



## NATIONAL STANDARD OF CANADA

CAN/BNQ 2501-500/2017

Geotechnical Site Investigations for Building  
Foundations in Permafrost Zones







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Foundations in Permafrost Zones

*Études géotechniques pour les fondations de bâtiments  
construites dans les zones de pergélisol*

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**GEOTECHNICAL SITE INVESTIGATIONS FOR  
BUILDING FOUNDATIONS IN PERMAFROST ZONES**



**Conseil canadien des normes**  
**Standards Council of Canada**

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\* At the time of publication of this standard, the aforementioned person no longer worked for this organization.

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## GEOTECHNICAL SITE INVESTIGATIONS FOR BUILDING FOUNDATIONS IN PERMAFROST ZONES

### INTRODUCTION

Geotechnical site investigations are essential for the appropriate design, construction and maintenance of buildings. In permafrost zones, these investigations have an added level of complexity due to the following factors:

- a) potential presence of ice within the soil or bedrock whose properties are dependent on several parameters, including, but not limited to temperature and salinity;
- b) influence of climate change, which is modifying the ground thermal regime thereby changing the properties of the permafrost;
- c) presence of saline soils.

This standard was developed to establish a consistent methodology for geotechnical site investigations, including the collection of data, and evaluation and reporting of site conditions while accounting for seasonal, and interannual climate conditions as well as the projected climate conditions over the service life of the building foundations. In the long term, it is expected that the application of this standard will help lessen persistent maintenance issues, which, as a result of climate change or improper site evaluation, can cause permanent damage to structures.

The level of detail of a geotechnical site investigation to obtain adequate site information to select and design foundations for a building in permafrost zones depends on many factors. This also applies for rehabilitation plans of existing building foundations located in permafrost zones.

This standard was developed with the view that the geotechnical site investigation should provide the information that will allow for the design and maintenance of a building within a reasonable timeframe and cost while taking into account the specific constraints of the North and the diverse nature of building projects.



This standard also ensures that each project is carried out within a risk management framework. Each project is assigned a risk level based on the sensitivity of the permafrost to climate change and the consequence of failure of the building foundations. For moderate/high-risk projects, the level of detail of geotechnical site investigations will be much higher than for low/negligible-risk projects. This standard therefore allows for some flexibility throughout the process of carrying out geotechnical site investigations, as the findings will influence the extent of work to be undertaken.

More specifically, this standard defines a consistent methodology for performing a geotechnical site investigation, but since the level of detail required to obtain adequate site information depends on many factors, it relies on the geotechnical consultant's judgement to make the proper recommendations to the client. It also requires that the geotechnical consultant and the client take the appropriate steps to have a common understanding of all work to be undertaken throughout the project. This two-way communication will ensure that the client is in a position to take risk-informed decisions in consultation with the geotechnical consultant.

This standard is the fifth in a suite of innovative National Standards of Canada (NSCs), aiming to foster the long-term sustainability and resiliency of Canada's Northern infrastructure. The four other National Standards of Canada that were developed as part of the Northern Infrastructure Standardization Initiative (NISI) include:

CAN/CSA-S500 [11]*	<i>Thermosyphon foundations for buildings in permafrost regions.</i>
CAN/CSA-S501 [12]	<i>Moderating the effects of permafrost degradation on existing building foundations.</i>
CAN/CSA-S502 [13]	<i>Managing changing snow load risks for buildings in Canada's North.</i>
CAN/CSA-S503 [14]	<i>Community drainage system planning, design, and maintenance in northern communities.</i>

All of these NSCs are complementary and contribute towards achieving the same objective of helping Canada's North build a resilient infrastructure despite the uncertainties of a changing climate.

This is also true of the document CSA PLUS 4011 *Technical Guide: Infrastructure in permafrost: A guideline for climate change adaptation*. It is a key document that was published in 2010 for a better understanding of how climate change may affect Canada's Northern infrastructure.

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\* The reference numbers in square brackets indicate documents whose full references are provided in Annex F.





## 1 PURPOSE

This standard specifies the minimum requirements applicable to the planning, conducting and reporting of geotechnical site investigations for building foundations in permafrost zones.

The purpose of this standard is to define a consistent methodology for performing geotechnical site investigations so that the results can be used to design building foundations with due consideration, in a risk management framework, of the conditions prevailing at the building site, including:

- the distinctive characteristics of permafrost;
- the seasonal and interannual climate conditions as well as the projected climate conditions over the service life of the building foundations;
- the other conditions that may have an impact on the design of the building foundations.

## 2 SCOPE

This standard applies to geotechnical site investigations performed in permafrost zones to provide essential information for the design of:

- foundations for all types of buildings;
- rehabilitation plans for existing building foundations.

It also applies to the measuring of site-specific conditions in the process of performing geotechnical site investigations. It does not apply to post-construction monitoring of the building site conditions, which is covered in the document CAN/CSA-S501 [12].

NOTE — The principles laid out in this standard are specific to geotechnical site investigations performed to support the design of building foundations. They may apply to other types of infrastructure located in permafrost zones. It is the user's responsibility to judge the suitability of this document in these cases.

This standard is primarily aimed at geotechnical consultants. It is also intended to be used by the owners of buildings, designers of buildings, contractors and regulators.