# RELATIONSHIP OF FATIGUE TO THE TENSILE STIFFNESS OF ASPHALTIC CONCRETE

Addendum to Final Report on Phase I: Laboratory Investigation

by

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The results of fatigue tests on the S-5 mix incorporating a 120-150 penetration asphalt, given in the report on this project issued in May 1971, were incomplete and were somewhat suspect because of mechanical difficulties with the fatigue testing device. Because of the questioned reliability of this set of data in the report, another series of tests were performed and the results are presented in this addendum.

Figure 1 reveals the strain-fatigue life curves obtained for four mixes, including the S-5 mix with the 120-150 penetration asphalt. In general, the new series of tests showed a longer fatigue life for this S-5 mix (Table I) than did the original tests.

Figure 2 illustrates the relation between the indirect tensile stiffness and the fatigue life of the mixes tested. There is a linear semilog relationship at a constant strain level for the mixes having identical aggregates and gradations but asphalt cements of different stiffnesses. The S-3 mix, which possessed the lowest stiffness, did not fit the linear semilog relationship. The fatigue life curve for the S-3 mix with a stiffness of 5,431 psi was approximately the same as that for the regular S-5 mix with a stiffness of 21,050 psi. This finding indicates that the linear correlation probably applies only to mixes of similar aggregate gradations and types.

Figure 3 illustrates the general semilog relationship between the penetration of the asphalt cement and the fatigue life at several strain levels for the four mixes. The trend was for the fatigue life to be less for mixes containing low penetration asphalt cements. Therefore, it is evident that the hardness of the asphalt cement has a definite influence on the fatigue life of the mixture.

Conclusion No. 5 in the final report should be amended to read: "There appears to be a general correlation between tensile stiffness and fatigue life at reasonable strain levels for mixes containing similar types and gradations of aggregates." Also Figures 3 and 5 of the final report should be replaced by Figures 2 and 3, respectively, of this report.

In summary, there was a semilog linear relationship between the indirect tensile stiffness and the constant strain fatigue life for mixes containing similar aggregate types and gradations but different asphalt cements.

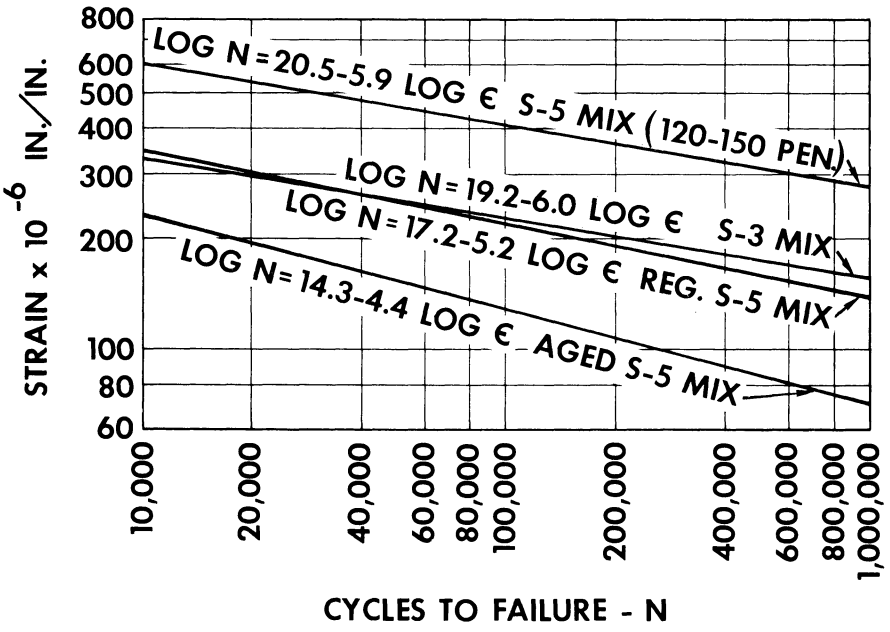


Figure 1. Constant strain fatigue tests.

TABLE I

FATIGUE RESULTS

| Mix Designation | Sample No. | Voids Total Mix, % | Strain, in./in. x $10^{-6}$ | Fatigue Life Cycles |
|---|---|---|---|---|
| Virginia S-5 with 120-150 pen. asphalt cement | 1F'-S5 | 4.1 | 300 | 1,430,351 |
| | 3F'-S5 | 4.5 | 350 | 150,409 |
| | 4F'-S5 | 4.3 | 325 | 754,841 |
| | 5F'-S5 | 4.3 | 375 | 336,411 |
| | 6F'-S5 | 4.5 | 400 | 193,210 |
| | 7F'-S5 | 4.4 | 340 | 29,967 |
| | 8F'-S5 | 4.5 | 375 | 154,603 |
| | 9F'-S5 | 4.6 | 350 | 323,599 |
| | 10F'-S5 | 4.4 | 325 | 786,190 |
| | 11F'-S5 | 4.5 | 385 | 108,986 |
| | 12F'-S5 | 4.5 | 300 | 336,618 |
| | 13F'-S5 | 4.5 | 335 | 630,744 |

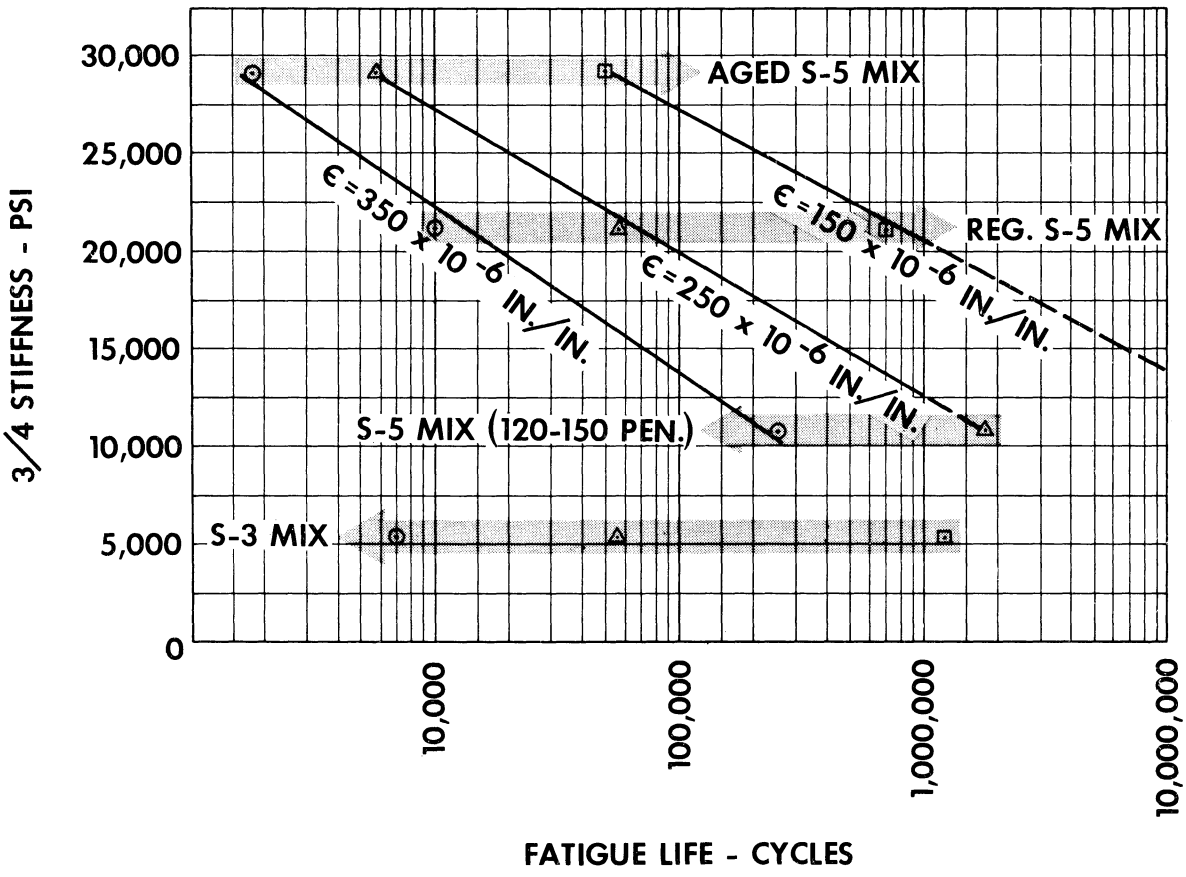


Figure 2. Fatigue vs. stiffness.

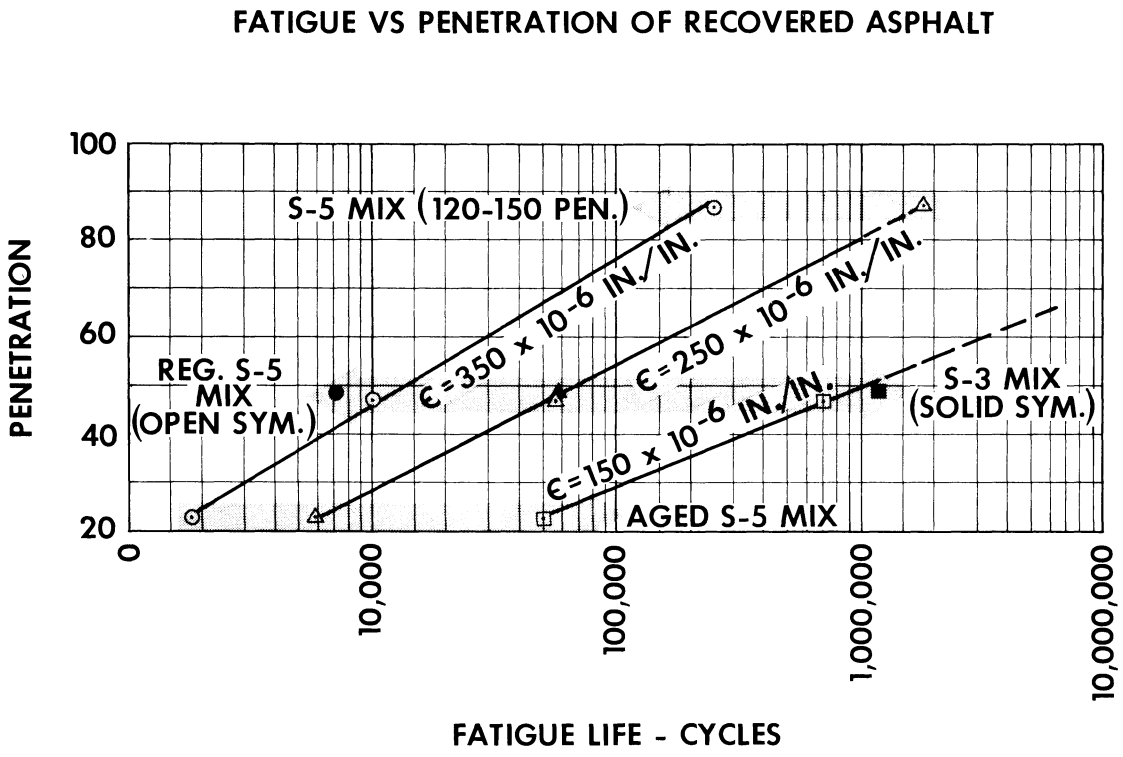


Figure 3. Fatigue vs. penetration of recovered asphalt.