CYS National Annex to CYS EN 1997-1:2004

Eurocode 7: Geotechnical Design

Part 1: General rules

Prepared by
Eurocodes Committee, Scientific and Technical
Chamber of Cyprus under a Ministry of Interior's Programme

NATIONAL ANNEX

TO

CYS EN 1997-1:2004 Eurocode 7: Geotechnical Design

Part1: General rules

This National Annex has been approved by the Board of Governors of the Cyprus Organisation for Standardisation on 11/06/2010.

INTRODUCTION

This National Annex has been prepared by the Eurocodes Committee of the Technical Chamber of Cyprus which was commissioned by the Ministry of Interior of the Republic of Cyprus

NA 1 SCOPE

This National Annex is to be used together with CYS EN 1997-1:2004

This National Annex gives:

(a) Nationally determined parameters for the following clauses of CYS EN 1997-1:2004 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), 8.5.2(2)P, 8.5.2(3), 8.6(4), 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.

(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 (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 and small earthworks 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 2.30, NA 2.32, NA 2.40 and NA 2.42 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 2.31, NA 2.33 and NA 2.41.

NA 2.4 Clause 2 .4.7.1(2)P Ultimate l imit st ates – persistent an d t ransient situations

The partial factors in persistent and transient situations are specified in clauses NA 2.30, NA 2.31, NA 2.32, NA 2.33, NA 2.34, NA 2.35, NA 2.37, NA 2.38, NA 2.39, NA 2.40, NA 2.41 and NA 2.42.

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 should be taken equal to 1,0. All values of partial factors for resistances should then be selected according to the particular circumstances of the accidental situation.

For seismic design situations, all values of partial factors for actions, the effects of actions and resistances should be taken equal to 1,0. The partial factors for ground strength parameters are specified in the National Annex to CYS EN 1998-5:2003. The full requirements for seismic design are given in CYS EN 1998-5:2003.

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

The partial factors for persistent and transient situations are specified in NA 2.30 and NA 2.31.

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 2.32 and NA 2.33.

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 2.34, NA 2.35, NA 2.37, NA 2.38 and NA 2.39.

NA 2.9 Clause 2. 4.7.3.4.1(1)P V erification o f S TR an d G EO l imit st ates – design approach

For the verification of the structural (STR) and geotechnical (GEO) limit states under persistent and transient situations Design Approach 2 shall be used.

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 2.40 and NA 2.41.

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 the National Annex to CYS EN 1990:2002. They are also shown in NA 2.42 of this National Annex.

NA 2.12 Clause 2.4.8(2) Serviceability limit states

Values of partial factors for serviceability limit states should be taken as 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 U ltimate co mpressive p ile r esistance f rom st atic load tests – correlation factors

The values of the correlation factors are specified in NA 2.36.

NA 2.16 Clause 7. 6.2.2(14)P Ultimate co mpressive p ile r esistance f rom st atic load tests – partial resistance factors

The partial factors in persistent and transient situations are specified in NA 2.35.

NA 2.17 Clause 7.6.2.3(4)P Ultimate co mpressive pile r esistance f rom g round test results – partial resistance factors

The partial factors in persistent and transient situations are specified in NA 2.35.

NA 2.18 Clause 7.6.2.3(5)P U ltimate co mpressive pile r esistance f rom g round test results – correlation factors

The values of the correlation factors are specified in NA 2.36.

NA 2.19 Clause 7.6.2.3(8) U ltimate co mpressive p ile r esistance f rom ground test results – alternative method

Model factors of at least 1,25 (depending on the number and variability of ground test result profiles used in the determination of base resistance and shaft resistance) should 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 1997-1:2004.

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 2.36.

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 2.35.

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 2.36.

NA 2.23 Clause 7.6.3.3(3)P U ltimate t ensile p ile r esistance f rom g round t est results – partial resistance factor

The partial factors in persistent and transient situations are specified in NA 2.35.

NA 2.24 Clause 7.6.3.3(4)P U ltimate t ensile p ile r esistance f rom g round t est results – correlation factors

The values of the correlation factors are specified in NA 2.36.

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

A model factor of at least 1,25 (depending on the number and variability of ground test result profiles used in the determination of shaft resistance) should 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 1997-1:2004.

NA 2.26 Clause 8.5.2(2)P Anchorage pull-out resistance determined from the results of suitability tests – partial resistance factor

The partial factors in persistent and transient situations are specified in NA 2.37.

NA 2.27 Clause 8.5.2(3) Anchorage pull-out resistance determined from the results of suitability tests – correlation factor

The correlation factor ξ_a must be based on comparable experience as defined in clause 1.5.2.2 of CYS EN 1997-1:2004. In the absence of comparable experience, the characteristic value $R_{a,k}$ should be related to the test results through the correlation factors $\xi_{a,1}$ and $\xi_{a,2}$ that take account of the number of tests and the variability of the test results in the following way:

$$R_{a,k} = \text{Min}\left\{\frac{\left(R_{a,m}\right)_{\text{mean}}}{\xi_{a,1}}; \frac{\left(R_{a,m}\right)_{\text{min}}}{\xi_{a,2}}\right\}$$

where $R_{a,m}$ is the measured value of R_a in one or several anchorage suitability tests and $\xi_{a,1}$ and $\xi_{a,2}$ are the correlation factors specified in Table 8.1(CYS) below.

Table 8.1(CYS): Correlation factors ξ_a to derive characteristic values from anchorage suitability tests (n - number of suitability tests)

ξ_a for n =	1	2	≥3
$\xi_{a,1}$	1,20	1,15	1,10
$\xi_{a,2}$	1,20	1,13	1,05

NA 2.28 Clause 8.6(4) Serviceability limit state anchorage design

A model factor of 1,35 should be applied to the calculated SLS anchorage force. The ULS design of the anchorages should then be performed with a design value of the anchor load equal to the greater of P_d and $1{,}35P_k$ where P_d results from the ULS design of the structure and P_k results from the SLS design of the structure.

NA 2.29 Clause 11.5.1(1)P Stability analysis for slopes – partial factors

The partial factors for persistent and transient situations are specified in NA 2.32, NA 2.33 and NA 2.39.

NA 2.30 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 with *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 2.31 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 2.32 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 set *A1*.

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

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

NA 2.33 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 set *M1*.

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

Soil parameter	**Symbol**	**Set**
		M1
Angle of shearing resistance[a]	$\gamma_{\varphi'}$	1,0
Effective cohesion	$\gamma_{c'}$	1,0
Undrained shear strength	γ_{cu}	1,0
Unconfined strength	γ_{qu}	1,0
Weight density	γ_γ	1,0
[a] This factor is applied to tan φ'		

NA 2.34 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 2.35 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 2.36 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 should 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 2.37 Clause A.3.3.4(1)P Partial resistance factors for pre-stressed anchorages

For the verification of the structural (STR) and geotechnical (GEO) limit states, the values of the partial factors $\gamma_{a;t}$ and $\gamma_{a;p}$ are specified in Table A.12(CYS) for the set *R2*.

Table A.12(CYS): Partial resistance factors (γ_R) for pre-stressed anchorages

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

NA 2.38 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 2.39 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 *R2*.

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

Resistance	Symbol	Set
		R2
Earth resistance	$\gamma_{R;e}$	1,1

NA 2.40 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 2.41 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 γ_a 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
Anchorage resistance	γ_a	1,40
[a] This factor is applied to tan φ'		

NA 2.42 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 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, Design Approach 2 shall be used.

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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CYPRUS ORGANISATION FOR STANDARDISATION
Limassol Avenue and Kosta Anaxagora 30,
2nd & 3rd Floor, 2014 Nicosia, Cyprus
P.O.BOX.16197, 2086 Nicosia, Cyprus
Tel: +357 22 411411 Fax: +357 22 411511
E-Mail: cystandards@cys.org.cy
Website: www.cys.org.cy