Appendix B. ATacker Displacement Rate Verification Experiment

The experiment described in this appendix was conducted to verify the rate of loading for the newly developed automated ATacker® device. During this verification, the ATacker rate adjustment was set to 20 in all experiments. Three different sets of test were performed (Table 1). The first set tested the device with no tack coat applied, and the rate was recorded. Figure 1 presents the deformation versus time curve for the no tack coat experiment. The corresponding rate of loading was determined to be 0.12 in/min., as shown in Figure 1. The second set of tests was performed using PG 64-22; the hold time was 10 minutes with a 40-lb dead load. Figure 2 presents the measured loading rate. The ATacker rate of loading was 0.08 in/min before peak and 0.14 in/min after peak.

The third set of tests was performed in similar conditions to the second set (rate adjustment of 20, dead load 40-lb, and hold time 10 minutes) except that the tack coat type was CRS-2L. Figure 3 presents the measured loading rate. The ATacker rate of loading was 0.07 in/min before peak and 0.15 in/min after peak.

Table 1. Summary of the experimental results.

	Rate of loading	
Experiment	Before Peak	After Peak
No Tack Coat	0.12	0.12
PG 64-22	0.08	0.14
CRS-2L	0.07	0.15

These results indicate that the rate of loading was not consistent throughout the experiments. The rate of loading was lower than no-load rate before peak load and higher than the no-load after peak load for both types of tack coat, indicating that it stored energy while approaching peak load and released this energy after peak load. Moreover, the rates of loading were not consistent for both types of tack coat. The results suggest that the device needed a more powerful actuator that would not be affected by the strength of the tack coat, and consequently, apply consistent rate of loading regardless of the tack coat type or application rate. Therefore, a new actuator and a driving motor (closed loop, servo-controlled) with improved control of the displacement rate were installed.

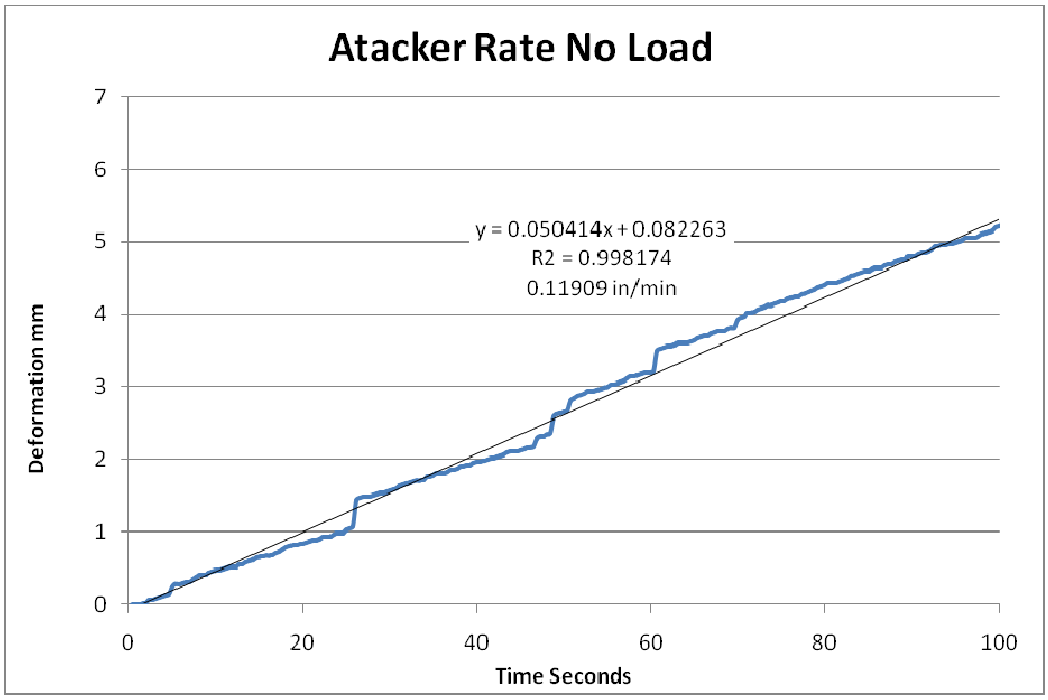


Figure 1. Loading rate of the ATacker with no tack coat.

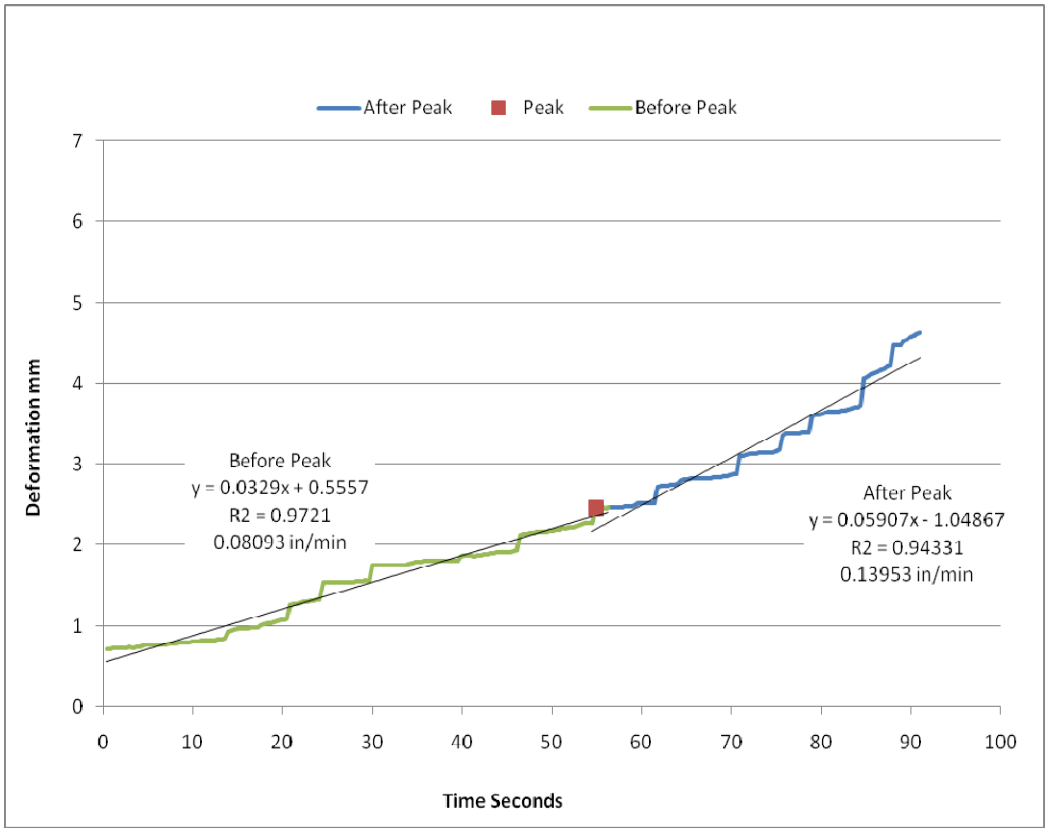


Figure 2. Rate of Loading of the ATacker while testing PG 64-22 tack material.

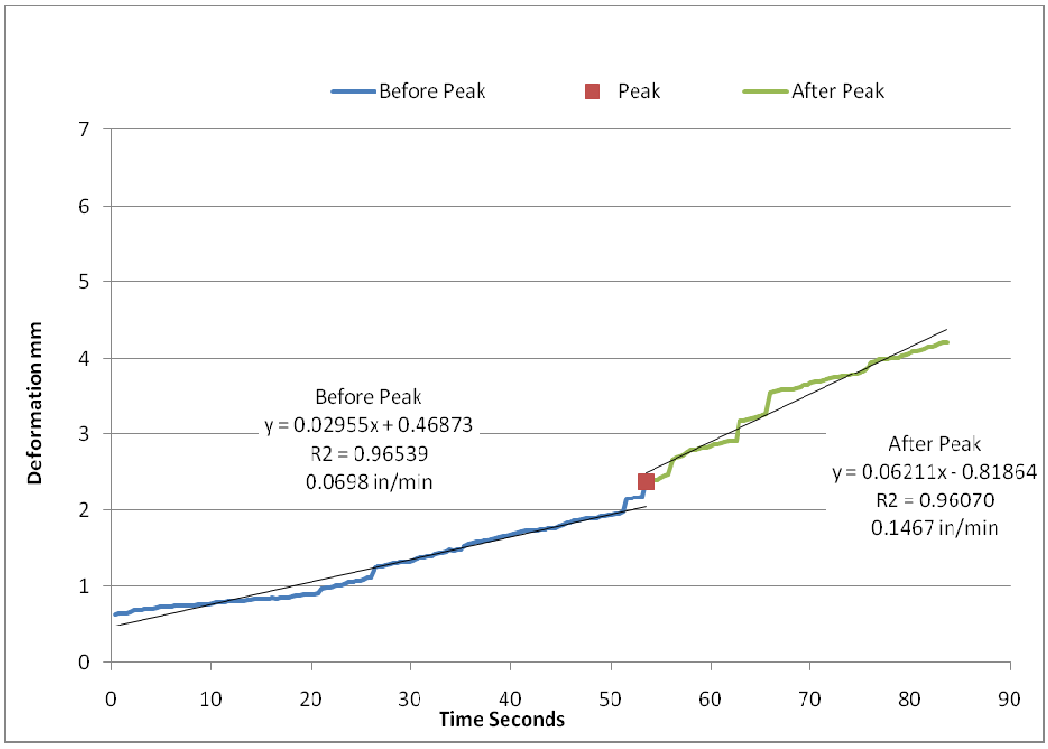
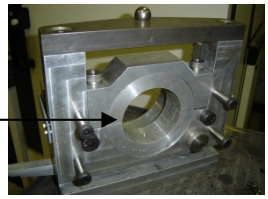
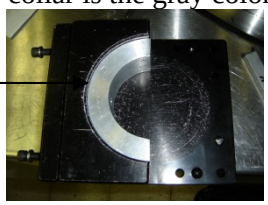
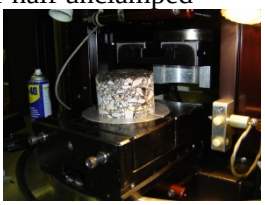


Figure 3. Rate of Loading of the ATacker while testing CRS-1 tack material.

Appendix D. Comparison of the LISST Device and the Simple Shear Tester (SST)

The objective of this experiment was to compare two interface bond strength testing devices, the Louisiana Interlayer Shear Strength Tester (LISST) and the Simple Shear Tester (SST). Interface bond strengths of similar mixtures were measured under similar testing and material conditions. Table 1 summarizes the testing procedures used in each device. For both devices, the bottom half of the sample was constrained from movement, while the top half was free to move.

Table 1. Comparison of the LISST and SST Shear Test Procedures

LISST	SST
• 5.9-inch diameter SGC samples are cored to a 4.0-inch diameter sample	• 5.9-inch diameter SGC samples are cored to a 4.0-inch diameter sample
• Sample is conditioned to 25°C for at least one hour	• Sample is conditioned to 25°C for at least one hour
• Attach the collar to the device to accommodate testing of 4.0-inch specimen Collar 	• Attach the collar to the device to accommodate testing of 4.0-inch specimen (note the collar is the gray color circle) Collar 
• Place sample in the device 	• Place sample in the device 
• Clamp the bottom half of the sample, keeping the upper half unclamped 	• Clamp the bottom half of the sample, keeping the upper half unclamped 
• A preload of 40 pounds is applied	• A preload of 40 pounds is applied
• Test the sample at a deformation rate of 0.02 in/min until failure. The shear load and the corresponding deformation were continuously measured.	• Test the sample at a deformation rate of 0.02 in/min until failure. The shear load and the corresponding deformation were continuously measured.

Test Factorial

A set of specimens consisted of two layers, top and bottom, with a tack coat at the interface of these layers. The diameter of each compacted specimen was 5.9-in. The bottom half of each specimen was prepared by compacting the mixture to a height of 2.2 in at 150°C using the Superpave Gyratory Compactor (SGC). The compacted specimens were then allowed to cool to room temperature and the air void content was measured. Compacted bottom halves having an air void content of 6±1 percent were selected for preparation of the test specimens. The asphalt materials used as tack coat were then heated to the specified application temperature. The calculated amount of the preheated tack coat was then applied on the bottom half of the specimen. Once the application of the tack coat was complete, it was allowed to cool to room temperature and the top half of the sample was compacted by placing the bottom half in the SGC mold and compacting loose mix on top of the tack coated bottom half. To prepare the test specimen, a 4-in core was extracted from SGC compacted samples. The test factorial for this experiment was as follows:

1. One mix type – 0.75-in Superpave mixture.
2. One tack coat material – PG 76-22 at one application rate – 0.05 gal/yd^2
3. Two testing devices, LISST and SST
4. One sample size – 4-in diameter cores
5. It is noted that both testing devices were designed to accommodate a sample that is 5.9 in in diameter. An insert (referred to as a collar) was fabricated to allow testing of 4.0-in diameter sample. Use of the same insert in both test devices minimizes possible testing variation due to friction at the interface between the sample and the collar.
6. One testing temperature – 25°C and one loading rate – 0.02 in/min. Note that the samples were loaded at a deformation rate of 0.02 inch/minute for this experiment. For the rest of the project, to reduce testing time, a loading rate of 0.1 inch/minute was adopted.

Test Results

Table 2 presents the mean ultimate shear load (P_{ult}) for the two devices along with the standard deviation (SD) and coefficient of variation (COV). The low values of COV indicate that the results of P_{ult} from both devices were consistent. Furthermore, statistical t-test results indicate that there is no significant difference of the measured P_{ult} from both devices, LISST and SST (P-value =0.12 > 0.05).

Table 2. Ultimate shear load for samples tested at LISST and SST devices

LISST		SST	
Sample ID	Load (lb)	Sample ID	Load (lb)
1	1548.6	1	1541.8
2	1440.9	2	1549.3
3	1484.0	3	1618.8
Average	**1491**	**Average**	**1570**
SD	**54.2**	**SD**	**42.5**
COV	**3.6**	**COV**	**2.7**