

STABILOMETER "S" VALUE STUDY

ON

ASPHALT CONCRETE SAMPLES

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INTRODUCTION

During the late fall of 1969 a study was made to determine the precision when testing asphalt concrete specimens for the Hveem stabilometer ("S") value (AASHTO T 246). Fifty samples, using Chevron 85-100 asphalt cement and aggregate from Walling Sand and Gravel (Salem Blacktop), were prepared at each of five asphalt contents. The asphalt contents ranged from 5.0 to 7.0 percent at 0.5 percent increments.

Both first compaction and second compaction were determined as well as "S" value and bulk specific gravity. The first compaction is to simulate field conditions at the time of construction and the second approximating long term conditions due to further densification from traffic.

DATA ANALYSIS

"S" Value

The mean and standard deviation for the stabilometer "S" value were determined for each asphalt content at both first and second compaction. Each value is based on 50 tests. The results are shown in Figure 1 and summarized below:

STABILOMETER "S" VALUE

| <u>Percent Asphalt</u> | <u>First Compaction</u> | | <u>Second Compaction</u> | |
|------------------------|-------------------------|-------------|--------------------------|-------------|
| | <u>Mean</u> | <u>S.D.</u> | <u>Mean</u> | <u>S.D.</u> |
| 5.0 | 36.34 | 3.04 | 50.84 | 2.84 |
| 5.5 | 37.06 | 3.20 | 49.80 | 3.07 |
| 6.0 | 36.70 | 2.34 | 48.73 | 2.61 |
| 6.5 | 37.38 | 2.05 | 48.96 | 2.36 |
| 7.0 | 36.10 | 3.27 | 42.69 | 6.83 |

"S" Value Range

AASHTO T 246 (Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus) states that stabilometer values from replicate specimens shall fall within a range of three units for mixtures with aggregate not larger than 1/2 inch, and four units for maximum sized aggregates of one inch. Since a class "B" mixture was used (3/4 inch maximum sized aggregate) the four unit range will be considered.

The variation of "S" value data for the 50 samples within each asphalt content is normally distributed (at the 95% level). Thus, using the four unit range, the standardized normal distribution and the actual distribution of the 50 samples would cover the following percentage of test specimens:

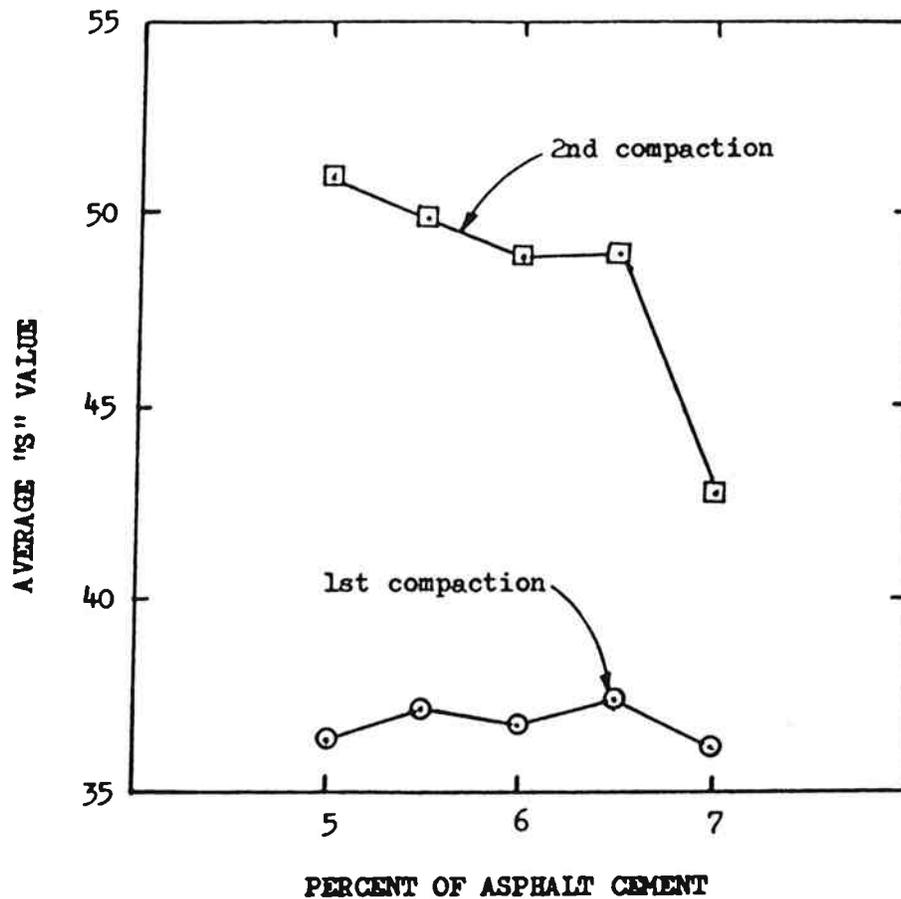


FIGURE 1. Stabilometer "S" value vs. asphalt content.

PERCENT OF "S" VALUES INCLUDED IN RANGE

| <u>Percent Asphalt</u> | <u>Percent Compaction</u> | | <u>Second Compaction</u> | |
|------------------------|---------------------------|----------------------|--------------------------|----------------------|
| | <u>Normal Distr.*</u> | <u>Actual for 50</u> | <u>Normal Distr.*</u> | <u>Actual for 50</u> |
| 5.0 | 81.4 | 90.0 | 84.2 | 96.0 |
| 5.5 | 78.8 | 90.0 | 80.6 | 90.0 |
| 6.0 | 91.2 | 98.0 | 87.4 | 98.0 |
| 6.5 | 94.8 | 100.0 | 90.0 | 94.0 |
| 7.0 | 77.8 | 84.0 | 43.8 | 50.0 |
| Average: | 84.8 | 92.4 | 77.4 | 85.6 |

*NOTE: One standard deviation would cover 68.3%, two standard deviations 95.4% and three standard deviations 99.7% of the expected values.

Bulk Specific Gravity

Bulk specific gravity was also determined for each sample. The following are the results from first and second compaction (also shown in Figure 2).

SPECIFIC GRAVITY

| <u>Percent Asphalt</u> | <u>First Compaction</u> | | <u>Second Compaction</u> | |
|------------------------|-------------------------|-------------|--------------------------|-------------|
| | <u>Mean</u> | <u>S.D.</u> | <u>Mean</u> | <u>S.D.</u> |
| 5.0 | 2.281 | 0.0185 | 2.347 | 0.0130 |
| 5.5 | 2.295 | 0.0159 | 2.365 | 0.0125 |
| 6.0 | 2.308 | 0.0161 | 2.379 | 0.0128 |
| 6.5 | 2.326 | 0.0144 | 2.396 | 0.0121 |
| 7.0 | 2.340 | 0.0133 | 2.404 | 0.0081 |

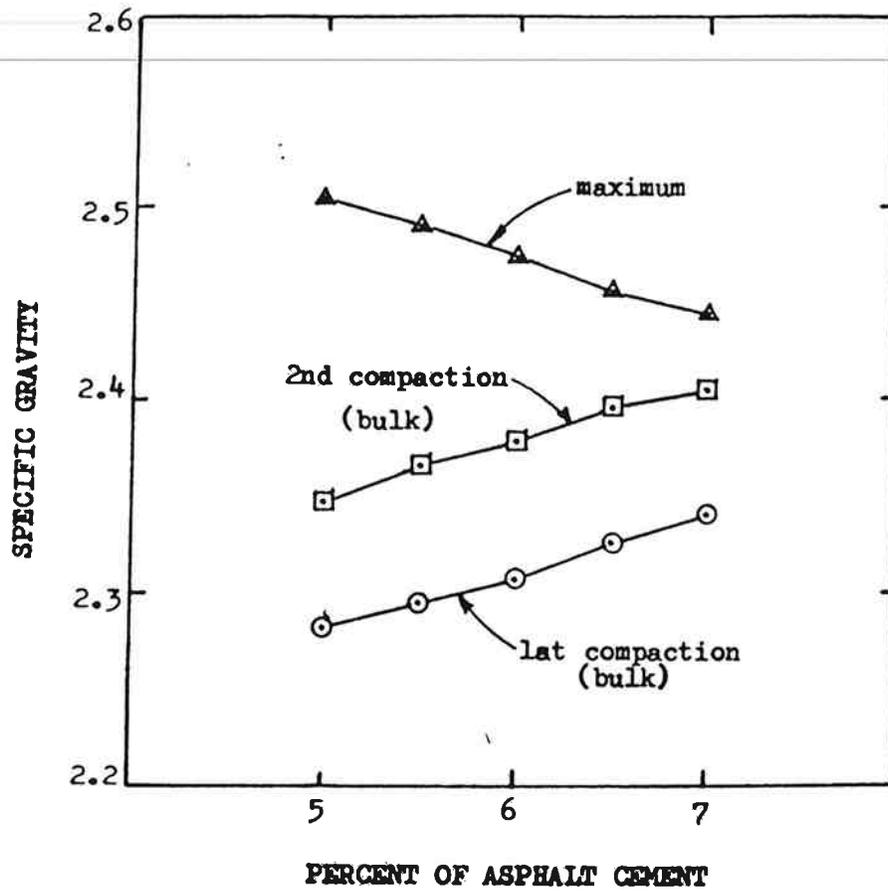


FIGURE 2. Specific gravity vs. asphalt content

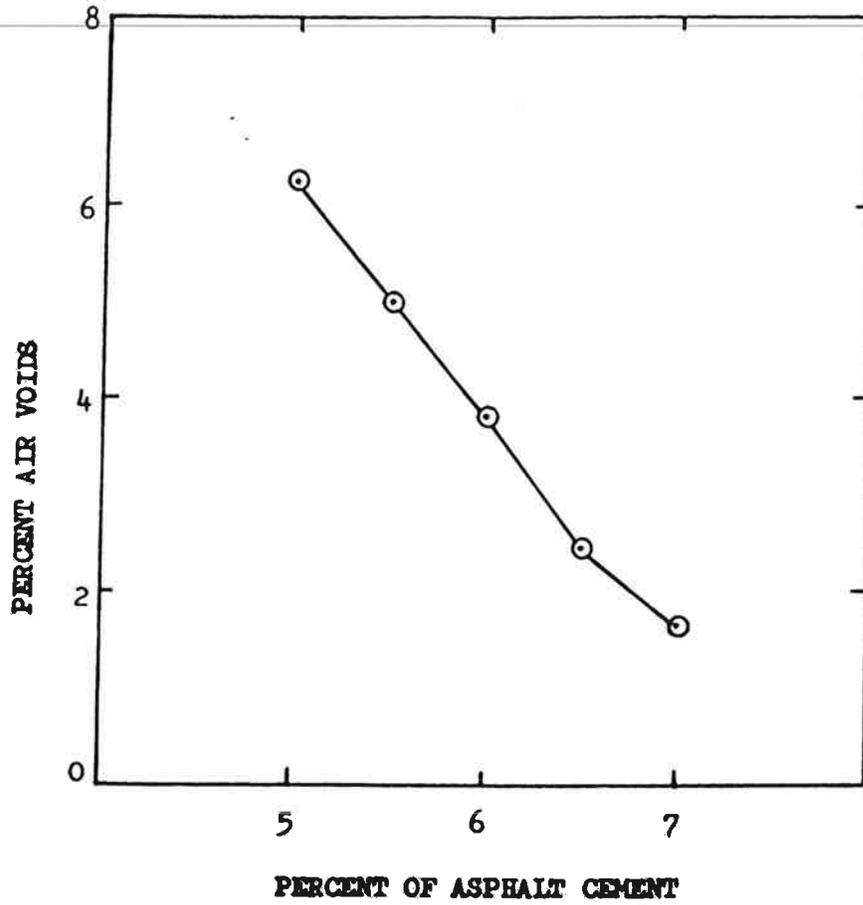


FIGURE 3. Air voids vs. asphalt content.

Air Voids

The percent air voids and the maximum (Rice) specific gravity were determined after the second compaction with the following results (see also Figure 3):

| <u>Percent Asphalt</u> | <u>Percent Air Void</u> | | <u>Real Sp. Gr.</u> | |
|------------------------|-------------------------|-------------|---------------------|-------------|
| | <u>Mean</u> | <u>S.D.</u> | <u>Mean</u> | <u>S.D.</u> |
| 5.0 | 6.25 | 0.73 | 2.503 | 0.0126 |
| 5.5 | 5.01 | 0.61 | 2.490 | 0.0064 |
| 6.0 | 3.80 | 0.60 | 2.473 | 0.0075 |
| 6.5 | 2.44 | 0.59 | 2.456 | 0.0075 |
| 7.0 | 1.62 | 0.40 | 2.444 | 0.0064 |

Lab Personnel Precision

Using the results from the five percent asphalt content, five groups of lab personnel were identified to have performed the "S" value test. Six tests from each of the five groups for both first and second compaction revealed that there was no significant difference in the results between groups (at the 95% level). The mean and standard deviation of the five groups are as follows:

| | <u>"S" Value</u> | |
|-------------------|------------------|-------------|
| | <u>Mean</u> | <u>S.D.</u> |
| First Compaction | 35.80 | 0.813 |
| Second Compaction | 50.67 | 0.995 |

Discussion and Conclusions

The range of "S" value as specified by AASHTO T 246, included 92.4 percent of the test results for first compaction and 85.6 percent for second compaction. The greatest variation (standard deviation) in test results occurred at the 7.0 percent asphalt content level. This variation is to be expected, due to the unstable nature of the mix at this high asphalt content. If the 7.0 percent values are eliminated, then 94.5 percent of the samples would fall within the required range for both compaction efforts.

The laboratory personnel appear to have no significant affect on the "S" value test results, as verified at the 5.0 percent asphalt content level.

In conclusion, the precision of the stabilometer "S" value testing procedure appears to be acceptable when the asphalt content is near of below optimum. For high asphalt contents, where the mix is unstable, the scatter of data points will be greater than normally acceptable.