NATIONAL ANNEX TO CYS EN 1997-1:2004

(Including AC:2009 +A1:2013)

Eurocode 7: Geotechnical Design Part 1: General rules

NATIONAL ANNEX

TO

CYS EN 1997-1:2004+AC:2009+A1:2013

Eurocode 7: Geotechnical Design Part 1: General rules

This National Annex has been approved by the Board of Directors of the Cyprus Organisation for Standardisation (CYS) on 12.07.2019.

INTRODUCTION

This National Annex has been prepared by the CYS TC 18 Standardisation Technical Committee of the Cyprus Organisation for Standardisation.

NA 1 SCOPE

This National Annex is to be used together with CYS EN 1997-1:2004+AC:2009+A1:2013.

Any reference in the rest of this text to CYS EN 1997-1:2004 means the above document

This National Annex gives:

(a) Nationally determined parameters for the following clauses of CYS EN 1997-1:2004+AC:2009+A1:2013 where National choice is allowed (see Section NA 2):

- 2.1(8)P
- 2.4.6.1(4)P
- 2.4.6.2(2)P
- 2.4.7.1(2)P
- 2.4.7.1(3)
- 2.4.7.2(2)P
- 2.4.7.3.2(3)P
- 2.7.4.3.3(2)P
- 2.4.7.3.4.1(1)P
- 2.4.7.4(3)P
- 2.4.7.5(2)P
- 2.4.8(2)
- 2.4.9(1)P
- 2.5(1)
- 7.6.2.2(8)P
- 7.6.2.2(14)P
- 7.6.2.3(4)P
- 7.6.2.3(5)P
- 7.6.2.3(8)
- 7.6.2.4(4)P
- 7.6.3.2(2)P
- 7.6.3.2(5)P
- 7.6.3.3(3)P
- 7.6.3.3(4)P
- 7.6.3.3(6)

- 8.5.1(1)P
- 8.5.1(2)P
- 8.5.2(1)P
- 8.5.2(2)P
- 8.5.2(3)P
- 8.5.2(5)P
- 8.5.3(1)P
- 8.5.3(2)P
- 8.5.3(3)P
- 8.5.3(4)P
- 8.6.2(2)P
- 8.6.2(3)P
- 10.2(3)
- 11.5.1(1)P

and for the following clauses in Annex A:

- A.2, A.3.1, A.3.2, A.3.3.1, A.3.3.2, A.3.3.3, A.3.3.4, A.3.3.5, A.3.3.6, A.4, A.5, A.6.

(b) The procedure to be used where alternative procedures are given in CYS EN 1997-1:2004 (see Section NA 3).

(c) Decisions on the use of the Informative Annexes B, C, D, E, F, G, H and J (see Section NA 4)

(d) References to non-contradictory complementary information to assist the user to apply CYS EN 1997-1:2004+AC:2009+A1:2013 (see Section NA 5).

NA 2 NATIONALLY DETERMINED PARAMETERS

NA 2.1 Clause 2.1(8)P Minimum requirements for geotechnical investigations, calculations and construction control checks

The minimum requirement for geotechnical investigations for light and simple structures (consequence class CC1 of EN 1990) and small earthworks (height less than 1,0m) is to obtain an indication of the stratification and groundwater levels within the zone of ground governing the behaviour of the structure or earthworks at the limit states being considered.

NA 2.2 Clause 2.4.6.1(4)P Design values of actions

The partial factors on actions providing an appropriate level of safety for conventional designs are specified in the National Annex to CYS EN 1990:2002. They are also shown in NA 2.41, NA 2.43, NA 2.50 and NA 2.52 of this National Annex.

NA 2.3 Clause 2.4.6.2(2)P Design values of geotechnical parameters

The partial factors for soil parameters providing a minimum level of safety for conventional designs are specified in NA 2.42, NA 2. 44 and NA 2.51.

NA 2.4 Clause 2.4.7.1(2)P Ultimate limit states – persistent and transient situations

The partial factors in persistent and transient situations are specified in clauses NA 2.41, NA 2.42, NA 2.43, NA 2.44, NA 2.45, NA 2.46, NA 2.48, NA 2.49, NA 2.50, NA 2.51, NA 2.52, NA 2.53 and NA 2.54.

NA 2.5 Clause 2.4.7.1(3) Ultimate limit states – accidental situations

All values of partial factors for actions or the effects of actions in accidental situations are equal to 1,0. All values of partial factors for resistances and soil parameters in accidental situations shall be taken as for persistent and transient situations.

For seismic design situations, all values of partial factors for actions and the effects of actions shall be taken at least equal to 1,0 , and the partial factors for resistances and soil parameters shall be taken as for persistent and transient situations, except for overall stability, equilibrium limit state (EQU) and uplift limit state (UPL) calculations, for which the partial factors for soil strength parameters are specified in the National Annex to CYS EN 1998-5. Consideration of strength parameters, with potential cyclic degradation effects, stiffness and energy dissipation properties should be taken into account in accordance to CYS EN 1998-5.

For seismic actions, consideration of the lower design life of temporary structures may be taken into account in accordance to CYS EN 1998-1, Clause 2.1.

NA 2.6 Clause 2.4.7.2(2)P Verification of static equilibrium (EQU)

The partial factors in persistent and transient situations are specified in NA 2.41 and NA 2.42.

NA 2.7 Clause 2.4.7.3.2(3)P Verification of STR and GEO limit states – design effects of actions

The partial factors in persistent and transient situations are specified in NA 2.43 and NA 2.44.

NA 2.8 Clause 2.4.7.3.3(2)P Verification of STR and GEO limit states – design resistances

The partial factors in persistent and transient situations are specified in NA 2.45, NA 2.46, NA 2.48, NA 2.49 and NA 2.54.

NA 2.9 Clause 2.4.7.3.4.1(1)P Verification of STR and GEO limit states – design approach

For the verification of the structural (STR) and geotechnical (GEO) limit states under persistent, transient, accidental and seismic situations, except in overall stability calculations, Design Approach 2 shall be used. Partial factors on actions may be applied either to the actions (commonly referred to as DA-2) or to the effects of actions (commonly referred to as DA-2*).

For the verification of geotechnical (GEO) limit states under persistent, transient, accidental and seismic situations in overall stability calculations, Design Approach 3 shall be used.

When using advanced analysis methods (e.g. finite element method) to simulate the ground, it shall be verified that STR and GEO limit states will not occur under persistent, transient, accidental and seismic situations with both Design Approaches 2 and 3. Verification of the GEO limit state using Design Approach 2 may not be straightforward using advanced analysis methods where the failure forms are not predetermined, in which case only Design Approach 3 may be used to verify GEO limit state, combined with both Design Approaches 2 and 3 to

verify STR limit states. In the case of Design Approach 3, the partial resistance factors γ_R are equal to 1,0.

NA 2.10 Clause 2.4.7.4(3)P Verification of uplift (UPL)

The partial factors for persistent and transient situations are specified in NA 2.50, NA 2.51 and NA 2.54.

NA 2.11 Clause 2.4.7.5(2)P Verification of resistance to failure by heave (HYD)

The partial factors for persistent and transient situations are specified in NA 2.52 of this National Annex.

NA 2.12 Clause 2.4.8(2) Serviceability limit states

Values of partial factors for serviceability limit states are equal to 1.0.

NA 2.13 Clause 2.4.9(1)P Limiting values for movements of foundations

Permitted foundation movements shall be established for each structure under consideration. In the absence of specified limiting values of structural deformations of the supported structure, the guidance given on structural deformation and foundation movement in Annex H may be used.

NA 2.14 Clause 2.5(1) Design by prescriptive measures

The prescriptive measures should be based on comparable experience as defined in clause 1.5.2.2 of CYS EN 1997-1:2004.

NA 2.15 Clause 7.6.2.2(8)P Ultimate compressive pile resistance from static load tests – correlation factors

The values of the correlation factors are specified in NA 2.47.

NA 2.16 Clause 7.6.2.2(14)P Ultimate compressive pile resistance from static load tests – partial resistance factors

The partial factors in persistent and transient situations are specified in NA 2.46.

NA 2.17 Clause 7.6.2.3(4)P Ultimate compressive pile resistance from ground test results – partial resistance factors

The partial factors in persistent and transient situations are specified in NA 2.46.

NA 2.18 Clause 7.6.2.3(5)P Ultimate compressive pile resistance from ground test results – correlation factors

The values of the correlation factors are specified in NA 2.47.

NA 2.19 Clause 7.6.2.3(8) Ultimate compressive pile resistance from ground test results – alternative method

The actual values of the model factors should depend on the number and variability of ground test result profiles used in the determination of base resistance and shaft resistance, as well as the size of the project area. Model factors of at least 1,25 shall be applied to the partial factors γ_b and γ_s when using the alternative method described in Clause 7.6.2.3(8) of CYS EN 1997-1.

NA 2.20 Clause 7.6.2.4(4)P Ultimate compressive pile resistance from dynamic impact tests – correlation factors

The values of the correlation factors are specified in NA 2.47.

NA 2.21 Clause 7.6.3.2(2)P Ultimate tensile pile resistance from pile load tests – partial resistance factor

The partial factors in persistent and transient situations are specified in NA 2.46.

NA 2.22 Clause 7.6.3.2(5)P Ultimate tensile pile resistance from pile load tests – correlation factors

The values of the correlation factors are specified in NA 2.47.

NA 2.23 Clause 7.6.3.3(3)P Ultimate tensile pile resistance from ground test results – partial resistance factor

The partial factors in persistent and transient situations are specified in NA 2.46.

NA 2.24 Clause 7.6.3.3(4)P Ultimate tensile pile resistance from ground test results – correlation factors

The values of the correlation factors are specified in NA 2.47.

NA 2.25 Clause 7.6.3.3(6) Ultimate tensile pile resistance from ground test results – alternative method

The actual values of the model factors should depend on the number and variability of ground test result profiles used in the determination of shaft resistance, as well as the size of the project area. Model factors of at least 1,25 shall be applied to the partial factor $\gamma_{s,t}$ when using the alternative method described in Clause 7.6.3.3(6) of CYS EN 1997-1.

NA 2.26 Clause 8.5.1(1)P Partial factors on actions and action effects for persistent and transient design situations of anchors at the ultimate limit state

The value of the partial factor γ_{Serv} is specified in NA 2.53.

NA 2.27 Clause 8.5.1(2)P Serviceability limit state design check for anchors

For permanent anchors, a separate evaluation of the serviceability limit state shall be carried based on the following inequality:

$$F_{Serv;k} \leq R_{SLS;d}$$

NA 2.28 Clause 8.5.2(1)P Test methods for the determination of measured anchor ultimate limit state resistance

Investigation and suitability tests for ultimate limit state resistance determination shall be performed using any of the anchor test methods of EN ISO 22477-5 (Methods 1, 2 & 3).

NA 2.29 Clause 8.5.2(2)P Anchor limiting creep rate for ultimate limit state

The limit values of the creep rate α_{ULS} and load loss rate $k_{l,ULS}$ are specified in NA 2.56.

NA 2.30 Clause 8.5.2(3)P Minimum number of investigation and suitability tests for ultimate limit state resistance

The minimum required number n of investigation and suitability tests per geological formation encountered in a given project shall be equal to 3% of the working anchors planned to be installed in each geological formation. The number n shall not be smaller than 3.

NA 2.31 Clause 8.5.2(3)P Characteristic value of anchor ultimate limit state resistance

The value of the correlation factor ξ_{ULS} is specified in NA 2.55.

NA 2.32 Clause 8.5.2(5)P Design value of anchor ultimate limit state resistance

The value of the resistance factor $\gamma_{a;ULS}$ is specified in NA 2.54.

NA 2.33 Clause 8.5.3(1)P Test methods for the determination of measured anchor serviceability limit state resistance

Investigation and suitability tests for serviceability limit state resistance determination shall be performed using any of the anchor test methods of EN ISO 22477-5 (Methods 1, 2 & 3)

NA 2.34 Clause 8.5.3(2)P Anchor limiting creep rate for serviceability limit state

The limit values of the creep rate α_{SLS} and load loss rate $k_{l,SLS}$ are specified in NA 2.56.

NA 2.35 Clause 8.5.3(3)P Minimum number of investigation and suitability tests for serviceability limit state resistance

The minimum required number n of investigation and suitability tests per geological formation encountered in a given project shall be equal to 3% of the working anchors planned to be installed in each geological formation. The number n shall not be smaller than 3.

NA 2.36 Clause 8.5.3(4)P Design value of anchor serviceability limit state resistance

The value of the resistance factor $\gamma_{a;SLS}$ is specified in NA 2.55.

NA 2.37 Clause 8.6.2(2)P Proof load for acceptance tests

The proof load for acceptance tests shall be specified in accordance to either

$$P_P \geq \gamma_{a;acc;ULS} \times E_{ULS;d} \quad \text{(for Test Methods 1 \& 2)}$$

or

$$P_P \geq \gamma_{a;acc;SLS} \times F_{Serv;k} \quad \text{(for Test methods 2 \& 3)}$$

The values of the partial factors $\gamma_{a;acc;ULS}$ and $\gamma_{a;acc;SLS}$ are specified in NA 2.55.

NA 2.38 Clause 8.6.2(3)P Anchor limiting creep rate for acceptance tests

The limit values of the creep rate and load loss rate for acceptance tests are specified in NA 2.56.

NA 2.39 Clause 10.2.5.2(2)P Uplift failure (UPL)

Friction forces shall be taken as resistances. Anchor forces shall be taken as stabilizing permanent vertical actions.

NA 2.40 Clause 11.5.1(1)P Stability analysis for slopes – partial factors

The partial factors for persistent and transient situations are specified in NA 2.43, NA 2.44 and NA 2.49.

NA 2.41 Clause A.2(1)P Partial factors for equilibrium state (EQU) verification – on actions

For the verification of the equilibrium state (EQU), the values of the partial factors $\gamma_{G;dst}$, $\gamma_{G;stb}$, $\gamma_{Q;dst}$ and $\gamma_{Q;stb}$ are specified in the National Annex to CYS EN 1990:2002, Table A1.2(A) (in which the subscripts *sup* and *inf* correspond to *dst* and *stb*). These values are also shown in Table A.1(CYS) below.

Table A.1(CYS): Partial factors on actions (γ_F)

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

NA 2.42 Clause A.2(2)P Partial factors for equilibrium state (EQU) verification – for soil parameters

For the verification of the equilibrium state (EQU), the values of the partial factors $\gamma_{\varphi'}$, $\gamma_{c'}$, γ_{cu}, γ_{qu} and γ_{γ} are specified in Table A.2(CYS).

Table A.2(CYS): Partial factors for soil parameters (γ_M)

Soil parameter	Symbol	Value
Angle of shearing resistance[a]	$\gamma_{\varphi'}$	1,25
Effective cohesion	$\gamma_{c'}$	1,25
Undrained shear strength	γ_{cu}	1,4
Unconfined strength	γ_{qu}	1,4
Weight density	γ_{γ}	1,0
[a] This factor is applied to tan φ'		

NA 2.43 Clause A.3.1(1)P Partial factors for structural (STR) and geotechnical (GEO) limit states verification – on actions or the effects of actions

For the verification of the structural (STR) and geotechnical (GEO) limit states, the values of the partial factors γ_G and γ_Q are specified in the National Annex to CYS EN 1990:2002, Tables A1.2(B) and A1.2(C). These values are also shown in Table A.3(CYS) below for the sets *A1* and *A2*.

Table A.3(CYS): Partial factors on actions (γ_F) or the effects of actions (γ_E)

Action		Symbol	Set	
			A1	*A2*
Permanent	Unfavourable	γ_G	1,35	1,0
	Favourable		1,0	1,0
Variable	Unfavourable	γ_Q	1,5	1,3
	Favourable		0	0

NA 2.44 Clause A.3.2(1)P Partial factors for structural (STR) and geotechnical (GEO) limit states verification – for soil parameters

For the verification of the structural (STR) and geotechnical (GEO) limit states, the values of the partial factors $\gamma_{\varphi'}$, $\gamma_{c'}$, γ_{cu}, γ_{qu} and γ_γ are specified in Table A.4(CYS) for the sets *M1* and *M2*.

Table A.4(CYS): Partial factors for soil parameters (γ_M)

Soil parameter	Symbol	Set	
		M1	*M2*
Angle of shearing resistance[a]	$\gamma_{\varphi'}$	1,0	1,25
Effective cohesion	$\gamma_{c'}$	1,0	1,25
Undrained shear strength	γ_{cu}	1,0	1,4
Unconfined strength	γ_{qu}	1,0	1,4
Weight density	γ_γ	1,0	1,0

[a] This factor is applied to tan φ'

NA 2.45 Clause A.3.3.1(1)P Partial resistance factors for spread foundations

For the verification of the structural (STR) and geotechnical (GEO) limit states, the values of the partial factors $\gamma_{R;v}$ and $\gamma_{R;h}$ are specified in Table A.5(CYS) for the set *R2*.

Table A.5(CYS): Partial resistance factors (γ_R) for spread foundations

Resistance	Symbol	Set
		R2
Bearing	$\gamma_{R;v}$	1,4
Sliding	$\gamma_{R;h}$	1,1

NA 2.46 Clause A.3.3.2(1)P Partial resistance factors for pile foundations

For the verification of the structural (STR) and geotechnical (GEO) limit states, the values of the partial factors γ_b, γ_s, γ_t and $\gamma_{s;t}$ are specified in Table A.6(CYS) for driven piles, in Table A.7(CYS) for bored piles and in Table A.8(CYS) for continuous flight auger (CFA) piles, all for the set *R2*.

Table A.6(CYS): Partial resistance factors (γ_R) for driven piles

Resistance	Symbol	Set
		R2
Base	γ_b	1,1
Shaft (compression)	γ_s	1,1
Total/combined (compression)	γ_t	1,1
Shaft in tension	$\gamma_{s;t}$	1,15

Table A.7(CYS): Partial resistance factors (γ_R) for bored piles

Resistance	Symbol	Set
		R2
Base	γ_b	1,1
Shaft (compression)	γ_s	1,1
Total/combined (compression)	γ_t	1,1
Shaft in tension	$\gamma_{s;t}$	1,15

Table A.8(CYS): Partial resistance factors (γ_R) for continuous flight auger (CFA) piles

Resistance	**Symbol**	**Set**
		R2
Base	γ_b	1,1
Shaft (compression)	γ_s	1,1
Total/combined (compression)	γ_t	1,1
Shaft in tension	$\gamma_{s;t}$	1,15

NA 2.47 Clause A.3.3.3(1)P Correlation factors for pile foundations

For the verification of the structural (STR) and geotechnical (GEO) limit states, the values of the correlation factors ξ_1, ξ_2, ξ_3, ξ_4, ξ_5 and ξ_6 are specified in Table A.9(CYS), Table A.10(CYS) and Table A.11(CYS).

Table A.9(CYS): Correlation factors ξ to derive characteristic values from static pile load tests (n - number of tested piles)

ξ for n =	**1**	**2**	**3**	**4**	**≥ 5**
ξ_1	1,40	1,30	1,20	1,10	1,00
ξ_2	1,40	1,20	1,05	1,00	1,00

Table A.10(CYS): Correlation factors ξ to derive characteristic values from ground test results (n - the number of profiles of tests)

ξ for n =	**1**	**2**	**3**	**4**	**5**	**7**	**10**
ξ_3	1,40	1,35	1,33	1,31	1,29	1,27	1,25
ξ_4	1,40	1,27	1,23	1,20	1,15	1,12	1,08

Table A.11(CYS): 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	≥ 15	≥ 20
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 with a model factor of 0,85 when using dynamic impact tests with signal matching.

[c] The ξ- values shall be multiplied with a model factor of 1,10 when using a pile driving formula with measurement of the quasi-elastic pile head displacement during the impact.

[d] The ξ-values shall be multiplied with a model factor of 1,20 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 should be considered separately when selecting the number n of test piles.

NA 2.48 Clause A.3.3.5(1)P Partial resistance factors for retaining structures

For the verification of the structural (STR) and geotechnical (GEO) limit states, the values of the partial factors $\gamma_{R;v}$, $\gamma_{R;h}$ and $\gamma_{R;e}$ are specified in Table A.13(CYS) for the set *R2*.

Table A.13(CYS): Partial resistance factors (γ_R) for retaining structures

Resistance	Symbol	Set
		R2
Bearing capacity	$\gamma_{R;v}$	1,4
Sliding resistance	$\gamma_{R;h}$	1,1
Earth resistance	$\gamma_{R;e}$	1,4

NA 2.49 Clause A.3.3.6(1)P Partial resistance factors for slopes and overall stability

For the verification of the structural (STR) and geotechnical (GEO) limit states, the value of the partial factor $\gamma_{R;e}$ is specified in Table A.14(CYS) for the set *R3*.

Table A.14(CYS): Partial resistance factor (γ_R) for slopes and overall stability

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

NA 2.50 Clause A.4(1)P Partial factors for uplift limit state (UPL) verifications – on actions

For the verification of the uplift limit state (UPL), the values of the partial factors $\gamma_{G;dst}$, $\gamma_{G;stb}$, $\gamma_{Q;dst}$ and $\gamma_{Q;stb}$ are specified in Table A.15(CYS).

Table A.15(CYS): Partial factors on actions (γ_F)

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

NA 2.51 Clause A.4(2)P Partial factors for uplift limit state (UPL) verifications – for soil parameters and resistances

For the verification of the uplift limit state (UPL), the values of the partial factors $\gamma_{\varphi'}$, $\gamma_{c'}$, γ_{cu}, $\gamma_{s;t}$ and $\gamma_{a;ULS}$ are specified in Table A.16(CYS).

Table A.16(CYS): Partial factors for soil parameters and resistances

Soil parameter	Symbol	Value
Angle of shearing resistance[a]	$\gamma_{\varphi'}$	1,25
Effective cohesion	$\gamma_{c'}$	1,25
Undrained shear strength	γ_{cu}	1,40
Tensile pile resistance	$\gamma_{s;t}$	1,40
Ultimate limit state anchor resistance	$\gamma_{a;ULS}$	1,40
[a] This factor is applied to tan φ'		

NA 2.52 Clause A.5(1)P Partial factors for hydraulic heave limit state (HYD) verification

For the verification of the hydraulic heave limit state (HYD), the values of the partial factors $\gamma_{G;dst}$, $\gamma_{G;stb}$, $\gamma_{Q;dst}$ and $\gamma_{Q;stb}$ are specified in Table A.17(CYS).

Table A.17(CYS): Partial factors on actions (γ_F)

Action	Symbol	Value
Permanent		
Unfavourable[a]	$\gamma_{G;dst}$	1,35
Favourable[b]	$\gamma_{G;stb}$	0,90
Variable		
Unfavourable[a]	$\gamma_{Q;dst}$	1,50
Favourable[b]	$\gamma_{Q;stb}$	0
a Destabilising b Stabilising		

NA 2.53 Clause A.6(1)P Partial factors on actions and action effects for persistent and transient design situations of anchors at the ultimate limit state

For the verification of actions and action effects for persistent and transient design situations at the ultimate limit state, the partial factor γ_{Serv} on the characteristic value of the maximum anchor force $F_{Serv;k}$ is equal to 1,35.

Table A.18(CYS) — Partial factors on actions and action effects for persistent and transient design situations at the ultimate limit state

Limit state		Symbol	Value
Ultimate	(Formula 8.3)	γ_{Serv}	1,35

NA 2.54 Clause A.6(2)P Partial factors for ultimate limit state resistance of anchors

The values of anchor resistance factor $\gamma_{a;ULS}$ are specified in Table A.19 (CYS).

Table A.19(CYS) — Partial resistance factors (γ_R) for anchors in ultimate limit states for persistent and transient design situations

Symbol	STR/GEO	UPL
	R2	
$\gamma_{a;ULS}$	1,1	1,4

NA 2.55 Clause A.6(3)P Correlation factor and partial factors for the determination of anchor resistance and proof load

The values of factors ξ_{ULS}, $\gamma_{a;SLS}$, $\gamma_{a;acc;ULS}$ and $\gamma_{a;acc;SLS}$ are specified in Table A.20(CYS).

Table A.20 (CYS) — Values depending on anchor test method for persistent and transient design situations at the ultimate limit state and for serviceability limit states

Symbol	Equation	Test method [a]		
		1	2	3
ξ_{ULS}	8.6	1,0	1,0	1,1
$\gamma_{a;SLS}$ [b]	8.10	1,0	1,0	1,2
$\gamma_{a;acc;ULS}$	8.13	1,1	1,1	NA
$\gamma_{a;acc;SLS}$	8.14	NA	1,0	1,25
NOTE NA = Not Applicable				
[a] For a description of the test methods see EN ISO 22477-5. [b] This is required for the serviceability limit state check of permanent anchors.				

NA 2.56 Clause A.6(4)P Limiting criteria for the verification of investigation, suitability and acceptance tests

For the verification of investigation, suitability and acceptance tests for persistent and transient design situations at ultimate limit state and serviceability limit state, the values of the limiting creep rates (a_{ULS}, a_{SLS}) and load loss rates ($k_{l,ULS}$, $k_{l,SLS}$) are specified in Table A.21(CYS).

Table A.21 (CYS) — Limiting criteria for investigation, suitability and acceptance tests for persistent and transient design situations at the ultimate and serviceability limit states

Test Method [a]	Limiting criterion	Investigation and suitability tests		Acceptance tests	
		ULS (Formula 8.5)	**SLS** (Formula 8.8)	**ULS** (Formula 8.13)	**SLS** (Formula 8.14)
1	α_1	2mm [f]	0,01Δe [c]/NA [d]	2 mm	0,01Δe [c]/NA [d]
2 [b]	k_1	5 % per log cycle of time	2 % per log cycle of time	5 % per log cycle of time	2 % per log cycle of time
3	α_3	5 mm	NA (use P_c)	NA	1,5 mm [e]
NOTE NA = Not Applicable					

[a] For a description of the test methods see EN ISO 22477-5.

[b] Times of observation for load loss in accordance with EN ISO 22477-5

[c] Δe = ($F_{serv;k}$ × tendon free length) / (area of tendon × elastic modulus of tendon)

[d] Value is only applicable when SLS-testing is undertaken

[e] Value given is for permanent anchors; for temporary anchors, α_3 = 1.8 mm

[f] A value of α_1 of up to 5mm may be used for investigation tests

NA 3 THE PROCEDURE TO BE USED WHEN ALTERNATIVE PROCEDURES ARE GIVEN IN CYS EN 1997-1:2004

NA 3.1 Clause 2.4.7.3.4.1(1)P Choice of design approach for the verification of Structural (STR) and Geotechnical (GEO) limit states

As indicated in NA 2.9, in overall stability calculations Design Approach 3 shall be used and for all other calculations Design Approach 2 shall be used. When using advanced analysis methods (e.g. finite element method) to simulate the ground, both Design Approaches 2 and 3 shall be used.

NA 3.2 Clauses 8.5.2(1)P & 8.5.3(1)P Test methods for the determination of measured anchor limit state resistances

As indicated in NA 2.28 and NA 2.33, all of the anchor test methods of EN ISO 22477-5 (Methods 1, 2 & 3) are permitted for performing investigation and suitability tests for the determination of limit state resistances of anchors.

NA 4 DECISION ON USE OF THE INFORMATIVE ANNEXES B, C, D, E, F, G, H AND J

NA 4.1 Annex B

Annex B may be used

NA 4.2 Annex C

Annex C may be used

NA 4.3 Annex D

Annex D may be used

NA 4.4 Annex E

Annex E may be used

NA 4.5 Annex F

Annex F may be used

NA 4.6 Annex G

Annex G may be used

NA 4.7 Annex H

Annex H may be used

NA 4.8 Annex J

Annex J may be used

NA 5 REFERENCES TO NON-CONTRADICTORY COMPLEMENTARY INFORMATION

None

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NA to CYS EN 1997-1:2004 (Including A1:2013 and AC:2009)

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