

REVIEW

REVIEW OF A NEW BOOK BY L.N. KHRUSTALEV
“CALCULATION OF ENGINEERING CONSTRUCTIONS ON PERMAFROST”

A.Yu. Gunar

*Lomonosov Moscow State University, Faculty of Geology, Leninskie Gory 1, Moscow, 119911 Russia***Corresponding author; e-mail: gunar_91@mail.ru*

A recently published book by L.N. Khrustalev, a leading specialist in engineering geocryology, professor of the Department of Geocryology, Faculty of Geology, Lomonosov Moscow State University is devoted to methods for solving a wide range of problems of engineering geocryology: thermal and mechanical interaction of engineering constructions with bearing rocks, land reclamation measures, methods for assessing the reliability of design solutions for construction in the permafrost zone, as well as methods of predictive calculations for monitoring of objects built on permafrost. This monograph contains a wide range of recommendatory and standard calculations, as well as some previously unpublished author's works. In essence, it is a desk reference for specialists involved in the design and calculations of engineering constructions on permafrost. Another highlight of the book is its electronic component: all the calculations proposed in the book are implemented in Microsoft Excel macros and are available for download and processing. This practically eliminates the possibility of errors (the user only needs to enter the correct input data).

Keywords: *permafrost engineering, book, thermo-technical calculation, reliability.*

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In 2021, a fundamental book by Prof. L.N. Khrustalev – *Calculation of Engineering Constructions on Permafrost: A Training Manual* – was published. This book is a training manual for study courses *Basics of Geotechnics on Permafrost* and *Reclamation of Frozen and Thawed Ground in Permafrost Area* for the Master of Science program (first study year). However, it can be used not only as a training manual for students of the high school (geology, civil engineering, and transport programs) but also as a reference book for scientists, designers, civil engineers, and surveyors dealing with the problems of economic development in permafrost areas.

Lev Nikolaevich Khrustalev is a prominent permafrost researcher, who has been working on geotechnical problems in permafrost areas for more than 60 years. He worked at the Northern Branch of the Institute of Foundations and Underground Constructions of the State Committee for Construction in the Soviet Union (Gosstroy) in Vorkuta for twenty-six years, and at the Geocryology Department of Lomonosov Moscow State University for thirty-seven years. He is a doctor of technical sciences, professor, Honored Inventor of the Komi ASSR, Honored Scientist of the Russian Federation, Honored Professor of MSU. He is the author of over 180 scientific and methodological publications, including 23 books and 33 patents for inventions. A number of these inventions have been implemented into practice with great economic effect.

The recently published book accumulates computational analytical methods applied in the design of engineering constructions on permafrost and available from regulatory and technical literature. The training manual consists of five chapters:

1. Problems of thermal interaction between engineering constructions and frozen ground.
2. Problems of mechanical interaction between engineering constructions and frozen ground.
3. Related problems of thermal and mechanical interaction between engineering constructions and frozen ground.
4. Safety of engineering constructions on permafrost.
5. Problems of engineering construction monitoring on permafrost.

The first chapter describes the methods for the assessment of the dynamics of the thermal state of permafrost under the impact of engineering constructions (freeze-thaw cycles, active layer depth) depending on the adopted technical solutions. The second chapter considers procedures for calculating the bearing capacity of foundation, its subsidence, estimates of heaving power, as well as calculations of linear objects. Further, methods of thermo-technical calculations for civil engineering facilities at sites with deepened permafrost table (artificial thawing, stabilization of the upper permafrost, and calculation of the working layer for railways and highways) are considered. The fourth chapter should be specially high-

lighted: it contains personal developments of L.N. Khrustalev on the approaches for analytical safety estimations of building foundations and linear constructions. These developments focus on the choice of design solutions allowing to reduce the risks of failures of geotechnical systems by determining the optimal parameters of foundations and geotechnical systems. That is the one of most important design objectives. The fifth chapter presents calculation methods allowing to perform predictive calculations of the ground temperature field based on monitoring observations, i.e., temperature measurements in a borehole located at some distance from a building or pipeline.

The book aims at accelerating the process of thermotechnical calculations; several normative calculation methods have been revised: for each particular method, the steps of calculation are given sequentially and in detail, without references to equations given in other chapters. The equations that have no analytical solutions are replaced by tables or approximated by linear functions. This approach significantly simplifies the calculations for the user. It should be noted that the search of the source literature is simple: reference sources are given within each chapter, where the equation is described in detail. When the equation is published for the first time, the description is given in the book. The derivations of the equations can also be found in the textbook by L.N. Khrustalev [2019]. The presented training manual is an excerpt from this book with several additions that were developed during the last two years after the textbook publication.

Calculation methods presented in the book were implemented by L.N. Khrustalev in the form of 44 MS Excel macros. They are stored in the cloud and can be requested using the link given in the book appendix. Macros work in the Excel environment, which makes them understandable and available for readers even without special training. The work with these programs is easy: user must only fill out the input column highlighted with yellow color and click the "Start" button located in the upper part of the sheet. Calculation results will appear in the gray column of this sheet. Herewith, the calculations are accelerated by several orders and are not subject to errors.



The new books by L.N. Khrustalev can be recommended for readers interested in engineering permafrost issues and specialists dealing with the economic development of areas underlain by permafrost. They can be ordered from publishers by phone:

+7 (495) 280-15-96 (add. 246) – "Infra-M" Publishing House

8-800-333-68-45 – "Direct-Media" Publishing House

References

Khrustalev L.N., 2019. *Fundamentals of Geotechnics on Permafrost*. Moscow, INFRA-M, 543 p. (in Russian).

Khrustalev L.N., 2021. *Calculation of Engineering Constructions on Permafrost: A Training Manual*. Moscow; Berlin, Direct-Media, 124 p. (in Russian).

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