CYS National Annex to CYS EN 1996-1-1:2005

Eurocode 6:

Design of masonry structures

Part 1-1:

General rules for reinforced and unreinforced masonry structures

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

NATIONAL ANNEX

TO

CYS EN 1996-1-1:2005 Eurocode 6: Design of masonry structures

Part1-1: General rules for reinforced and unreinforced masonry structures

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 1996-1-2:2005

This National Annex gives:

(a) Nationally determined parameters for the following clauses of CYS EN 1996-1-1:2005 where National choice is allowed (see Section NA 2)

- 2.4.3 (1)P
- 2.4.4 (1)
- 3.2.2 (1)
- 3.6.1.2 (1)
- 3.6.2 (3),(4) and (6)
- 3.6.3 (3)
- 3.7.2 (2)
- 3.7.4 (2)
- 4.3.3 (3) and (4)
- 5.5.1.3 (3)
- 6.1.2.2 (2)
- 8.1.2 (2)
- 8.5.2.2 (2)
- 8.5.2.3 (2)
- 8.6.2 (1)
- 8.6.3 (1)

(b) Decisions on the use of the Informative Annexes A, B, C, D, E, F, G, H , I and J (see Section NA 3)

(c) References to non-contradictory complementary information to assist the user to apply CYS EN 1996-1-1:2005. In this National Annex such information is not provided (see Section NA 4).

NA 2 NATIONALLY DETERMINED PARAMETERS

NA 2.1 Clause 2.4.3 Ultimate limit states

(1)P The recommended values (see Table 1 CYS) for the partial factor for materials, $\gamma_{M,}$ used for the ultimate limit state are adopted.

NA 2.2 Clause 2.4.4 Serviceability limit states

(1) The recommended value of γ_M=1.0 for serviceability limit state is adopted.

NA 2.3 Clause 3.2.2 Specification of masonry mortar

(1) Acceptable equivalent mixes are provided in Table 2 (CYS) below.

NA 2.4 Clause 3.6.1.2 Characteristic compressive strength of masonry other than shell bedded masonry

(1) The characteristic compressive strength can be determined experimentally based on (i) method or using method (ii).

Table 1 (CYS): Recommended values for the partial factor for materials, γ_M

	Material	γ_M				
		Class				
		1	2	3	4	5
	Masonry made with:					
A	Units of Category I, designed mortar[a]	1,5	1,7	2,0	2,2	2,5
B	Units of Category I, prescribed mortar[b]	1,7	2,0	2,2	2,5	2,7
C	Units of Category II, any mortar[a, b, e]	2,0	2,2	2,5	2,7	3,0
D	Anchorage of reinforcing steel	1,7	2,0	2,2	2,5	2,7
E	Reinforcing steel and prestressing steel	1,15				
F	Ancillary components[c, d]	1,7	2,0	2,2	2,5	2,7
G	Lintels according to EN 845-2	1,5 to 2,5				

[a] Requirements for designed mortars are given in EN 998-2 and EN 1996-2.
[b] Requirements for prescribed mortars are given in EN 998-2 and EN 1996-2.
[c] Declared values are mean values.
[d] Damp proof courses are assumed to be covered by masonry γ_M.
[e] When the coefficient of variation for Category II units is not greater than 25 %.

Table 2 (CYS): Acceptable equivalent mortar mixes-Composition and Strength

Type of Mortar	Minimum Compressive Strength at 28 days, N/mm^2	Approximate Composition in parts by volume		
		Cement	Hydrated Lime	Sand
M20	20	To be confirmed by tests		
M15	15	1	0-0.25	3
M10	10	1	0.25-0.50	4-4.5
M5	5	1	0.50-1.25	5-6
M2	2.5	1	1.25-2.50	8-9

NA 2.5 Clause 3.6.2 Characteristic shear strength of masonry

(3) The value of characteristic shear strength of masonry, f_{vk}, in equation 3.5 should not be greater than $0.065f_b$.

(4) The value of characteristic shear strength of masonry, f_{vk}, in equation 3.6 should not be greater than $0.045f_b$.

(6) The initial shear strength of the masonry, f_{vko}, should be selected from the values given in Table 3 (CYS).

Table 3 (CYS): Values of the intitial shear strength of masonry, f_{vko}

Masonry units	f_{vko} (N/mm²)			
	General purpose mortar of the Strength Class given		Thin layer mortar (bed joint ≥ 0,5 mm and ≤ 3 mm)	Lightweight mortar
Clay	M10 - M20	0,30	0,30	0,15
	M2,5 - M9	0,20		
	M1 - M2	0,10		
Calcium silicate	M10 - M20	0,20	0,40	0,15
	M2,5 - M9	0,15		
	M1 - M2	0,10		
Aggregate concrete	M10 - M20	0,20	0,30	0,15
Autoclaved Aerated Concrete	M2,5 - M9	0,15		
Manufactured stone and Dimensioned natural stone	M1 - M2	0,10		

NA 2.6 Clause 3.6.3 Characteristic flexural strength of masonry

(3) Where test data are not available values for the characteristic flexural strength of masonry, f_{kx1} and f_{kx2}, may be taken from the recommended values given in Tables 4 (CYS) and 5 (CYS) below. The limitations given in CYS EN 1996-1-1:2005 should be applied.

NA 2.7 Clause 3.7.2 Modulus of Elasticity

(2) The recommended value of K_E=1000 is adopted.

NA 2. 8 Clause 3.7.4 C reep, m oisture e xpansion or s hrinkage a nd t hermal expansion

(2) The recommended ranges of values for the deformation properties of masonry given in Table 6 (CYS) are adopted.

Table 4 (CYS): Values of f_{xk1}, for plane of failure parallel to bed joints

Masonry Unit	f_{xk1} (N/mm^2)			
	General purpose mortar		Thin layer mortar	Lightweight mortar
	$f_m < 5$ N/mm^2	$f_m \geq 5$ N/mm^2		
Clay	0,10	0,10	0,15	0,10
Calcium silicate	0,05	0,10	0,20	not used
Aggregate concrete	0,05	0,10	0,20	not used
Autoclaved aerated concrete	0,05	0,10	0,15	0,10
Manufactured stone	0,05	0,10	not used	not used
Dimensioned natural stone	0,05	0,10	0,15	not used

Table 5 (CYS): Values of f_{xk2}, for plane of failure perpendicular to bed joints

Masonry Unit		f_{xk2} (N/mm^2)			
		General purpose mortar		Thin layer mortar	Lightweight mortar
		$f_m < 5$ N/mm^2	$f_m \geq 5$ N/mm^2		
Clay		0,20	0,40	0,15	0,10
Calcium silicate		0,20	0,40	0,30	not used
Aggregate concrete		0,20	0,40	0,30	not used
Autoclaved aerated concrete	$\rho < 400$ kg/m^3	0,20	0,20	0,20	0,15
	$\rho \geq 400$ kg/m^3	0,20	0,40	0,30	0,15
Manufactured stone		0,20	0,40	not used	not used
Dimensioned natural stone		0,20	0,40	0,15	not used

NA 2.9 Clause 4.3.3 Reinforcing steel

(3) Recommended reinforcing steels for durability given in Table 7 (CYS) are adopted.

(4) Recommended concrete cover depth, c_{nom}, values given in Table 8 (CYS) are adopted.

NA 2.10 Clause 5.5.1.3 Effective thickness of masonry walls

(3) The recommended value of factor k_{tef} (defined as E_1/E_2) should not be taken to be greater than 2.

NA 2.11 Clause 6.1.2.2 Reduction factor for slenderness and eccentricity

(2) The recommended value of λ_c=15 is adopted. The final creep coefficient for different types of masonry is given in Table 6 (CYS).

Table 6 (CYS): Range of coefficients of creep, moisture expansion or shrinkage, and thermal properties of masonry

Type of masonry unit		Final creep coefficient[a] ϕ_∞	Long term moisture expansion or shrinkage[b] mm/m	Coefficient of thermal expansion, α_t, 10^{-6}/K
Clay		0,5 to 1,5	-0,2 to +1,0	4 to 8
Calcium Silicate		1,0 to 2,0	-0,4 to –0,1	7 to 11
Dense aggregate concrete and manufactured stone		1,0 to 2,0	-0,6 to -0,1	6 to 12
Lightweight aggregate concrete		1,0 to 3,0	-1,0 to -0,2	6 to 12
Autoclaved aerated concrete		0,5 to 1,5	-0,4 to +0,2	7 to 9
Natural stone	Magmatic	[c]	-0,4 to +0,7	5 to 9
	Sedimentary			2 to 7
	Metamorphic			1 to 18

[a] The final creep coefficient $\phi_\infty = \varepsilon_{c\infty} / \varepsilon_{el}$, where $\varepsilon_{c\infty}$ is the final creep strain and $\varepsilon_{el} = \sigma / E$.

[b] Where the long term value of moisture expansion or shrinkage is shown as a negative number it indicates shortening and as a positive number it indicates expansion.

[c] These values are normally very low.

NA 2.12 Clause 8.1.2 Minimum thickness of wall

(2) The value of t_{min} should satisfy the outcome of the calculations for a robust wall that satisfies this standard, as recommended by the standard.

NA 2.13 Clause 8.5.2.2 Cavity and veneer walls

(2) The recommended value of n_{tmin}=2 for both cavity and veneer walls is adopted.

NA 2.14 Clause 8.5.2.3 Double-leaf walls

(2) The recommended value of j=2 is adopted.

NA 2.15 Clause 8.6.2 Vertical chases and recesses

(1) The recommended values for $t_{ch,v}$ given in Table 9 (CYS) are adopted.

Table 7 (CYS): Selection of reinforcing steel for durability

Exposure class[a]	Minimum level of protection for reinforcing steel	
	Located in mortar	Located in concrete with cover less than required according to (4)
MX1	Unprotected carbon steel[b]	Unprotected carbon steel
MX2	Carbon steel, heavily galvanised or with equivalent protection[c]	Unprotected carbon steel or, where mortar is used to fill in the voids, carbon steel, heavily galvanised or with equivalent protection[c]
	Unprotected carbon steel, in masonry with a rendering mortar on the exposed face [d]	
MX3	Austenitic stainless steel AISI 316 or 304	Carbon steel, heavily galvanised or with equivalent protection[c]
	Unprotected carbon steel, in masonry with a rendering mortar on the exposed face [d]	
MX4	Austenitic stainless steel AISI 316 Carbon steel heavily galvanised or with equivalent protection [b] with a rendering mortar on the exposed face [d]	Austenitic stainless steel AISI 316
MX5	Austenitic stainless steel AISI 316 or 304[e]	Austenitic stainless steel AISI 316 or 304[e]

[a] See EN 1996-2

[b] For the inner leaf of external cavity walls likely to become damp, carbon steel, heavily galvanised or with equivalent protection as c, should be used.

[c] Carbon steel should be galvanised with a minimum mass of zinc coating of 900 g/m^2 or galvanised with a minimum mass of zinc coating of 60 g/m^2 and provided with a bonded epoxy coating of at least 80 μm thickness, with an average of 100 μm. See also 3.4.

[d] The mortar should be general purpose or thin layer mortar, not less than M4, the side cover in figure 8.2 should be increased to 30 mm and the masonry should be rendered with a rendering mortar in accordance with EN 998-1.

[e] Austenitic stainless steel may still not be suitable for all aggressive environments, and these should be considered on a project by project basis.

NA 2.16 Clause 8.6.3 Horizontal and inclined chases

(1) The recommended values for $t_{ch,h}$ given in Table 10 (CYS) are adopted.

Table 8 (CYS): Recommended values for the minimum concrete cover c_{nom} for carbon reinforced steel

Exposure class	Minimum cement content [a] kg/m^3				
	275	300	325	350	400
	Maximum water/cement ratio				
	0,65	0,60	0,55	0,50	0,45
	Thickness of minimum concrete cover mm				
MX1[b]	20	20	20[c]	20[c]	20[c]
MX2	—	35	30	25	20
MX3	—	—	40	30	25
MX4 and MX5	—	—	—	60[d]	50

[a] All mixes are based on the use of normal-weight aggregate of 20 mm nominal maximum size. Where other sized aggregates are used, cement contents should be adjusted by +20 % for 14 mm aggregate and +40 % for 10 mm aggregate.

[b] Alternatively, a 1: 0 to ¼ : 3: 2 (cement : lime: sand : 10 mm nominal aggregate mix by volume) may be used to meet exposure situation MX1, when the cover to reinforcement is a minimum of 15 mm.

[c] These covers may be reduced to a minimum of 15 mm provided that the nominal maximum size of the aggregate does not exceed 10 mm.

[d] Where the concrete infill may be subjected to freezing while still wet, frost resistant concrete should be used.

Table 9 (CYS): Sizes of vertical chases and recesses in masonry, $t_{ch,v}$, allowed without calculation

	Chases and recesses formed after construction of masonry		Chases and recesses formed during construction of masonry	
Thickness of wall mm	max depth mm	max width mm	minimum wall thickness remaining mm	max width mm
85 - 115	30	100	70	300
116 – 175	30	125	90	300
176 – 225	30	150	140	300
226 – 300	30	175	175	300
> 300	30	200	215	300

NOTE 1 The maximum depth of the recess or chase should include the depth of any hole reached when forming the recess or chase.

NOTE 2 Vertical chases which do not extend more than one third of the storey height above floor level may have a depth up to 80 mm and a width up to 120 mm, if the thickness of the wall is 225 mm or more.

NOTE 3 The horizontal distance between adjacent chases or between a chase and a recess or an opening should not be less than 225 mm.

NOTE 4 The horizontal distance between any two adjacent recesses, whether they occur on the same side or

on opposite sides of the wall, or between a recess and an opening, should not be less than twice the width of the wider of the two recesses.

NOTE 5 The cumulative width of vertical chases and recesses should not exceed 0,13 times the length of the wall.

Table 10 (CYS): Sizes of horizontal and inclined chases in masonry, $t_{ch,h}$, allowed without calculation

Thickness of wall mm	Maximum depth mm	
	Unlimited length	Length ≤ 1 250 mm
85 - 115	0	0
116 - 175	0	15
176 - 225	10	20
226 - 300	15	25
over 300	20	30

NOTE 1 The maximum depth of the chase should include the depth of any hole reached when forming the chase.

NOTE 2 The horizontal distance between the end of a chase and an opening should not be less than 500 mm.

NOTE 3 The horizontal distance between adjacent chases of limited length, whether they occur on the same side or on opposite sides of the wall, should be not less than twice the length of the longest chase.

NOTE 4 In walls of thickness greater than 115 mm, the permitted depth of the chase may be increased by 10 mm if the chase is machine cut accurately to the required depth. If machine cuts are used, chases up to 10 mm deep may be cut in both sides of walls of thickness not less than 225 mm.

NOTE 5 The width of chase should not exceed half the residual thickness of the wall.

NA 3 DECISION ON USE OF THE INFORMATIVE ANNEXES A-J

NA 3.1 Annex A

Annex A may be used

NA 3.2 Annex B

Annex B may be used

NA 3.3 Annex C

Annex C may be used

NA 3.4 Annex D

Annex D may be used

NA 3.5 Annex E

Annex E may be used

NA 3.6 Annex F

Annex F may be used

NA 3.7 Annex G

Annex G may be used

NA 3.8 Annex H

Annex H may be used

NA 3.9 Annex I

Annex I may be used

NA 3.10 Annex J

Annex J may be used

NA 4 REFERENCES TO NON-CONTRADICTORY COMPLEMENTARY INFORMATION

None

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