NAALAKKERSUISUT
GOVERNMENT OF GREENLAND

Ineqarnermut, Attaveqaasersuutinut Isorliunerusunullu Naalakkersuisoqarfik
Ministry of Housing, Infrastructure and Outlying Districts

EN 1997-1 GL NA:2025

National Annex to

Eurocode 7: Geotechnics – Part 1: General rules

Foreword

This Greenlandic National Annex (GL NA) replaces EN 1997-1 GL NA:2024.

This Annex is based on DS/EN 1997-1 DK NA:2021.

Scope

This Annex is adapted to national, geographical and climatic conditions as well as national legislation and specifies how EN 1997-1:2007 including amendments are to be applied in Greenland.

The Annex provides Greenlandic national choices and complementary information. For any complementary information, it is specified whether it is normative or informative. Normative information comprises requirements to be followed.

The numbering in the Annex refers to the numbering in EN 1997-1:2007 or DS/EN 1997-1 DK NA:2021.

Overview of Greenlandic national choices and complementary information

DS/EN 1997-1 DK NA:2021 is applicable with the following national choices and complementary information:

Clause	Subject	Change
DK NA	References in DK NA	National choice
2.4.3 (7)P	Climate change considerations	Complementary information
2.4.3 (8)P	Climate change assessment	Complementary information
2.4.3 (9)	Salinity of pore water	Complementary information
5.3.2 (6)	Selection of filling material	Complementary information
Annex D	D.1 General Spread foundations	Complementary information
Annex G	G2 Rock anchors Simplified rules for anchoring small houses in rock	Complementary information
Annex L	L1 Geostatic analysis Pile foundations	Complementary information
	Bibliography	Complementary information

National choices

References in DK NA
References in DS/EN 1997-1 DK NA:2021 to other Danish National Annexes are replaced by references to corresponding Greenlandic National Annexes. Where these do not exist, the Danish National Annexes apply.

Complementary information
Normative

2.4.3(7)P Climate change considerations
(7)P When determining the properties of the soil, climate change shall be taken into account over the entire service life of the geotechnical structure.

2.4.3(8)P Climate change assessment
The significance of climate change shall be assessed for the specific location, the specific soil conditions, and the specific geotechnical structure.

NOTE – Climate change can, among other things, cause changes in the depth to any permafrost table, changes in the thickness of an active layer, and changes in the bearing capacity of the soil. Climate change can also cause altered groundwater conditions or changes in hydrological flows in the ground.

2.4.3(9) Salinity of pore water
When assessing soil characteristics, the salinity of the pore water shall be taken into account.

5.3.2(6) Selection of filling material
Backfill around geotechnical structures covered by Sections 6-12 shall consist of a coarse-grained, non-frost-susceptible material.

Complementary information
Informative

Amendment to Annex D – Spread foundations

D1 General

(4)
Deleted.

(6)P Spread foundations on loose soil that is not coarse-grained, where there is no permafrost, or where there is a risk of saturation of the soil, are to be placed at frost-proof depth.

(7) The frost-proof depth is assessed for the particular location. Table D.1-1 GL NA provides indicative values for frost-proof depth for spread foundations at a number of locations where permafrost does not affect the foundation conditions.

Table D.1-1 GL NA Indicative values for frost-proof depth

Location	Frost-proof depth [m]
Nanortalik	1,6
Ivigtut, Qaqortoq	1,7
Narsaq	1,8
Nuuk, Paamiut, Tasiilaq	2,0
Maniitsoq, Kuummiut	2,1

NOTE 1 – Loose soil may be considered coarse-grained when at least 95 % (by weight) has a grain size greater than 2 mm.

NOTE 2 – Frost-proof depth corresponds to the underside of the active layer, which thaws in summer and freezes in winter.

NOTE 3 – The values in this table can be used for buildings with open or ventilated unheated crawl spaces. For buildings with floor slabs to heated rooms, or unventilated and partially heated crawl spaces, the values may be reduced by 0,2 m.

NOTE 4 – North of 66° N latitude, frost-free periods during summer cannot be assumed; see also Clause (9), NOTE 1.

(8) Frost-proof foundation depth in accordance with Clause (7) may be reduced by technical measures that raise the soil temperature.

NOTE – Technical measures that raise the ground temperature may, for example, include horizontal insulation in the terrain or heating of the ground by active or passive means.

(9) Buildings shall not be founded directly on permanently ice-rich deposits or on loose soil that, during winter, contains more ice than the pore volume of the corresponding thawed and drained material, with the following exceptions:

– Buildings in the low consequence class (CC1) without occupancy for persons may be founded directly on such loose soil layers, provided it is ensured that temperature changes in the ground do not result in unacceptable differential settlements or heave.

– Buildings in the medium consequence class (CC2) intended for dwellings without horizontal apartment separations may be founded directly on such loose soil layers, provided that solutions are implemented:
  - that ensure stability throughout the service life of the building;
  - that can counteract differential settlements or heave.

NOTE 1 – Permanently ice-rich deposits may consist of permafrozen loose soil, ice, or mixtures thereof. North of 66° N latitude, permafrost shall be assumed to extend all the way to the coast. South of 66° N latitude, permafrost may occur all the way to the coast in local areas where the annual average air temperature is 0 °C or lower; for example, in ravines, on the north-facing sides of rock, or at the bottom of fjords.

NOTE 2 – In accordance with EN 1990 GL NA, buildings in the low consequence class include, e.g. carports, sheds and small buildings for industrial use or storage.

NOTE 3 – Changes in soil temperature may, for example, be caused by the building's influence on the temperature conditions, by local conditions such as snow cover and meltwater, or by local consequences of global climate change; see 2.4.3(7) and (8).

NOTE 4 – Unacceptable differential settlements and heave may, for example, be counteracted by adjustable pad foundations, by horizontal insulation in the ground to reduce thaw depth, or by active or passive cooling of the soil.

(10) For spread foundations on permanently ice-rich deposits or loose soil that, during winter, contains more ice than the pore volume of the corresponding thawed and drained material, stability may be ensured by replacement with coarse-grained, non-frost-susceptible material.

(11) Backfill along spread foundations on loose soil or rock shall consist of a coarse-grained, non-frost-susceptible material with a width of at least 0,3 m along the foundation over the full height of the foundation, both on the inside and on the outside of the foundation. The backfill shall be drained at the bottom.

(12) Spread foundations through loose soil onto rock shall be anchored in the rock to resist an upward frictional force resulting from seasonal temperature changes in the ground.

Amendment to Annex G

G2 Simplified rules for anchoring small houses in rock

(1)P As an alternative to the rules in EN 1997-1, anchoring in rock of buildings in the low consequence class (CC1), as well as buildings in the medium consequence class (CC2) with a maximum of 2 storeys used as single-family houses, terraced houses or holiday homes, may be considered sufficiently safe when conforming to the simplified rules of this amendment.

(2) The rock shall be uniform, consistent with the characteristics of the rock type, and shall not be fractured or cracked within a distance corresponding to the depth of the rock anchor from the location of the rock anchor.

NOTE – See DS/EN ISO 14689:2018 for identification and classification of rock.

(3) Anchoring into rock of buildings with reinforced concrete strip foundations may be considered safe when the strip foundation

- either (a) has a height throughout of at least 500 mm, measured from the rock to the top of the foundation, with deviations of no more than 10 % per metre, and has a minimum width of 300 mm;
- or (b) is restrained with vertical fully grouted anchors at maximum spacings of 1,5 m to a depth below the rock surface of at least 0,8 m.

(4) For foundation types other than those specified in (3), the geotechnical tensile resistance of rock anchors may be taken as the minimum of the bond resistance between the anchor and the grout, or between the grout and the rock, but not greater than the effective weight of the rock mass contained within a cone with an apex angle of 90°, with the apex at the centre of the anchorage zone and the central axis coinciding with the anchor.

NOTE 1 – Partial factors for determining the design load and stabilising weight are given in DS/EN 1997-1 DK NA:2021, Table A.3-2 DK NA, Combination of actions 1.

NOTE 2 – The tensile resistance of steel tensile elements is documented in accordance with EN 1993-5 and the associated DS/EN 1993-5 DK NA 2017.

NOTE 3 – Fully grouted rock anchors may be regarded as rock bolts capable of resisting all internal forces and shall be designed for combinations thereof in accordance with EN 1993-1.

NOTE 4 – The bond resistance between the anchor and the grouting material, or between the grouting material and the rock, can be documented in accordance with the marking or a statement provided by the supplier of the grouting material.

(5) For a group of anchors or for closely spaced anchors, the total tensile resistance shall be determined with consideration of group effects in the case of any overlapping rock volumes as defined in (3b) or (4).

Amendment to Annex L – Pile foundation

L1 Geostatic analysis

(12)P Piles in permanently ice-rich deposits or in loose soil that, during winter, contains more ice than the pore volume of the corresponding thawed and drained material shall, throughout the service life of the building, have sufficient geotechnical bearing capacity and be protected against unacceptable settlements and heave.

NOTE – Climate change as mentioned in 2.4.3 (7) - (9) shall be taken into account

(13) Piles shall be protected against unacceptable settlements in accordance with (12) caused by heating of the ground, and against unacceptable heave in accordance with (12) caused by ground freezing.

NOTE – Unacceptable seasonal or permanent settlements and heaving of piles in permanently ice-rich deposits or in loose soil that, during winter, contains more ice than the pore volume of the corresponding thawed and drained material may be counteracted e.g. by:

- sufficient anchorage length in permanently frozen ground
- active or passive cooling of the ground, or
- rock anchorage.

Unacceptable permanent settlements and heave may, for example, be mitigated by adjustable installation of the building structure on pile foundations.

(14) Around piles for foundations in permanently ice-rich deposits or in loose soil that, during winter, contains more ice than the pore volume of the corresponding thawed and drained material, and which are installed or cast in an excavation, the backfill shall consist of a coarse-grained, non-frost-susceptible material with a thickness of at least 0,3 m around the pile perimeter over the full length of the pile. The backfill shall be drained at the bottom.

Note – (14) also applies to columns from soil to rock; see D.1 (12).

Complementary information,
Informative

Bibliography

The following contains essential information on foundations in arctic areas:

Andersland O.B. & Ladanyi B. (2003). *Frozen Ground Engineering*. 2nd Edition.

Dansk Standard (2001). Thermal performance of buildings – Thermal design of foundations to avoid frost heave DS/EN ISO 13793:2001

Gaarslev A. & Gravesen F. (1983). *Fundering af lavt byggeri i Grønland*. Technical University of Denmark. Instituttet for anlægsteknik og Instituttet for Husbygning.

Nielsen & Rauschenberger (1957). *Frost og fundering*. GTO Publikation Nr.1. Grønlands Tekniske Organisation.

Pedersen, J. M., & Ingeman-Nielsen, T. (2021). FOSS: *Fjeld- og SprængStensegenskaber i Grønland*. Technical University of Denmark, Department of Civil Engineering

Wang T. et al. (2022). *Frost jacking of piles in seasonally and perennially frozen ground*. Journal of Cold Regions Science and Technology. 203 (2022) 103662.