Annex 18

NATIONAL ANNEX

TO

SFS-EN 1997-1 EUROCODE 7: GEOTECHNICAL DESIGN
Part 1 – General Rules

This national annex is used together with Standard SFS-EN 1997-1:2004

CONTENTS

1. Foreword

The National annex is used together with the standard SFS-EN 1997-1:2004. The nationally determined parameters are valid for house building and related excavation and earth works.

2. Nationally determined parameters

Partial and correlation factors for ultimate limit states are presented in Annex A (normative) of the standard SFS-EN 1997-1; the values of these factors are the nationally determined parameters. Table 1 shows in which clauses of this National annex the values of these parameters to be used in Finland are given or the table states these values. The values in Tables A(FI) of this National Annex replace the recommended values in Annex A of SFS-EN 1997-1:2004.

In the standard SFS-EN 1997-1:2004 there are numerous references to ‘a model factor’ which has no ascribed value. To items without a clearly stated numerical value by Table 1, a designer may apply values considered by himself. Selection of these values shall be made so that the national overall safety level will be preserved (cf. clause 6.2).

Partial safety factors recommended in Table A(FI) are valid for normally persistent and transient design situations. In cases with exceptionally high risks or with unusual or exceptionally difficult soil or loading conditions, appropriate partial factors on actions $\gamma_{G/Q}$ K_{FI} are applied. In addition, to achieve a sufficient safety, partial resistance factors (γ_R) may be increased by a model factor the value of which is not provided in this National Annex. See clause 6.2 of this National Annex.

For temporary structures or in temporary design situations, appropriate partial safety factors $\gamma_{G/Q}$ K_{FI} on actions are applied. As appropriate, the partial safety factors (γ_R) given below for respective limit states are applied on resistances. See item 6.2 of this National Annex.

Symbols used in the National Annex are presented in clauses 1.6 of the standards SFS-EN 1997-1:2004 and SFS-EN 1990:2002

3. Country specific data

3.1. Required foundation depth to overcome frost heave

General guidelines for house building on determination of ground frost susceptibility and required foundation depth at the construction site against frost heave are provided in clauses 2.5.1.ja 4.4.1.2. of the National Building Code of Finland part B3 (2004).

3.2. Risk of flood and landslide

Risk of flood and landslide related to the construction site is considered according to clauses 2.6.1 and 2.6.2 of the National Building Code of Finland part B3 (2004).

3.3. Contaminated ground

Purity of the ground at the construction site and the effect of harmful substances on the planning and execution of construction is clarified according to clause 2.7.1 of the National Building Code of Finland part B3 (2004).

3.4. Risk of radon

Risk of radon at the construction site is taken into consideration in planning and construction according to clause 2.8.1 of the National Building Code of Finland part B3 (2004).

4. Procedure to be followed when alternative methods are given in EN 1997-1:2004

In Finland, Design Approach 2 is used in the design of spread foundations, pile foundations, anchorages and retaining structures. In the design of slopes and overall stability, Design Approach 3 is used.

Note: 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 calculation in verifying the ultimate limit state condition (see Designers' guide to EN 1997-1 - EUROCODE 7: Geotechnical design - General rules. Thomas Telford 2004; ISBN 0 7277 3154 8).*

When using the design approach DA2 special attention shall be given to the verification of the stability of a foundation structure.*

5. Use of informative annexes

The annex H is not valid in Finland. Other annexes may be used in Finland.

In the building design, regulations given in clauses 4.1.5.and 4.1.6 of the National Building Code of Finland part B3 are followed instead of those in annex H.

6. Reference to non-contradictory, complementary information to assist the user in applying the Eurocode

6.1. Prescriptive methods

Design situations in which exceeding limit states may be avoided by the use of prescriptive measures involving conventional and generally conservative rules, are among others frost heave, flood and landslide (cf. 3.2), contaminated ground (cf. 3.3) and risk of radon and the design of easy foundation engineering works. (Cf. SFS-EN 1997-1:2004; clause 2.5)

6.2. Internationally recognized standards and recommendations

In the standard SFS-EN 1997-1:2004 there are references to procedures to be applied, in the absence of SFS-EN standards, according to 'internationally recognized standards and recommendations', e.g. in clauses 3.1(3)P, 7.5.2.1(1)P and 7.5.3(1). Those international and national standards and specifications may be used before the substitutive SFS-EN standards have been published.

Table 1(FI) – Clauses in which national choices exist and where quidance is given in this National Annex.

Item	**Object**	**Rules of this National annex**
2.1(8)P	Minimum requirements *for light and simple structures and small earth-works*	When judging complexity of design at a project level one may proceed as stated in the National Building Code of Finland, part A2. See clause 6.1 of this National Annex and Table B1(FI) in the National Annex to SFS-EN 1990.
2.4.6.1(4)P	Value of partial safety factor γ_F in equation (2.1a).	Take values in Tables A.1(FI), A.3(FI), A.15(FI) and A.17(FI) of this National Annex.
2.4.6.2(2)P	Value of partial safety factor γ_M in equation (2.2).	Take values in Tables A.2(FI), A.4(FI) and A.16(FI) of this National Annex.
2.4.7.1(2)P	Values of partial safety factors *in persistent and transient situations.*	Take values in Tables A(FI) of this National Annex if applicable.
2.4.7.1(3)	Values of partial safety factors *in accidental situations.* Values of partial safety factors for *resistance*	The value to be taken for actions or the effects of actions is 1,0. If applicable, take values of appropriate limit states given below.
2.4.7.2(2)P	NOTE.2: Values of partial safety factors *in persistent and transient situations.*	Take values in Tables A.1(FI) and A.2(FI) of this National Annex.
2.4.7.3.2(3)P	Values of partial safety factors in equations (2.6a) and (2.6b).	Take values in Tables A.3(FI) and A.4(FI) of this National Annex.
2.4.7.3.3(2)P	Values of partial safety factors in equations (2.7a, b and c).	Take values in Tables A.5(FI) - A.8(FI) and A.12(FI) – A.14(FI) this National Annex
2.4.7..3.4.1(1)P	NOTE.1: Design Approach to be used	In the design of spread foundations, pile foundations, anchors and retaining structures, Design Approach 2 is used. In the design of slopes and overall stability, Design Approach 3 is used. (See section 4).
2.4.7.4(3)P	Values of partial safety factors *in persistent and transient situations.* in equation (2.8).	Take values in Tables A.15(FI) and A.16(FI) of this National Annex.
2.4.7.5(2)P	Values of partial safety factors *in persistent and transient situations.* in equation (2.9a and 2.9b).	Take values in Table A.17(FI) of this National annex.
2.4.7.5(2)P	Values of partial safety factors *in persistent and transient situations.* in equation (2.9a and 2.9b).	
2.4.8(2)	Values of partial safety factors in *serviceability limit state.*	Take the value of 1,0.
2.4.9(1)P	Permitted foundation movements.	Permitted values are not given in this National annex. Suggestive limit values are given in clauses 4.1.5 and 4.1.6 of the National Building Code of Finland, part B3 (2004).
2.5(1)	Conventional and generally conservative	See clause 2.1(8)P above and clause 6.1 of this National Annex.
7.6.2.2(8)P	Values of correlation factors ξ_1 and ξ_2.	Take values in Tables A.9(FI) of this National Annex.
7.6.2.2(14)P	Values of partial safety factors γ_b, γ_s and γ_t.	Take values in Tables A.6(FI), A.7(FI) and A.8(FI) of this National Annex depending on the pile type.
7.6.2.3(4)P	Values of partial safety factors γ_b and γ_s.	Take values in Tables A.6(FI), A.7(FI) and A.8(FI) of this National Annex depending on the pile type.
7.6.2.3(5)P	Values of correlation factors ξ_3 and ξ_4.	Take values in Tables A.10(FI) of this National Annex.
7.6.2.3(8) NOTE.	Value of model factor correcting the partial safety factors γ_b and γ_s.	Take a model factor not less than 1,60 for friction piles. For cohesion piles the model factor is $\geq$ 1,95 in long-term loading and $\geq$ 1,40 in short-term loading.
7.6.2.4(4)P	Values of partial safety factor γ_t and correlation factors ξ_5 and ξ_6	For partial safety factor γ_t, take the values in TablesA.6(FI), A.7(FI) and A.8(FI) of this National Annex depending on the pile type. For correlation factors ξ_5 and ξ_6, take the values in Table A.11(FI) of this National Annex.
7.6.3.2(2)P	Value of partial safety factor $\gamma_{s;t}$.	Take values in Tables A.6(FI), A.7(FI) and A.8(FI) of this National Annex depending on the pile type.
7.6.3.2(5)P	Values of correlation factors ξ_1 and ξ_2.	Take values in Tables A.9(FI) of this National Annex.
7.6.3.3(3)P	Value of partial safety factor $\gamma_{s;t}$	For partial safety factor $\gamma_{s;t}$, take the values in TablesA.6(FI), A.7(FI) and A.8(FI) of this National Annex depending on the pile type.
7.6.3.3(4)P	Values of correlation factors ξ_3 and ξ_4 .	Take values in Tables A.10(FI) of this National Annex.
7.6.3.3(6)	Value of model factor correcting the partial safety factor $\gamma_{s;t}$.	Take a model factor not less than 1,50 for both short and long-term loading.
8.5.2(2)P	Value of partial safety factor γ_a .	Take values in Tables A.12(FI) of this National Annex.
8.5.2(3) NOTE.	Value of correlation factor ξ_a.	Value for ξ_a is not given in this National Annex.
8.6(4)	Value of model factor.	Value of model factor is not given in this National Annex.
11.5.1(1)P	Values of partial safety factors	Take values in Tables A.3(FI), A.4(FI) ja A.14(FI) of this National Annex.

Partial and correlation factors for ultimate limit states to be applied in Finland

Table A.1(FI) – Partial factors on actions (γ_F) (EQU)

Cf. National Annex of SFS-EN 1990:2002, Table A1.2(A)(FI)

Action	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
[b] Stabilising

K_{FI} depends on the reliability class in SFS-EN1990 Annex B, Table B2 as follows:
in reliability class RC3 $K_{FI} = 1,1$
in reliability class RC2 $K_{FI} = 1,0$
in reliability class RC1 $K_{FI} = 0,9$

Consequences classes CC3…CC1 clarifying the reliability classes are presented in Table B1(FI) of the National Annex of SFS-EN 1990: Definition of consequences classes..

Symbols used in this National Annex are presented in clause 1.6 of the standard SFS-EN 1997-1:2004 and in clause 1.6 of the standard SFS-EN 1990:2002.

Comment: Earth pressure in this limit state is calculated as earth pressure at rest.

Table A.2(FI) – 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	γ_{γ}	1,0

[a] The factor is applied to tan ϕ'

Table A.3(FI) – Partial factors on actions (γ_F) or the effects of actions (γ_E) (STR/GEO)

Cf. National annex of SFS-EN 1990: Table A1.2(B)(FI) and set A1 and Table A1.2(C)(FI) and set A2

Action	**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: The case can be expressed as a design equation so that the less favourable of the two following expressions is used as the combination of actions.

$$1{,}15\ K_{FI}\ G_{kj,sup} + 0{,}9\ G_{kj,inf} + 1{,}5\ K_{FI}\ Q_{k,1} + 1{,}5\ K_{FI} \sum_{i>1} \psi_{0,i}\ Q_{k,i} \qquad \text{(Eq.6.10b)}$$

$$1{,}35\ K_{FI}\ G_{kj,sup} + 0{,}9\ G_{kj,inf} \qquad \text{(Eq.6.10a)}$$

K_{FI} depends on the reliability class in SFS-EN1990 Annex B, Table B2 as follows:

in reliability class RC3 K_{FI} = 1,1
in reliability class RC2 K_{FI} = 1,0
in reliability class RC1 K_{FI} = 0,9

Consequences classes CC3…CC1 clarifying the reliability classes are presented in Table B1 (FI) of the National Annex SFS-EN 1990: Definition of consequences classes..

Symbols used in this National Annex are presented in clause 1.6 of the standard SFS-EN 1997-1:2004 and in clause 1.6 of the standard SFS-EN 1990:2002.

Note 2: See also values of partial safety factors γ applied in forced movement or strain state in the standards SFS-EN 1992 … SFS-EN 1999.

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 instance, all the 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.

Note 4: See also Tables A1.2(B)(FI) and A1.2(C)(FI) in the standard SFS-EN 1990.

Table A.4(FI) – Partial factors for soil parameters (γ_M) (STR/GEO)

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'

Taulukko A.5(FI) – Partial resistance factors (γ_R) for spread foundations

Resistance	Symbol	Set *R2*
Bearing	$\gamma_{R,v}$	1,55
Sliding	$\gamma_{R,h}$	1,1

Table A.6(FI) – Partial resistance factors (γ_R) for driven piles

Resistance	Symbol	Set *R2*
Base	γ_b	1,20
Shaft (compression)	γ_s	1,20
Total/combined (compression)	γ_t	1,20
Shaft in tension:		
- short-term loading	$\gamma_{s,t}$	1,35
- long-term loading	$\gamma_{s;t}$	1,50

Tble A.7(FI) – Partial safety factors (γ_R) for bored piles

Resistance	Symbol	Set *R2*
Base	γ_b	1,20
Shaft (compression)	γ_s	1,20
Total/combined (compression)	γ_t	1,20
Shaft in tension:		
- short-term loading	$\gamma_{s,t}$	1,35
- long-term loading	$\gamma_{s;t}$	1,50

Table A.8(FI) – Partial resistance factors (γ_R) for CFA piles

Resistance	Symbol	Set *R2*
Base	γ_b	1,20
Shaft (compression)	γ_s	1,20
Total/combined (compression)	γ_t	1,20
Shaft in tension:		
- short-term loading	$\gamma_{s,t}$	1,35
- long-term loading	$\gamma_{s;t}$	1,50

Table A.9(FI) – Correlation factors ξ to derive characteristic values from static pile load tests (n – number of tested piles)[a,b]

ξ for 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 (A.9(FI)) are multiplied with a model factor 1,25.

Table A.10(FI) – Correlation factors ξ to derive characteristic values from ground test results (n – number of test profiles)

ξ for 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 A.11(FI) – Correlation factors ξ to derive characteristic values from dynamic impact tests[a,b,c,d,e] (n – number of tested piles)

ξ for n	=>2	=>5	=>10/50 %	=>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 are valid for dynamic impact tests.

b The ξ-values may be multiplied with a model factor 0,9 when using signal matching.

c The ξ-values are multiplied with a model factor 1,1 when using a pile driving formula with measurement of the quasi-elastic pile head displacement during the impact.

d The ξ-values are multiplied with a model factor 1,2 when using a pile driving formula without 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 n of test piles.

Comment: The ξ-values may be multiplied with 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 values ξ_5 *and* ξ_6 *may be divided by 1,1.*

The number of piles 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 similar piles in similar soil conditions (50 %, 100 %). According to the number or percentage, the one giving the smaller correlation value is selected.

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

Table A.12(FI) – Partial resistance factors (γ_R) for pre-stressed anchorages.

Resistance	Symbol	Set *R2*
Temporary	$\gamma_{a,t}$	1,25
Permanent	$\gamma_{a,p}$	1,50

Table A.13(FI) – Partial resistance factors (γ_R) for retaining structures

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

Table A.14(FI) – Partial resistance factors (γ_R) for slopes and overall stability

Resistance	Symbol	Set *R3*
Earth resistance	$\gamma_{R,e}$	1,0

Table A.15(FI) – Partial factors on actions (γ_F) (UPL)

Action	Symbol	Value
Permanent:		
Unfavourable[a]	$\gamma_{G,dst}$	1,1 K_{FI}
Favourable[b]	$\gamma_{G,stb}$	0,9
Variable		
Unfavourable[a]	$\gamma_{Q,dst}$	1,5 K_{FI}

[a] Destabilising action
[b] Stabilising action

Table A.16(FI) – 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	γ_a	1,5

[a] This factor is applied to tan ϕ'

Table A.17(FI) – Partial factors on actions (γ_F) (HYD)

Action	Symbol	Value
Permanent:		
Unfavourable[a]	$\gamma_{G,dst}$	1,35 K_{FI} (favourable soil conditions)
- ” -	”	1,8 K_{FI} (unfavourable soil conditions)
Favourable[b]	$\gamma_{G,stb}$	0,9
Variable:		
Unfavourable[a]	$\gamma_{Q,dst}$	1,5 K_{FI}

[a] Destabilising action
[b] Stabilising action