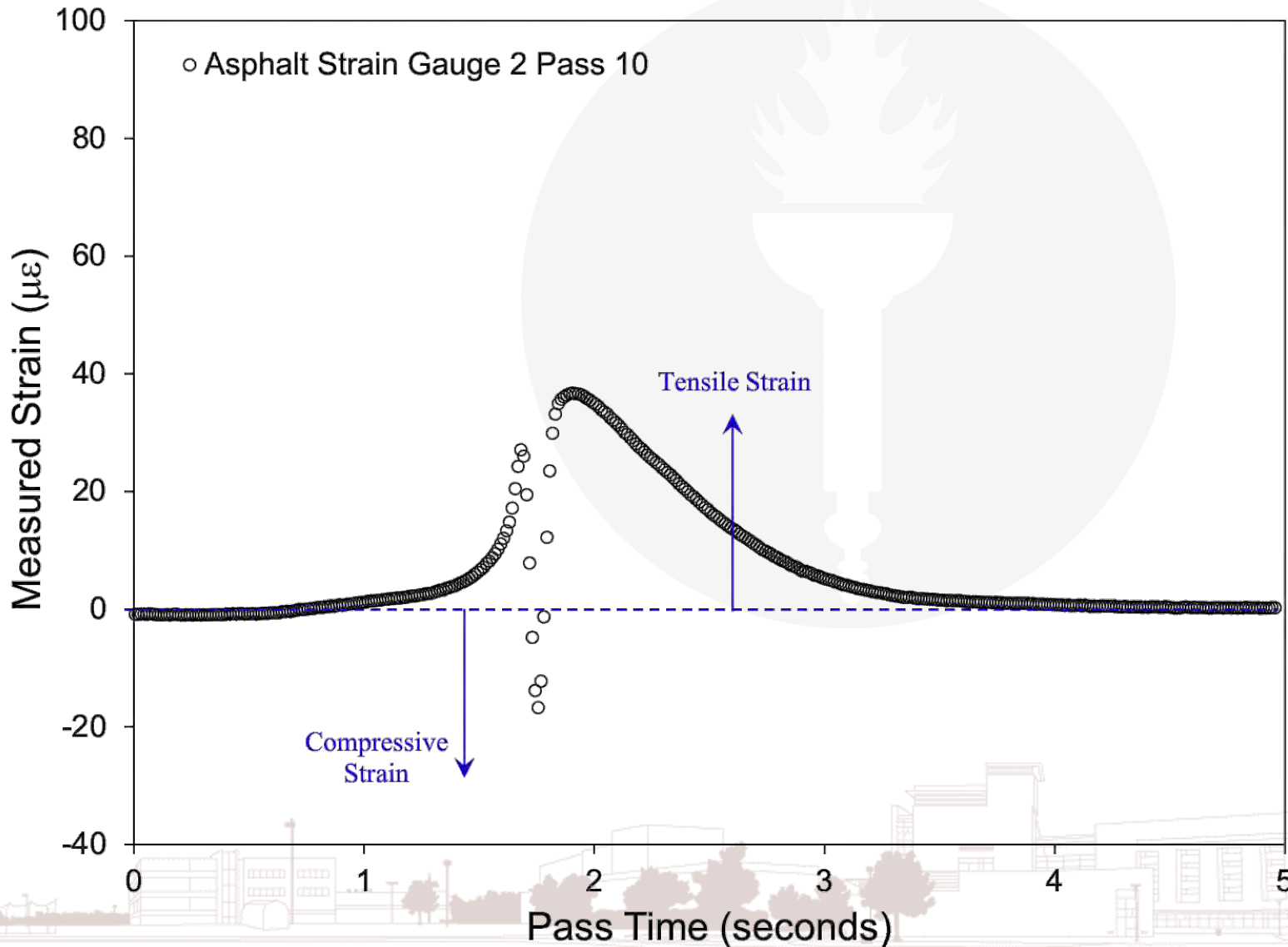
Test Section 2 (Strains)



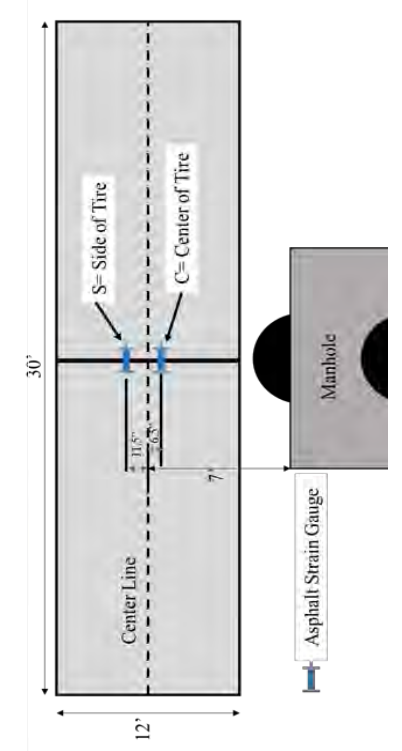
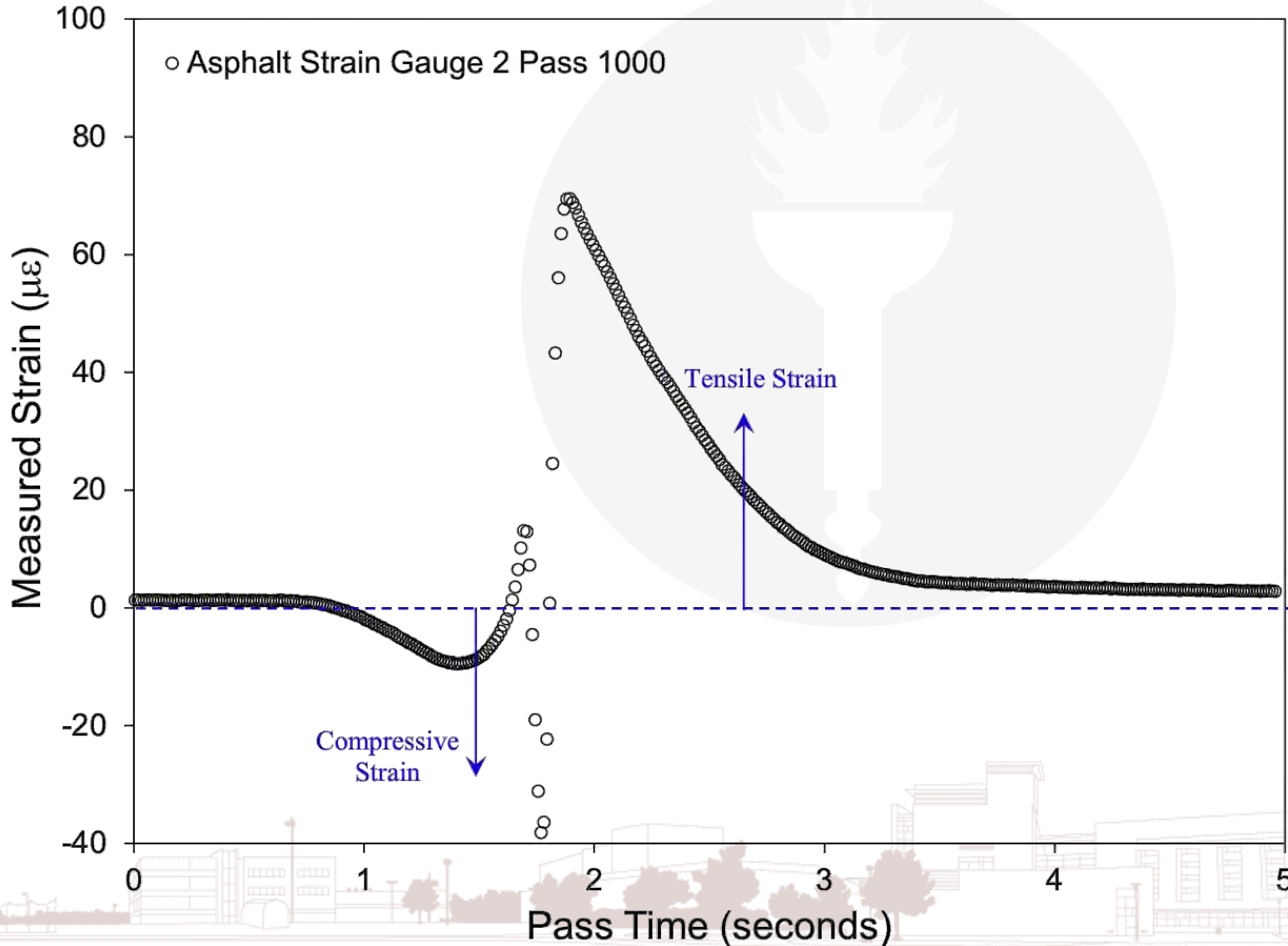
Test Section 2 (Strains)



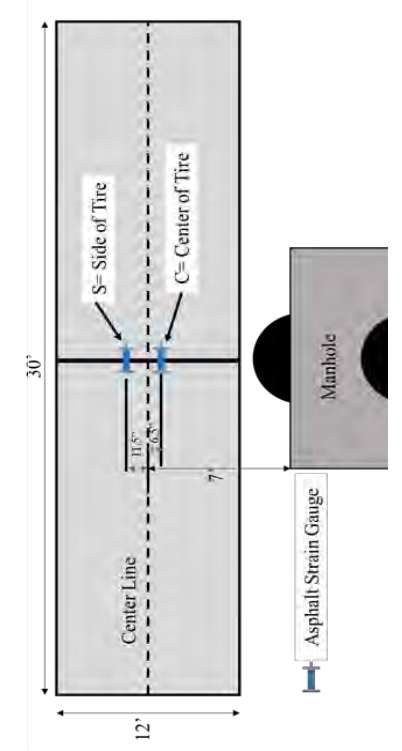
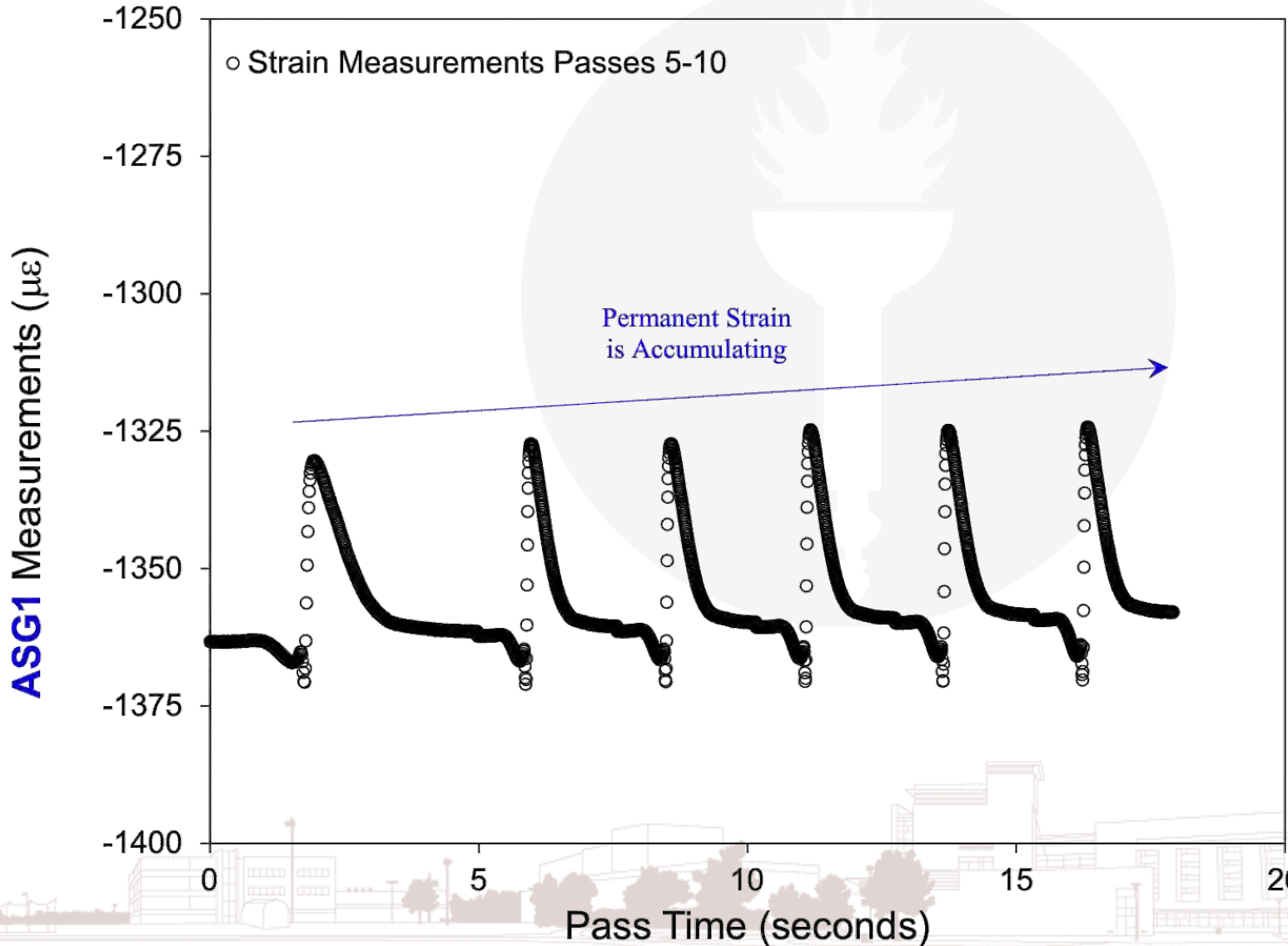
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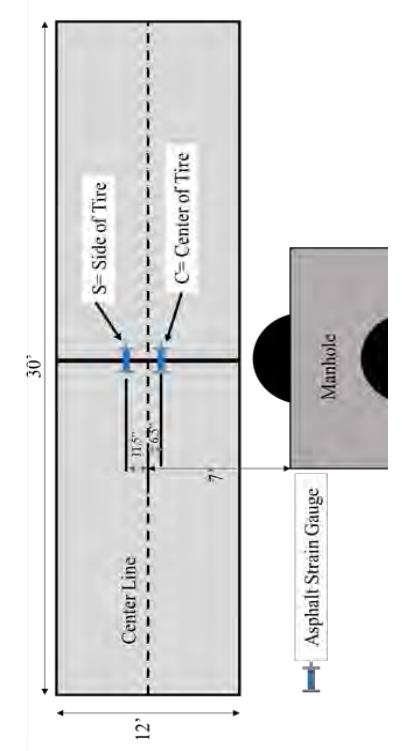
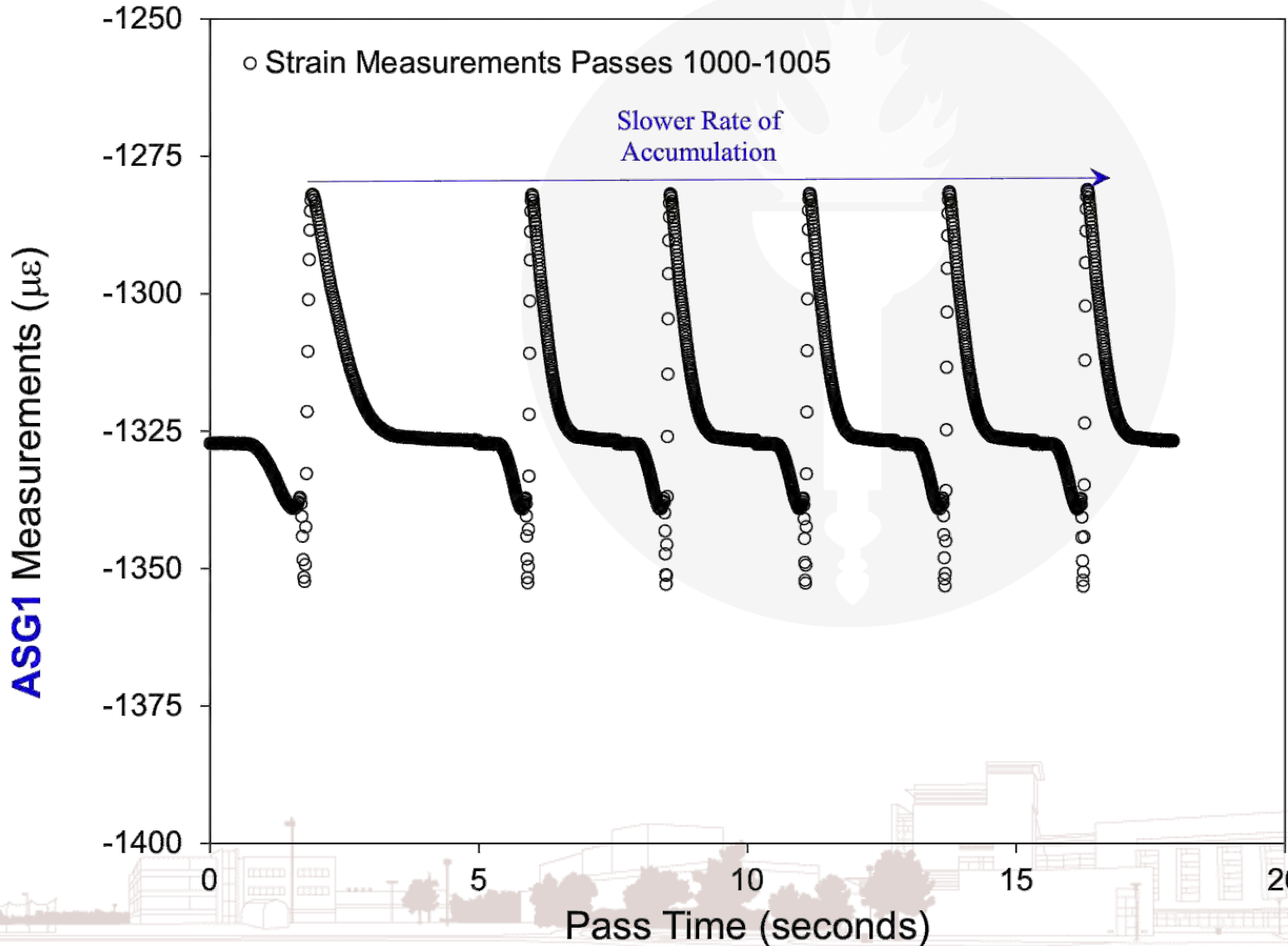
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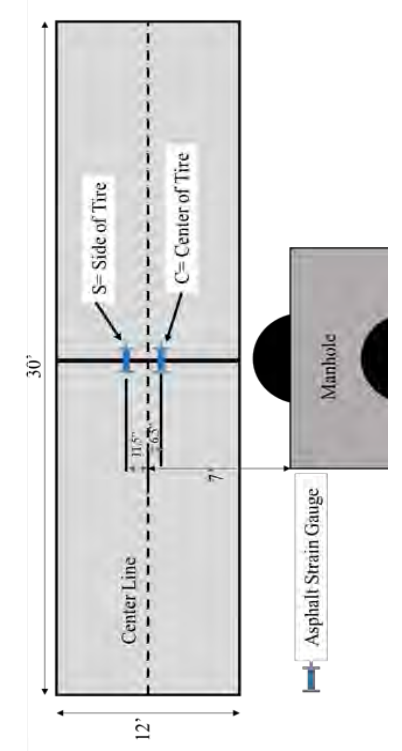
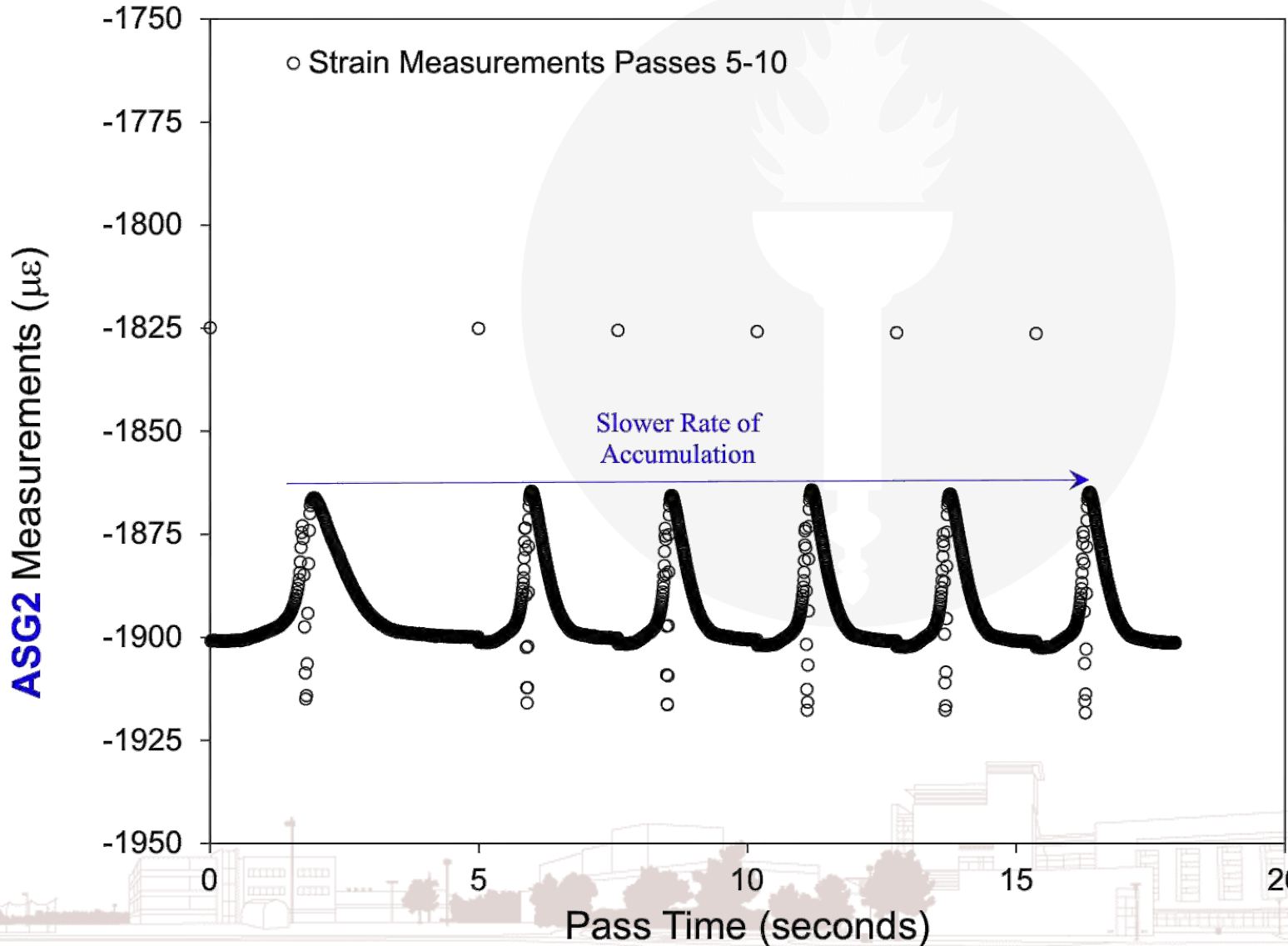
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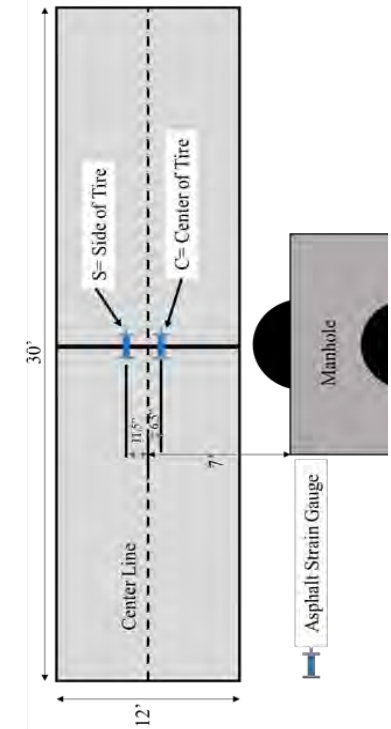
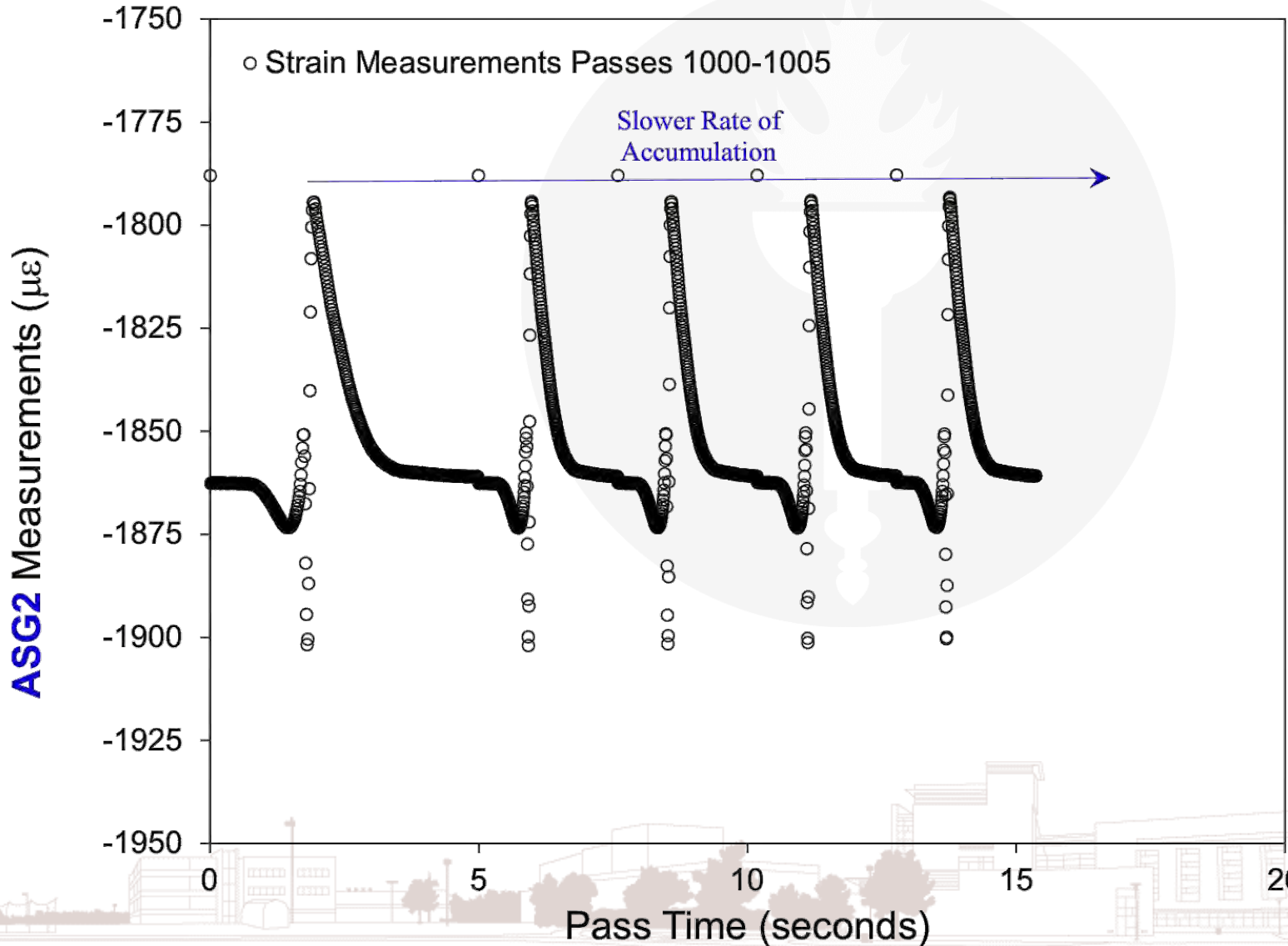
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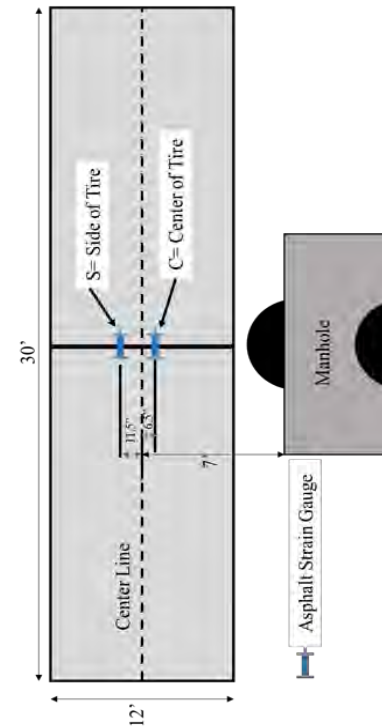
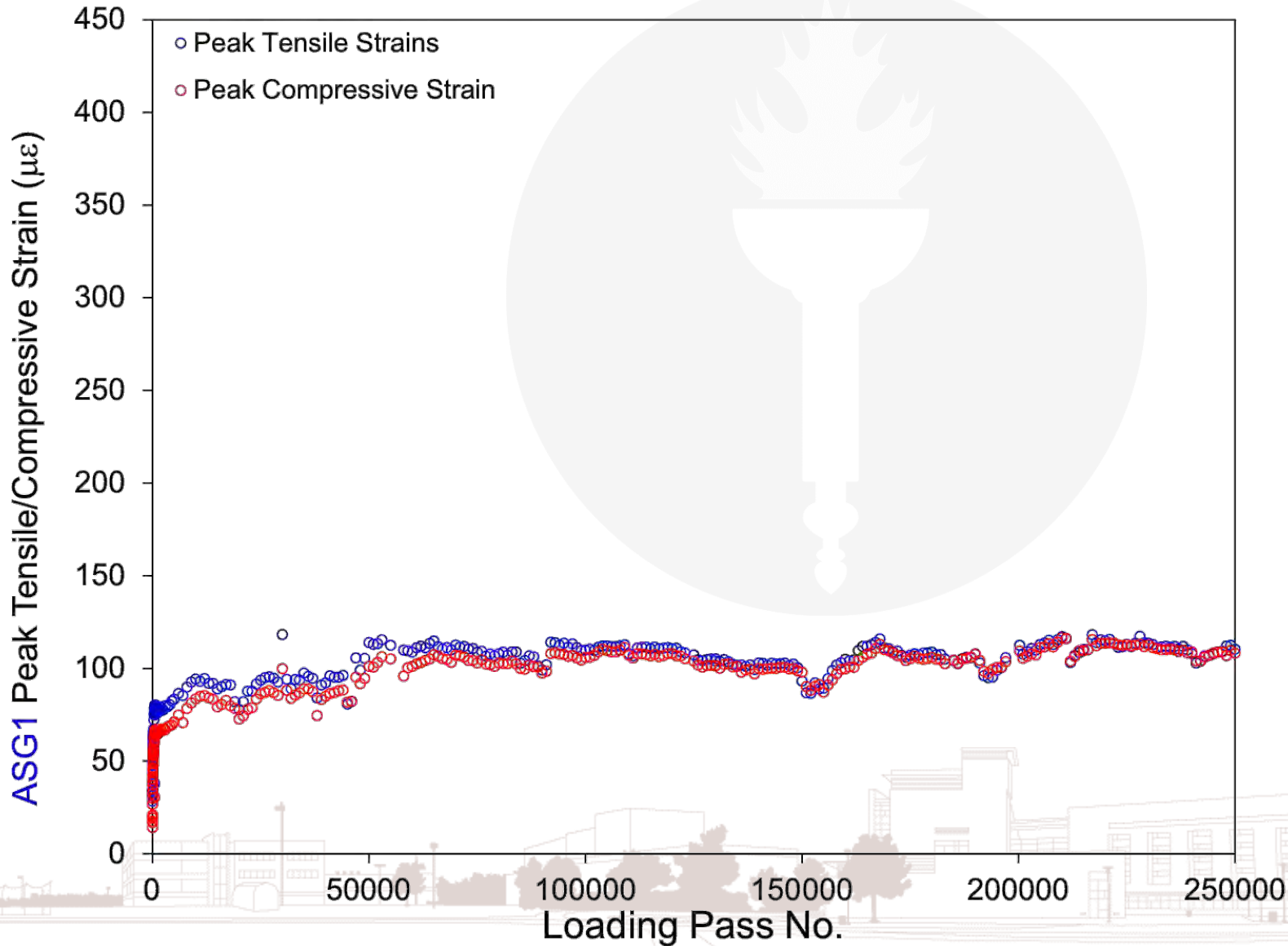
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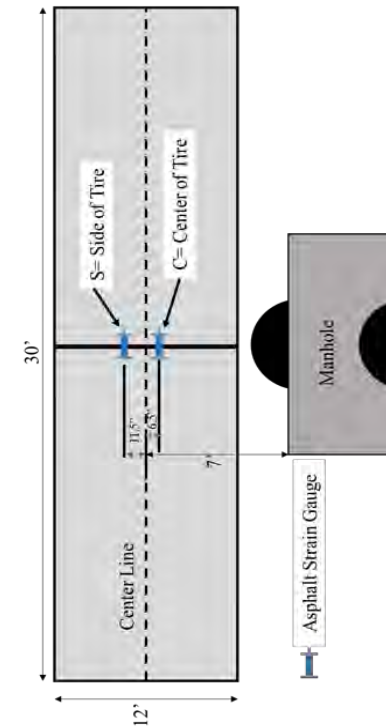
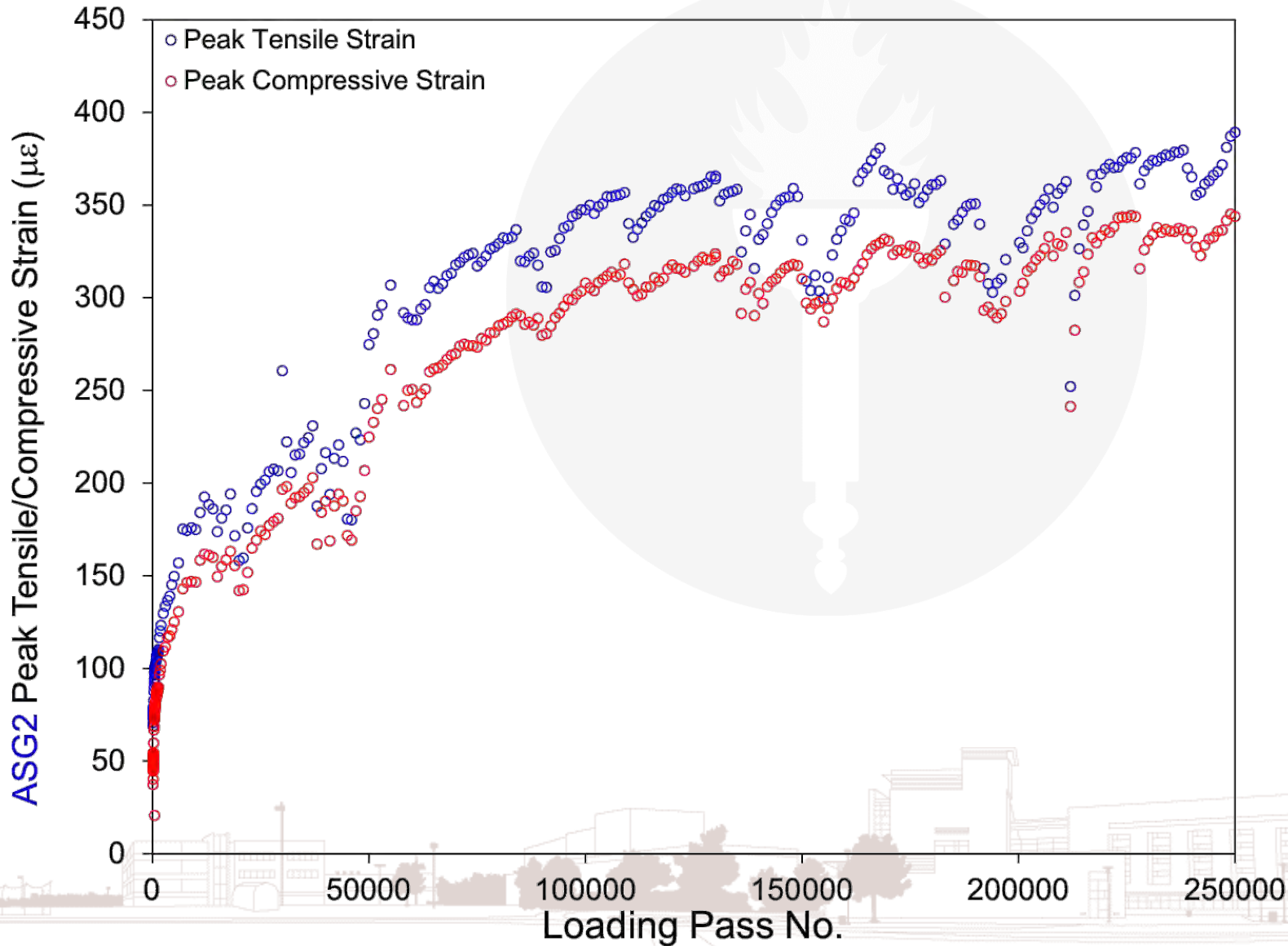
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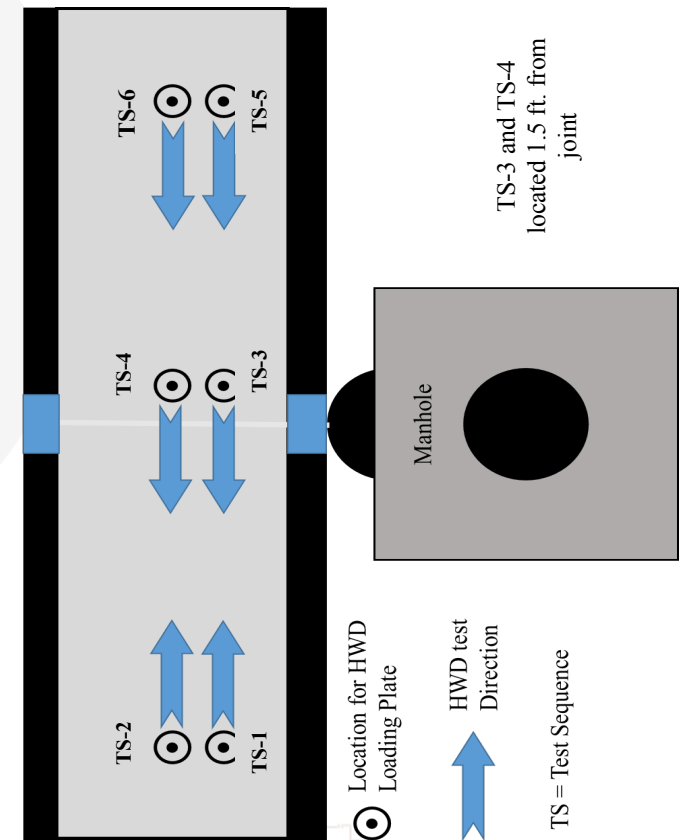
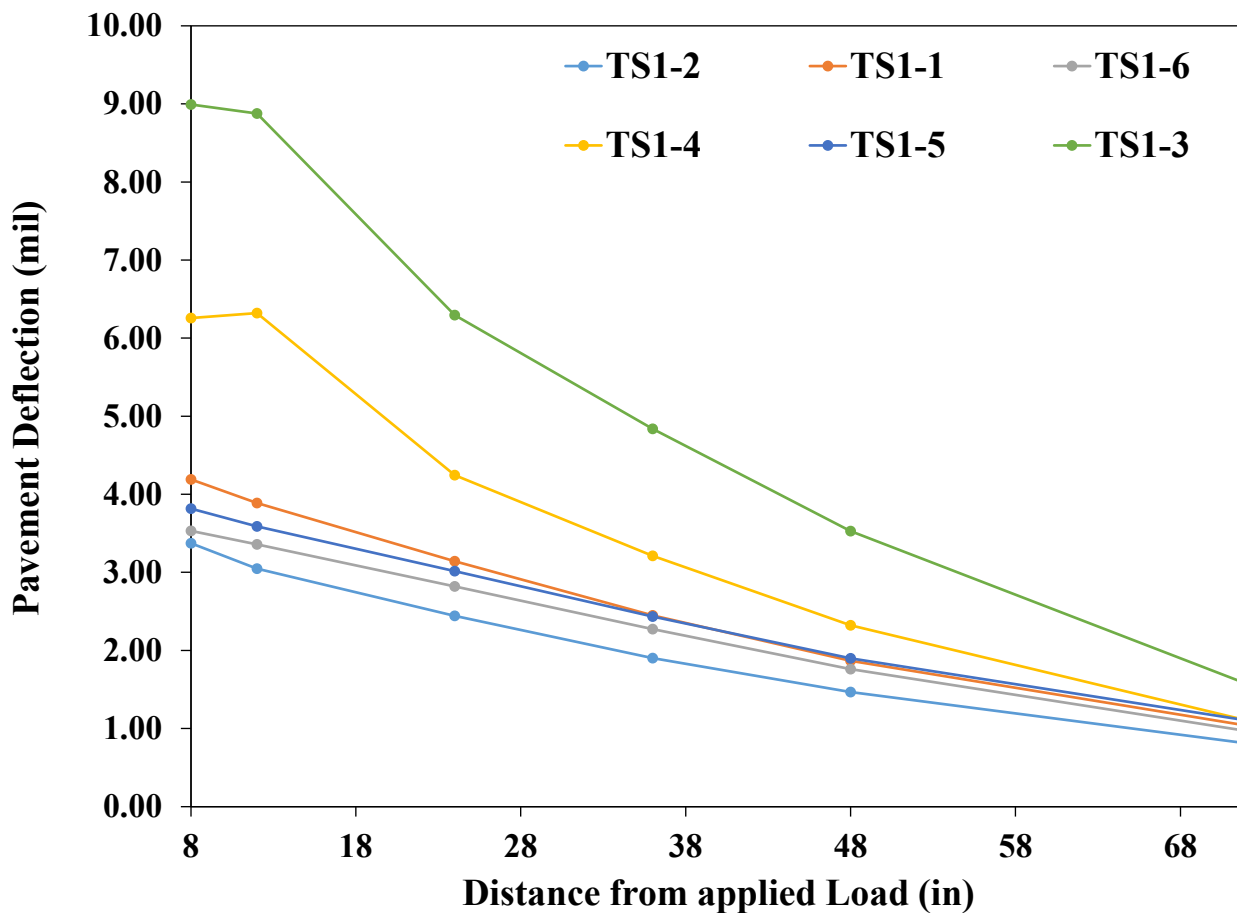


Test Section 2 (Strains)



Conduct Accelerated Pavement Testing

Heavy Weight Deflectometer Testing Results (Initial)



Summary of Observations

- ❑ The joint between the two concrete slabs is progressively opening with the increase in number of loading passes applied on top of section.
- ❑ Joint opening in section 1 after 260,000 loading passes was around 0.022 inches (about 0.0175 in. for section 2)
- ❑ A similar trend has been observed for the tensile strains at the bottom of the HMA overlay layer.
- ❑ Section 2 is currently experiencing approximately 400 $\mu\epsilon$ (tensile) at the bottom of the HMA overlay.

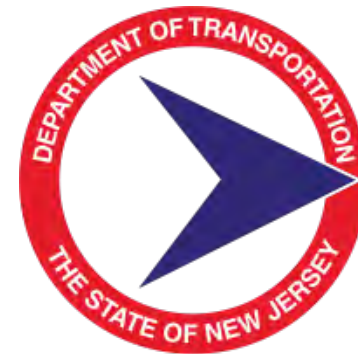




Other CREATEs Projects



**US Army Corps
of Engineers®**
Engineer Research and
Development Center



Geogrid Reinforced Airfield Pavements

- ❑ Project Sponsor: United States Department of Defense-United States Army Corps of Engineers (USDoD-USACE).
- ❑ Goals:
 - ❑ Comprehensive laboratory evaluation of the potential benefits for using Geogrids as a stabilizing element in airfield pavements.
 - ❑ Numerical modeling (FEM) of geogrid-reinforced airfield pavement.
- ❑ Status: In-Progress



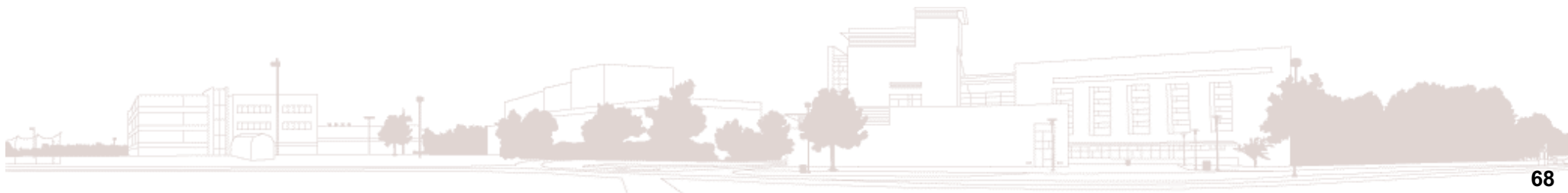
Evaluation of Cold In-Place Recycling

- ❑ Project Sponsor: United States Department of Defense-United States Army Corps of Engineers (USDoD-USACE).
- ❑ Goals:
 - ❑ Comprehensive laboratory and full-scale testing of Cold In-Place Recycling (CIPR) technologies implemented by various State DOTs in the northeast.
- ❑ Status: In-Progress



Evaluation Rapid Precast and CIP Systems

- ❑ Project Sponsor: The New Jersey Department of Transportation (NJDOT)
- ❑ Goals:
 - ❑ Full-scale evaluation of precast and Cast In-Place (CIP) concrete pavement rapid repair technologies.
 - ❑ Recommending a list of systems for inclusion in NJDOT's Approved Materials List.
- ❑ Status: Project Awarded/Under Contract



Thank you from the CREATEs team

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