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NATIONAL ANNEX (MINISTRY OF TRANSPORT AND COMMUNICATIONS)

SFS-EN 1997-1:2004 + A1:2013

GEOTECHNICAL DESIGN

General rules: Application to infrastructures

MINISTRY OF TRANSPORT AND COMMUNICATIONS

11.2.2015

NATIONAL ANNEX (MINISTRY OF TRANSPORT AND COMMUNICATIONS)
TO STANDARD

SFS-EN 1997-1+A1 EUROCODE 7: GEOTECHNICAL DESIGN
Part 1 – General rules:
Application to infrastructures

This Annex is used together with Standard SFS-EN 1997-1:2004 +A1.

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1. Foreword

This National Annex is used together with Standard SFS-EN 1997-1:2004 + Amendment A1:2013. The provisions of this National Annex apply to roads, railways and bridges under the administration of the Ministry of Transport and Communications.

2. Nationally determined parameters

Partial and correlation factors for ultimate limit states are stated in Annex A (normative) of 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 can be found, or the table states these values. The values in Table A(FI) of this National Annex replace the recommended values in Annex A to SFS-EN 1997-1:2004.

In 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 (see clause 6.2).

Partial safety factors recommended in Tables 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 loads $\gamma_{G/Q}$ K_{FI} are applied. In addition, to achieve 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 loads are applied. As appropriate, the partial safety factors (γ_R) given below for respective limit states are applied to resistances. See clause 6.2 of this National Annex.

Symbols used in this National Annex are presented in clause 1.6 of Standard SFS-EN 1997:2004 and Amendment A1:2013 and in clause 1.6 of Standard SFS-EN 1990:2002.

3. Country-specific data

General guidelines regarding determination of ground frost susceptibility of infrastructures can be found in the publications of the Ministry of Transport and Communications.

Flood and landslide risk is considered according to the Ministry of Transport and Communications guidelines.

Contaminated ground is handled according to the Ministry of Transport and Communications guidelines.

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

In Finland, Design Approach (DA) 2, which can be used in two different ways, is used in the design of spread footing foundations, pile foundations, anchorages and retaining structures. In the design of slopes and overall stability, DA 3 is used.

Note: DA 2 can be applied in two ways, denoted as DA2 and DA2. In DA2, the loads are factored at their source and the design calculation is performed using factored values of loads. In DA2*, the design calculation is performed using characteristic values of loads, 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 - clause 2.4.5. Thomas Telford 2004; ISBN 0 7277 3154 8).*

In Finland, DA2* is recommended to be used in the design of spread footing foundations, pile foundations, anchorages and retaining structures of infrastructures (including bridges). When using DA2, calculations will be easier and the design will generally be on the safe side compared with DA2*.

Note: when using DA2, special attention shall be given to the verification of the stability of a foundation structure.*
Note: In pile foundations, where the axial forces of the piles also accept horizontal loads, DA2 and DA2 will yield the same results.*

5. Use of informative annexes

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

For infrastructures, Ministry of Transport and Communications guidelines are followed instead of those in Annex H.

6. Reference to non-contradictory, complementary information

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, inter alia, the consideration of ground frost and the design of foundation engineering works according to geotechnical design class 1 (see SFS-EN 1997-1:2004; clause 2.1(15))

6.2. Internationally recognised standards and recommendations

In Standard SFS-EN 1997-1:2004, there are references to procedures to be applied, in the absence of SFS-EN standards, according to 'internationally recognised 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 guidance is given in this National Annex.

Standard clause	Object	Rules of this National Annex
2.4.6.1(4)P	Value of partial safety factor γ_F in equation (2.1a).	Take the values in National Annex (Ministry of Transport and Communications) to SFS-EN 1990:2002/A1.
2.4.6.2(2)P	Value of partial safety factor γ_M in equation (2.2).	Take the values in National Annex (Ministry of Transport and Communications) to SFS-EN 1990:2002/A1.
2.4.7.1(2)P	Values of partial safety factors in *persistent and transient situations.*	Take the values in Tables A(FI) of this National Annex, if applicable.
2.4.7.1(3)	Values of partial safety factors in *accidental situations*.	Take the values for partial safety factors and combined factors in Table A2.5(FI) of this National Annex A2 of standard SFS-EN 1990:2002/A1.
2.4.7.2(2)P	NOTE 2: values of partial safety factors in *persistent and transient design situations.*	Take the values given in National Annex (LVM) to SFS-EN 1990:2002/A1.
2.4.7.3.2(3)P	Values of partial safety factors in equations (2.6a) and (2.6b).	Take the values for partial safety factors and combined factors in Tables A2.4(A) (FI) and A2.4(B) (FI) of this National Annex A2 of Standard SFS-EN 1990:2002/A1 as well as the values stated in Table 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.13(FI) – A.14(FI) and A.18(FI) – A.21(FI) of this National Annex.
2.4.7.3.4.1(1)P	NOTE 1: DA to be used.	In the design of spread footing foundations, pile foundations, anchorages and retaining structures, DA2* is used. When designing riverbanks, slopes and overall stability, DA 3 is used. (See clause 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), A.16(FI) and A.19(FI) of this National Annex.
2.4.7.5(2)P	Values of partial safety factors in *persistent and transient situations in equations* (2.9a and 2.9b).	Take values in Table A.17(FI) of this National Annex.
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 stated in this National annex. Limit state values are stated in the Ministry of Transport and Communications guidelines.
2.5(1)	Conventional and generally conservative rules.	See SFS-EN 1997-1:2004, clause 2.1(15).
7.6.2.2(8)P	Values of correlation factors ξ_1 and ξ_2.	Take values in Table 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 Table 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 Tables A.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 $\gamma_{s;t}$.	For partial safety factor $\gamma_{s;t}$, take the 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 Table 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 Tables A.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 Table 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 no less than 1.50 for both short and long-term loading.
8.5.1(1)P	Value of partial safety factor γ_{SERV}.	NOTE 1: take values in Table A.18(FI) of this National Annex.
8.5.1(2)P	Assessment of serviceability limit state	NOTE 1: the serviceability limit state for anchorages is only given as part of a potential serviceability limit state inspection of an entire retaining wall. NOTE 2 - A serviceability limit state inspection is conducted only as part of an SLS inspection of an entire retaining wall.
8.5.2(1)P	Test method and number of tests n.	NOTE: take values in Table A.20(FI) of this National Annex.
8.5.2(2)P	Limit state values for loading tests	NOTE Table A21(FI). An assessment of anchorage creep or load drop shall be conducted if it is presented in the project's blueprint as part of the retaining wall inspection.
8.5.2(3)P	Value of correlation factor ξ_{uls}.	NOTE 1: take values in Table A.20(FI) of this National Annex.
8.5.2(3)P	Minimum number of tests n	NOTE 2: take values in Table A.20(FI) of this National Annex.
8.5.2(5)P	Value of partial safety factor $\gamma_{a,SLS}$.	NOTE: take values in Table A.19(FI) of this National Annex.

8.5.3(1)P	Test method and number of tests n.	NOTE 1: take values in Table A.20(FI) of this National Annex.
8.5.3(2)P	Limit state values for loading tests	NOTE: Table A21(FI). An assessment of anchorage creep or load drop shall be conducted if it is presented in the project's blueprint as part of the retaining wall inspection.
8.5.3(3)P	Value of partial safety factor $\gamma_{a,SLS}$.	NOTE: take values in Table A.20(FI) of this National Annex.
8.5.3(4)P	Test method and number of tests n.	NOTE: take values in Table A.20(FI) of this National Annex.
8.6.2(2)P	*Acceptance tests*	NOTE 1: take values in Table A.20(FI) of this National Annex NOTE 2: the test load for the acceptance test will be determined in the project's blueprint based on the ultimate limit state.
8.6.2(3)P	*Acceptance tests*	NOTE: take values in Table A.21(FI) of this National Annex. NOTE 2: when checking the creep speed/load drop, the other load levels (according to ultimate limit state) shall be presented in the blueprint.
11.5.1(1)P	*Values of partial safety* factors.	Take values in Tables A.3b(FI), A.4(FI) and A.14(FI) of this National Annex.
A.4	Anchorage resistance in the ultimate limit state	Take values in Table A.16(FI) of this National Annex.
A.6	Selection of test method	Only take the values for test method 1 stated in this National Annex.
A.6	Partial resistance factors; values depending on the anchorage test method; Limit criteria for research, suitability and acceptance testing	Take values in Tables A.19(FI), A.20(FI) and A.21(FI) of this National Annex.

Partial and correlation factors in the ultimate limit state to be applied in Finland

Symbols used in this National Annex can be found in clause 1.6 of Standard SFS-EN 1997-1:2004 and in clause 1.6 of Standard SFS-EN 1990:2002.

Design values for partial factors on loads or the effects of loads in limit states, static equilibrium (EQU) and resistance of structural parts STR/GEO:
Take the values stated in the tables of this National Annex (Ministry of Transport and Communications) to SFS-EN 1990:2002/A1.

- A2.4(A) (FI) (replaces Table A.1 of SFS-EN 1997-1),
- A2.4(B) (FI) (replaces Table A.3 Set A1 of SFS-EN 1997-1)
- A2.4(C) (FI) (replaces Table A.3 Set A2 of SFS-EN 1997-1)

The principles of using K_{FI} factors can be found in Annex B of Standard SFS-EN 1990.

Explanation: the value of factor KFI may be determined project-specifically.

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}	1.4
Unconfined compressive strength	γ_{qu}	1.4
Weight density	γ_{γ}	1.0

[a] The factor is applied to tan ϕ'

Note 1: All characteristic values of permanent loads coming from one source are multiplied by the partial safety factor $\gamma_{G,sup}$ if the total load effect is unfavourable, and by the partial safety factor $\gamma_{G,inf}$ if the total load effect is favourable. For instance, all the loads originating from the self-weight of the structure may be considered as coming from one source; this also applies if different materials are involved.

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

Soil parameter	Symbol	Set	
		M1	***M2***
Angle of shearing resistance[a]	$\gamma_{\phi'}$	1.0	1.25
Effective cohesion	$\gamma_{c'}$	1.0	1.25
Undrained shear strength	γ_{cu}	1.0	1.4
Unconfined compressive test	γ_{qu}	1.0	1.4
Weight density	γ_{γ}	1.0	1.0

[a] The factor is applied to tan ϕ'

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

Resistance	Symbol	Set *R2*
Load-bearing resistance	$\gamma_{R,v}$	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

Table 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 to derive ξcharacteristic values from static pile load tests (n[c] – number of tested piles)[a,b]

ξ where n =	1/ 2 %	2 /10 %	3/50 %	4/75 %	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 by a model factor of 1.25

[c] The number of piles 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 A.10(FI) – Correlation factors to derive ξ characteristic values from ground test results (n – number of test profiles)

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

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

ξ where n	2-4 /1–4 %	5–9 /5–39 %	10–14 /40–64 %	15–19/65–89%	≥20/ 90–100 %
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 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.

c The ξ values are multiplied by a model factor of 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 by a model factor of 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.

f The number of piles 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.

Note: 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 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.

Remark: Table A.12 (FI) regarding anchorages has been removed from EN 1997-1:2004 with Amendment A1:2003. The requirements for anchorages can be found in clause A6 of this document.

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

Resistance	Symbol	Set *R2*
Load-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 loads (γ_F) (UPL)

Load	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 load

[b] Stabilising load

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}	1.4
Tensile pile resistance	$\gamma_{s,t}$	1.5
Anchorage resistance	$\gamma_{a;ULS}$	[b]

[a] The factor is applied to tan ϕ'

[b] Shown in Table A19 (FI)

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

Load	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 load

[b] Stabilising load

A.6

Table A.18 (FI) – Partial factors on loads for persistent and transient situations in the ultimate limit state (anchorage)

Limit state	Symbol	Value
Ultimate limit state (equation 8.3)	γ_{serv}	1.0
NOTE: the recommended γ_{serv} value is used in design methods		

Table A.19(FI) – Partial resistance factors (γ_R) for anchorages in persistent and transient situations

Symbol	STR/GEO Set	UPL
	R2	
$\gamma_{a;ULS}$		
Temporary anchorage	1.25	1.25
Permanent anchorage	1.50	1.50

Only test method 1 (Tables A.20(FIN) and A.21(FIN)) is used in Finland.

Table A.20(FI) — Values for persistent and transient situations in the ultimate limit state and for serviceability limit states based on the anchorage test method

Symbol	Equation	Test method [a]
		1
ζ_{uls}	8.6	1.0[b]
$\gamma_{a;SLS}$	8.10	N/A
n (rock anchorage) n (soil anchorage)		- [c] 5 (5%) [d]
$\gamma_{;acc;ULS}$ temporary anchorage permanent anchorage	8.13	 1.25 1.50
$\gamma_{a;acc;SLS}$	8.14	N/A
NOTE: N/A = not applicable		

a Description of test methods in Standard EN ISO 22477-5

b This value is used if the acceptance test for each anchorage (test loads according to equation 8.13) confirms that $E_{ULS;d} \leq R_{ULS;d}$.

c An acceptance test is conducted for all anchorages. Suitability tests shall be carried out according to the construction plan for the project if the anchorages are supported by ground conditions for which no comparable experiences exist. Research testing shall be carried out according to the construction plan if no comparable experiences exist for the anchorage types.

d An acceptance test is conducted for all anchorages. Suitability tests shall be carried out according to the construction plan for the project on at least 5 or 5 % of anchorages if they are supported by ground conditions for which no comparable experiences exist. Research testing shall be carried out according to the construction plan if no comparable experiences exist for the anchorage types.

Table A.21 - Limit criteria for research, suitability and acceptance testing in persistent and transient situations in the ultimate limit state and serviceability limit states

Test method[a]	**Limit criterion**	**Research and suitability tests**		**Acceptance tests**	
		ULS (Equation 8.5)	**SLS** (Equation 8.8)	**ULS** (Equation 8.13)	**SLS** (Equation 8.14)
1	α_1	2 mm	N/A	2 mm	N/A
NOTE: N/A = not applicable					
[a] Description of test methods in EN ISO 22477-5. [b] Load drop discovery times according to Table H.1, Annex H, EN ISO 22477-5					