Standards Council of Canada
Conseil canadien des normes

NORTHERN INFRASTRUCTURE STANDARDIZATION INITIATIVE

Northern Infrastructure Standardization Initiative (NISI) fosters the development of technical standards for sustainable, adaptive infrastructure design, construction and maintenance to address impacts from a changing climate (e.g. severe and erratic weather-related events, degrading permafrost), resulting in more resilient northern infrastructure.

The Standards Council of Canada, with support from Aboriginal Affairs and Northern Development Canada and with funding provided by the Government of Canada, is working with those on the front lines of Northern adaptation to ensure a protected, sustainable future for generations to come.

NISI STANDARDS	Thermosyphon foundations for buildings in permafrost regions	Moderating the Effects of Permafrost Degradation on Existing Building Foundations	Managing Changing Snow Load Risks for Buildings in Canada's North	Community drainage system planning, design, and maintenance in northern communities
OVERVIEW	Thermosyphons are essentially a heat-transfer device, which draw heat out of the ground. The warmth of the ground causes the liquid contained in the thermosyphon tubes to evaporate into gas which then rises to the top of the tube, where the heat it carries is dissipated into the air; this cycle is continuous and automatic.. Thermosyphon foundations help to preserve permafrost underneath critical infrastructure.	Permafrost is ground (soil or rock) that remains at or below a temperature of 0°C for two or more consecutive years. The layer of material above the permafrost that thaws and refreezes annually is called the active layer. Permafrost degradation may cause the foundation of a building to become unstable.	Snow overloading occurs when the weight of the snow on the roof of a building approaches or exceeds its original design capacity to withstand heavy snow conditions.	Community drainage planning in the North is unique due to long periods of extremely low temperatures; exceptionally large and remote drainage basins; permafrost; small, isolated communities with low population density; and consideration for the social and cultural context of land use.
RATIONALE FOR STANDARD	• Increased use of thermosyphons. • Recent performance failures • No publically available guidance, set of best practices, or commonly accepted set of key principles for how to design, install, commission, or monitor thermosyphons foundation. • Need to understand how to integrate climate change information into the design of thermosyphon supported foundations.	• Increased impacts of permafrost degradation. • Climate change will further contribute to the degradation of permafrost, amplifying the destabilizing impact on building foundations. • Potential major losses of capital investments and critical services. • Improper operations and maintenance practices can accelerate permafrost degradation.	• Increased snowfall, and changing snow-water equivalent and more winter rain events are resulting in heavier snow impacting snow load weight. • Increased risks to the health and safety of occupants from building roof failures. • More attention is required to ensure that snow loads are adequately incorporated into the design and maintenance of buildings. • Consideration of changing climate impacts for the lifespan of structures.	• Accelerated degradation of northern community infrastructure due to ad-hoc development of community drainage planning; increased maintenance and replacement costs. • Need to develop and implement drainage plans that account for both site-level and community-wide snowmelt / ice melt / rainfall-induced runoff conditions. • Runoff events can contribute to the loss of roads / bridges, and the degradation of permafrost. • No generally accepted guidance for development and maintenance of northern community-wide drainage plans.
SOLUTIONS	Standardization will help ensure that thermosyphon foundations are sited, designed, installed, and monitored correctly, ensuring the long-term performance of thermosyphon-supported foundation systems under changing environmental conditions.	Engineering-based interventions can play important roles in moderating and remediating the impacts of permafrost degradation on building foundations; ensuring the building maintains its function and usefulness in communities.	Communities need a standardized protocol to establish ongoing practices to reduce snow overloading risks over the lifespan of the building, which include pre-season roof snow removal planning and building maintenance to reduce risks of collapse and extend the life of the roof.	As precipitation levels in various regions of the North continue to change, a new, comprehensive standard is expected to contribute to a needs-based toolkit for designing, building, and maintaining drainage systems, thereby helping to reduce the vulnerability of community infrastructure.
KEY ELEMENTS	• Performance, monitoring, and maintenance expectations. • Materials specifications. • Information regarding the technology throughout its life cycle. • Guidance to maximize the long-term viability under changing environmental conditions.	• Measures to maintain permafrost beneath and adjacent to existing buildings or structures. • Assessment protocol. • Mitigation techniques. • Guidance on long-term performance of foundation rehabilitation.	• Snow overload planning and maintenance procedures. • Detection, monitoring, and assessment of snow overloading risk for buildings. • Guidance on snow removal from roofs safety.	• Techniques to plan for and implement community drainage systems. • Practices for site and community planning to conserve community infrastructure. • Provide implementable, low cost respecting local constraints on capacity and resources.
END USERS	• Owner and operators (building and land) • Contractors • Design professionals, planners and reviewers • Engineers • Educators • Regulators • Inspectors • Community maintainers • Community administrators			

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