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Engineering prevention and treatment of salt soil diseases caused by pulping on low-grade highways in xinjiang

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ABSTRACT: The frost boiling disease caused by saline soil is a common disease of grade three and four highways at present. In this paper, the mechanism of frost boiling highway disease in saline soil is analyzed. And through simplified calculation combined with engineering experience, the concrete measures for preventing and curing the disease are put forward. Finally, through engineering practice verification, the expected results have been achieved.

1. Research significance

During the spring thawing period, the strength of soil decreases sharply due to the excessive water content in the upper layer of soil foundation. Under the action of driving, the road surface appears uneven fluctuation, soft or cracked slurry. And these phenomena are called frost boiling。Turning over is one of the main highway diseases in the third and fourth grade highways, especially in xinjiang saline soil with a wide geographical distribution, and the phenomenon of turning over is quite common to a certain extent. Therefore, it is very important to timely carry out the research work of turning over control and verify the research conclusions through engineering practice.

2.The cause of salt road muck

The nature of the existence of saline fine soil (hereinafter referred to as saline soil) is mostly composite saline soil, that is, a variety of combined salts in different proportions mixed in the soil exists, a variety of combined salts in general (its content is not very large) can aggravate and deteriorate slurry. Firstly, the chloride salts have high solubility and are easy to rise to the surface with water.

This kind of saline soil has obvious hygroscopicity, and the hygroscopic water evaporates slowly. This kind of soil can maintain high water content for a long time, that is, this kind of soil is in a low strength state for a long time. In addition, when the chloride salt content of this kind of soil is not very large, its freezing point decreases. In winter, the accumulation time of underground water increases, resulting in the increase of negative temperature effect water and ice in the shallow layer below the surface. When thawing in spring, the water content at a certain depth under the road surface is high, and sometimes there is even a state of oversaturation. In the wet state, the strength of chloride saline soil decreases rapidly with the increase of salinity, and can reach the state of liquidity and plasticity with a small water content. At the same time, the wetting process can lose its stability faster and more rapidly than that of non-saline soils. This is because when the chloride salts in the soil do not exceed their critical dissolved content, the salts dissolve in water to lubricate the soil and the internal friction

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Angle decreases sharply, while the salts are contained in the soil particles, the distance between the soil particles will increase and the cohesive force will naturally decrease. In a word, chloride saline soil has great hygroscopicity, strong water retention and ice accumulation, which makes this kind of saline soil with poor water stability extremely easy to be in the working condition of low bearing capacity for a long time, so it is very easy to molt under the action of axial load.

3.Mechanism and prevention and cure of salt soil highway grouting

Due to the low grade of grade iii and grade iv highways, the granular structure layer with good water stability is not very thick. Generally, the top surface of the soil bed filled with fine grained soil is close to the road surface. If the soil bed due to excessive water content or salt and alkali lead to a rapid reduction in strength, under the impact of driving load, the part of the soil strength is insufficient, resulting in grouting. However, if the salt soil mass with poor water stability that causes grouting is controlled at a certain depth below the road surface and the upper soil mass is always kept in a dry state (large bearing capacity and stable mechanical index), grouting can be guaranteed.

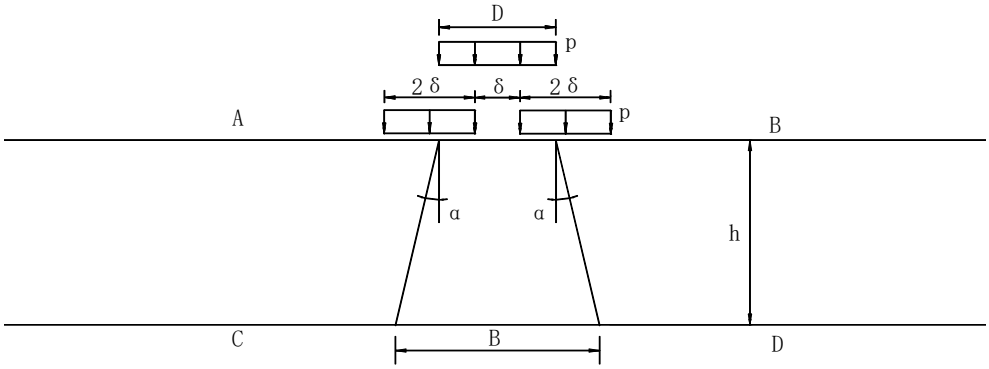


Figure 1Pavement AB load distribution

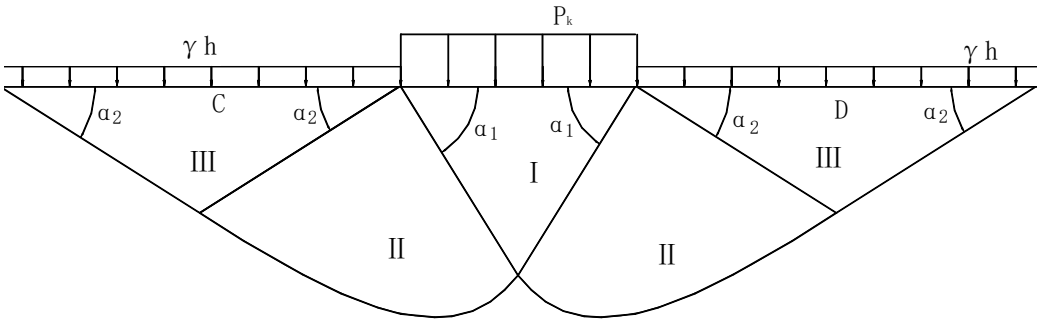


Figure 2（α1=π/4+φ/2，α2=π/4-φ/2）

As shown in Figure 1，There is wheel load acting on the pavement AB,P=0.7MPa，Double circle load diameter 2δ=21.3cm, Equivalent load single circle diameterD=2δ× $\sqrt{2}$ =30.12cm。Assuming that the soil mass that is likely to be rolled under the surface of CD has no resistance to deformation (except downward force transfer), the soil mass between ABCD has no resistance to deformation (except downward force transfer). The soil bulk density γ=18KN/m3.There is only one standard axle load on the AB pavement and the function of two wheels on the rear side

Under the surface of CD, adverse working condition parameters are taken according to fine soil: coagulative power C=15KPa，internal friction angleΦ=100。Simplify the external force on the CD surface to the CD surface as shown in figure 2.or

$$B=D+2h\mathrm{tg}\,\alpha \qquad (1)$$

$$P_k=P\frac{\frac{\pi}{4}D^2}{\frac{\pi}{4}B^2}+\gamma h \qquad (2)$$

Assuming that the soil mass between ABCD has no resistance to deformation, if the foundation under CD surface is unstable, then the road AB will also lose stability -- grouting (mechanical parameters C, phi is small) will occur and reflect on the road AB. According to the principle of limit equilibrium theory of soil mechanics, the modified l. prandtl formula of strip load is applied to CD surface under circular load in the above example, then the ultimate load Pk 'is:

$$Pk'=Nb\,\gamma\,B+Nq\,\gamma\,h+NcC \qquad (3)$$

$$N_b=\frac{1}{2}tg\left(\frac{\pi}{4}+\frac{\phi}{2}\right)\left[tg^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right)e^{\pi tg\phi}-1\right],\quad N_q=tg^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right)e^{\pi tg\phi}$$

$$N_c=ctg\,\Phi\left[tg^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right)e^{\pi tg\phi}-1\right]$$

According to the assumption derived from the limit theory formula of soil mechanics, there should be a certain safety factor K in the application:

$$K=Pk'/Pk \qquad (4)$$

From equations (1), (3) and (4), it is known that the larger the Angle of alpha is, the greater the ultimate load Pk 'will be, and thus the greater the safety factor K will be. Therefore, alpha = is taken as the safe value, and K=3 is taken as the safety factor according to the regulations. After trial calculation, h=0.76 (m).

The experience of the author for many years engaged in road construction, all this section of the engineering example of excavation section were showed: the top of the lesions were all within the pavement under 0.7 m, so we will be treated as h 0.8 m to protect against it, i.e. road under 0.8 m within the scope of backfilling fine grained soil total salt content less than 1.0%, salt dilatant salt content less than 0.5%, which laid the waterproof layer. It is proved that the scheme is feasible by engineering practice in the past two years.

4.engineering verification

Fangma highway (X194), which covers a total length of 40Km, was expanded into a standard third-level highway in 2002. The highway pile no. K14+500 to K20+500 is a low-lying area, and 6 meters west of the road is accompanied by fangcaohu west trunk canal without seepage prevention. The project area is the downstream of the fine soil plain of hutubi river basin. Field pit sampling of the road section showed that the upper layer (0 ~ 50cm of the original road surface) was sulfuric acid and sulfite soil, the average content of Na2SO4 was 1.6%, and the average total salt content was 2.7%, and the lower layer (50 ~ 100cm) was chlorite and chlorite soil, with the total salt content of 1.5%. Implementation plan: take the highway design shoulder as the benchmark, dig down to the base shoulder 0.9m, the width is about 11m, and the excavation depth is 0.4m ~ 0.6m. Then lay down 10cm of wind

Farm tong group highway: ja ja farm tong road belongs to the alluvial plain of fine soil in which the upstream, the road 100 m were continuously throughout the year, the field sampling underground within 1 m between 1.2% ~ 2.6%, total salt groundwater is apart from the ground 0.6 m to 1.0 m, mainly vertical evaporation discharge of groundwater, the field plan comparison, decided to dig to abandon the old subgrade, pumping in wind-blown sand filling a distance of 450 m, in filling length of 100 m, the depth of 1.5 m ~ 0 m range, out of the ground after filling the wind volume is more than 0.45 cm, upper pavement structure of its 0.37 cm according to the conventional construction. The project started in 2002 and opened to traffic after completion in November of the same year.The author paid three return visits in 2002 and 2003, and the road surface showed no signs of turning over and turning over.

Shihezi main line (S312) highway. The pile no. K71+300 ~ K71+750 of the highway is similar to the situation of fangma highway, so the treatment method is the same, except that the highway was completed in September 2001, to November 2003, the section did not show any signs of molting and molting.

5.Conclusion

It is suggested that the following measures should be adopted in engineering to prevent frothing of saline highway: the waterproofing layer is set at 0.8m under the shoulder to ensure that the total salt content of fine-grained soil with backfilling in the range of 0.8m is not more than 1% and the salt swelling salt content is not more than 0.5%.

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