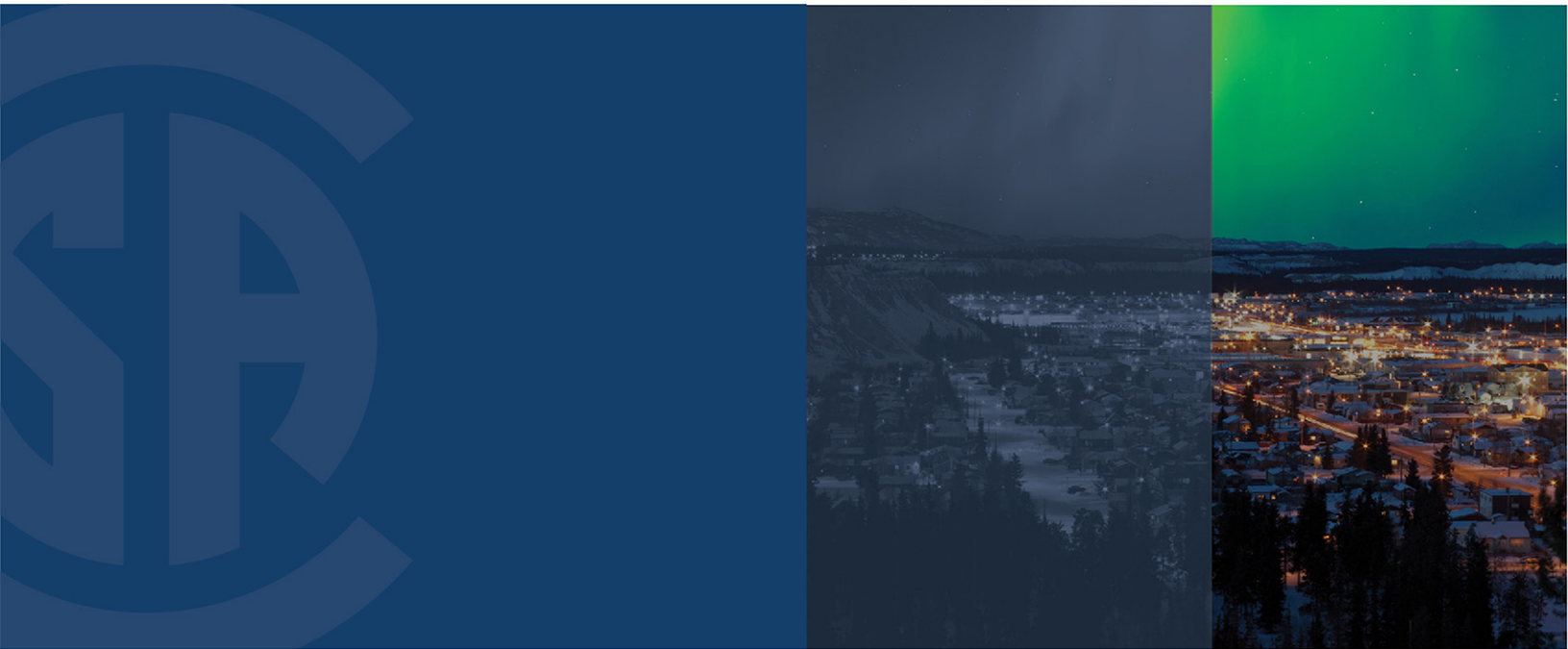


# **Technical Guide: Design and construction considerations for foundations in permafrost regions**



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# Preface

This is the first edition of CSA PLUS 4011.1, *Technical Guide: Design and construction considerations for foundations in permafrost regions*.

CSA Group received funding for the development of this Guideline from the Standards Council of Canada, as part of the Northern Infrastructure Standardization Initiative (NISI) with input from the Northern Advisory Committee (NAC).

This Guideline was prepared by the Subcommittee on Foundations in Permafrost Technical Guide, under the jurisdiction of the Technical Committee on Northern Built Infrastructure and the Strategic Steering Committee on Construction and Civil Infrastructure, and has been formally approved by the Technical Committee.

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  - b) *relevant clause, table, and/or figure number;*
  - c) *wording of the proposed change; and*
  - d) *rationale for the change.*

# CSA PLUS 4011.1:19

## **Technical Guide: Design and construction considerations for foundations in permafrost regions**

### **1 Introduction**

#### **1.1 Background**

In 2010, CSA Group published CSA PLUS 4011, *Technical Guide: Infrastructure in permafrost: A guideline for climate change adaptation*. The intent of that document was to provide stakeholders with information on the potential impacts of climate change on infrastructure in Canada's permafrost regions. It is recognized that climate change might impact permafrost terrain more dramatically than terrain in temperate regions. Those involved in the development, design, procurement, construction, and operations of infrastructure in permafrost terrain would benefit from current knowledge on the potential impacts of a changing climate on those activities.

In 2019, CSA Group published an update to the 2010 edition of CSA PLUS 4011. In making revisions and updates to the 2019 document, it was recognized that stakeholders could gain additional benefit if a supplemental document was developed that provided current information on the issues related to the design and construction of foundations in permafrost regions. It is the foundation of buildings that will be most dramatically impacted by rapid and high-magnitude warming of air temperatures.

#### **1.2 Purpose**

While both the 2010 and 2019 versions of CSA PLUS 4011 provide discussions on foundations in permafrost, this Guideline is intended to provide more detailed technical information on the attributes of the various foundation systems, selection criteria, ground conditions, and related issues.

This Guideline is a companion document to CSA PLUS 4011. The CSA Subcommittee made a deliberate decision not to include equations, formulas, and design guidelines in this document. It is not a design manual — it is informative. This Guideline is intended to assist developers, designers, the general public, and other stakeholders understand the permafrost terrain of Canada, as well as the general selection process and choices for permafrost foundations and their limitations.

#### **1.3 Document structure**

This Guideline is laid out as follows.

Clause [2](#) introduces and describes the permafrost of Canada. For this Guideline, permafrost is limited to “northern” permafrost. Topics covered include the distribution of permafrost in Canada, ground temperatures, ice content, salinity, terrain sensitivity, surface hydrology, and the effects of a changing climate on the performance of building foundation.

Clause [3](#) describes some important considerations for foundation design in permafrost terrain. Topics include ground temperature and its effect on soil strength, creep, effects of pore water salinity, effects of surface disturbance on the thermal regime of the ground, the need for geotechnical investigations,