NATIONAL ANNEX

TO

CYS EN 1998-2:2005 Eurocode 8: Design of structures for earthquake resistance

Part2: Bridges

Public Enquiry Draft

Period of Enquiry

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Readers are advised that this is a draft document and subject to change

Prepared by: Eurocodes Committee
Ministry of Interior / Technical Chamber of Cyprus

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 1998-2:2005

This National Annex gives:

(a) Nationally determined parameters for the following clauses of CYS EN 1998-2:2005 where National choice is allowed (see Section NA 2)

- 1.1.1 (8)
- 2.1 (3)P
- 2.1 (4)P
- 2.1 (6)
- 2.2.2 (5)
- 2.3.5.3 (1)
- 2.3.6.3 (5)
- 2.3.7 (1)
- 3.2.2.3
- 3.3 (1)P
- 3.3 (6)
- 4.1.2 (4)P
- 4.1.8 (2)
- 5.3 (4)
- 5.4 (1)
- 5.6.2 (2)P b
- 5.6.3.3 (1)P b
- 6.2.1.4 (1)P
- 6.5.1 (1)P
- 6.6.2.3 (3)
- 6.6.3.2 (1)P
- 6.7.3 (7)
- 7.4.1 (1)P
- 7.6.2 (1)P
- 7.6.2 (5)
- 7.7.1 (2)
- J.1 (2)
- J.2 (1)

(b) Decision on the informative or normative use of Annexes A, B, C, D, E, F, H, JJ and K (see Section NA 3)

NA 2 NATIONALLY DETERMINED PARAMETERS

NA 2.1 Clause 1.1.1 (8) Scope of CYS EN 1998-2:2005

Annexes A, B, C and D of CYS EN 1998-2:2005 shall be used as Informative Annexes, whereas Annexes E, F, H, JJ and K of CYS EN 1998-2:2005 shall be used as Normative Annexes.

NA 2.2 Clause 2.1 Design seismic action

(3)P The value for the reference return period T_{NCR} is set equal to 475 years.

(4)P Bridges are classified in three importance classes, as follows:

Importance class II comprises bridges of average importance with the exceptions noted below.

Importance class III comprises bridges of critical importance for maintaining communications, especially in the immediate post-earthquake period, bridges the failure of which is associated with a large number of probable fatalities and major bridges where a design life greater than normal is required.

Importance class I comprises bridges of less than average importance. A bridge shall be classified to importance class I when both of the following conditions are met:

- the bridge is not critical for communications, and
- the adoption of either the reference probability of exceedance, P_{NCR}, in 50 years for the design seismic action, or of the standard bridge design life of 50 years is not economically justified.

(6) The values of the importance factor γ_I for importance classes I, II, and III are defined as follows:

γ_I = 0,85 for importance class I

γ_I = 1,00 for importance class II

γ_I = 1,30 for importance class III

NA 2.3 Clause 2.2.2 (5) No-collapse (ultimate limit state)

The seismic action shall not be considered as an accidental action under any conditions. Clauses 2.2.2 (3) and 2.2.2 (4) of CYS EN 1998-2:2005 are always applicable.

NA 2.4 Clause 2.3.5.3 (1) Local ductility at the plastic hinges

The expression of the length of plastic hinges L_p for concrete members is given by equation E.19 of Annex E of CYS EN 1998-2:2005.

NA 2.5 Clause 2.3.6.3 (5) Control of displacements - Detailing

The value of fraction for the design seismic displacement p_E is set equal to 0.4, and for the thermal movement p_T is set equal to 0.5.

NA 2.6 Clause 2.3.7 (1) Simplified criteria

Clause 2.3.7 (1) of CYS EN 1998-2:2005 is not applicable in Cyprus.

NA 2.7 Clause 3.2.2.3 Near source effects

A seismotectonic fault is considered to be active when there is an average historic slip rate of at least 1 mm/year and topographic evidence of seismic activity within the Holocene times (past 11000 years).

NA 2.8 Clause 3.3 Spatial variability of the seismic action

(1)P The value of the continuous deck limiting length, L_{lim}, is specified as

$$L_{lim} = \frac{L_g}{1.5}$$

where the length L_g is defined in clause 3.3 (6) Table 3.1N of CYS EN 1998-2:2005.

(6) The values of the distance L_g, beyond which ground motions are considered as completely uncorrelated, depending on the ground type are given in Table 3.1N:

Table 3.1N: Distance beyond which ground motions are considered uncorrelated

Ground Type	A	B	C	D	E
L_g (m)	600	500	400	300	500

The factor accounting for the magnitude of ground displacements occurring in apposite direction at adjacent supports β_r is defined as follows:

β_r = 0.5 when all three supports have the same ground type

β_r = 1.0 when the ground type at one of the supports is different than at the other two.

NA 2.9 Clause 4.1.2 (4)P Masses

The values of ψ_{21} factor for traffic loads assumed concurrent with the design seismic action are defined as:

ψ_{21} = 0 for bridges with normal traffic and footbridges

ψ_{21} = 0,2 for road bridges with severe traffic, and

ψ_{21} = 0,3 for railway bridges with severe traffic.

NA 2.10 Clause 4.1.8 (2)P Regular and irregular seismic behaviour of ductile bridges

The upper limit for the value of ρ_o is set equal to 0,2.

NA 2.11 Clause 5.3 (4) Capacity design

The value of the overstrength factor is set equal to

γ_o = 1,35 for concrete members, and

γ_o = 1,25 for steel members.

NA 2.12 Clause 5.4 (1) Second order effects

Approximate methods for estimating second order effects in linear analysis under seismic actions are based on the assumption that the increase of bending moments of the plastic hinge section due to second order effects is

$$\Delta M = \frac{1+q}{2} d_{Ed} N_{Ed}$$

where N_{Ed} is the axial force and d_{Ed} is the relative transverse displacement of the ends of the considered ductile member, both in the design seismic situation.

NA 2.13 Clause 5.6.2 (2)P b Structures of limited ductile behaviour

The value of the additional safety factor against brittle failure γ_{Bd1} is set equal to 1,25.

NA 2.14 Clause 5.6.3.3 (1)P b Shear resistance of members outside the region of plastic hinges

To determine the value of the additional safety factor γ_{Bd} on shear resistance of ductile members outside the region of plastic hinges, equation (5.8b) is recommended since it is more conservative.

NA 2.15 Clause 6.2.1.4 (1)P Required confining reinforcement

All types of confinement reinforcement are allowed.

NA 2.16 Clause 6.5.1 (1)P Verification of ductility of critical sections

Clause 6.5.1 (1)P of CYS EN 1998-2:2005 is not applicable in Cyprus.

NA 2.17 Clause 6.6.2.3 (3) Elastomeric bearings

According to Clause 2.2.2 (5) of CYS EN 1998-2:2005, the seismic action shall not be considered as an accidental action under any conditions.

NA 2.18 Clause 6.6.3.2 (1)P Holding-down devices

The value of the percentage of the compressive (downward) reaction p_H due to the permanent load that is exceeded by the total vertical reaction on a support due to the design seismic action, for holding-down devices is specified as follows:

p_H = 80% in bridges of ductile behaviour, where the vertical reaction due to the design seismic action is determined as a capacity design effect,

p_H = 50% in bridges of limited ductile behaviour, where the vertical reaction due to the design seismic action is determined from the analysis under the design seismic action alone (including the contribution of the vertical seismic component).

NA 2.19 Clause 6.7.3 (7) Abutments rigidly connected to the deck

The upper value of the design seismic displacement d_{lim} to limit damage of the soil or embankment behind abutments rigidly connected to the deck is given in Table 6.2N:

Table 6.2N: Recommended limit value of design seismic displacement at abutment rigidly connected to the deck

Bridge Importance class	Displacement Limit d_{lim} (mm)
III	30
II	60
I	No limitation

NA 2.20 Clause 7.4.1 (1)P Design spectra

The value of period T_D for the design spectrum of bridges with seismic isolation is specified as T_D = 2.5 sec.

NA 2.21 Clause 7.6.2 Isolating system

(1)P The value of the amplification factor γ_{IS} on design displacement of isolator units is specified at γ_{IS} = 1,50.

(5) The value γ_m for elastomeric bearings is specified at γ_m = 1,15.

NA 2.22 Clause 7.7.1 (2) Lateral restoring capability

The values of factors δ_w and δ_b for the lateral restoring capability of the isolation system are set equal to:

δ_w = 0,015

δ_b = 0,5.

NA 2.23 Clause J.1 (2) Factors causing variation of design properties

The value of minimum isolator temperature in the seismic design situation is given by:

$$T_{\min,b} = \psi_2 T_{\min} + \Delta T_1$$

where

T_{min} is the value of the minimum shade air temperature at the bridge location having an annual probability of (negative) exceedance of 0.02, in accordance with EN 1990-1-5:2007, 6.1.3.2.

ψ_2 = 0.50 is the combination factor for thermal actions for seismic design situation, in accordance with EN 1990:2002 – Annex A2 and

ΔT_1 takes the following values depending on the material of the bridge deck, in accordance with Figure 6.1 of EN 19991-1-5:2003

Table J.1N: Value of ΔT_1 for the determination of the minimum isolator temperature

Deck	Concrete	Composite	Steel
ΔT_1 (°C)	7.5	5.0	-2.5

NA 2.24 Clause J.2 (1) Evaluation of the variation

The values of λ-factors for commonly used isolators are given in Annex JJ, which shall be used as Normative Annex.

NA 3 DECISION ON THE INFORMATIVE OR NORMATIVE USE OF ANNEXES A, B, C, D, E, F, H, JJ AND K

NA 3.1 Annex A Probabilities related to the reference seismic action. Guidance for the selection of design seismic action during the construction phase

Annex A may be used as Informative Annex

NA 3.2 Annex B Relationship between displacement ductility and curvature ductility factors of plastic hinges in concrete piers

Annex B may be used as Informative Annex

NA 3.3 Annex C Estimation of the effective stiffness of reinforced concrete ductile members

Annex C may be used as Informative Annex

NA 3.4 Annex D Spatial variability of earthquake ground motion: Model and methods of analysis

Annex D may be used as Informative Annex

NA 3.5 Annex E Probable material properties and plastic hinge deformation capacities for non-linear analyses

Annex E shall be used as Normative Annex

NA 3.6 Annex F Added mass of entrained water for immersed piers

Annex F shall be used as Normative Annex

NA 3.7 Annex H Static non-linear analysis (pushover)

Annex H shall be used as Normative Annex

NA 3.8 Annex JJ λ-factors for common isolator types

Annex JJ shall be used as Normative Annex

NA 3.9 Annex K Tests for validation of design properties of seismic isolator units

Annex K shall be used as Normative Annex