Investigation on the Damaged Factors of Paving Asphalt Pavement

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Abstract: Pavement has been a technical difficulty in road engineering. This paper compares the two pavement schemes of modified asphalt mixture pavement and pouring asphalt pavement. Through the finite element method simulation analysis, considering the influence of different parameters, we explore the relationship between the stress value and deformation under different conditions. The analysis results show that longitudinal shear stress is an important factor to destroy the road surface and affect the traffic.

1 INTRODUCTION

For a long time, road pavement has always been an international research difficulties.Road pavement materials not only greatly affected the normal use of roads and the transportation function, but also plays an extremely important role in traffic safety. In the study of road pavement, the key problem lies in the small surfacing layer stiffness and large deformation, which requires good deformation of asphalt pavement structure layer. At the same time, the stress condition of the pavement is complex, affected by temperature, in a larger horizontal shear stress, the pavement layer shear displacement and damage, appear easily affect the use and the traffic. According to incomplete statistics, each year more than billion yuan for the study of the road, of which more than 35% is used in the pavement. At the same time, the government to coordinate the area highway construction in west China, the implementation of the western traffic construction projects of science and technology research has achieved fruitful results.

2 PAVEMENT STRUCTURE AND CHARACTERISTICS

Road pavement mainly refers to a layer of asphalt mixture on the road surface layer, passing through the asphalt mixture layer to transfer the force to the lower base. Although it is based on the actual need to choose different structure layer, but whatever the form of pavement, generally can be divided into two categories, namely waterproof (sometimes called rust) system and body shop system (Wen, 2003).

The pavement plan is different from the actual project. In the present stage, the asphalt pavement is mainly modified with asphalt concrete and pouring asphalt concrete (Ding, 2002). And the composition, function and construction method of these two kinds of pavement materials are very different from each other.

2.1 Modified asphalt mixture paving layer

In the early stage, due to lack of understanding of modified asphalt mixture and pavement, there are many diseases such as rutting, crack and passage in road use. With the progress of materials and technology, the comprehensive performance has been improved greatly. The process of the paving scheme is becoming more and more mature, and the construction technology is simple, and it is used in the municipal highway with small area and no special requirement.

2.2 Casting asphalt concrete

The casting type asphalt concrete originated in Britain, the main way of application of the pavement in commonwealth countries .After the introduction of our country, according to China's national conditions, to adjust and optimize the structure and material, formed the casting type pavement typical structure. The scheme is the most commonly used in our country, and the life is more than 12 years,no matter from the late construction quality and

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reliability maintenance. Compared with similar schemes, it has obvious advantages, but also has its corresponding faults, high temperature stability, easy to form in at high temperature rut.

3 ANALYSIS OF STRESS CHARACTERISTICS OF ASPHALT PAVEMENT

Safety is the first requirement, we are in use in the process of building surfacing with good performance is the important guarantee of safe driving vehicles, but a lot of road traffic within a few years pavement layer occurs the problem such as cracks, deformation, seriously affected the normal use of roads and dramatically reduces the transportation capacity.

Under the action of driving load, there are two main ways to damage the pavement layer: first, the internal damage is caused by the shear stress inside the pavement layer, which causes the shear failure of the paving layer. External damage mainly because of pavement layer and layer panel joint surface between the cohesive force is insufficient, weak ability to resist horizontal shear, so prone to shear displacement in horizontal direction, the final package, goes on, beat on the pavement, as well as the aging situation (Xu, 2002).

In this paper, based on the finite element software ANSYS calculation, analysis of modified asphalt mixture surfacing and the casting type asphalt layer of internal force, when the maximum shearing stress state, at the same time, considering pavement changes related parameters, vehicle status and level on the stress caused by different factors, such as stress changing.

3.1 The influence of variation of each parameter of asphalt concrete pavement on the stress of pavement layer

In this paper, the influence factors of stress mainly consider the thickness and elastic modulus of pavement layer. In the design process of pavement, an important index is to select the corresponding structural layer according to the actual situation of material and grade composition, and determine its thickness (Luo, 1999). It is mainly due to the particularity of asphalt concrete and the non-uniqueness of asphalt concrete modulus. In the process of development, asphalt concrete materials are more and more functional, and different materials are different in terms of modulus and intensity. Secondly, even if the asphalt concrete material is the same, the difference of temperature and the time of loading will also affect the elastic modulus. The change of elastic modulus will cause the force change of the whole structure, and even to another completely different stress equilibrium state. And for the same material, because the modulus changes with the temperature, the strength of the material changes.

3.2 Relationship between thickness and stress of pavement layer

In order to analyze the relationship between the thickness of the modified asphalt mixture and the structural stress, this paper uses the thickness of the surface layer of 3cm, 5cm, 7cm, 9cm, 11cm,13cm and 15cm.

(1) In the process of continuous change in the thickness of the surface layer, the variation of the main stress, normal stress and shear stress in the surface layer is shown in table 1, and the relationship curves of each stress and thickness are shown in FIG. 1:

Table 1: variation of stress with thickness of modified asphalt mixture.

Thickness（cm）	σ1(Mpa)	σx(Mpa)	σz(Mpa)	τxy(Mpa)	τyz(Mpa)
3	0.6695	0.4459	0.6643	0.3216	0.3356
5	0.6385	0.4471	0.6355	0.2899	0.3043
7	0.5987	0.4143	0.6159	0.2829	0.2806
9	0.5876	0.3987	0.5998	0.2673	0.2525
11	0.5839	0.3597	0.5902	0.2643	0.2412
13	0.5789	0.3312	0.5832	0.2613	0.2388
15	0.5013	0.2896	0.5799	0.2195	0.1932

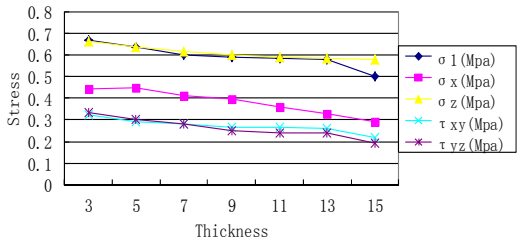

Figure 1: The relationship between stress and thickness

From table 1 and figure 1, it can be seen that in a certain range, the greater the thickness of the modified asphalt mixture pavement layer, the lower the stress value in the asphalt concrete surface layer. It can be seen that the thickness of pavement layer is beneficial to the internal stress of the surface layer. The longitudinal and vertical stress decreases, and the transverse damping is larger. The transverse shear stress decreases with the same thickness, and the transverse shear stress is less than the longitudinal shear stress.

(2) The main stress, normal stress and shear stress vary with thickness as shown in table 2, and the variation curve of relevant stress values and pavement thickness is shown in FIG. 2.

Table 2: the value of the stress changes with thickness of asphalt concrete pavement.

Thickness（cm）	σ1(Mpa)	σx(Mpa)	σz(Mpa)	τxy(Mpa)	τyz(Mpa)
3	0.7369	0.3912	0.5437	0.1744	0.5593
5	0.6998	0.2846	0.4778	0.1621	0.4796
7	0.6801	0.2565	0.4553	0.1403	0.4611
9	0.6415	0.2312	0.4172	0.1279	0.4368
11	0.6032	0.2003	0.3889	0.1174	0.4098
13	0.5622	0.1933	0.3658	0.1076	0.3922
15	0.4936	0.1644	0.3422	0.0958	0.3503

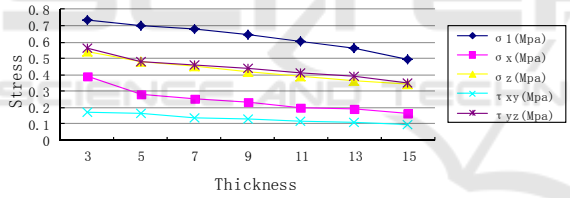

Figure 2: The relationship between stress and thickness

It can be seen from the above curve that in a certain range, the longitudinal and transverse shear stresses of the castable asphalt concrete pavement are inversely proportional to the thickness. When the stress is reduced, the decrease of longitudinal shear stress is less than that of transverse shear stress. It can be seen that increasing the thickness of the pavement layer has a weak influence on the shear stress. In practical application, the thickness of the pavement layer should not be too large.

Other conditions by the above analysis we can see that the same circumstances, with the gradual increase of surfacing layer thickness, modified asphalt mixture surfacing in lateral shear stress change is higher than the change of shear stress in the casting type concrete pavement layer. From table 1 you can see in table 2 casting type concrete pavement layer of longitudinal shear stress is significantly higher than the same conditions of modified asphalt layer of longitudinal shear stress, and modified asphalt pavement layer transverse and longitudinal shear stress values gap is smaller.

4 CONCLUSION

On the basis of finite element simulation, the stress analysis of pavement layer is carried out. The maximum shear stress in two pavement layers and the maximum vertical deformation of the pavement layer are compared. Analyze the relationship between these variables and draw the following conclusions:

(1) Through the simulation analysis, it is shown that the longitudinal shear stress is mainly used to control the strength of the pavement when subjected to both horizontal and vertical forces. Therefore, longitudinal shear stress is the main factor that damages the pavement layer, and is also the key factor in traffic design.

(2) The stress in pavement layer is inversely proportional to the thickness of asphalt layer in the process of continuous change of pavement layer

thickness. The vertical deformation of asphalt surface is proportional to the thickness of asphalt.

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