STUDY ON SNOW DISASTER PREVENTION ALONG THE HIGHWAY FROM TIECHANGGOU TO EMIN

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Abstracts:

The Provincial Highway No. 318 from Tiechanggou to Emin in Tacheng, Xinjiang, China goes from east to west has a total length of 85 km, because of special geography conditions and climate, there are frequent snow disasters each year, especially at the most serious road section from Mayitashi to Camel Neck total 33km. Every from December in winter to March in the spring of next year, the traffic is cut, and frostbited or even winterkill people are often reported. In order to change the situation, in 1998, the Xinjiang Communication Department approved to carry out a research on highway snow disaster prevention at this area. This paper mainly covered the snow disaster prevention scheme and practical measures used there.

Key Words：Highway Wind-blown Snow Prevention and treatment

1. Natural environment

1.1 Geography and Topography

S318 Highway from Tiechanggou to Emin is located in the macro narrow channel formed by Rurikexiayi and Jiayierxi Mountains, High in the east and low in the west, the attitude N46° 30′ ～ 46° 40′. In winter the east wind caused by the high pressure of Mongolia and the cold and wet current from the west present alternately, two directional gale is formed, and the macro narrow channel speeds the wind. Tacheng Emin Plain has a shape of bell mouth to the west, it is advantageous for the influx of western air current with rain and snow, the landform gradually going up from the west to east makes it easy to capture rainfall, all these make a consolidate basis for snow wind.

1.2 Climate Characteristics

The observation data of Mayitashi meteorology observation station collected by the study team during 1998 – 2001 showed:

1.2.1 Wind days covered 95.5%，still days 4.5%. Among wind days, days with wind speed faster than snow particle start speed (3-5m/s) covered 96.1%, and days with wind that can fill the air with snow, and ground visibility less than driving sight distance (wind speed >8m/s) covered 87%. West wind 34.6%, east wind 60.9%. The deposited snow brought by the western snow wind was blown back by

the eastern wind, the interactive action made the snow wind current even more dangerous. The maximum wind speed can reach 30.5m/s. Wind with 8 or high grade took place about 50 times in one year.

1.2.2 The average temperature was -6.9° from November to March of next year. The early days' (November) average temperature was -6.6°, that of March when snow wind would be over was -7.3°. Generally, when the temperature was lower than -5°, it is suitable for snow particle to be blown up.

1.2.3 Continuous gale made it difficult to precisely measure the rainfall and stable snow cover thickness. According to the observation, about 70-80% snow was lost, the total snowfall in five months was 26.5mm, evidently less than normal. In the same wind area, about 35km away, the snowfall at Laofengkou in winter was 139.2mm.

2. Harmfulness of snow wind

The snow disaster investigation began in march 1980, without break. In recent 20 years, it is believed that the present S318 highway shall be rebuilt along the same line (referred as the middle line in the following)，and this is ideal. After the investigation and research work by the study team, the original idea was not correct.

The section from Tiechanggou to Emin of S318 Highway, during 353km～388km, there are sections with wind-blown snow which cut traffic in winter here and there, the total length was about 35km. Among them, the most serious section is 358km～375km, totally 17km. It can be divided into 4 small section according to the topography.

2.1 353km～372km

Leeward snow deposit caused by two direction wind. The thickness of snow cover on road surface was 0.8-1.5m, the maximum was 1.8m. From December, the snow cover on road surface is to be a serious and cut the traffic, until the snow cover melts over in the next year, the road was open to traffic. See figure 2-1.

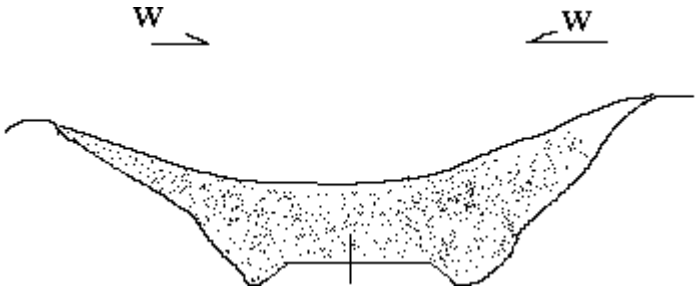

Figure 2-1 Leeward snow deposit by two direction wind

2.2 372km～375km

Leeward snow deposit caused by the east wind. Because the ground shape changed continuously,

and there was a lot of excavation, the excavated road base formed a large weak wind area, and lots of snow deposited there. The maximum thickness can reach 3.4m. See Figure 2.2.

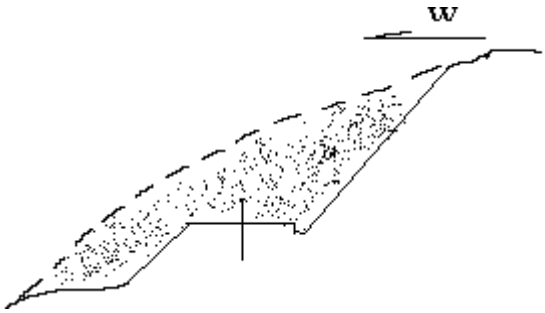

Figure 2-2 Leeward deposit by excavation

2.3 375km～380km

The highway goes the same direct as the snow, the longitude slope grade was 6%～7%，and goes down with the wind, the wind speed was slowed down so snow deposits on road surface. The snow cover on road is about 0.5-0.8m thick, only few places have snow more than 1.0m thick. See Figure 2-3

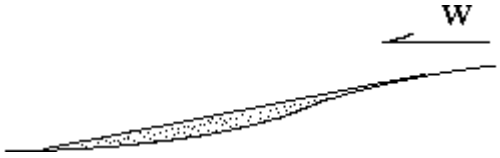

Figure 2-3 Large longitude slope grade caused leeward deposit

2.4 380km～388km

Snow deposit caused by the east wind and natural snowfall. This section was getting gradually far from the main current of snow wind, and the wind speed was getting slow, the wind-blown snow on road surface was replaced by natural snowfall. Because the road base was lower, the snow cover on road surface is about 0.3-0.8m thick, and 1.0m at most.

3. Counter measures for snow disaster prevention and treatment

Based on the geography and climate characters, to solve the snow disaster problem four steps shall be taken.

3.1 Route

The route shall pass through wide areas with little snow deposit and little snow adversity. The longitude slope grade of leeward sections shall be less than 3%, and the radius at bend shall not be limited.

3.2 Road base

The road base shall be widen by 3-4m, in favor to driving and snow-sweep work. The height of

road base shall be 0.5m-1.0m higher than the stable snow. The grade of the road side slope facing the wind shall be controlled to be 1:4.

3.3 Snow protection engineering

Including snow fences, wind guiding board and snow protection woods, combining engineering and biological means. When snow disaster is prevented, the local environment is also improved.

3.4 Necessary machines

Necessary and effective snow sweeping machines shall be equipped in snow disaster areas.

4. Comparison of Routes

Since October 1998 when the study team began to work, the study team have thought that the route selection is the key of snow disaster prevention and treatment. According to the meteorology observation and investigation results, and after determination of the principles for highway survey and design of sections with snow disasters, different routes were compared:

4.1 Up route

The up route has a height difference of about 300m from current route. The up route is consisted of two slope routes and one crossing mountain route. This route is winding, its angle with snow wind changes frequently, and the construction will destroy the natural topography, these all lead to snow deposit on road. Further, the route height increases, then the total length and longitude slope grade of the route increases, it is disadvantageous for traffic. So the up route is not advisable.

4.2 Middle route

It is mainly to improve the old highway so as to promote its grade and reduce snow disasters. This route limited by topography has serious snow disaster problems. Moreover, because of the busy traffic, a auxiliary road shall be constructed so as to keep the highway open. But the Up and Down Routes do not have this problem.

4.3 Down Route

The down route locates 1-3km far to the south of middle route, it fundamentally eliminate the leeward snow deposit adversity. The down route is about 27kmlong, and can be divided into two landform sections: the first 19km plain area (to Tiechanggou), the last 8km heavy hilly area.

a. The first 19km plain area

It is wide and smooth. Because it locates in the main current area of snow wind,that is the movement area, there is less snow, the snow cover is usuall 30cm thick, 80cm at most. The route is straight and the average longitude grade is about 1%, single form of road banking can be usded. There the suitable water and soil conditions are favor to construct snow protection trees, and the leeward

snow deposit by two direction wind can be prevented and treated.

b. The last 8km heavy hilly area

The route pass through many isolated or connected hills, its is designed to be on the slopes with going up wind, the foot of hill becomes a natural snow deposit place. At many sections snow protection construction can be set up, the condition for snow disaster prevention and treatment is far better than that of middle route.

Its route shape and longitude grade have little difference with those of middle route,but the construction work amount is increased a little.

The disadvantage of the down route is that it use more fields than other routes.

5. Conclusion

After the above comparison, the study team recommended the down route.

Because of the importance of this highway (it will be a national trunk line highway), it shall be clear and fast. So the newly constructed highway shall have high standard in plan and longitude, and giving enough considering for profile design and snow protection construction implementation.

After many year continuous investigation and site observation, compared repeatedly, the route was chosen to pass through wide and smooth areas with little snow movement. The profile of road base was design to use banking as much as possible, few places using excavation, and the side slope grade was controlled with reasonable scope.

Under the condition of fully using local water and soil resources, snow prevention engineering is to give comprehensive treatment measures mainly of biological means, so as to radically prevent snow disaster and change adversities in to advantages.