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THE AFFECTS OF THE NATURAL FACTORS ON ROADWAY CONSTRUCTIONS AND FACILITIES

Mongolia is specific for its geographical location in the depth of the continent the changeable nature, seasonal feature, distinct laws of horizontal and vertical belts. Its climate has a contrasting nature. Its continental climate is severe with much fluctuation. Its cold period is long.

There are a lot of natural belts. Because of the numerous surfaces cuts in the mountainous areas. The streams are rapid. The southern part of the permacost passes through the northern part of the country's territory. The frequency of soil freezing and thawing is high. It has the areas with much tectonic movement and land vibration activity. These are the natural factors that adversely affect the motor road constructions and facilities, and would shorten the road stability and durability. Therefore in building and utilizing the road facilities in Mongolia the above peculiarities must be considered and reflect the protective measures in the technical decisions.

Let's have loot at the major natural factors that adversely affect the roads and their facilities:

1. <u>The Influence of the Climatic and Atmospheric Factors on the Road Facilities:</u>

A. In spring and autumn the strong wind and storms ever more affect any part of the road. The strong wind causes depletion in the embankment surface and the road clothing, and easily breaks and carries it away. That's why it becomes necessary to coordinate the construction of roads and the location of the facilities in view of the major direction of the wind. In the places where strong wind is frequent it is necessary to put up engineering facilities, plant bushes or trees, and try to build a new settlement against the wind direction.

B. The asphalt and hard surfaced road facilities and installations bring in line and field changes. The line changes occur as a result of indirect actions. This line action change can vary in the width of coverage. In particular, the light gas, heavy metal, duct etc spread over various distances due to their weight differences. It has been established by the research that in general, the smoke, heavy metal and dust spread is active over 100-250 markets outside the road depending on the surface formation and wind strength. The direction of their spread from the road varies due to the land features. Depending on the climatic specifics the car smoke and damageable gas hand on in the morning hours after the night with the wind being marginal. But in winter and summer they linger on in the surrounding places. But when there's much wind or in autumn they are carried away by the wind.

C. The longer the snow cover stays along the road the longer the ice remains on the road threatening to cause accidents caused by slippery. On the other hand it frequently happens in the cold season that snow piles up deep against the wind in all parts of the road, or especially along the road sides concave, cavities and snow heaves push on to the road. It brings adverse affects that would add burdens such as the construction of road facilities, spending of more money and disruption of traffic.

   Since the Mongolian climate is too much continental, severe and with contrasting actions it would be a scientific way of reducing the costs if the climatic conditions are effectively taken into consideration in the construction of new facilities, restoration of the old ones, extension of durability and evaluation of labor conditions. We present here a summary of the attempts and their results to take a look at the climatic conditions and realistic situation in road construction and to make climatic classifications.

The adverse affects of the climate on the road quality are determined by the following indices:

- the daily fluctuation of air temperature
- the quarterly fluctuation of air temperature
- the amount and form of precipitation
- the wind regime and strength

The high fluctuation of air heat exerts more adverse affect on the asphalt toads than the local climate. Such contrasting changes as strong heat and bitter cold during one day, sharp temporary freezing and thawing easily damage the road structure and materials. In any case, the road durability is short and needs constant caring in Mongolia's hard climatic conditions.

It's imperative to always keep in mind that Mongolia with continental climate has unstable atmospheric indices and that the short-term climatic phenomena always exert adverse affects on the quality of road building and the normal conditions of roads.

2. The Affects of Surface Water and Water Net Factors on the Roadway Facilities:

The surface water may exert following adverse affects on the road facilities:

2 The rivers, streams, torrents, water-collecting depressions across the roads and their construction can cause damage.

--Plant debris accumulated by the river water pile up in the bridges, pipes and other facilities and installations, and water- weeds grow damaging the given facility.

--The temporary flow of water across the road can damage its facilities and installations.

--The temporary and regular flow of water intensifies the line erosion along the embankment and destabilizes it.

It's observed that highly intensive rain usually pours from mid July through to the end of August. Mongolian experts such as N. Dashdeleg, Ts. Sugar (1971), Kh. Natsagdorj, M.M. Bolgov (1982) and G. Namkhaijantsan (1987) divided Mongolia's territory into 3-4 regions by the rain statistics and discovered that the most volume

($H\tau$) of rain that continued 5,20,60,150,720,1440,2880 minutes (τ) grew as the raining time got longer. It can be expressed as:

$$H\tau = f(\tau)$$

But all the space and duration of rain intensification is expressed by:

$$H\tau = H\tau/\tau = f\tau\ (\tau)$$

The link of the most volume (H) of the entire rain with P% abundance and the duration (τ) will be the following:

$$H\tau + f(P, \tau)$$

The average intensification of the rain that fell anytime will be found by the following:

$$I\psi = H\tau + Hp\ \Psi p\ (\tau)$$

The volume ($H\tau^1$ %) of the most rain with 1% abundance that fell at the station of any of the above-mentioned regions can be found. Besides the average intensification (H 1%) of the rain fallen near that station can be found with the help of ordinates in two formulations below:

$$H\tau\ 1\ \% = Hx\ 1\%\ \Psi\ 1\%\ (\tau)\ mm$$

$$J\ \tau\ 1\% = Hx\ \ \Psi\ 1\%\ (\tau)\ mm/min$$

The most spent amount with 1% abundance will be the following:

$$Q\ 1\% = 16.67\Psi\ (\tau)\ H\ 1\%\ \alpha\ A$$

Q 1% is the most spending of 1% abundance m□/sec

Ψ (τ) are the average ordinate of the rain intensification and the lasting period of the rain fall.

H 1% is the most precipitation mm of a day with 1% abundance.

α is the coefficient of the most spending.

The amount of the biggest flooding with 1% abundance can be calculated using the following shift coefficient:

$$Q25\ \% = \lambda\ p\ /\ Q\ 1\%$$

All the ditches along which water can flow, can be divided into:

1. unchangeable: is covered inside with concrete, stone and wood, and there are blockages, dams and ground heaves for diverting the water or coordinating the flow.

2. The ditch that can be constantly changeable: the natural ditch and road installations.
3. The ditch not undergone hydro-technical activities; temporary ditches or those that can cause flow flooding (E6M6 Lorsen, N.P. Gaya, B.V. Simons, E.B. Richardson, V.A. Vanoni Lee-san Fan, S.P. Garg, A. K. Agrawala, P.R. Singh).

There are a lot of research carried out in the natural conditions by I. L. Rozovsky on the laws of river ditch changes and its process, and there are many works based on the studies in the lab and the nature. But the calculations made by several methods and tests show they do not suit well the conditions of Mongolia that is situated in the Asian plateau and has contrasting climatic conditions.

One of the numerous indications of the stability of rivers, streams, dry ravines and water-collecting depressions is the capability of enduring the rate of the debris flow in the bed. in other words, the index of resistance to remain unmoved. This capability of resistance directly depends on the weight of the debris. In other words, the amount of the debris and its average diameter d (the amount of the debris diameter), the ability of the flow that will carry away the debris or the hydrodynamic pressure on every piece of debris are V* d. Then according to the theory the ability of the flow to carry away the debris (V) depends in any conditions on the slope of the ditch and the hydrodynamic pressure on every piece of the debris is V J.

From among them we can base on the limitless indices of Russian-Kazak scientist V.M. Lokhtin and assess the stability of rivers, streams, ravine and the water-collecting depression. According to V.M. Lokhtin figures, the higher the given index, the more stable and smaller the ditches the more changeable it is. V.M. Lokhtin index is expressed by the following:

$$L \text{ too} = d / dJ = d/J$$

The ratio of width of the river ditch and the average depth of the flow by the measure of water surface is another index of the ditch change and evolution. V.G. Glushkov expresses this as follows:

$$B \text{ markets} / H = KI$$

From among many methods mentioned above the general principle of the changes of Mongolian rivers, streams, ravine and water-collecting depressions is shown on the figures below. It's highly probable that for Mongolia situated on the Central

Asian plateau and which has comparatively many mountain streams such changes will take place intensively.

In the case of water passing installations along the road and those with inside clothing it is necessary to ensure the rate of spreading and flowing of flood water and flows.

$$V = 6.0\ d\ 1/3\ H\ 1/16$$

Here v is the rate of flow m/sec

D – the diameter of the debris piled in the ditch

H – the depth of flow or ravine and depression

4. <u>The Influence of the underground water and the frost factors on the road facilities.</u>

Underground water and frost factors can exert following adverse affects on the road and its facilities:

1. In some places and around the road the level of underground rivers and marsh accumulates on the lower part of the embankment, affecting the soil capacity and quality.
2. When underground water level rises near the surface and the cold season begins it causes soil heave and affects the road embankment and installations.
3. If the road and its facilities are built above the many years' frost bitten soil its heat regime changes and will thaw after many years.
4. Because of the changes in the heat regime of frost rock its mechanic quality will change and its carrying capability will reduce.
5. The long standing frost field mostly has on top mud and muddy soil and water cup above the field. In such cases during freezing-thawing the soil heaping and depression will occur, which in their turn will quite possibly damage the road. It makes it possible to create ice heaves and soil slippery on the slanting slopes. It's necessary to take engineering measures for protecting the road and its installations from them.

4. <u>The Influence of the geological conditions and earthquake factors on the road facilities.</u>

The geological structure, the physique (texture) of base course of the road and its installations of the great important for the road installations. Judging by the general

geological make up and its principles of Mongolia the following adverse effect on the road installations:

1. Since Mongolia belongs to the region of high frequency of earthquake and neotectonic movement there often happens quakes and micro quakes. Mongolia has active earthquake centers that are located in the west, south west and north western parts of the country. By the intensity of earthquake and by the fact that 2/3 of the country are the earthquake active divide Mongolia into 6 regions. During the earthquake the road embankment, clothing and installations are vulnerable to destruction.
2. If the deep and wide spread cracks in the geological bodies spread over the region and on the local areas are in the active tectonic conditions it affects to a certain degree the lines and facilities passing through it. For instance, if the cracks become wider then the lines and installations on them may be cut.
3. The stability of the line installations can change depending on the geological structure of base course, the feature of its capacity, the quality of causing heaves and hollows.
4. The geological process in the given area, in particular the mass shifting on the slanting surface, the stone collapse, cold crack, solifluction processes exert damaging effects on the road and its installations.

5. <u>The Ways of Reducing the Effects of Natural Factors</u>

As to the climate and atmosphere

1. It's very important to create a forest belt in order to reduce some adverse effects on the road building. This will play a role not only in protecting the area around towns and settlements along the road from noise and chemical contamination, but also in sheltering the road and vehicles from powerful air flow, especially from storm effects and snowdrifts. The reliable way of protecting the area along the road from noise contamination is the planting of trees on both sides of the road, especially against the wind. In doing so the distance of the trees from the road, thickness and the course of planting trees must be precisely established taking into consideration of the given area, the wind direction and speed. In other words, it should be arranged so that snow, sand and dust accumulated on the bottom of the trees and the road is cleaned

by the wind. It's appropriate to build the forest belt in the thick or average thick soil in the hollow or valley between the mountains or in the river valley. It's ecologically and technically hard to create a forest belt on the rocky mountain tops or elevated places.

2. There is a need to put up on high hills, knolls and the stony slope of the mountain special enclosures and dikes to protect the asphalt road from snow covers in winter and from spring and autumn winds.
3. The durability of road materials in the high temperature fluctuation on land and road surfaces of Mongolia should be calculated.

In Mongolia, it's -50°C in winter on the land surface and it reaches +50 in summer with 100° fluctuation. And 10-20° fluctuation is observed in 24 hours. It is important to calculate the road material deformation , the durability and strength in coldness in the above mentioned sharp temperature fluctuation.

As to the surface water:

1. It is imperative to calculate the flows that can form in dry ravines, water-collecting depressions, rivers and streams in choosing the building of the protective facilities, and deciding on the form, size, capacity and the ability to pass the water through. Besides protection from water flow these facilities would create a condition for free passage of these flows.
2. Besides the most abundant flows in the ditches across the road the ditch stabilization should be evaluated, and if need be take additional measures to stabilize the ditch, plan and build more installations. If the preliminary calculations of water passing installations are done not completely, after certain period of time water stops flowing and it can divert to another place changing the direction, thus damaging that part oaf the road. That's why the evaluation of ditch stability, determination of the need in additional installations become an important step towards avoiding additional economic spending and the damage of the nature and environment in the cases other than normal.

As to the deep water and frost conditions:

The following measures have to be taken to reduce the effects of the frosty and rocky road and to protect the road from the frost phenomena:

1. To build the road and road installations with the calculations of keeping many years frost in the places where frost is widespread, with much ice and moisture, also considering that when frost base course thaws there will be more depression than the road's possible deformation, or else, you can thaw the place in advance and condense whereby the depression which occurs again would be less than the road's possible deformation.
2. To build the road and installations with the calculation that many years frost will thaw during or after the construction in the place where the depression after the thawing of frozen base ground with small amount of many years frost spread ice and moisture is less than the possible road deformation. Here the method of building the road and road installations should be adopted.
3. In the place where in the freezing-thawing process of the seasonal heaves and depression take place that are possible to damage the road and road installations the embankment should be high so that its bottom wouldn't be touched by the freezing-thawing.
4. To lay bid pieces of stones in the lower part of the road to protect it from the elevation of soil water.
5. To build installations to avert the effects of ice heaves, slippery, soil creep and other frost phenomena on the road and its installations.
6. To put water passing pipes in the places with many years' frost and much moisture where high mound or depression can occur.

As to the geological conditions:

1. As to the preventive measures against earthquakes:

In planning the construction of road engineering installations and buildings in the area of active earthquake it is imperative to reflect and implement all the measures contained in Mongolian standard CniP-II-7-81 M87.

2. As to the protection of the road from various geological processes:

In protecting the road facilities from geological phenomena, particularly from the erosion of banks by water, the solifluction of creating massive shifting, the geological process of the land extending 200 markets around the road should be reflected in the map and it's important to plan the installations for protecting from those phenomena or permanently the process intensification, and is need be make ready a project of measures to take.

Finally as a conclusion, we attach very much importance to meeting the international standard in building and utilizing the roads and their facilities of the national or local significance, and also take into consideration the natural conditions and factors of Mongolia, planning at the same time the measures to reduce their effects. That would be conducive to extending the road exploitation, reducing the spending on repair and maintenance and ensuring the traffic security.