EGU2020-6695, updated on 08 May 2021
https://doi.org/10.5194/egusphere-egu2020-6695
EGU General Assembly 2020

Bearing capacity of frozen soils for foundations of objects in the North of Western Siberia

Fedor Iurov and Valery Grebenets
Lomonosov Moscow State University, Cryolithology and Glaciology, Russian Federation (fdiurov@gmail.com)

Keywords: permafrost, forecast, bearing capacity, foundation

The North of Western Siberia is a very promising region for industrial development. It is rich in oil and gas deposits, large settlements are located here and there is an extensive system of transport infrastructure (gas and oil pipelines, roads and railways). The territory has very differentiated permafrost-geological conditions in various types of landscapes. The development of new production sites, the construction and operation of infrastructure objects often activates dangerous cryogenic processes.

Trends in increasing air temperatures result in increase in the active layer depth, which leads to the decrease in the freezing area of frozen foundations, as well as in increase of the soil temperature, which reduces the forces of freezing. The problem is enhanced by the anthropogenic impact, which intensifies the negative changes in permafrost.

Quantitative estimation of changes in the bearing capacity of frozen pile foundations in the North of Western Siberia was carried out up to 2050 for various types of soils (sand, clay soils, peat) with trends in increasing temperatures of frozen soils and trends in increasing thickness of the active layer taken into account. Detailed calculations were carried out for the route of the “Vankor-Purpe” oil pipeline.

The calculations showed that maintaining current rate of climate warming, by 2050, there will be significant deterioration of the engineering-geocryological situation. The largest negative changes will take place in the southern part of the permafrost zone of Western Siberia (in the Tazovsky, Novourengoysky and Nadymsky districts), where the decrease in bearing capacity will exceed 50%. In the more northern regions (on the territory of Yamal), the predicted changes in the bearing capacity of frozen pile foundations by 2050 will not be so critical (no more than 20%). However, an increase in the thickness of the active layer can cause activation of the thermokarst process due to closeness of the thick stratal ice to the surface, as well as other destructive cryogenic processes.

In the region of investigation, under the influence of rising soil temperatures and an increase in the depth of seasonal thawing, the most vulnerable to climatic changes are loamy soils, which, according to the calculations, are characterized by the maximum decrease in the bearing capacity of frozen piles (up to 10% over 10 years). Sandy soils are more stable, a decrease in bearing

capacity occurs in such areas at a lower speed (up to 5–7% over 10 years). Areas with moss-peat layer at the surface are less susceptible to changes in bearing capacity, however, with industrial methods of foundation construction, the layer is destroyed in places where the piles are built.

This work was supported by the RFBR grant 18-05-60080 “Dangerous nival-glacial and cryogenic processes and their impact on infrastructure in the Arctic”.