

Conquering the permafrost: urban infrastructure development in Norilsk, Russia

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The city of Norilsk was established in 1935 as a GULAG mining and metallurgy work camp to explore the rich deposits of non-ferrous metals. By the 1989, the population of Norilsk reached 179,757 people. Two additional cities were developed in proximity to Norilsk in the 1960s-1980s: Talnakh (1989 population 65,710); and Kaerkan (1989 population 29,824) making the Norilsk region a major Arctic metropolis. While such rapid growth is not unusual for developing industrial cities, the geographic location makes Norilsk rather unique among world urban centers. It was built in Central Siberia at 69°51' N latitude (above the Arctic Circle), in region characterized by harsh subarctic climate (mean annual temperature around -10 °C), over forest tundra/tundra transitional landscapes underlined by perennally frozen ground (permafrost). Throughout its existence, the Norilsk region was highly isolated: it is not connected to Russian road and railroad systems.

The harsh environmental conditions provided significant and rather unique challenges to Norilsk development. Specifically, the presence of ice-rich permafrost imposed restrictions on application of standard urban planning and engineering practices. This presentation analyzes the history of permafrost construction in Norilsk. It shows how though initial trial and errors, a set of guiding principles and engineering methods of construction on permafrost were developed allowing a rapid urbanization of the area during the 1960-1980s. However, despite significant advances in permafrost engineering, the pronounced permafrost degradation has become evident in Norilsk by the mid 1980s and has accelerated rapidly since the mid 1990s resulting in widespread deformation of buildings. Climatic changes are frequently identified as a major cause of accelerated deterioration of infrastructure build on permafrost. However, we argue that other factors, including the complexity of interactions between deferent components of urban infrastructure and permafrost, quality of construction, operation, and maintenance of infrastructure as well as socio-economic transformations are also responsible for emergence and intensification of the negative permafrost-related geotechnical processes manifested by the structural deformations of buildings in Norilsk.

Keywords: Permafrost, Russian, Urban Development, Arctic, Infrastructure