NATIONAL BUILDING CODE OF FINLAND

Strength and stability of structures

Design of foundations

Ympäristöministeriö
Miljöministeriet
Ministry of the Environment

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Foreword

From 1 January 2017 onward, the Ministry of the Environment publishes the recommendations for strength and stability related to foundations in the National Building Code of Finland. The instruction also includes the provisions concerning the construction of foundations from the Land Use and Building Act and the Decree of the Ministry of the Environment on Foundation Structures (465/2014).

National annexes in these instructions include provisions from the decree of the Ministry of the Environment concerning national choices for general geotechnical design rules when applying the standard SFS-EN 1997-1:2004, and the related recommendations. The National Annex to standard 1997-2 contains the recommendations concerning ground surveys and testing.

The beginning of the national annexes presents those clauses in the standard where national choice is permitted, and where such a choice has been made.

Helsinki, 10 January 2018

Head of the Buildings and Construction unit
Building Counsellor Teppo Lehtinen

Contents

1. Legal basis

Land Use and Building Act [(21.12.2012/958)]

Section 117, Requirements concerning construction

A building must be designed, constructed, altered and repaired, and its intended use changed, in a manner where the building meets the integral technical requirements set forth in sections 117 a–117 g, while taking into account the generally anticipated actions and the intended use and occupancy of the building.

Land Use and Building Act [(21.12.2012/958)]

Section 117 a, Strength and stability of structures

A party engaging in a building project shall ensure that the building is designed and constructed in a manner where its structures are strong and stable, suitable for the conditions at the construction site and able to last for the intended life of the building. The design and dimensioning of load-bearing structures shall be based on the rules of structural mechanics and a generally accepted basis of design, reliable test results or other available information.
Building products that are suitable in terms of structural strength and stability shall be used in the construction of the buildings.

The building shall be designed and constructed in a manner where the actions it is subjected to during construction and use will not cause it to collapse, create deformations that affect strength or stability, or damage the other parts of the building or the equipment or permanent fittings. Furthermore, the building shall be designed and constructed in a manner where any damage caused to the structures by an external contributor is not disproportionately large when compared to the event that caused it. A decree of the Ministry of the Environment may be used to issue more detailed provisions for the construction of a new building, repair and alteration of an existing building or a change in the intended use and occupancy of the building, as regards:
1) the strength and stability required from the structures;
2) the design and dimensioning of the load-bearing structures;
3) the loads during construction and use;
4) the building products used for load-bearing structures.

2. Design of foundations

2.1 Scope

Decree of the Ministry of the Environment on Foundation Structures (465/2014)

Section 1 Scope of application

This Decree applies to the design and execution of permanent and construction site foundations and to the repair and alteration of foundations. Section 1 Scope of application.

Foundations are designed by incorporating the behaviour of soil and rock into the design of the foundation structures in such a way that the above-ground structures function as designed and that the building or structure does not become damaged or unusable.

Instruction

Foundation structures are either permanent, such as foundations for buildings and structures, ground-supported slab or wall structures resting against the ground, structures for dewatering, frost protection and other protective structures as well as mass replacements, embankments and slopes, or temporary, such as retaining structures for excavations, groundwater level reduction structures and working-time protection structures.

The instructions in the National Building Code of Finland concerning the basis of structural design and actions on structures also apply to geotechnical design and execution and the design and execution of foundation structures.

The design tasks related to foundation structures comprise both geotechnical design performed by the designer of the foundation structures and structural design performed by the structural designer.

Geotechnical design is used to determine the geotechnical operation and dimensioning of the structures as well as the practices used to achieve the planned result to a sufficient level of detail.

Design of foundation structures and structural design are separate, special fields of design as referred to in Section 120 c of the Land Use and Building Act.

The Government Decree on the definition of construction design tasks contains provisions regarding defining the difficulty classes of design tasks. The Ministry of the Environment's instruction on the qualification of building designers provides separate instructions for the designers of foundation structures and load-bearing structures.

2.2 Strength and stability of foundation structures

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
Section 2 Strength and stability of foundation structures

A party engaged in a building project shall ensure that foundation structures are designed and executed in a manner so that they maintain adequate strength and stability against collapse throughout the entire planned service life.

Foundation structures and earthworks shall be designed and executed so that the settlement, shifting, twisting and changes in shape of the structures remain sufficiently minor so that the use of the building or structure is not impaired, and so that structures exhibit no detrimental cracks or permanent deformation. There shall be an adequate factor of safety against collapse of the ground and structures both during construction and during the service life of the structures.

The party engaged in a building project is responsible for ensuring that the construction causes no danger to the immediate environment. The structures shall be designed and executed in such a way that the construction, with due consideration to the conditions of the location, causes as little detriment as possible to the surrounding natural environment, to the health and comfort of people in the nearby areas, and to adjacent buildings.

2.3 Design and execution of foundation structures

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
Section 3 Design and execution of foundation structures

The essential technical requirements for buildings are met if the foundation structures and earth structures are designed and executed in accordance with the Eurocodes and the relevant national decisions issued by decree of the Ministry of the Environment.

If design and execution systems other than those specified in subsection 1 are applied, the party engaged in a building project shall demonstrate to the building control authority, if so required by the authority, that the design and execution fulfil the essential technical requirements regarding the strength and stability of the structures, serviceability and service life.

Only one unified design and execution system may be used for new structures that function as one structural unit.

Instruction

The Eurocodes and national choices present the minimum values for structural loads that must be followed during the design. However, it is possible that, for climatic loading, local special conditions may lead to higher load values and/or a different load distribution than the one presented in the Eurocodes or the national choices. In these cases, a value of action that is sufficient with regard to the conditions shall be used in the design.

The building control authority may approve the use of a different design system on a per-case basis, assuming that the level of reliability of the design system in question is the same as the level of reliability achieved with a structure designed according to the Eurocodes and their relevant national choices.

The starting point for a harmonised design and execution system is to ensure the reliability of structures and to prevent the risks related to the operation of structures resulting from the mixing of different systems.

2.4 Geotechnical design

Decree of the Ministry of the Environment on Foundation Structures (465/2014)

Section 4 Geotechnical design

A party engaged in a building project shall ensure that the design of foundation structures takes into consideration the conditions of the construction site and its immediate environment, nearby foundations of buildings and structures and other foundation structures, and the potential effects of possible future construction. Additionally, it shall be taken into account in the design that any potential future construction is not impeded.

Foundation structures shall be strengthened if so required because of changes in loads, damage to foundations, neglect of maintenance, a deepening of basement space, construction nearby or deeper into the ground, a change in the intended use of a building, or other special reasons.

Furthermore, foundation structures and earthworks shall be designed to prevent the detrimental effects of moisture transfer from the ground into the structure, and to avoid harm and structural damage from ground frost. The radon risks of the construction site shall also be taken into consideration.

Instruction

Potential future construction refers to future construction that is either recorded or planned. Among other things, the municipal building codes may contain provisions concerning lowest foundation depths; areas with risk of flooding, collapse or landslides; important groundwater areas and areas with contaminated soil; radon risk areas; and areas sensitive to traffic-induced vibration.

The structural design of permanent retaining structures or construction-time retaining structures that support permanent buildings or structures or whose area of impact includes permanent buildings or structures is performed according to the confidence level requirements for permanent structures, in a manner that keeps the strain on permanent structures within the acceptable limits.

The foundation structure plan provides detailed instructions on the construction of the excavation and the work phases, such as the space requirements for the excavation, the support or sloping of the excavation walls, the soil structures constructed at the bottom of the excavation or on its slopes, and the dewatering of the excavation.

If there are permanent buildings or structures within the excavation's area of impact, the excavation is designed according to the requirements for permanent structures. In other cases, the confidence level for execution-time excavations is applied.

For the purpose of tracking the displacements and changes in groundwater level caused by the excavation, a follow-up measurement programme is drawn up and used to track the displacements in the environment and the groundwater level during the excavation work and, if necessary, once the excavation work is complete. The follow-up measurement programme is included in the geotechnical design report for the construction works.

If it is to be expected that construction causes adverse changes in the natural conditions of the environment, soil and bedrock, groundwater or the buildings and structures of the construction area or its environment, measurements are taken during the construction according to a follow-up programme prepared in advance. The measurement equipment is installed and the measurements are started in a manner that allows for determining the status before the construction work.

The number and precision of the measurements within the risk area shall be such that adverse impacts can be observed in a timely manner. Monitoring measurements are also performed to a sufficient extent below the ground level.

Monitoring measurements are especially important when using new foundation construction methods, building in densely constructed areas or if factors arise during the construction whose impacts could not have been reliably analysed in advance.

The adverse effects shall be primarily reduced and limited during the design stage. The principles and requirements for the prevention of adverse environmental impacts for demanding (GL2) and very demanding (GL3) foundation structures are presented in the geotechnical design report.

When designing the foundations for pipelines, attention shall be paid to interfaces with structures that have different settling characteristics, crossings with other pipelines, and fillings and other additional loads. Transition structures and connecting wells that allow for a sufficient difference in settling are used when necessary. Pipelines, cables and equipment constructed below the base floors and outside of basement structures are planned and executed in a manner that allows them to be serviced and replaced without modifying the load-bearing structures.

The adverse effects on indoor air quality from radon and other gases and impurities that are detrimental to health and comfort are prevented with structures and/or actions that are applicable to the project under design.

Commonly used practices for the prevention of the adverse effects of radon include sealed base floors, base floor ventilation and radon pipelines. When repairing an existing building that has no radon pipeline, practices used for radon prevention include the suction point method i.e. a radon vacuum, radon wells, ventilation repairs and the sealing of ground-supported floor and wall structures and their joints.

The impact of the structure and/or action on the indoor air radon concentration can be determined by measuring the radon concentration in the indoor air after the construction work or action is completed.

2.5 Seriousness of consequences

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
Section 5 Seriousness of consequences

The susceptibility of the building and structure to risk and any expected consequences of potential damage or defect shall be taken into consideration in the design and execution of foundation structures.

Consequences are deemed severe if the potential damage or defect in a structure may cause significant personal injury or have extensive societal effects. Extremely demanding structures, specified in section 150d of the Land Use and Building Act (132/1999), and exceptionally demanding structures, specified in section 120d of the Land Use and Building Act are included in the severe consequences class. The terms extremely demanding structures and exceptionally demanding structures can be considered to refer to structures in relation to which the requirement for an exceptionally in-depth knowledge of the related theoretical principles and design methods is emphasised, and to innovative structures with regard to which no prior design experience is available. Consequences are medium if they are neither severe nor low. These are demanding structures where the design and dimensioning require a good knowledge of the related theoretical principles. Consequences are low if the repercussions attributable to the potential damage or defect in a conventional structure with regard to personal injury, or to societal effects, are small or negligible.

In cases where the building or structures consist of structurally independent parts, the seriousness of consequences for each part may be determined separately.

Instruction

The seriousness of consequences and the difficulty of the design tasks are affected by several factors, such as the size and intended use of the building, the site and its immediate surroundings and the proportions and characteristics of the structures. The seriousness of the consequences and the difficulty of the design task shall therefore be assessed on a per-case basis. For example, the design of a sports hall and a storage hall may be difficult, but the consequences may be severe in the case of a sports hall but medium in the case of a storage hall. The difficulty classes of the design tasks are presented in the Ministry of the Environment's guidelines on the difficulty classes of design tasks, YM1/601/2015.

2.6 Construction site investigation and survey of environmental conditions

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
6 § Construction site investigation and survey of environmental conditions

A party engaged in a building project shall, in connection with the planning of the construction project, assess the ground conditions by means of a ground survey to be conducted at the construction site.

A party engaged in a building project shall determine whether the ground at the construction site is contaminated, if activities have been carried out on the site earlier, or if the ground is contaminated for any other reason, or if harmful substances may be released from the ground.

If it is to be expected that construction will cause detrimental changes to the natural environmental conditions, to soil and rock, to groundwater flow, to groundwater or to buildings and structures in the surrounding environment, the party engaged in a building project shall determine the effects of these changes. To avoid detrimental changes, the effects during the construction and possibly during the use of the building shall be monitored according to a monitoring programme drawn up by the party engaged in a building project and a monitoring system shall be applied when necessary.

Instruction

Ground surveys are a part of geotechnical design.

The ground survey is usually designed by the geotechnical designer of the construction project, together with the structural designer if necessary.

At simple (GL1) locations, a terrain inspection performed in advance by an expert may be sufficient; the decisions made on the basis of the inspection are enclosed with the other design documents for the construction works.

The instructions for the identification, description and classification of the soil and bedrock at the construction site are presented in standards SFS-EN ISO 14688-1, SFS-EN ISO 14688-2 and SFS-EN ISO 14689-1.

The method descriptions concerning the sampling methods involved in the ground surveys and the groundwater measurements are presented in standard SFS-EN ISO 22475-1. Method descriptions concerning field tests commonly used in Finland are presented in standard SFS-EN ISO 22476-1 (electrical cone penetration test), standard SFS-EN ISO 22476-2 (dynamic probing), standard prEN 22476-9 (vane shear test) and technical specification CEN ISO/TS 22476-10 (weight sounding). The national application rules related to the method descriptions are presented in the national annex to standard SFS-EN 1997-2.

The geotechnical designer of the construction project is responsible for the programming of the ground surveys, which includes the selection of the survey methods to be used and the planning of the number and location of the survey points. The geotechnical designer follows the progress of the ground survey, assesses its results and, if necessary, supplements the survey programme and is responsible for the interpretations presented in the geotechnical design report.

The contamination of the soil at the construction site is studied, if there is reason to believe that the soil has been contaminated by earlier activities in the area or that dangerous gases may be released from the soil. The permissible concentrations for hazardous substances transferred from the soil into the building depend on the intended use and occupancy of the building. Excavating contaminated soil always requires a permit decision from a competent authority.

In areas that were previously constructed, preparations are made for actions required in case substances that are detrimental to health or the environment are uncovered during the construction, even when such detrimental effects have not been observed before the construction.

If it is observed that the soil has been contaminated or that hazardous gases may be released, this is reported to the client, the landowner and a competent authority. The remediation of contaminated soil is reported to a competent authority.

The definitions for the contamination and the need of remediation of soil are presented in Government Decree 214/2007. Chapter 14 of the Environmental Protection Act (527/2014) concerns the remediation of soil and the contents of the remediation report.

Radon risks at the site are taken into account when performing the ground survey. The radon risks of the foundation are always affected by both the original soil and the artificial fill and gravel used for subsurface drains. A thick layer of gravel fill may in itself generate concentrations of radon that exceed the allowed maximum value for indoor air.

The magnitude of the vibration impacts may be estimated based on earlier measurements performed under similar conditions. If vibration is measured from the ground, the amplification of vibration within the building will be estimated separately.

2.7 Design plans for foundation structures

Decree of the Ministry of the Environment on Foundation Structures (465/2014)

Section 7 Design plans for foundation structures

The design plans for foundation structures shall show, as applicable to the design task, the following:

1) the structural function and models describing the bracing of the structure;
2) the seriousness of consequences, requirements for execution or execution class, exposure class related to environmental conditions describing the stress on the environment and, where applicable, the tolerance class;
3) loading and combinations of loads;
4) force variables;
5) requirements for construction product properties;
6) ultimate limit state and serviceability limit state tests, and the appropriate accident design tests and fire design;
7) the fastening of structures and the functional parts of structures, and the dimensions of joints, and the weight and centre of gravity of elements to be lifted;
8) durability and service life;
9) bracing and stability tests for the duration of the execution and the finished structure;
10) structures to be restored and demolished during repair and alteration work;
11) data affecting the use and maintenance of new and restored foundation structures.

The execution class referred to above in subsection 1(2) is a set of classes of itemised execution requirements that may be applicable to the entire construction project, a specific structural member or a specific detail.

Instruction

The design of foundation structures takes into account the ground properties of the site and its surroundings, as presented in the geotechnical design report and the maps and profile drawings attached to it.
The definition of geotechnical actions is based on standard SFS-EN 1997-1 and its national choices.

If the foundation and other base structures are subjected to large concentrated actions, substantial horizontal actions or moment actions or substantial cyclical or dynamic actions, the geotechnical design of the structure is considered to be in difficulty class (GL3).

The significance of actions may be assessed as follows:
- a concentrated action is large when it exceeds 5 MN
- a horizontal action is substantial when it amounts to more than one third of the foundation's vertical action, i.e. the vertical action on the foundation from the superstructure and the weight of the foundation and the soil on top of it
- a moment action is substantial when the geotechnical design of the foundation is determined by the moment of the foundation
- actions with a maximum frequency of 1 Hz are considered cyclical

- actions with a frequency of over 1 Hz are considered dynamic

Buildings are not considered very demanding foundation construction locations due to wind actions, unless the building or structure is tall or slender. Actions caused by traffic vibration are also not considered substantial.

Foundation structures and earth works are divided into execution classes 1, 2 and 3. The responsible foundation designer will determine the execution class. The execution class will primarily be chosen based on geotechnical classes GL1...GL3, but the selection will also take into account the consequences of possible damage. If the geotechnical class and consequences class lead to a different execution class, the execution class selected for the project will be the more demanding of the two.

Execution class 1 may only be adopted when the risk in terms of the overall stability or ground movements is insignificant. Furthermore, the excavation may not extend below the water surface, unless local and comparable experience indicates that such work is simple to execute. Routine methods may be adopted in the execution.

Execution class 2 includes conventional structure and foundation types that do not involve exceptional risks or abnormally difficult ground or load conditions. Routine methods may be adopted in the execution.

In execution class 3, the execution of structures is designed with special care, and options that differ from the routine methods and standards are used when necessary.

2.8 Execution documents for foundation structures

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
Section 8 Execution documents for foundation structures

The structural designer of a foundation structure shall prepare the execution documents containing the technical specifications and requirements needed for the execution of the foundation structures before starting the execution of the foundation structure in question. The execution documents include the geotechnical design report, the drawings for earthworks and foundation plans, geotechnical and structural design calculations and the specifications. If Eurocodes are applied in the design and execution process, the execution specification is considered to be an execution document. The geotechnical design report shall present the initial assumptions, original data and calculation methods of the geotechnical plan, and the results of the verification of safety and serviceability. Additionally, the design report contains the ground survey report and the monitoring and follow-up plans.

Foundation structures which require inspections during construction or maintenance after the completion of construction shall be specified in the geotechnical design report.

Instruction

For very demanding (GL3) and demanding (GL2) design tasks, the execution documents cover the foundations, other permanent base structures, load-bearing soil structures, frost protection, radon solution, dewatering for the foundation and yard area, excavations, the pipeline and yard connections of the building and the construction of the pipelines and yard area. For simple (GL1) design tasks, the design of the foundation's frost protection, radon solution and foundation dewatering are generally sufficient.

Geotechnical design calculations are presented for the design of very demanding (GL3) and demanding (GL2) foundation structures. In areas with organic and fine-grain soil, the complete settlement calculations are always presented. Geotechnical design is usually not required for the design of simple buildings and structures (GL1).

2.9 Inspection plan for foundation designs

Decree of the Ministry of the Environment on Foundation Structures (465/2014)

Section 9 Inspection plan for foundation designs

The structural designer of foundations shall ensure the quality control of foundation designs so that the foundation plans are inspected before they are submitted to the building control authority. The quality control of the plans focuses on the calculations, drawings and text documents prepared by the structural designer, and on other design data provided by the structural designer.

The scope of the inspection plan for foundation designs is determined on the basis of the consequences for the building or a specific foundation structure, or on how demanding the design task is.

In order to ensure the quality of the plans, an inspection plan for foundation designs must be drawn up describing the plan inspection procedure, persons responsible for the inspection, and the relationship of these persons to the project team of the design project, if the potential consequences for a building or specific structural member are severe or medium.

For severe consequences or design tasks classified as exceptionally demanding or extremely demanding, quality control shall, in accordance with the practices of the design office, be carried out by a third party or a person assigned exclusively to quality control in the project and who has the qualifications for the competence class of the design task.

For medium consequences or design tasks classified as demanding, quality control shall be carried out by a person who has the qualifications for the competence class of the design task.

Instruction

The quality assurance of foundation designs concerns the execution documents drawn up by the ground surveyor, geotechnical designer and foundation designer.

2.10 Planned service life

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
Section 10 Planned service life

The structural designer shall define the planned service life of the foundation structure, i.e. the period for planning purposes during which the structure or structural member is expected to be used for the planned purpose with the anticipated maintenance measures, and the exposure categories representing the environmental conditions.

A party engaged in a building project shall ensure that the structure is designed and executed so that the required properties laid down in the plans for the structure and for the building materials used are maintained throughout the entire planned service life.

Instruction

The Decree does not provide guide values for defining the service life; this is left to the designer. For instance, some reference values are presented in the Basis of Structural Design part of the Eurocodes, SFS-EN 1990. For conventional buildings, the planned service life of the structure may be considered to be not less than 50 years; for significant valuable structures, the service life shall be not less than 100 years. Temporary structures or parts thereof that may be disassembled and reused for the same purpose shall be designed for a service life of not less than 50 years. In the interest of durability, foundations and other structural members that are hard to replace should be designed for a longer service life than the rest of the structure.

The remaining service life within the selected exposure class for structures that will be preserved during repair or alteration work is based on a condition survey of the structures.

The durability of the structure is ensured already at the execution stage by protecting the structures against weather effects to the necessary degree.

Normally, the characteristic values of actions are specified as values that correspond to a recurrence time of 50 years. Unless more detailed analyses are provided, the characteristic value of loads caused by the climate may be seen to depend on the planned service life in a manner where, if the planned service life exceeds 50 years, the characteristic values are increased by 10%, and if the planned service life exceeds 100 years, the characteristic values of actions are increased by 20%. Loads caused by the climate include snow, wind and ice loads and loads caused by temperature variation. The characteristic values of imposed loads are generally considered to be independent of the planned service life.

2.11 Work plan for the execution of foundation structures

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
Section 11 Work plan for the execution of foundation structures

A party engaged in a building project shall ensure that a work plan for the execution of foundation structures is drawn up and that the work plan contains sufficient data for the execution.

When the potential consequences of a defect or damage in a building or structure are severe or medium, a quality control plan shall be prepared for the building as part of the work plan for the execution of the structure. This plan shall contain an assessment of the executing party's competence and resources in terms of the requirements that have been set, a description of the executing party's project team and its responsible persons, the principles of the inspection and responsibilities, and a plan for the quality control measures and records.

Instruction

The work plans for the execution of the foundation structures are drawn up on the basis of the execution documents.

The constructor draws up an execution quality plan if the execution document presents a requirement concerning such. The execution quality plan is a building project quality control document that includes an assessment of the constructor's capabilities to complete the construction project, a description of the execution organisation and its responsible individuals, the principles of inspection with the related responsibilities and a plan of the quality control activities and records.

In small construction works, the quality plan may, with permission from the building control authority, be replaced by an existing a construction inspection document; a separate, written execution quality plan is not required for such sites.

The foundation construction work quality plan presents in detail the implementation method of the control and follow-up plan included in the geotechnical design report. In the absence of a control plan prepared in advance, the methods, precision and frequency of measuring the achieved quality are presented before starting a work phase. The quality plan also presents the templates for the performance protocol.

If it is discovered during the work that the ground conditions, groundwater conditions or surrounding structures differ from the information in the foundation structure plan and execution specification, the execution plans are reviewed and any changes possibly required by the deviations are made therein.

Methods, materials and equipment are selected for the work plan for the execution of foundation structures in order to ensure soil structures that are of uniform quality, technically in line with the requirements presented in the plans and reliable.
Execution instructions for earth works and subgrade reinforcement are presented in the following standards:

- SFS-EN 12715 Grouting
- SFS-EN 12716 Jet grouting
- SFS-EN 14679 Deep mixing
- SFS-EN 14731 Ground treatment by deep vibration

- SFS-EN 14475 Reinforced fill
- SFS-EN 14490 Soil nailing
- SFS-EN 15237 Vertical drainage

When constructing in winter, any snow, ice and frozen soil are carefully removed from the surface that will remain under the soil fill. If the frozen soil is artificially thawed instead of removal, the thawed ground is carefully compressed before the filling material is spread on top of it. The compressed material shall be as dry as possible, and no snow, ice or frozen soil may be mixed into it.

The execution of excavation work is planned in a manner where no work phase will cause danger or unreasonable detrimental effects to the environment or the people, buildings, structures or equipment in the excavation’s area of impact due to factors such as vibration, displacement or noise.

Execution instructions for retaining structures are presented in the following standards:
- SFS-EN 12063 Sheet pile walls (*steel and wood sheet pile walls*)
- SFS-EN 1538 Diaphragm walls
- SFS-EN 1537 Ground anchors
- SFS-EN 12715 Grouting
- SFS-EN 12716 Jet grouting.

The execution of pile driving work is planned in a manner where the piles can be installed, intact, into the planned locations and at the planned angles, and where they can penetrate to the minimum levels presented in the plan without causing damage to the already installed piles and the nearby buildings or structures.

Execution instructions for pile driving work using different piles are presented in the following standards:
- SFS-EN 12063 Sheet pile walls (*steel and wood sheet pile walls*)
- SFS-EN 12699 Displacement piles
- SFS-EN 14199 Execution of special geotechnical works. Micropiles
- SFS-EN 1536 Bored piles.

Rock quarrying is based on the foundation structure plan and a written quarrying plan in a manner where it does not cause damage, unnecessary quarrying or breaking of bedrock. The plans are kept up to date and modified during the work if necessary. A bedrock reinforcement plan is prepared when necessary when quarrying next to a building or a building foundation below the foundation level. If necessary, the rock walls to be quarried are reinforced with bolts before the quarrying.

The quarrying plan includes information on the boring, the explosives to be used, detonation, necessary covering and blasting times. Furthermore, the properties of the location to be blasted, such as the quality and structure of the soil layers and bedrock, are analysed to a necessary extent within the quarrying area.

Environmental reviews are carried out to the necessary extent before quarrying. When quarrying near vibration-sensitive structures or sensitive equipment, vibration measurements are commonly performed during quarrying.

2.12 Repair and alteration of foundation structures in buildings and changes in the intended use

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
Section 12 Repair and alteration of foundation structures in buildings and changes in the intended use

In the planning and execution of building repair and alteration work and of changes in the intended use, the properties and conditions of a building and its foundation structures shall be taken into account and, for special reasons investigated, and the possibility of an increase in loading on the foundation structures shall be determined. For partial alteration of structures, it shall be ensured that the alterations to the structural system do not affect the fulfilment of requirements, in accordance with section 3 of this Decree.

When the repair and alteration work in buildings or changes in the intended use do not cause an increase in the loading on foundation structures, but the condition of the foundation structures is such that the strengthening of them is required, the regulations valid at the time of the construction of the building, and the best building practices in effect at that time may be applied.

When the repair and alteration work in buildings or changes in the intended use do cause an increase in the loading on foundation structures, sections 2 to 7 of this Decree shall apply in the design and execution of new foundations and foundations to be strengthened.

Instruction

The repair or alteration work of a building requires special knowledge of the materials, working methods and structures used in the construction. A special reason may be the poor condition of the structures that necessitates their repair even if the loading of the structures is not increased. In particular, the condition of the structures shall be analysed to the necessary extent if the alteration or change of intended use causes the loading of the structures to increase when compared to the situation before the work in question. The report shall also concern the foundation structures to the extent required by the repair or alteration work.

A special reason due to which the characteristics and condition of the building and its structures must be analysed may also be that the building is one protected as significant in terms of cultural history and its condition is not completely known. This is important in terms of the technical success of the renovation and the preservation of the building heritage.

The stresses caused by environmental conditions are defined according to the National Building Code’s instructions concerning the material in use. The requirements set for the materials and products are defined on the basis of the stresses.

2.13 Construction products

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
Section 13 Construction products

The properties of construction products used in foundation structures shall meet the requirements presented in the respective design plans and the construction products shall be suitable for the construction site conditions.

Construction products shall be used in the construction of earthworks and foundations according to the design plans and by applying the working methods in the plans.

Soil materials used at the construction site shall not contain harmful amounts of contaminants and their use shall not be detrimental to health. The use of these materials shall not pose a risk to ground water at the construction site or in its vicinity, shall not contaminate the ground or cause damage such as corrosion from contact between materials and structures.

A party engaged in a building project shall ensure that the suitability of construction products is checked prior to the execution of their use.

Instruction

Substances and supplies that are CE marked pursuant to a harmonised product standard or the European Technical Approval/assessment (ETA) are used in foundation structures. If CE labelling is not possible, substances and supplies with qualifications approved pursuant to Act 954/2012 are used.

The characteristics of the following products are central in terms of the reliability of the foundation and soil structures:
- rock materials
- geosynthetic products
- dewatering systems
- foundation structures and the products used therein
- frost protection products
- moisture and water insulation in the foundation structures.

Load-bearing soil structures use coarse-grain natural soil materials, crushed rock materials, recycled materials (reused rock materials) and artificial rock materials that are suitable for the location and of sufficiently uniform quality in terms of technical characteristics. The soil and rock materials brought to the site may not contain hazardous amounts of impurities, and their use must not cause detrimental effects or hazards to the people residing in the building. Furthermore, their use may not cause a risk of groundwater or soil contamination at the site or its vicinity or damage, such as corrosion, on any structures that come into contact with the materials in question.

Standard SFS-EN 13242 concerns natural rock material and recycled material used in load-bearing soil structures. Standard SFS-EN 13055-2 applies to lightweight aggregates.

Provisions regarding the environmental permits for recycled materials may be found in the Environmental Protection Act (527/2014) and Decree (713/2014). The current standard SFS-EN 13251 applies to the characteristics and functional requirements for geosynthetic products used in earthworks and the construction of foundations and retaining structures.

The current standard SFS-EN 13252 applies to the characteristics and functional requirements for geosynthetic products used in the construction of dewatering systems.

The permanence of the mechanical and hydraulic characteristics of geosynthetic products during long-term use and their resistance to chemical, biological and thermal stress occurring at the location of use and the effects of ultra-violet light are ensured in advance.

Grouting mortar is processed as a load-bearing structure if it is used to fill in the gap between the foundation structure and the ground or bedrock in order to fasten end-anchored tendons or tensioning piles. If grouting mortar is only used to increase the sleeve durability of tensioning piles or compression piles, it does not need to be processed as a load-bearing structure.

Materials that are used to prevent adverse effects caused by frost heave in the building ground are required to maintain their heat insulation capacity at the moisture conditions prevailing at the installation site at a level corresponding to the design values used in the design of the frost protection throughout the entire design life of the frost protection.

The frost protection materials are also required have sufficient mechanical, chemical, thermal and biological resistance in order for them to remain operable under the stresses present at the frost protection's location of use.

The grouts and stabilizers being used must not cause the contamination of the groundwater or soil at the site or its vicinity, either on their own or when reacting to each other or the substances in the soil. The non-toxicity and chemical composition of the grouting and mixing substances are ensured before they are taken into use. The origin of all grouting and mixing substances is analysed and the information is recorded.

2.14 Suitability of structures

Decree of the Ministry of the Environment on Foundation Structures (465/2014)
Section 14 Suitability of structures

A party engaged in a building project shall ensure that the foundation structures or construction products fulfil the requirements set on them.

Instruction

When applying Eurocodes, the suitability assessment for foundation structures is based on the design of the foundations being done appropriately according to standards SFS-EN 1997 and their national annexes, and on the foundation structures being executed and inspected according to the execution documents.

The inspections related to the execution supervision of the foundation structures are performed to the extent required by the execution documents. During the execution, the responsible work supervisor or a separately appointed specialist work supervisor will supervise that the plans and instructions concerning foundation structures are followed and that the appropriate documents are prepared for the work.

In order to determine the suitability of the foundation structures, a sufficiently detailed performance protocol is maintained for each individual work performance, with the appropriate measurement and observation results.

The review protocols, quality control reports and performance protocols are compiled into an inspection document that is kept up to date at the worksite at all times.

The performance protocols are immediately delivered to the responsible foundation designer. If no performance protocols are required for a work performance, the approval of the work will nevertheless be recorded in the inspection document. In particular, performance protocols are maintained for the following:

- pile driving
- construction of excavation, such as the driving-in and anchorage of retaining walls, the pumping volumes of seepage water and the height measurements for the groundwater level
- base reinforcement work, such as grouting, jet grouting, deep mixing and compaction
- the material quality and compaction supervision of soil structures.

The quality control material is documented and compiled into a single entity

3. References

If the version of a reference has not been specified, the latest edition of the reference (with amendments) is applied.

SFS-EN 1536	Execution of special geotechnical works. Bored piles
SFS-EN 1537	Execution of special geotechnical works. Ground anchors
SFS-EN 1538	Execution of special geotechnical works. Diaphragm walls
SFS-EN 1990	Eurocode. Basis of structural design
SFS-EN 1997-1	Eurocode 7: Geotechnical design. Part 1: General rules
SFS-EN 1997-2	Eurocode 7. Geotechnical design. Part 2: Ground survey and testing
SFS-EN 12063	Execution of special geotechnical works. Sheet pile walls
SFS-EN 12699	Execution of special geotechnical works. Displacement piles
SFS-EN 12715	Execution of special geotechnical works. Grouting
SFS-EN 12716	Execution of special geotechnical works. Jet grouting
SFS-EN 13055-2	Lightweight aggregates. Part 2: Lightweight aggregates for bituminous mixtures and surface treatments and for unbound and bound applications
SFS-EN 13242	Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction
SFS-EN 13251	Geotextiles and geotextile-related products. Characteristics required for use in earthworks, foundations and retaining structures
SFS-EN 13252	Geotextiles and geotextile-related products. Characteristics required for use in drainage systems
SFS-EN 14199	Execution of special geotechnical works. Micropiles
SFS-EN 14475	Execution of special geotechnical works. Reinforced fill
SFS-EN 14490	Execution of special geotechnical works. Soil nailing
SFS-EN 14679	Execution of special geotechnical works. Deep mixing
SFS-EN 14731	Execution of special geotechnical works. Ground treatment by deep vibration
SFS-EN 15237	Execution of special geotechnical works. Vertical drainage
SFS-EN ISO 14688-1	Geotechnical investigation and testing. Identification and classification of soil. Part 1: Identification and description
SFS-EN ISO 14688-2	Geotechnical investigation and testing. Identification and classification of soil. Part 2: Principles for a classification
SFS-EN ISO 14689-1	Geotechnical investigation and testing. Identification and classification of rock. Part 1: Identification and description.
SFS-EN ISO 22475-1	Geotechnical investigation and testing. Sampling methods and groundwater measurements. Part 1: Technical principles for execution

SFS-EN ISO 22476-1	Geotechnical investigation and testing. Field testing. Part 1: Electrical cone and piezocone penetration test
SFS-EN ISO 22476-2	Geotechnical investigation and testing. Field testing. Part 2: Dynamic probing
prEN ISO 22476-9	Ground investigation and testing. Field testing. Part 9: Field vane test
CEN ISO/TS 22476-10	Geotechnical investigation and testing. Field testing. Part 10: Weight sounding

4. National annexes to Eurocode SFS-EN 1997

National Annex to standard SFS-EN 1997-1:2004: Geotechnical design. Part 1: General rules

1. Scope

Ministry of the Environment Decree (13/16) concerning national choices with regard to the general rules for geotechnical design, when applying standard SFS-EN 1997-1

Section 1 Scope

This Decree, together with standard SFS-EN 1997-1:2004, shall apply to geotechnical design.

Instruction

As regards standard SFS-EN 1997-1, the recommended values set forth in standard SFS-EN 1997-1 and all the annexes to standard SFS-EN 1997-1 are followed unless otherwise stated in this National Annex.

The Non-Contradictory Complementary Information (NCCI) is presented in italics in the instructions.

National choice concerning buildings is permitted in the following clauses of Standard SFS-EN 1997-1:

- 2.1(8)P, Section 2
- 2.4.6.1(4)P, Note 1 Section 3 and instruction in Section 3
- 2.4.6.2(2)P, Note 1 Section 3 and instruction in Section 3
- 2.4.7.1(2)P, Section 3 and instruction in Section 3
- 2.4.7.1(3), Section 3
- 2.4.7.1(4), Section 4
- – 2.4.7.1(5)
- – 2.4.7.1(6)
- 2.4.7.2(2)P, Note 2 in Section 4
- 2.4.7.3.2(3)P, Section 4 and instruction in Section 4
- 2.4.7.3.3(2)P, Section 4 and instruction in Section 4
- 2.4.7.3.4.1(1)P Note 1 Section 4 and instruction in Section 4
- 2.4.7.4(3)P, Section 4 and instruction in Section 4
- 2.4.7.5(2)P, Section 4 and instruction in Section 4
- – 2.4.8(2)
- – 2.4.9(1)P
- 2.5(1), Instruction in Section 4.
- 7.6.2.2(8)P, Section 5
- 7.6.2.2(14)P, Section 5 and instruction in Section 5
- 7.6.2.3(4)P, Section 5 and instruction in Section 5
- 7.6.2.3(5)P, Section 5 and Table 13
- 7.6.2.3(8), Section 5
- 7.6.2.4(4)P, Section 5 and instruction in Section 5

- 7.6.3.2(2)P, Section 6 and instruction in Section 6
- 7.6.3.2(5)P, Section 6 and instruction in Section 6
- 7.6.3.3(3)P, Section 6 and instruction in Section 6
- 7.6.3.3(4)P, Section 6
- 7.6.3.3(6), Section 6
- 8.5.2(2)P, Instruction in Section 7

– 10.2(3)

- 11.5.1(1)P, Section 8 and instruction in Section 8
- A.2(1)P, Table 4
- A.2(2)P, Table 5
- A.3.1(1)P, Table 6
- A.3.2(1)P, Table 7
- A.3.3.1(1)P, Table 8
- A.3.3.2(1)P, Tables 9, 10 and 11
- A.3.3.3(1)P, Tables 12, 13 and 14
- A.3.3.5(1)P, Table 15
- A.3.3.6(1)P, Table 16
- A.4(1)P, Table 17
- A.4(2)P, Table 18
- A.5(1)P, Table 19

A national choice has been made in the clauses marked •.

2. Design requirements

Ministry of the Environment Decree (13/16) concerning national choices with regard to the general rules for geotechnical design, when applying standard SFS-EN 1997-1

Section 2 Design requirements

The requirements and guidelines of geotechnical class 1 shall apply to the design of light and simple structures, clause 2.1(8)P of the standard.

3. Design values

Ministry of the Environment Decree (13/16) concerning national choices with regard to the general rules for geotechnical design, when applying standard SFS-EN 1997-1

Section 3 Design values

The design value of the action given in clause 2.4.6.1(4)P shall be defined by applying the partial safety factor in accordance with the Ministry of the Environment Decree concerning national choices for the basis of structural design, when applying standard SFS-EN 1990. In the uplift limit state under unfavourable load conditions, the partial safety factor for permanent actions is 1.1 KFI and for variable actions it is 1.5 KFI, where KFI is the load coefficient used for the reliability class. For the hydraulic heave limit state, the partial safety factor for permanent actions in favourable soil conditions is 1.35 KFI and in unfavourable soil conditions it is 1.8 KFI. The partial safety factor for variable actions in unfavourable load situations is 1.5 KFI.

The design values of geotechnical parameters are derived, in accordance with clause 2.4.6.2(2)P of the standard, by using the partial safety factor 1.5 for undrained shear strength and uniaxial compressive strength, and for the uplift limit state, the value of the partial safety factor is 1.5 for undrained shear strength, tensile pile resistance and anchorage resistance.

Instruction

Design values of actions

2.4.6.1(4)P, Note 1
Tables 4, 5, 18 and 20 present values for partial factor γ_F.

2.4.6.1(8)
The design of the structures adopts water levels that may reoccur once per 50 years at the site. If reliable statistical data regarding the groundwater level is not available for analysing a reoccurrence period of 50 years, the following approach may be adopted.

The geotechnical designer will use groundwater observations to determine the HW, MW and NW water levels by comparing the observations to long-term observations made under similar conditions and taking into account the annual groundwater level variations and precipitation during the observation period. After this, the dimensioning groundwater level or free water surface level (= design level) is determined pursuant to Figure 1. The partial factor (γ) is the partial factor for permanent action $\gamma = 1{,}15$. The design value for water pressure is calculated on the basis of the dimensioning water surface level, and no other safety is adopted.

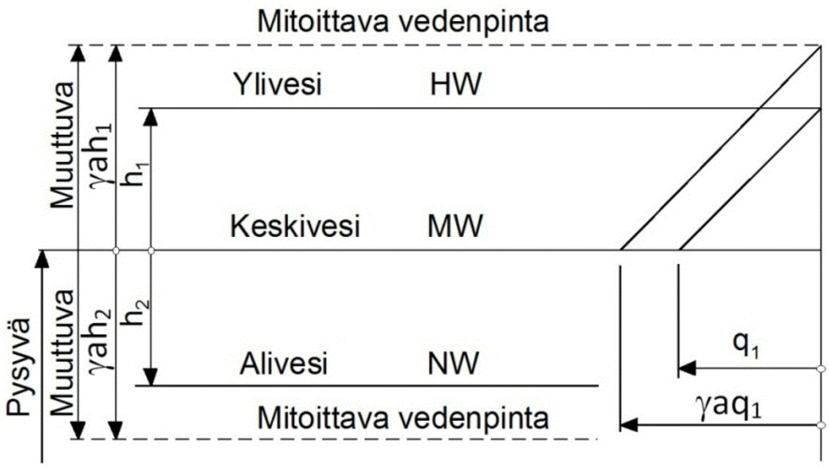

Figure 1. *Determining the dimensioning water surface level. Observation period dependent correction factor a = 1.1, when the observation period is ≥ 3 years; a = 1.25, when the observation period is ≥ 1 year and a = 1.4, when the observation period is short-term.*

Alternatively, the dimensioning water level may also be derived directly by applying a safety margin to the MW water level. The safety margin is selected in a manner where the dimensioning water level is, taking into account the local conditions, either the maximum or minimum water level during the working life of the structure or its lifecycle. In addition to this, no safety is applied to water pressure (without a specific reason).

Instruction

Design values for geotechnical parameters

2.4.6.2(2)P, Note 1
Tables 5, 7, 17 and 19 present the values for partial factor γ_M.

General

2.4.7.1(2)P
The values given in Tables 4, 6, 18 and 20 are used as partial factors at ultimate limit states under persistent and transient design situations.

4. Ultimate limit states

Ministry of the Environment Decree (13/16) concerning national choices with regard to the general rules for geotechnical design, when applying standard SFS-EN 1997-1

Section 4 § Ultimate limit states

When selecting the values of partial safety factors in accidental situations and their effect on partial safety factors, clause 2.4.7.1(3) of the standard, the Ministry of the Environment Decree concerning national choices for the basis of structural design is applied, when applying standard SFS-EN 1990.

When selecting the values of partial safety factors in persistent and transient situations, in accordance with clause 2.4.7.2(2)P, Note 2 of the standard, the Ministry of the Environment Decree concerning national choices for the basis of structural design is applied, when assessing the limit state for static equilibrium or total structural or soil movement. The value of the partial safety factor for soil parameters for undrained shear strength and shaft compression resistance is 1.5.

When applying partial safety factors on actions or the effects of actions, in accordance with clause 2.4.7.3.2(3)P of the standard, the Ministry of the Environment Decree concerning national choices for the basis of structural design shall apply to the selection of the partial safety factors on actions. Set M2 shall be applied to partial safety factors for soil parameters so that the value of the partial safety factor for undrained shear strength and compression resistance for one axis is 1.5.

For footing and spread foundations, Set R2 of the partial factors on resistance shall be applied, in accordance with clause 2.4.7.3.3(2)P of the standard, so that the value for bearing resistance is 1.55 and for sliding it is 1.1.
Design Approach 2 (DA2) shall be applied to footing and spread foundations, pile foundations, anchorages and support structures, in accordance with clause 2.4.7.3.4.1(1)P, Note 1, of the standard. DA3 shall be applied to the design procedure for embankment stability, slope stability and overall stability.

The values given in Section 3(1) of this Decree, in accordance with clause 2.4.7.4(3)P of the standard, shall be applied to the partial safety factors for uplift design. The value of the partial safety factor for soil parameters for undrained shear strength and tensile piles is 1.5. For temporary anchorages, the partial resistance factor is 1.25 and for permanent anchorages it is 1.5.

When considering a limit state of failure by heave due to seepage of water in the ground, in accordance with clause 2.4.7.5(2)P of the standard, the partial safety factors set down in Section 3(1) of this Decree shall be applied to a limit state of failure by heave.

Instruction

Demonstration of static balance

2.4.7.2(2)P, Note 2
Tables 4 and 5 present values for partial factors.

Design impacts of actions

2.4.7.3.2(3)P

Tables 6 and 7 present partial factors for actions.
Design values of resistance

2.4.7.3.3(2)P
Tables 8, 9, 10, 11, 16, 17 and 19 present partial factors for resistance.

General

2.4.7.3.4.1(1)P, Note 1
Design Approach 2 can be applied in two ways, denoted as DA2 and DA2*. In DA2, the actions are factored at their source and the design calculation is performed using factored values of actions. In DA2*, the design calculation is performed using characteristic values of actions, and partial safety factors are applied only at the end of the calculation in verifying the ultimate limit state condition. When using the design approach DA2*, special attention shall be given to the verification of the stability of a foundation structure.

In pile foundations where horizontal loads are also received by the axial forces of the piles, design approaches DA2 and DA2* create the same end result.

Design method and partial factors for uplift

2.4.7.4(3)P
Tables 17, 18 and 20 present values for partial factors.

Demonstrating resistance against fracture caused by hydraulic uplift due to seepage flow

2.4.7.5(2)P
Table 20 presents partial factors for actions.

Limiting values for foundation displacement

2.4.9(4)P
When designing building projects, the following guideline limiting values for settlement and displacement in foundation structures are followed in place of Annex H.

Table 1 presents limiting values for angular motion caused by the overall settlement of the building and the uneven settlement of adjacent foundations or the bending of slab foundations for different types of structure. The values in the table are determined according to the requirements set for the serviceability of the load-bearing superstructures of conventional buildings and, as such, do not apply to structures that are subject to special requirements.

Normally, a maximum of one third of the total depression values given in Table 1 is allowed as horizontal displacement.

Table 1. Guideline limiting values for total building settlement and relative motion in load-bearing structures

Type of structure	*Limit values of total settling(mm)*	*Tolerance of limit values of angular rotations*	
		Coarsegrained subgrade	*Fine-grained subgrade*
Massive rigid structures	*100*	*1/250–1/200*	*1/250–1/200*
Statically determinate structures	*100*	*1/400–1/300*	*1/300–1/200*
Statically undeterminate structures			
– Timber structures	*100*	*1/400–1/300*	*1/300–1/200*
– Steel structures	*80*	*1/500–1/200*	*1/500–1/200*
– Masonry structures	*40*	*1/1000–1/600*	*1/800–1/400*
– Reinforced concrete structures	*60*	*1/1000–1/500*	*1/700–1/350*
– Reinforced concrete element structures	*40*	*1/1200–1/700*	*1/1000–1/500*
– Reinforced frame structures	*30*	*1/2000–1/1000*	*1/1500–1/700*

Accepting the limit values for total settlement presented in Table 1 requires that the relative angular motions of load-bearing structures remain within acceptable limits and that the total settlement does not cause excessive tilting of the structure or problems in relation to the functions related to the structure.

A ground-supported base floor may normally be used when the foundations of the structure are laid on coarse soil (or moraine) or bedrock, or when the filling under the floor is built layer by layer up to the planned compactness in a manner where the base floor is depressed by at most 5 mm more than the building.

Design based on prescriptive rules

2.5(1)
The regular and generally conservative rules concern the frost susceptibility of the ground, the risk of flooding and landslide at the site, the contamination of the ground, the prevention of radon risk and foundations on bedrock

Required foundation depth to overcome frost heave

Table 2 presents the average frost-free foundation depth corresponding to frost F_{50} for the foundations of warm buildings (facilities) built on soil susceptible to frost. The wall line refers to the building's outer wall line with no cantilevers or outside corners. According to the design frost, the values for the corner are applied up to a distance of 1.5 to 2.5 metres from the corner. When applying the table, the foundation wall is insulated to at least half-way between the ground surface and the foundation's bottom level. The frost-free basic depth pursuant to Table 2 may be reduced with frost protection.

The value of the frost heave-free depth is increased by the distance of the protruding part from the outer surface of the foundation wall; however, at the most by the distance required for the foundation depth of non-heated buildings. The location-specific frost data is given in the publications based on statistics from the Finnish Meteorological Institute.

In case of a semi-heated building (interior temperature > +5°C…< +17°C), the values of Table 2 for foundation depth are increased by 0.2...0.3 metres.

The frost heave-free foundation depth for non-heated structures is determined in a manner that corresponds to a frost depth that occurs once per 50 years. The foundation depths for minor buildings and structures may be reduced if the structures can withstand the movements caused by frost heave or if the protective effect of snow can be taken into account. The frost depth can also be assessed by means of calculations on the basis of climate and soil conditions that affect the depth.

***Table 2.** Frost heave-free foundation depth for warm buildings susceptible to frost when the building width is > 4 m and the interior temperature is ≥ + 17°C. The ground beside the building is free from snow. The lower foundation depth is used for fine soil types and the higher foundation depth is used for coarse soil types (and moraines). The depths between the frost values are interpolated.*

Foundation type	*Foundation part*	*Frost heave-free foundation depth, m Frost amount F_{50}, Kh*		
		35000	*50000*	*65000*
Ground-supported base floor; thermal resistance for base floor structure 5m²K/W,	*Wall line*	*1.0/1.2*	*1.3/1.5*	*1.6/1.9*
thermal insulation at outer surface of foundation wall	*Corner*	*1.3/1.6*	*1.6/2.0*	*2.0/2.3*
Crawlspace, ventilation from outside 0.6 l/sm²;	*Wall line*	*1.1/1.4*	*1.4/1.8*	*1.8/2.2*
thermal resistance for base floor structure 4.5 m²K/W,	*Corner*	*1.4/1.8*	*1.7/2.2*	*2.1/2.6*

The frost heave-free depth in soil layers not susceptible to frost heave is higher than the depth occurring once per 50 years referred to above. This is taken into account in the design of the thermal insulation for pipelines and the frost protection, among other things.

<u>Risk of flood and collapse</u>

The lowest acceptable building height in terms of flooding refers to the highest level to which water may rise at the site without damaging buildings. Whenever possible, buildings are located on higher ground and/or protected against flood water and break-up of ice by means of dykes and embankments.

No residential buildings, buildings intended for work or other demanding structures are to be constructed in an area with a risk of collapse or landslide unless these risks are systematically eliminated by structural means.

<u>Contaminated ground</u>

If the investigations performed at the site determine that the environmental risks or health risks caused by contaminated ground are so large that risk management activities are required, a design of the reconditioning is started in order to permanently remove the contamination of the ground or to substantially reduce risks.

Field investigations are not necessarily required at locations where no justified cause exists to suspect the contamination of the ground. However, any conclusions drawn on the basis of a pre-emptive survey regarding the lack of contamination at the site must be presented in writing and appended to the design report for the construction works.

Risk of radon

The risk of radon at the site is taken into account in the design and construction.

Basic requirements

5.2(1)P
Yard areas and their structures are designed and executed in a manner where the settlement, sway, frost heave and other possible deformations of the structures located in the area are so small and their dewatering is arranged in such a manner that the use of the yard and its related structures is not unreasonably affected over the service life of the area.

Dewatering

5.4(1)P
The subgrade is kept dry so that the groundwater level is kept at a sufficient distance from the floor and the ground level within the crawlspace, and the capillary flow of water into the structures is cutted-off. The surface water absorbed into the ground is routed away from the foundation and from below the building.

Basement structures are separated from the ground with a structure that interrupts capillary water transfer, unless the structure has been insulated against water pressure or unless it can be otherwise demonstrated that capillary water transfer does not harm the structures or the operation of the building. Capillary water transfer is cutted-off by means of an aggregate that meets the granularity requirements for a subsurface drain layer.

If necessary, the mixing of the subsoil with the subsurface drain layer is prevented by means of a filter fabric or a filter layer that meets the requirements for filtration between separated soil layers. The filtration requirements are also taken into account between the different zones of the subsurface drain layer.
If facilities for accommodation or work are built on a load-bearing base floor, a crawlspace with sufficient ventilation must be built below the base floor. A crawlspace is not required if the non-compressibility and dewatering of the filling below the base floor have been verified.

Design and structural analyses

6.4(4)P
The lowest recommended foundation depth for a foundation wall footing is 0.5 m and the minimum width is 0.3 m. The recommended minimum size for column footing is 0.4 x 0.4 m^2. The recommended lowest foundation depth for a uniform slab foundation is 0.3...0.5 m. Along the outer wall lines, the recommendation for the foundation depth of a slab foundation is not less than 0.5 m.

Sliding resistance

6.5.3(5)

The sliding resistance R_d for the foundation base is usually mobilised at a lower lateral displacement level than the soil pressure $R_{p;d}$ that focuses on the side of the foundation and resists displacement.

Loads with large eccentricities

6.5.4(1)P

Since Design Approach DA2 only uses partial factors at the end of the calculation, the safety is focused on the effect of the action on the lower surface of the ground-based foundation, but not the moment load of the foundation.*

When using Design Approach DA2, the highest eccentricity allowed (without special protective measures) for the most unfavourable combination of permanent and variable actions is 1/3 of the width of the foundation. This is achieved when the resultant of the actions is located within the area delimited by the ellipse in Figure 2. The load located on the ellipse in the figure creates a triangular pressure at the bottom of the footing, from the edge of its footing to the centre. Equation for the ellipse: $(L_e/L)^2 + (B_e/B)^2 = 1/9$*

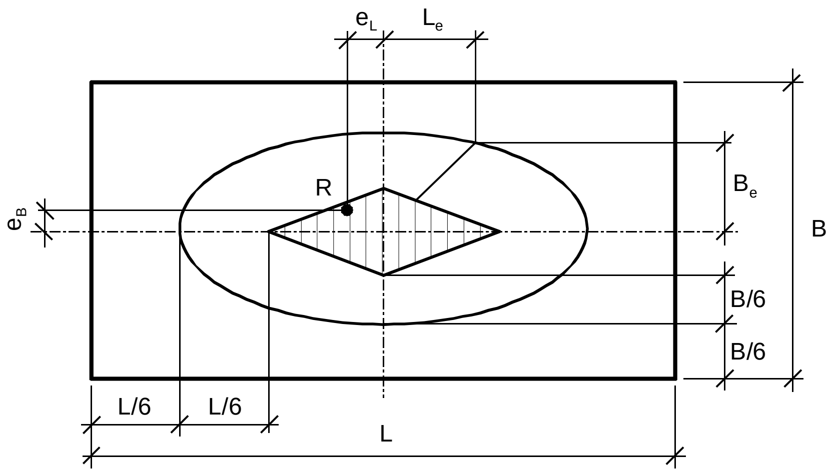

***Figure 2**. Symbols related to the eccentricity of actions at the bottom of a ground-supported footing*

Foundations are designed in a manner where the resultant of the permanent loads is located within the striped core pattern in Figure 2, in which case the entire base is compressed.

When using a round foundation, the above most unfavourable resultant load must be within the radius r_e = 0.59 r, wherein r is the radius of the foundation.

When dealing with eccentric loads, even small changes in measurements may lead to large differences in load-bearing resistance.

Settlement

6.6.2(8**)**
When assessing the magnitude of settlement, the possible lowering of the groundwater level during the service life of the building, especially due to the effects of pipeline excavations is taken into account. Normally, a one-metre reduction in the groundwater level is estimated to result from pipeline excavations.

Foundations on bedrock: additional design analyses

6.7(1)P
If the bedrock has an inclination of more than 15^{o} at the foundation level, the foundation is levelled or terraced or rock bolts are used to prevent sliding. The sufficient corrosion protection of the bolts is ensured.

If a value above 8.0 MPa is adopted as the characteristic value of the bedrock resistance when calculating the design value for the load-bearing resistance, the resistance of the bedrock is always determined on the basis of bedrock studies. A partial factor value of 1.55 is adopted when determining load-bearing resistance.

Foundations on rock-bottom that has been quarried and compacted are examined in a similar manner as foundations on ground with high load-bearing capacity. In this case, a value of at most 0.5...1.0 MPa may be used for the geotechnical resistance of a wedged and compacted rock-bottom without a separate analysis; in this case, the settlement are generally 5...10 mm depending on the compaction method of the rock-fill when the rock-fill thickness is approximately one metre.

When the bedrock is completely decayed, it is generally treated as compacted coarse soil in the design and dimensioning.

5. Compressive ground resistance

Ministry of the Environment Decree (13/16) concerning national choices with regard to the general rules for geotechnical design, when applying standard SFS-EN 1997-1

Section 5 Compressive ground resistance

When conducting geotechnical load tests of the compressive resistance of piles, in accordance with clause 7.6.2.2(8)P of the standard, the correlation factors $\xi_1$and ξ_2 given in the standard shall be multiplied by the model factor 1.25. When testing the ultimate compressive resistance of driven piles, bored piles and Continuous Flight Auger (CFA) piles, in accordance with clause 7.6.2.2(14) P, clause 7.6.2.3(4)P and clause 7.6.2.4(4)P of the standard,, Set R2 for partial resistance factors shall be applied. For base, shaft and total/combined (compression) cases the partial safety factor is 1.2, and for tensile piles it is 1.35 in short-term loading and 1.5 in long-term loading.

When determining the correlation factor to derive characteristic values for base and shaft resistance from ground test results, in accordance with clause 7.6.2.3(5)P of the standard, the values below shall be applied to correlation factors ξ_3 and ξ[illegible]. The number of test profiles is 'n'.

ξ, where n =	1	2	3	4	5	7	10
ξ_3	1.85	1.77	1.73	1.69	1.65	1.62	1.60
ξ_4	1.85	1.65	1.60	1.55	1.50	1.45	1.40

When assessing the compressive resistance of a pile foundation according to the alternate method given in clause 7.6.2.3(8) of the standard, the value of the model factor correcting the partial safety factors for friction piles is 1.60 or greater. For cohesion piles, the model factor is 1.95 or greater in long-term loading and 1.40 or greater in short-term loading.

Instruction

Ultimate compressive resistance from static load tests

7.6.2.2(14) P
The values for partial factors for the pile strength are given in Tables 9, 10 and 11.

Ultimate compressive resistance from ground test results

7.6.2.3(4)P
The values for partial factors for the pile strength are given in Tables 9, 10 and 11.

Ultimate compressive resistance from dynamic impact tests

7.6.2.4(4)P
The values for partial factors for the pile resistance are given in Tables 9, 10 and 11 and the values for correlation factors ξ_5 and ξ_6 are given in Table 14.

6. Ground tensile resistance

Ministry of the Environment Decree (13/16) concerning national choices with regard to the general rules for geotechnical design, when applying standard SFS-EN 1997-1
Section 6 *Resistance*

When deriving the design value of pile resistance, in accordance with clause 7.6.3.2(2)P and clause 7.6.3.3(3)P of the standard, Set R2 for partial resistance factors for driven piles, bored piles and CFA piles shall be applied. For base, shaft and total/combined (compression) cases, the partial safety factor for tensile piles is 1.35 in short-term loading and 1.5 in long-term loading.

When determining the characteristic value of the pile resistance, in accordance with clause 7.6.3.2(5)P of the standard, the correlation factors ξ_1 and ξ_2 given in the standard shall be multiplied by the model factor 1.25.
When determining the characteristic value of the pile resistance, in accordance with clause 7.6.3.3(4)P of the standard, the values given in Section 5(3) shall be applied to the correlation factors. When determining the characteristic value of the pile resistance, in accordance with clause 7.6.3.3(6) of the standard, the value of the model factor correcting the partial safety factor shall be at least 1.5 for both short-term and long-term loading.

Instruction

Ultimate tensile resistance from pile load tests

7.6.3.2(2)P
The values for partial factors for the pile strength are given in Tables 9, 10 and 11.

7.6.3.2(5)P
The values for correlation factors are set forth in Table 12.

Ultimate tensile resistance from ground test results

7.6.3.3(3)P
The values for partial factors for the pile strength are given in Tables 9, 10 and 11.

7. Anchorages

Ministry of the Environment Decree (13/16) concerning national choices with regard to the general rules for geotechnical design, when applying standard SFS-EN 1997-1
Section 7 Anchorages

When determining the pull-out resistance in the ultimate limit state, in accordance with clause 8.5.2(2)P of the standard, i, Set R2 shall be applied so that the partial factor for pull-out resistance is 1.25 for temporary anchorage and 1.5 for permanent anchorage.

Instruction

The values for partial factors for preloaded anchors are given in Table 15.

9 Retaining structures

Instruction

Additional loads

9.3.1.3(1)P
If the soil structure or retaining structure is susceptible to vibration caused by heavy traffic, quarrying, pile driving or and other foundation work or to other types of heavy vibration, the effect on soil pressure is determined by taking into account the nature of the vibration, the distance to the source and the properties of the soil layers. Unless another calculation method is available, the earth pressure at rest state is used on the active side near the centre of the vibration, and passive soil pressure is reduced by not less than 25%.

Limiting values for earth pressure

9.5.3(2)
The limiting values for earth pressure and their formation regarding the displacement is calculated according to Informative Annex C to SFS-EN 1997-1, unless site-specific values can be reliably determined based on sufficiently long-term test loads.

Using factors K_p from Annex C to standard SFS-EN 1997-1 for the passive pressure is especially recommended when the ground's internal friction angle is large.

8. Stability analysis for slopes

Ministry of the Environment Decree (13/16) concerning national choices with regard to the general rules for geotechnical design, when applying standard SFS-EN 1997-1
Section 8 Stability analysis for slopes

The overall stability of slopes shall be verified, in accordance with clause 11.5.1(1)P of the standard, with design values of actions, resistances and strengths, which shall be determined in accordance with the Ministry of the Environment Decree concerning national choices for the basis of structural design, when applying standard SFS-EN 1990. Set M2 shall be applied to partial safety factors for soil parameters so that the value of the partial safety factor is 1.5 for undrained shear strength and compression resistance. Set R3 shall be applied to partial safety factors for soil resistance so that the value of the partial safety factor is 1.0 for slopes and overall stability.

Instruction

Stability analysis for slopes

11.5.1(1)P
The values for partial factors are given in Tables 6, 7 and 16.

Serviceability limit state design

11.6(3)
The approximate serviceability limit state design can be performed by limiting the mobilising shear strength by means of applying raised partial factors for soil parameters. The approximate serviceability limit state design may only be used when the soil characteristics

can be reliably determined under the studied, possibly changed conditions. The changed conditions may be related to stress or groundwater flow, for example. In this case, a second stability calculation is performed following the ultimate limit state analysis pursuant to clause 11.5 of standard SFS-EN 1997-1, where the loads are included at their characteristic values and the partial factors for soil parameters are taken from Table 3. In practice, the partial factors in the table correspond to the overall safety required at the serviceability limit state.

In cases where the ground displacements cannot be calculated to a sufficient level of reliability and the ground displacements are has influence, the calculation of the displacements can be replaced by an additional serviceability limit state analysis of the stability that uses a higher safety level. These include, for example, situations where structures are located within the area of plastic displacements.

Table 3. *Elevated partial factors (γ_M) for soil parameters that are used in stability analysis of serviceability limit state in different consequence classes. In the stability analysis pursuant to the serviceability limit state, the partial factor used for loads is 1.0.*

Soil parameter	*Symbol*	*Set M2**		
		CC1	*CC2*	*CC3*
Angle of shearing resistance[a] ("Friction angle")	$\gamma_{\phi'}$	*1.5*	*1.65*	*1.8*
Effective cohesion	$\gamma_{c'}$	*1.5*	*1.65*	*1.8*
Undrained shear strength	γ_{cu}	*1.65*	*1.8*	*2.0*
Unconfined strength	γ_{qu}	*1.65*	*1.8*	*2.0*
Weight density	γ_{γ}	*1.0*	*1.0*	*1.0*

During the execution stage of the construction plan in the design of short-term load conditions, partial factor values of one class lower may be adopted in consequences classes CC2 and CC3, if there are no structures sensitive to the effects of displacement within the area of impact of the sliding surface.

Annex A
Partial and correlation factors for ultimate limit states and recommended values

Instruction

Partial factors for demonstrating static equilibrium limit state (EQU)

A.2(1)P

Table 4. Partial factors for actions (γ_F) (EQU).

Load	*Symbol*	*Value*
Permanent		
Unfavourable[a]	$\gamma_{G,dst}$	*1.1K_{FI}*
Favourable[b]	$\gamma_{G,,stb}$	*0.9*
Variable		
Unfavourable[a]	$\gamma_{Q,dst}$	*1.5 K_{FI}*
Favourable[b]	$\gamma_{Q,stb}$	*0*
[a] Destabilising load [b] Stabilising load		

A.2(2)P

Table 5. Partial factors for soil parameters (γ_M) (EQU).

Soil parameter	Symbol	Value
Angle of shearing resistance[a] ("Friction angle")	$\gamma_{\phi'}$	1.25
Effective cohesion	$\gamma_{c'}$	1.25
Undrained shear strength	γ_{cu}	1.5
Unconfined strength	γ_{qu}	1.5
Weight density		1.0
[a] The factor is applied to tan ϕ'		

Partial factors for actions (γ_F) or the effects of actions (γ_E)

A.3.1(1)P

Table 6. Partial factors for actions (γ_F) or the effects of actions (γ_E) (STR/GEO).

Load	Symbol	Set	
		A1	A2
Permanent:			
Unfavourable			
(Eq.6.10a)		1.35 K_{FI}	
(Eq.6.10b)	$\gamma_{Gkj,sup}$	1.15 K_{FI}	
(Eq.6.10)			1.0 K_{FI}
Favourable			
(Eq.6.10a)		0.9	
(Eq.6.10b)	$\gamma_{Gkj,inf}$	0.9	
(Eq.6.10)			1.0
Variable			
Unfavourable			
(Eq.6.10b)	γ_Q	1.5 K_{FI}	
(Eq.6.10)			1.3 K_{FI}
favourable		0	0

Note 1:
In design approaches DA 2 and DA 2*, the load combination used is the less favourable of the following two expressions. Set A1 is used as the partial factors.

$$1.15\ K_{FI}\ G_{kj,sup} + 0.9\ G_{kj,inf} + 1.5\ K_{FI} Q_{k,1} + 1.5 K_{FI} \sum_{I>1} \psi_{0,i}\ Q_{k,i} \quad (1.1)$$

$$1.35\ K_{FI}\ G_{kj,sup} + 0.9\ G_{kj,inf} \quad (1.2)$$

In design approach DA 3, the loads are combined with the expression 1.3 and the partial factors are taken from set A2.

$$1.0\ K_{FI}\ G_{kj,sup} + 1.0\ G_{kj,inf} + 1.3\ K_{FI}\ Q_{k,1} + 1.3\ K_{FI} \sum_{i>1} \psi_{0,i}\ Q_{k,i} \quad (1.3)$$

In expressions 1.2 and 1.3, $\psi_{0,i}$ is the combination factor for variable loads whose values concerning buildings are presented in the Ministry of Environment's decree on national choices concerning standard SFS-EN 1990. In the combination of other variable actions, the combination factor $\psi_{0,i} = 1{,}0$ is adopted unless other more detailed analyses are made.

K_{FI} depends on the reliability class given in table B3 of Annex B to standard SFS-EN 1990.

Note 3:
All characteristic values of permanent actions coming from one source are multiplied by the partial safety factor $\gamma_{G,sup}$, if the total action effect is unfavourable, and by the partial safety factor $\gamma_{G,inf}$, if the total action effect is favourable. For example, all actions originating from the self-weight of the structure may be considered as coming from one source; this also applies if different materials are involved.

Partial factors for soil parameters (γ_M)

A.3.2(1)P

Table 7. Partial factors for soil parameters (γ_M) (resistance and geotechnical load-bearing capacity of structural members).

Soil parameter	Symbol	Set	
		M1	M2
Angle of shearing resistance[a] ("Friction angle")	$\gamma_{\phi'}$	1.0	1.25
Effective cohesion	$\gamma_{c'}$	1.0	1.25
Undrained shear strength	γ_{cu}	1.0	1.5
Unconfined strength	γ_{qu}	1.0	1.5
Weight density	γ_{γ}	1.0	1.0
[a] The factor is applied to tan ϕ'			

Partial resistance factors for spread foundations

A.3.3.1(1)P

Table 8. Partial resistance factors (γ_R) for spread foundations.

Resistance	Symbol	Set R2
Bearing re-sistance	$\gamma_{R,v}$	1.55
Sliding	$\gamma_{R,h}$	1.1

Partial resistance factors for piling foundations

A.3.3.2(1)P

Table 9. Partial resistance factors for driven piles (γ_R).

Resistance	Symbol	Set R2
Base	γ_b	1.2
Shaft (compression)	γ_s	1.2
Total/combined (compression)	γ_t	1.2
Shaft in tension: - short-term loading - long-term loading	 $\gamma_{s,t}$ $\gamma_{s,;t}$	 1.35 1.5

Table 10. Partial resistance factors for bored piles (γ_R).

Resistance	Symbol	Set R2
Base	γ_b	1.2
Shaft (compression)	γ_s	1.2
Total/combined (compression)	γ_t	1.2
Shaft in tension: - short-term loading - long-term loading	 $\gamma_{s,t}$ $\gamma_{s,;t}$	 1.35 1.5

Table 11. Partial resistance factors for CFA piles (γ_R).

Resistance	Symbol	Set R2
Base	γ_b	1.2
Shaft (compression)	γ_s	1.2
Total/combined (compression)	γ_t	1.2
Shaft in tension: - short-term loading - long-term loading	 $\gamma_{s,t}$ $\gamma_{s,t}$	 1.35 1.5

Correlation factors for pile foundations

A.3.3.3(1)P

Table 12. Correlation factors ξ to derive characteristic values from static pile load tests (n– number of tested piles)[a,b].

ξ when n=	1	2	3/50%	4	5/100%
ξ_1	1.40	1.30	1.20	1.10	1.00
ξ_2	1.40	1.20	1.05	1.00	1.00

[a]The values in the table are valid for compressed piles.
[b]For tensile piles, the values in the table are multiplied by a model factor of 1.25
[c]The number means the number of measurements in similar piles in similar soil conditions regarding the geotechnical resistance or the proportion of measured piles of the total number of similar piles in similar soil conditions. According to the number or percentage, the one giving the smaller correlation factor is selected.

Table 13. Correlation factors ξ to derive characteristic values from ground test results (n – number of test profiles).

ξ when n =	1	2	3	4	5	7	10
ξ_3	1.85	1.77	1.73	1.69	1.65	1.62	1.60
ξ_4	1.85	1.65	1.60	1.55	1.50	1.45	1.40

Table 14. Correlation factors ξ to derive characteristic values from dynamic impact tests [a,b,c,d,e] (n – number of test loaded piles).

ξ when n =	= or >2	=>5	=> 20/50%	=>15	=> 20/100%
ξ_5	1.60	1.50	1.45	1.42	1.40
ξ_6	1.50	1.35	1.30	1.25	1.25

[a] The ξ values of in the table are valid for dynamic impact tests.
[b] The ξ values may be multiplied by a model factor of 0.9 when using signal matching. The values may be multiplied by 0.9 also without signal matching when the piles rest reliably on the bedrock and the geotechnical resistance of the pile depends principally on its structural resistance.
[c] The ξ values are multiplied by a model factor of 1.1 when a pile driving formula is used and the quasi-elastic pile head displacement is measured during the impact.
[d]The ξ values are multiplied by a model factor of 1.2 when using a pile driving formula without the measurement of the quasi-elastic pile head displacement during the impact.
[e] If different piles exist in the foundation, groups of similar piles are considered separately when selecting the number of test piles n.
[f]The number means the number of measurements in similar piles in similar soil conditions regarding the geotechnical resistance or the proportion of the total amount of piles of the total number of . According to the number or percentage, the one giving the smaller correlation factor is selected.

The ξ values may be multiplied by 0.9 also without signal matching when the piles rest reliably on the bedrock and the resistance of the pile depends principally on its structural resistance.

For structures having sufficient stiffness and strength to transfer loads from “weak” to “strong” piles, the factors ξ_5 and ξ_6 may be divided by 1.1.

The number n means the number of measurements in similar piles in similar soil conditions regarding the geotechnical resistance or the proportion of measured piles of the total number of piles. According to the number or percentage, the one giving the smaller correlation factor is selected.

The use of a pile driving formula requires that the formula is previously regarded reliable under similar conditions and that the piling rig has been calibrated under appropriate site conditions.

Partial resistance factors for anchors

A.3.3.4(1)P

Table 15. Partial factors for preloaded anchors (γ_R).

Resistance	Symbol	Set R2
Temporary	$\gamma_{a,t}$	1.25
Permanent	$\gamma_{a,p}$	1.5

Partial resistance factors (γ_R) for retaining structures

A.3.3.5(1)P

Table 16. Partial resistance factors for retaining structures (γ_R).

Resistance	Symbol	Set R2
Bearing resistance	$\gamma_{R,v}$	1.55
Sliding resistance	$\gamma_{R,h}$	1.1
Earth resistance	$\gamma_{R,e}$	1.5

Partial resistance factors (γ_R) for slopes and overall stability

A.3.3.6(1)P

Table 17. Partial resistance factors (γ_R) for slopes and overall stability

Resistance	Symbol	Set R3
Earth resistance	$\gamma_{R,e}$	1.0

Partial factors for uplift limit state (UPL) verifications

A.4(1)P

Table 18. Partial factors for actions (γ_F) (UPL).

Load	Symbol	Value
Permanent		
Unfavourable[a]	$\gamma_{G,dst}$	1.1K_{FI}
Favourable[b]	$\gamma_{G,,stb}$	0.9
Variable		
Unfavourable[a]	$\gamma_{Q,dst}$	1.5 K_{FI}
[a] Destabilising load [b] Stabilising load		

A.4(2)P

Table 19. Partial factors for soil parameters and resistances (UPL).

Soil parameter	Symbol	Value
Angle of shearing resistance[a] (“Friction angle”)	$\gamma_{\phi'}$	1.25
Effective cohesion	$\gamma_{c'}$	1.25
Undrained shear strength	γ_{cu}	1.5
Tensile pile resistance	$\gamma_{s,t}$	1.5
Anchorage resistance at ultimate limit state	$\gamma_{a:ULS}$	1.5
[a] The factor is applied to tan ϕ'		

Partial factors for hydraulic heave limit state (HYD) verification

A.5(1)P

Table 20. Partial factors for actions (γ_F) (HYD).

Load	Symbol	Value
Permanent		
Unfavourable[a] Unfavourable[a]	$\gamma_{G,dst}$ $\gamma_{G,dst}$	1.35K_{FI} favourable soil conditions 1.8K_{FI} unfavourable soil conditions
Favourable[b]	$\gamma_{G,,stb}$	0.9
Variable		
Unfavourable[a]	$\gamma_{Q,dst}$	1.5 K_{FI}
[a] Destabilizing [b] Stabilising		

9. Annex H (informative): Limiting values of structural deformation and foundation movement

Ministry of the Environment Decree (13/16) concerning national choices with regard to the general rules for geotechnical design, when applying standard SFS-EN 1997-1

Section 9 Annex H (informative): Limiting values of structural deformation and foundation movement

Annex H is not used.

National Annex to standard SFS-EN 1997-2: Geotechnical design.
Part 2: Ground survey and testing

Instruction

Standard SFS-EN 1997-2 refers to the technical guidelines of CEN ISO/Technical Specifications (CEN ISO/TS) used as supplementary material. The recommendations concerning the use of the guidelines are given in Table 1. The choices concerning the use of the informative annexes to standard SFS-EN 1997-2 are set out in Table 2 of this National Annex.

Some of the CEN ISO/TS publications and informative annexes (or their parts) are suitable for use as such. Some of them remain informative until they are published as standards.

Instructions for application are given in the SFS manuals SFS 179-2:2008 concerning geotechnical research and testing.

Table 1. Use of CEN ISO/TS publications in Finland

Item/CEN ISO/TS	Adopted as such	**Further information**
4.8.1(2)P, Note, CEN ISO/TS 22476-10:2005 (Weight sounding)	No	Used together with national application instructions
4.10.1(4), Note, CEN ISO/TS 22476-11:2005 (Flat dilatometer)	Yes	
5.5.3.1(3), Note, CEN ISO/TS 17892-1:2004 (Determination of water content)	No	SFS-EN ISO 17892-1
5.5.4.1(3)P, Note, CEN ISO/TS 17892-2:2004 (Determination of bulk density)	No	SFS-EN ISO 17892-2
5.5.5.1(2)P, Note, CEN ISO/TS 17892-3:2004 (Determination of particle density)	No	Used together with national application instructions
5.5.6.1(1), Note, CEN ISO/TS 17892-4:2004 (Determination of particle size distribution))	No	Used together with national application instructions
5.5.7.1(5), Note, CEN ISO/TS 17892-12:2004 (Determination of consistency limits)	No	Used together with national application instructions
5.7.2(1)P, Note, CEN ISO/TS 17892-6:2004 (Fall cone test)	No	Used together with national application instructions
5.8.4.1(2), Note, CEN ISO/TS 17892-7:2004 (Unconfined compression test)	Yes	Note: Does not apply to stabilised soil.
5.8.5.1(3)P, Note, CEN ISO/TS 17892-8:2004 (Unconsolidated undrained triaxial test)	Yes	
5.8.6.1(1)P, Note, CEN ISO/TS 17892-9:2004 (Consolidated triaxial compression test)	No	Used together with national application instructions
5.8.7.1(1)P, Note, CEN ISO/TS 17892-10:2004 (direct shear test)	Yes	
5.9.2.2(7)P, Note, CEN ISO/TS 17892-5:2004 (Incremental loading oedometer test)	No	Used together with national application instructions
5.11.2(1)P and (8), Note, CEN ISO/TS 17892-11:2004 (Determination of permeability by constant and falling head test)	No	Used together with national application instructions
5.12.4.1(5)P, Note, Annex U.3 and clause X.4.9.2 (Determination of rock water content)	Yes	
5.12.5.1(4), Note, Annex U.4 and clause X.4.9.3 (Determination of density and porosity)	Yes	
5.12.5.2(3), Note, CEN ISO/TS 17892-3:2004 (Determination of density and porosity)	Yes	

Table 2. Use of informative annexes in Finland

Annex/subject	Adopted as such	**Further information**
A List of investigation results of geotechnical test standards	Yes	
B Design of geotechnical investigations: - *B.1 Stages of ground investigations* - *B.2 Choice of ground investigation methods* - *B.3 The spacing for survey points and the survey depths*	Yes Yes	Geophysical methods other than seismic sounding may also be approved for use. When determining the spacing for survey points and the survey depths, the small scale of geological formations in Finland is taken into account.
C An example of the derivation of groundwater pressure on the basis of a model and long-term observations	Yes	
D Static sounding tests, CPT, CPTU and CPTM tests	Yes	
E Pressometer test (DMT)	Yes	
F SPT drilling	Yes	
G Dynamic probing (DP)	Yes	
H Weight sounding (WST)	Yes	
I Field vane test (FVT)	Yes	
J Dilatometer test (DMT)	Yes	
K Plate loading test (PLT)	Yes	
L Preparation of soil sample for testing	Yes	
M.1 Check list for classification tests	Yes	
*M.2 **D**etermination of water content*	Yes	
M.3 Determination of bulk density	Yes	
M.4 Determination of solid density	No	Used together with national instructions
M.5 Grain size analysis	No	Used together with national instructions
M.6 Determination of relative density	Yes	
M.7 Determination of dispersion of soil type	Yes	
M.8 Determination of frost susceptibility	Yes	
N Soil chemical tests	Yes	
O Strength index tests of soil	No	
P Strength tests of soil: - *triaxial compression tests* - *consolidated direct box shear tests*	 No Yes	 Used together with national instructions
Q Compressibility tests of soil (oedometer test)	No	Used together with national instructions
R Compaction tests of soil	Yes	
S Water permeability tests of soil	No	Used together with national instructions
T Preparation of rock samples	Yes	
U Classification test of rock material	Yes	
V Expansion tests of rock material	Yes	
W Strength tests of rock material	Yes	
X Literature	Informative use	