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EN 1998 – Elaboration of NA

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Overview of the presentation

- Key features of the development of Eurocodes and the relevant National Annexes (NA)
- The role of NSB and the role of the "Authortity"
- An historic flash-back on codes applied in Greece for the design of civil engineering structures
- Brief overview of the procedure for the implementation of ENVs and EN-Eurocodes in Greece
- Some key issues/choices of the NA for the EN 1998 parts – The case of Greece

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Key features of the development of Eurocodes and the relevant National Annexes (NA)

- The drafting, issuance and implementation of the EN Eurocodes is a huge achievement of European Engineers, but unavoidably is reflecting existing differences of culture, educational systems, professional conditions and legal framework
- Therefore, in a Eurocode Part (= EN standard), there may be procedures/methods, values, classes etc., for which agreement on unification (harmonization) could not be reached within CEN TC250 Subcommittees.
- For each of them, a NOTE in the EN standard : indicates that a National choice should be given in a NATIONAL ANNEX to this Eurocode Part and gives a recommendation for a National choice that provides the acceptable level of reliability.
- Another reason for the need of National choices is linked to the fact that all matters of safety within EU remain of National Competence

Key features of the development of Eurocodes and the relevant National Annexes (NA)

- (Reminder): A National Annex contains information on the Nationally Determined Parameters (NDPs), to be used for the design of buildings and other civil engineering works dealt within the Eurocodes. They may be :
  - values and/or classes where alternatives are given in the Eurocode;
  - values to be used where a symbol only is given in the Eurocode;
  - country specific data (geographical, climatic, etc.) e.g. snow map;
  - a procedure to be used where alternative procedures are given in the Eurocode.

Key features of the development of Eurocodes and the relevant National Annexes (NA) (cont.)

- (Reminder) : A National Annex may also contain :
  - decisions on the application of informative annexes;
  - references to "non contradictory complementary information (NCCI)" to assist the user to apply the Eurocode.

Note : The NCCI may also refer to topics not covered by the Eurocodes.

A danger : Some of the NCCI clauses not being really "non-contradictory"

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The role of NSB and the role of the "Authority"

- A "standard" (in general) is the outcome of a voluntary procedure among the parts participating in its drafting and issuance and, subsequently, its application is in principle non-mandatory. A Country is represented within an International Standard Organization by its National Standard Organization (or Body), NSO/B.
- The implementation of a standard within a National Regulatory Framework is usually the responsibility and right of the relevant "Authority" (often the competent Ministry)
- It may differ considerably from Country to Country, e.g. :

  - "codes of practice" or "design standards" (non-mandatory but practically generally applied under the responsibility of the professionals (engineers); (cont' d)

The role of NSB and the role of the "Authority" (cont.)

- in some Countries mandatory application for those more closely and directly linked to safety issues, such as vis-à-vis fire or seismicity
- introduced in the National Legal System as mandatory, by means of a Ministerial or a "Common" Ministerial Decision, a Circular, a Decree or even a Law

But : For EU MS (Member States) the implementation at the national level should remain compatible with the European legal framework

As a general rule safety issues are recognised as a national responsibility (competence)

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Historic flash-back of Greek (Design) Codes

- 1945 : Loading of structures
- 1945+ : German Codes (DIN) 1045, 1050, 1055 etc. (for concrete and steel structures, loading etc.)
- 1959 : Paraseismic Code
- 1984 : "Additional clauses" (to the Paraseismic Code)
- 1989 : Code for RC structures, "New" paraseismic code
- 1996+ : ENV Eurocodes (for steel, composite steel-concrete, masonry and timber structures)
- 2000 : Code for RC structures, Paraseismic code
- 2010+ : EN Eurocodes, Code for retrofitting of structures (NCCI)

Brief overview of the procedure for the implementation of ENVs and EN-Eurocodes in Greece

- Initially (Feb. 1991) a typical Technical Committee within the framework of ELOT (Hellenic Standard Organization), chaired by Prof. Th. P. Tassios has been created. This TC (ELOT 67) has been successively partially restructured in 1998, 1999 and 2008. Its major problem has been for several years the lack of financial means
- In view of the aspects of future implementation of Eurocodes (initially as ENVs), on one hand, and considering the mis-functioning of ELOT TC 67, on the other hand, the then Ministry of Environment, Planning and Public Works (MEPPW) decided the establishment (Nov. 1995) of the "Eurocodes Committee" (Chairman : Prof. Th. P. Tassios, Secretary : Dr Alex Plakas (2003 - June 2007), Dr Nikolaos Malakatas (July 2007 – 2012))

Brief overview of the procedure for the implementation of ENVs and EN-Eurocodes in Greece (cont.)

- In establishing a "Eurocodes Committee" care has been taken so that most of its members were at the same time members of ELOT TC 67, which was functioning in parallel, as a kind of "shadow committee", to be mobilised, whenever issues involving the NSOs were appearing (e.g. voting procedures)
- During its first period of activity (late '90ies), corresponding more or less to the preparation of the ENV-Eurocodes and the equivalent of National Annexes (NA), then called "National Application Documents", which comprised the equivalent of the Nationally Determined Parameters (NDP), then called "Boxed Values" , the "Eurocode Committee" worked for the drafting of the NADs and the supervision of the ENV translations into Greek, essentially financed by the Technical Chamber of Greece (TCG)

Brief overview of the procedure for the implementation of ENVs and EN-Eurocodes in Greece (cont.)

- An important step forward was achieved by ensuring since March 2003 a financing of 600.000 euros to support the activities of the "Eurocodes Committee" over the next years, essentially :
  - Translations of the EN-Eurocodes into Greek (Translation period : essentially 2004 – 2007, few last ones until 2009) made by Working Groups under its monitoring
  - Drafting of the National Annexes made also by Working Groups under its monitoring (Drafting of NA period : 2006 - 2010)
- For administrative and financial purposes the management of these activities has been attributed to the Earthquake Planning and Protection Organization (EPPO)

Brief overview of the procedure for the implementation of ENVs and EN-Eurocodes in Greece (cont.)

- Issuance by the Ministry of Environment, Planning and Public Works of the "Provisional Recommendations for the design of bridges in conjunction with the use Eurocodes" (end of 2007). Extension to other types of Civil Engineering Works one year later (August 2008)
- Issuance of ELOT EN-Eurocodes and their NAs (end of 2010)
- For practically three years a "dormant" (non-active) period due to two unresolved problems :
  - lack of financing
  - incompatibility of publication of the corpus of the documents in the O.J. of Hellenic Republic, in case of mandatory application, without addressing the copyright issues

Brief overview of the procedure for the implementation of ENVs and EN-Eurocodes in Greece (cont.)

- In order to bypass the publication-copyright problems decision for a non-mandatory implementation of the use of EN-Eurocodes + NAs by issuing a "Common Ministerial Decision" (June 2014). By this same decision all existing codes became non-mandatory.
- In the same time reactivation by ELOT of the TC 67 "Structural Eurocodes" with Dr N. Malakatas as Chairman and Mrs Eug. Gardeli as Secretary. With the same decision 11 WG have been established within TC 67 (for the existing 10 EN-Eurocodes and the future one on FRP structures)
- A funding of more than 200.000 euros has been recently ensured by the Greek Government for supporting the activities of this TC until the end of 2016

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Brief overview of the procedure for the implementation of ENVs and EN-Eurocodes in Greece (cont.)

- The main tasks of this Committee are :
  - translation of corrigenda and amendments issued since October 2009
  - reviewing and all NAs in view of the aforementioned new documents and users' comments
  - translation of NAs into English
  - uploading NAs etc. in the JRC Data Base
  - establishing a "contact point" for addressing questions
  - financing the participation of Greek delegates in CEN/TC 250 and its SCs, WGs et al.
  - hosting relevant meetings etc.

Some key issues/choices of the NA for the EN 1998 parts – The case of Greece

- In the following the choices made by Greece for EN 1998-x /NA which differ from the recommended choices are cited. It is to note that the existing NAs have been issued by the end of 2010, consequently they do not reflect the virtual influence of the amendments and corrigenda published since. These adjustments, where judged necessary, are planned for the next few months
- It is to remind that EN 1998 comports the following six parts:

Part 1 : General rules, seismic actions and rules for buildings

Part 2 : Bridges

Part 3 : Assessment and retrofitting of buildings

Part 4 : Silos, tanks and pipelines

Part 5 : Foundations, retaining structures and geotechnical aspects

Part 6 : Towers, masts and chimneys

ELOT EN 1998-1/NA

Adoption of recommended choices (31 out of 55)

- ***3.1.1(4) Conditions under which ground investigations additional to those necessary for design for non-seismic actions may be omitted and default ground classification may be used.***
- *The extent of the required ground investigations/studies depends on the Ground Type, the Seismicity and the Importance Class of the building. More specifically:*
- *For buildings of importance class I on ground type A, B or C, and for buildings of importance class II or for one-storey buildings of importance class III, on ground type A or B, the estimation of the ground type and the soil strength may be based on available experience from nearby structures founded on similar ground formations. These structures should not present significant settlements, and should have shown good behaviour during significant seismic actions that have occurred in the past.*

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- ***3.1.2(1) Ground classification scheme accounting for deep geology, including values of parameters S, T_B, T_C and T_D defining horizontal and vertical elastic response spectra in accordance with 3.2.2.2 and 3.2.2.3.***
- *The identification of ground types A, B, C, D and E is made in accordance with Table 3.1 of EN 1998-1:2004 without further accounting for the deeper geology. The values of parameters S, T_B, T_C and T_D for the horizontal as well as the vertical spectrum of elastic response are given in provisions that follow.*

- ***3.2.1(1), (2),(3) Seismic zone maps and reference ground accelerations therein.***
- *Figure 1 shows the map of the three seismic zones Z1, Z2 and Z3 that is applicable in Greece.*
- *The reference value a_{gR} of the maximum ground acceleration corresponding to ground type A, is defined for each seismic zone. In following Table 1. This value corresponds to the reference value of the return period T_{NCRB} = 475 years.*

Figure 1

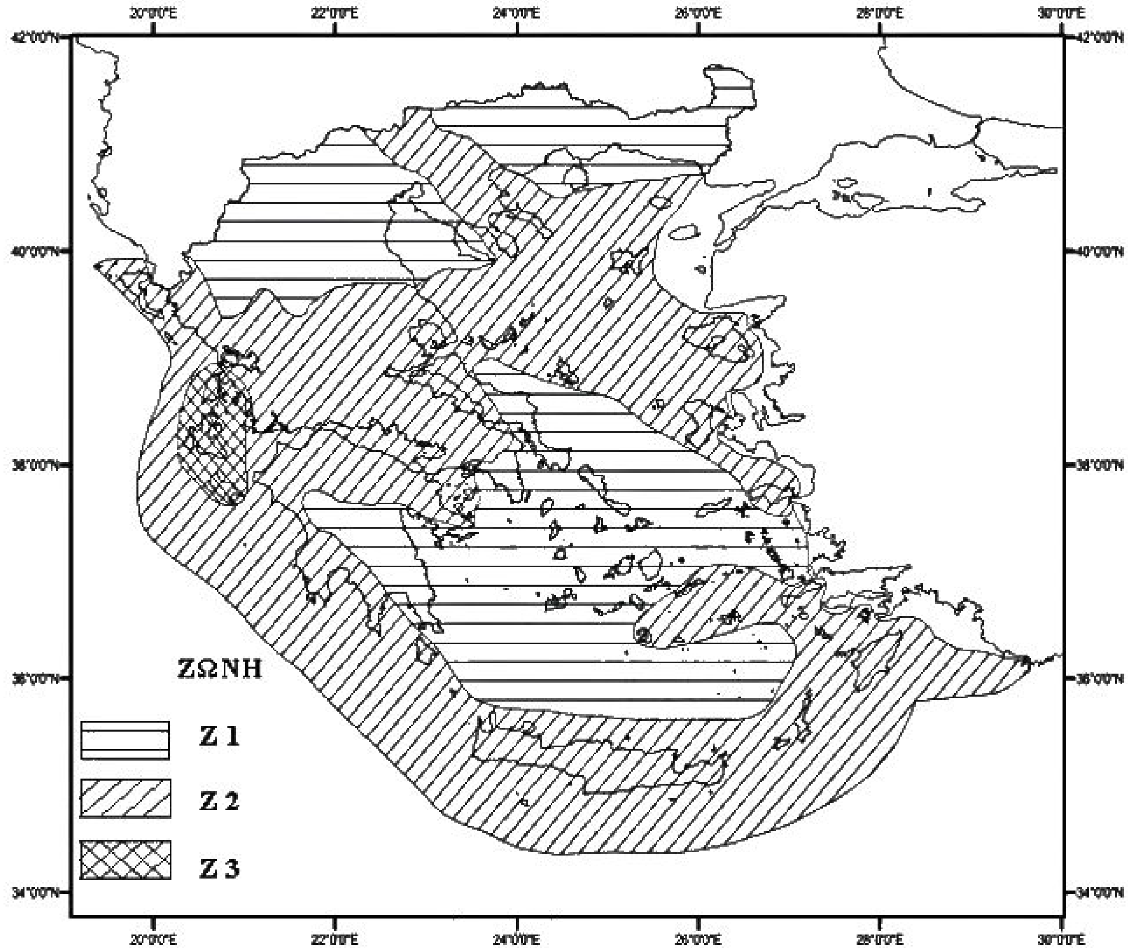

Table 1 : Reference values a_{gR}

of the maximum ground acceleration in ground type A

Zone	a_{gR}/g
Z1	0,16
Z2	0,24
Z3	0,36

- ***3.2.1(4) Governing parameter (identification and value) for threshold of low seismicity.***
- *No zones of low seismicity are applicable in Greece.*

- ***3.2.1(5) Governing parameter (identification and value) for threshold of very low seismicity.***
- *No zones of very low seismicity are applicable in Greece.*

- ***3.2.2.1(4), 3.2.2.2(1)P, 3.2.2.2(2)P Parameters S, T_B, T_C, T_D defining shape of horizontal elastic response spectra.***
- *For all seismic hazard zones in Greece, the Type 1 horizontal spectrum of elastic response is applicable, with parameters shown in following Table 3.*

Table 3

Values of parameters defining the horizontal spectrum of elastic response (Type 1)

Ground Type	S	T_B (s)	T_C (s)	T_D (s)
A	1,0	0,15	0,4	**2,5**
B	1,2	0,15	0,5	**2,5**
C	1,15	0,20	0,6	**2,5**
D	1,35	0,20	0,8	**2,5**
E	1,4	0,15	0,5	**2,5**

- ***4.2.3.2(8) Reference to definitions of centre of stiffness and of torsional radius in multi-storey buildings meeting or not conditions (a) and (b) of 4.2.3.2(8).***
- *For both cases reference is made to clause 3.3.3 and to Annex ΣT of EAK2000 (Greek Paraseismic Code) and the corresponding comments.*

- ***4.2.5(5)P Importance factor γ_I for buildings.***
- *The values given in following Table 4 are applicable.*

Table 4

Values of Importance Factor γ_I

Importance Class	I	II	III	IV
Importance Factor γ_I	0,80	1,00	1,20	1,40

- ***4.3.3.1 (4) Decision on whether nonlinear methods of analysis may be applied for the design of non-base-isolated buildings. Reference to information on member deformation capacities and the associated partial factors for the Ultimate Limit State for design or evaluation on the basis of nonlinear analysis methods.***
- *The use of methods of non-linear seismic analysis for buildings is allowed only in combination with the linear response spectrum analysis method that is based on the design response spectrum (of 3.2.2.5). Such a use may be considered as a means for investigating and gaining insight in the results of the latter method. However these results should not be reduced on the basis of less demanding results of non-linear seismic response analysis, with the exception of the following cases:*
  a. *Buildings with seismic isolation*
  b. *For checking and correcting the value of the overstrength ratio α_u/α_1 in accordance and within the limits defined by 5.2.2.2, 6.3.2 and 7.3.2 of EN 1998-1 (cont.)*

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c. *For assessment of the behaviour of existing buildings or buildings to be retrofitted, in accordance with EN 1998-3*

Regarding the deformation capacity of members and the relevant material safety factors in the ultimate seismic limit state, to be used in the corresponding member verifications, reference is made to following sources:

a. *The Informative Annexes A to C of EN 1998-3:2005, using the limiting deformations given there for the Ultimate State of "Significant Damage"*

b. *For reinforced concrete buildings Greek "Regulation for Retrofitting" (ΚΑΝΕΠΕ), Chapter 7: Determination of Element Behaviour and Chapter 9: Safety Verifications, using limit deformations defined there for post elastic analysis and verification at Performance Level "Life Safety".*

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- ***4.3.3.1 (8) Threshold value of importance factor, γ_I, relating to the permitted use of analysis with two planar models.***
- *The threshold value of the importance factor for this purpose is defined as $\gamma_I = 1,0$.*

- ***5.2.2.2(10) q_o-value for concrete buildings subjected to special Quality System Plan.***
- *No increase of the value of the behaviour factor q_o is allowed due to any special Quality System Plan.*

- ***5.2.4(1), (3) Material partial factors for concrete buildings in the seismic design situation.***
- *The γ_M-values applicable for persistent and transient design situations shall be used.*

- ***5.11.1.3.2(3) Ductility class of precast wall panel systems.***
- *For precast wall systems and for cell structures (see 5.11.1.1(4) of EN 1998-1) ductility class M (DCM) shall be applied.*
- ***6.1.2(1) Upper limit of q for low-dissipative structural behaviour concept; limitations on structural behaviour concept; geographical limitations on use of ductility classes for steel buildings.***
- *The upper limit of q for low-dissipative shall be taken as q = 1,5. No limitations are set regarding the use of the three ductility classes and the relevant design principles.*
- ***7.1.2(1) Upper limit of q for low-dissipative structural behaviour concept; limitations on structural behaviour concept; geographical limitations on use of ductility classes for composite steel-concrete buildings.***
- *For low dissipative ductile behaviour the maximum value of q shall be taken as q = 1,5. No limitations are set, regarding the use of the three ductility classes and the corresponding design principles.*

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- ***6.2(7) Information as to how EN 1993-1-10:2004 may be used in the seismic design situation.***
- *The verifications on the basis of EN 1993-1-10:2004 (Material toughness etc.) concerning the seismic design situation shall be performed according to the expression (2.2) of 2.2(4) of EN 1998-1:2004, replacing T_{md} by $T_{mE,d}$ where*

$$T_{mE,d} = \psi_2 T_{md}$$

where

T_{md} is the value of the minimum air temperature in shade of the site location having an annual probability of being exceeded equal to 0,02 in accordance with 6.1.3.2 of EN 1990-1-5:2004 (see National Annex to EN 1991-1-5).

ψ_2 = 0,25 is the nationally defined value of the combination coefficient for thermal actions in the seismic design situation for buildings.

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- ***8.3(1) Ductility class for timber buildings.***
- *No geographical limitations are imposed for structures of ductility classes M or H; neither for structures of ductility class L, when in the last case the value q = 1 is used for the behaviour factor in designing the relevant timber structure.*
- ***9.2.1(1) Type of masonry units with sufficient robustness.***
- *Stones of group 1 and 2 of Table 3.1 of EN 1996-1-1:2000 shall be used.*
- ***9.2.4(1) Alternative classes for perpendicular joints in masonry.***
- *Joints with mortar shall be used.*
- ***9.3(2) Conditions for use of unreinforced masonry satisfying provisions of EN 1996 alone and Minimum effective thickness of unreinforced masonry walls satisfying provisions of EN 1996 alone.***
- *This provision is not applicable in Greece i.e. the use of unreinforced masonry, satisfying the provisions of EN 1996 alone, is not allowed .*

- ***9.3(4) Table 9.1, q-factors for buildings with masonry systems which provide enhanced ductility.***
- *The value of q for masonry systems of enhanced ductility shall be determined for each specific project on the basis of existing verification and validation certified by ETA (European Technical Approval) or by test results approved by the competent Public Authority in Greece.*

- ***10.3(2)P Magnification factor on seismic displacements for isolation devices.***
- *The value $\gamma_x = 1,5$ shall be applied.*

ELOT EN 1998-2/NA

Adoption of recommended choices (21 out of 30)

- ***1.1.1(8) Informative Annexes A, B, C, D, E, F, H, K and JJ.***
- *Informative Annexes A, B, C and D of EN 1998-2 retain their informative status. Informative Annexes E, F, H, K and JJ of EN 1998-2 become normative.*

- ***2.2.2(5) Conditions under which the seismic action may be considered as accidental action, and the requirements of 2.2.2(3) and 2.2.2(4) may be relaxed.***
- *This provision is not applicable in Greece.*

- ***2.3.7(1) Cases of low seismicity – Simplified criteria for the design of bridges in cases of low seismicity.***
- *This provision is not applicable in Greece.*

- ***3.3(1)P   Length of continuous deck beyond which the spatial variability of seismic action may have to be taken into account.***

- *The value* $L_{\lim} = \dfrac{L_g}{1{,}25}$ *should be used, with value of* L_g *as given in Table 3.1N.*

- ***5.4(1)   Simplified methods for second order effects in linear analysis.***
- *In the absence of a rigorous analysis the approximation given in the Note may be applied.*

- ***5.6.3.3(1)P b   Alternatives for determination of additional safety factor*** γ_d ***on shear resistance of ductile members outside plastic hinges.***
- *Expression (5.8a), that takes into account the capacity design shear* V_{CO}*, is applicable.*

- ***6.5.1(1)P Simplified verification rules for bridges of limited ductile behaviour in low seismicity cases.***
- *This provision is not applicable in Greece.*

- ***6.6.2.3(3) Allowable extent of damage of elastomeric bearings in bridges where the seismic action is considered as accidental action, but is not resisted entirely by elastomeric bearings.***
- *This provision is not applicable in Greece.*

- ***7.4.1(1)P Value of control period T_D for the design spectrum of bridges with seismic isolation.***
- *The values of T_D given in the National Annex to EN 1998-1 are applicable.*

- ***7.7.1(2) Values of factors δ_w and δ_d for the lateral restoring capability of the isolation system.***

- *The following values are applicable:*

$$\delta_w = 0{,}015$$
$$\delta_d = 0{,}2$$

ELOT EN 1998-3/NA

Adoption of recommended choices (7 out of 10)

- ***2.2.1(7)P Partial factors for materials.***
- *The values given by Eurocode EN 1998-1 and its National Annex are applicable, except if otherwise specified for the specific structure.*

- ***3.4.4(1) Levels of inspection and testing.***
- *Table 3.2 is applicable except if otherwise specified for the specific structure.*

- ***4.4.4.5(2) Complementary, non-contradictory information on non-linear static analysis procedures that can capture the effects of higher modes.***
- *The relevant provisions of Eurocode EN 1998-1 and ΚΑΝΕΠΕ (Code of tructural Interventions) are applicable.*

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NCCIs (for concrete bulidings)

- ***Walls :*** *Greece consider the definition for walls as a step back. In order to accept a ductile behaviour the following additional conditions are set :*

  - min l = 1,50 m, for buildings up to 4 floors

  - min l = 2,00 m, for buildings with more than 4 floors

  This min length may be diminished by 0,20 if the extremities have a Γ or Π form

- *Wall systems or dual systems equivalent to concrete walls or steel/composite systems with bracings are deemed to satisfy the criteria of cl. 4.3.6.2 (of EN 1998-1)*

- ***Short-columns :*** *Additional provisions are to be applied according to Draft ELOT Standard 1442 : "Guidelines for the aseismic design of concrete short columns"*

NCCIs (general)

- ***Seismic isolation :*** *Additional provisions are to be applied according to Draft ELOT Standard 1440 : "Guidelines for the design of buildings with seismic isolation"*

- ***Code of Structural Interventions (Code for Retrofitting of Buildings) – ΚΑΝΕΠΕ*** *(To become ELOT Standard 1442)*

  This is a major document of approximately 350 pages, worked out during a decade and recently adapted to EN 1998-3. Its contents :

Chapter 1 : Scope – Field of application – Obligations and responsibilities
Chapter 2 : Basic principles, criteria and procedures
Chapter 3 : Investigation and documentation of an existing structure
Chapter 4 : Basic data for assessment and redesign
Chapter 5 : Analysis prior and after the intervention
Chapter 6 : Basic behaviour models
Chapter 7 : Assessment of behaviour of structural elements
Chapter 8 : Design of interventions
Chapter 9 : Safety verifications
Chapter 10: Required contents of the design
Chapter 11: Construction – Quality assurance – Maintenance

- ***Code of Structural Interventions (Code for Retrofitting of Buildings) – ΚΑΝΕΠΕ (cont.)***

  The English version of the document may be downloaded freely from the website www.oasp.gr following the path of the European Center on Prevention and Forecasting of Earthquakes (or directly ecpfe.oasp.ge/en)

- *A major issue (from the practical point of view) has always been and remains the handling of the design, assessment and retrofitting of extensions/additions to existing structures (either in height or at level). The problem is linked to the fact that most commonly the existing part and the new part of the structure (building) have been designed when different codes or code versions where in force. This leads, from time to time, to the issuance of additional guidelines (only few pages) on how to deal with every case.*

  The procedure and outcome are naturally linked on whether the structure is meant to be designed for its original safety level and actions or for the new ones (if different)

ELOT EN 1998-4/NA

Adoption of recommended choices only (10 out of 10)

ELOT EN 1998-5/NA

Adoption of recommended choices (2 out of 3)

- ***3.1(3) Partial factors for material properties.***

- *In conformity to the National Annex to Eurocode 7-1 (EN 1997-1), for the seismic design situation of foundations, retaining structures and other geotechnical works, Design Approach 2 (DA-2) and more specifically variation 2*, (DA-2*), shall be applied. In this Design Approach (DA-2*), in general, the characteristic values of the soil parameters (group M1 with γ_M = 1,00) are used and the total resulting soil resistance is divided by the resistance coefficient (γ_R) of group R2. (cont.)*

- *For the seismic design situation the value of γ_R shall be taken as 1 (γ_R = 1,00) in all analyses under seismic actions (i.e. sliding resistance verification or other failure mode of retaining structures, bearing resistance or overall stability verifications of spread footings or deep foundations, stability verifications of slopes and embankments).*

- *It is noted that for the design seismic situation the applicable value of the coefficient for actions is in general γ_E = 1,00 (to be reconsidered).*

ELOT EN 1998-6/NA

Adoption of recommended choices (3 out of 6)

- ***3.5(2) The lower bound factor β on design spectral values, if site-specific studies have been carried out with particular reference to the long-period content of the seismic action.***
- *The value of β=0,1 should be applied in cases in which a project-specific study has been performed referring specifically to the long period content of the seismic action.*
- ***4.3.2.1(2) Detailed conditions, supplementing those in 4.3.2.1(2), for the lateral force method of analysis to be applied.***
- *The lateral force method may be applied for the analysis of Towers or Chimneys when following conditions, supplementing those of 4.3.2.1(2), are met: total height non exceeding 60m and Importance Class I or II.*
- ***4.7.2(1)P Partial factors for materials.***
- *The relevant provisions of Eurocode EN 1998-1 and the Greek National Annex shall be applied.*

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THANK YOU FOR YOUR ATTENTION