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The Research on the Cracks of the Asphalt Pavement

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ABSTRACT
The cracking is one of the common diseases of the asphalt pavement. According to the shape and the forming reasons, the cracks can be divided into two categories. Each categories can be divided into several types. Through the comparison and the analysis of the causes of different cracks, the prevention and the treatments are proposed in the respects of the structural design, material design and construction
Keywords **-** asphalt, crack, prevention, treatment

I. INTRODUCTION

The crack is one of the common diseases of asphalt pavement. The early crack has little influence on the performance of the use of the road, however, with the increasing of the cracks, quantitative accumulation leads to qualitative transformation the and has serious influence on pavement performance, even lead to the damage of the integrity of the road.[1]Therefore, It is necessary for us to start from the early crack, analyzes its causes and puts forward prevention measures. The cracks of the asphalt pavement is inevitable and can't be avoided, we are only able to improve the design and construction techniques to reduce the generation of cracks and delay initial cracking time.

II. THE TYPES AND CAUSES OF THE ASPHALT PAVEMENT

There are all kinds of the cracks of the asphalt pavement. According to the shape of the cracks. They can be classified into the transverse crack, the longitudinal crack, the map crack, the massive crack and the irregular crack; on the basis of crack formation, they can be divided into the loaded crack, the reflective crack, the temperature crack, the temperature fatigue crack, the loaded fatigue crack and the water damage crack.

Due to the different type of cracks, the causes of cracks are diverse.

The transverse crack. This kind of crack is caused by the temperature shrinkage of itself asphalt surface and the reflective cracks in road base course. Temperature rise is the condition of fatigue cracks of the asphalt layer bottom. It also has a lot of external factors, Such as, the poor quality of its construction, the thin asphalt layer and the bad Water stability.

The longitudinal crack. It parallel roughly to the longitudinal of road. Sometimes it is accompanied by a small amount of the seam. There are many reasons that mainly is related to the construction. The first,, the quality of the lining linkage is failed to deal with when the the asphalt layer is paved. under the action of the vehicle load, the pavement is cracking gradually; The second, the cracking of the asphalt pavement is caused by the Insufficient compaction and the uneven settlement of the subgrade The Third, the construction joint of subgrade is failure to deal well . Uneven compaction and strength of the Joint on both sides give rise to the cracking of the asphalt pavement. The fourth, the uneven settlement of the Half filling and half digging area cause some cracks. In addition, The different driving speed each lane, the different vehicle models, more heavy vehicles On the driveway, more small cars on the passing way, and the unbalanced force each lane for a long time, are also the cause of the uneven settlement, eventually leading to cracking.

The map crack. The map crack is sinking crack commonly, that is the result of the driving load repeatedly and the crossing of the fracture each other, forming a series of polygon mesh of small pieces. At first, a single or multiple parallel longitudinal cracks appear in the wheel track along the belt. And then, The transverse crack and Inclined crack appear Between the each longitudinal crack. Gradually, The map crack forms. The appearance of map cracks are often accompanied by surface subsidence. The size of the crack is commonly 500 mm. sometimes, Its size of they only range 50 to 100 mm. The generation of the map crack is mainly due to the insufficient strength of the structure layer .It is difficult to sustain heavy load of the vehicle. The poor performance of asphalt mixture in low temperature Is also the cause of the map crack. Furthermore, the poor controlling of the

constructional quality, natural disasters, such as earthquakes, can also lead to the map crack.

The massive crack. It is formed to polygonal large cracks by the crisscrossing between longitudinal and transverse cracks. Compared with the map crack, the block is larger. The size of the block is usually more than 500mm.

The irregular crack. The irregular crack is result from the insufficient strength of pavement surface and the poor stability of the pavement base. In addition, unreasonable structure design, the thinner asphalt layer, insufficient compaction and improper ratio of pavement materials or mixing unequally can also cause the irregular cracks. It is the comprehensive reflection of the reasons of the different types of cracks.

The temperature crack and the temperature fatigue crack. Because of the bigger stiffness of the asphalt mixture, lower ductility and higher brittle point of asphalt in the low temperature, the temperature crack easily appears when the asphalt mixture shrinks in the low temperature. Temperature cracks usually occur in the northern region, especially in winter cold area. Temperature fatigue crack is due to the large difference in temperature .Repeated swell-shrink of the the asphalt mixture lead to the fatigue crack. The formation of the cracks are not necessarily to the lower temperature. It can happen as long as the temperature is largely different.

The loaded crack and the loaded fatigue crack. The load cracks are due to intensely large load or more than the bottom tensile strength of the Asphalt layer. It is usually caused by overloaded vehicles or improper structure design and construction. Loaded fatigue cracks are due to load under the repeated action, leading to the decrease of the tensile strength of the asphalt layer. This crack usually occur in big traffic road.

The reflective crack. Semi-rigid base of asphalt pavement appears some cracks after long-term exposure to tensile stress. Under the effect of the concentrated stress, the crack cuts through from the bottom to the surface[2]. In the end, asphalt surface appears lots of cracks. This kind of crack usually causes great damage to the road, resulting from the insufficient strength of the semi-rigid base or the subgrade.

The water damage crack. This kind of cracks are caused by water erosion. In the rainy areas, the water level of the underground can rise because of the poor drainage system. Part of the water stays in the base of the pavement, and even the asphalt layer. Under the vehicle load, the materials of the base or surface layer under the effect of dynamic water pressure are scoured repeatedly. The fine aggregates are able to transfer from the gap to the road surface. Ultimately, The pumping slurry cracking appears in the gap of the surface layer[3].

III. THE PREVENTION OF THE CRACKS

The prevention from the material design of the pavement. In the case of guarantee strength, reducing the amount of inorganic binder and mineral powder can helps to reduce dry shrinkage crack or temperature shrinkage crack. In the case of well-funded, choosing the flexible base materials can effectively reduce the crack of semi-rigid base. On the premise of guaranteeing the high temperature stability, selecting the bigger ductility , smaller viscosity of the asphalt can availably increase the ability of stress relaxation of the asphalt mixture and reduce stiffness at low temperature.

The prevention from the structure design of the pavement. First of all, The thickness of the base course and asphalt layer should be in strict accordance with the design requirements. Then, the level between the asphalt layer and the base course should be set stress absorbed layer to prevent the reflection cracks. For another, the level between the base course and the subgrade should be set the drainage layer.

The Prevention from the construction. For each layer, the degree of compaction and curing period should meet the requirements of the specification. When the asphalt layer is constructing, each link of the construction temperature should be strictly controlled[4]. For instance, the discharging temperature, the mixing temperature, the paving temperature and the rolling temperature.

IV. THE TREATMENTS OF THE CRACKS

There are many ways about the treatments of cracks. The suitable approach should be adopted according to different types of the cracks. Firstly, the surface repairing method is adapted to small cracks and undamaged structure layer. Secondly, the Grouting treatment is mainly aimed at those map cracks or the massive cracks. Its surface has the effect of the seepage control and the reinforcement. Thirdly, the structural reinforcement mainly adopts the bolts and steel plates.[5] It can effectively strengthen and restrict the live cracks stretching. Besides, the notching and grouting is an effective way, But getting the technology to achieve the desired effect need to special equipment .As a result, the cost is high.

V. CONCLUSION

The cracks of asphalt pavement was inevitable. Early cracks may be ignored, so the cracks should be treated as soon as possible, to prevent the spreading of the cracks. Before treating cracks, the researchers should analyze the reasons of cracks to take some .appropriate measures to curb. The preventive measures of the cracks are considered mainly from material design, structural design, construction and so on .Therefore, combining the prevention with the treatment is the best way to reduce the cracks of asphalt pavement.

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