Influence Factors of Bond Performance between Asphalt Surface Layer and Semi-rigid Base

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Abstract: Referring to foreign LPDS shear test method, the influence of asphalt mixture, sticky layer material, semi-rigid base material, the interface of asphalt mixture and sticky layer material, the interface of viscous layer material and semi-rigid base on the shear strength between asphalt surface layer and semi-rigid base was studied with self-designed interior direct shear test and oblique shear test. The shear strength and the unit shear strength were the test evaluation indexes. It is shown that increasing the maximum nominal size and the compactness of asphalt mixture can improve interlayer bond strength. High strength, coarse and dense semi-rigid material can improve interlayer bond strength. Viscosity isn 't main influence factor to select viscous layer materials, but the species and doses of viscous layer materials should be selected according to engineering practice test. Cleaning the surface of semi-rigid base is an important measure to improve bond interlayer s level. Prime coat should be sprinkled with 0. 3-0.6 L m-2 after the surface of semi-rigid base is cleaned. Casting single particle size, coarse specification and alkaline crushed stone above interlayer hot asphalt is easy to construct, and can improve interlayer bond strength 15 tabs, 6 figs, 10 refs.

Keywords: Pavement engineering; Performance; Shear strength; Influence asphalt pavement; Semi-rigid base; Interlayer bond factors

1. Introduction

Semi-rigid base and asphalt pavement material are two different kinds of pavement structure layer, when they are combined together, it cannot be effectively bonded. In order to improve the stress state of pavement structure and improve the road performance and durability, a certain engineering treatment is usually carried out between the base layer and the surface layer. The purpose of this is to ensure that the two can be effectively connected. Semi rigid base asphalt pavement is the most important form of pavement structure, while other countries related research methods are more complex. A great deal of asphalt pavement damage in the United States is directly related to the interlayer bonding state of asphalt surface and semi rigid base. On the basis of the LPDS shear test abroad, the direct shear test and the oblique shear test equipment are adopted to study the influence of the bonding between the asphalt surface and the semi-rigid layer.

2. Analysis of Influencing Factors

2.1. Effect of asphalt mixture

For the general semi-rigid asphalt pavement structure, the particle size of the mixture is thickened from top to bottom. The commonly used asphalt pavement is 18 cm thick, and the mixture of 25 or 30 is generally used on the top surface of semi-rigid base. But for some thinner pavement structure, such as: bridge deck pavement, cement concrete and asphalt surface layer, the particle size of these mixture is generally small, mostly asphalt mixture of type 20, type 16 or even 10. In this study, the influence of particle size on interlayer bonding was analyzed.

The test adopts direct shear and oblique shear test, while the test temperature is 25 degrees centigrade. At the same time, the inclined shear test has been carried out at 40 degrees centigrade. The base material of the test is the same as that of the adhesive layer. The test results are shown in Table 1.

Table 1. Influence of Particle Size on Shear Strength

Gradation of mixture	AC10	SAC10	SAC16	SAC20
Direct shear strength/Mpa	0.464	0.489	0.482	0.534
Diagonal shear strength/Mpa	1.556	1.516	1.601	1.656
Diagonal shear strength at 40℃/Mpa	0.756	0.688	0.824	0.804
Ratio of shear strength to direct shear strength	3.35	3.1	3.32	3.1

Figure 1 shows the compaction degree is 94%, 96%, 98%, 100% and 102% between asphalt layer and base

shear test results respectively. The construction of asphalt mixture surface compaction equipment tonnage is relatively large, and the overload transportation, so the indoor compaction effect seventy-fifth times Marshall compaction test is not ideal [1]. In actual use, the degree of compaction of the asphalt mixture can reach or exceed 100%. Therefore, the range of degree of compaction in this test varies from 94% to 102%[2].

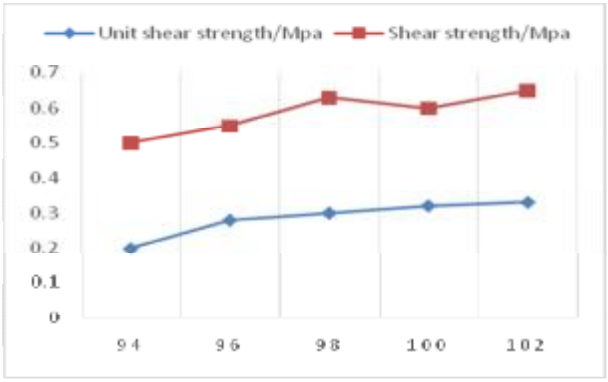

Figure 1. Test Curves of Compactness and Shear Strengths

From the test results, with the increase of the degree of compaction, the failure displacement between asphalt and semi-rigid materials decreases gradually, while the shear strength increases gradually. According to the curve shape, the increase of strength is parabola relation with the increase of compaction degree. That is to say, when the degree of compaction is low, the increase of the degree of compaction has great influence on the shear strength of the interlayer. When the degree of compaction is high, the effect of improving the degree of compaction on the shear strength of the interlayer is not obvious. Based on the analysis of the test, it is considered that the shear strength of the interlayer interface will increase as the compaction passes high.

2.2. The influence of semi-rigid base

Table 2 is the grading curve of 6 kinds of cement stabilized crushed stones (CSCS) for testing. As can be seen from table 1, the minimum throughput of 4.75 mm is 25.5%, and the maximum is 49.6%. Table 1 also shows that from coarse to fine, each gradation interval of about 5%.

Table 2. Six Gradations of CSCS

Gradation	Sieve aperture (mm) pass rate/%				
	31.5	19	4.75	2.36	0.075
Z	100	85.9	25.5	15.5	2.1
Y	100	88	30.3	19.2	2.6
X	100	90.2	35.2	11.1	3.2
W	100	92.3	40	13.2	3.7
V	100	94.4	44.8	15.3	4.2
U	100	96.6	49.6	17.6	4.7

To sum up, the strength level is the most important factor to improve the interlayer bonding effect between semi rigid material and asphalt mixture. Only when semi-rigid material has sufficient strength can it effectively strengthen its connection with asphalt mixture. In addition, through the contrast of U and V gradation mixture, it can be seen that the roughness of semi-rigid material can be improved by appropriately increasing the content of crushed stone in semi-rigid material. In a word, semi-rigid materials with high strength, roughness and compactness will effectively improve their bonding with asphalt surface and prolong pavement service performance.

3. Influence of Adhesive Layer Material

At present, the applied layer material is mainly modified emulsified asphalt and modified asphalt. The analysis suggests that when conventional asphalt mixes with modifiers such as SBS, a chemical reaction is produced that alters the structure of the asphalt. The resulting network or chain structure strengthens the cohesion between the asphalt molecules, thus increasing their viscosity levels. But it also has a side effect: when the temperature is low or the temperature is not high, the modified asphalt and the bond properties of the mixture will drop. This is the reason why the viscosity of the modified asphalt is high and the shear strength of the interlayer is rather low. However, as a bonding material, asphalt is not the lower viscosity, but also has a certain degree of toughness.

4 . Conclusions

The higher the degree of compaction of asphalt mixture, the greater the strength, and the shear strength of the interlayer is also higher. At the same time, the coarser the particle size is, the better the pavement performance is. High strength, coarse and dense semi-rigid materials will effectively improve the bonding properties of asphalt concrete and asphalt pavement. The influence of bonding material on interlayer bonding state is complex, so it is not the higher viscosity of adhesive layer material, the higher shear strength between layers. At present, the evaluation of asphalt index is not applicable to evaluate the adhesive material. In practical engineering, the choice of adhesive material requires not only the evaluation of asphalt properties, but also the relevant shear tests.

It is not only of engineering significance to sprinkle a certain amount of crushed stone on hot asphalt, but also has obvious effect on improving the interlayer bonding between asphalt mixture and semi rigid material. But the crushed stones should be of a single particle size, because of the coarser size and alkaline adhesion of asphalt. As a kind of material used to improve the

binding between semi-rigid and asphalt surface layer, permeable coating oil should have good permeability, but the penetration depth is not the only index to evaluate the construction quality of permeable coatings. The amount of oil spread through the layer should not be too high, and it can generally be controlled at 0.3-0. 6, L, m-2 or so.

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