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EN 1992 –
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 1992 parts – The case of Greece

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.

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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"

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)

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)

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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 Partameters (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

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.

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Adoption of recommended choices (111 out of 120)

- ***3.1.2 Strength***

- *(2)P The strength classes in this code are based on the characteristic cylinder strength f_{ck} determined at 28 days with a maximum value of C_{max}.*

- ***Note:*** *The value of C_{max} for use in a Country may be found in its National Annex. The recommended value is C90/105.*

- ***GR NA :*** *The maximum allowable concrete grade is: C_{max} = C50/60. Subject to the approval of the Authority in charge, use of concrete grade up to C90/105 is allowed.*

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- ***3.1.6 Design compressive and tensile strengths***
- *(1)P The value of the design compressive strength is defined as*

  $$f_{cd} = \alpha_{cc} f_{ck} / \gamma_C \qquad (3.15)$$

  where:

  γ_C is the partial safety factor for concrete, see 2.4.2.4, and

  α_{cc} is the coefficient taking account of long term effects on the compressive strength and of unfavorable effects resulting from the way the load is applied.
- ***Note:*** *The value of α_{cc} for use in a Country should lie between 0,8 and 1,0 and may be found in its National Annex. The recommended value is 1.*
- ***GR NA :*** *The value of α_{cc} is taken α_{cc}= 0.85 for bending verifications, with or without axial force, according to clause 6.1 of ELOT EN 1992-1-1. For all the other cases where α_{cc} is used in evaluating f_{cd}, including all verifications required by all parts of ELOT EN 1998 the value of α_{cc} is to be taken taken α_{cc}= 1,0*

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- ***3.2.2 Properties***

- *(3)P The application rules for design and detailing in this Eurocode are valid for a specified yield strength range, f_{yk} = 400 to 600 MPa.*

- ***Note:*** *The upper limit of f_{yk} within this range for use within a Country may be found in its National Annex.*

- ***GR NA :*** *The maximum value of yield strength of steel reinforcement is: f_{yk} = 500MPa*

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- ***4.4.1.2 Minimum cover, cmin***

- *(5) The minimum cover values for reinforcement and prestressing tendons in normal weight concrete taking account of the exposure classes and the structural classes is given by $c_{min,dur}$.*

- ***Note:*** *Structural classification and values of* $c_{min,dur}$ *for use in a Country may be found in its National Annex. The recommended Structural Class (design working life of 50 years) is S4 for the indicative concrete strengths given in Annex E and the recommended modifications to the structural class is given in Table 4.3N. The recommended minimum Structural Class is S1.*
- *The recommended values of* $c_{min,dur}$ *are given in Table 4.4N (reinforcing steel) and Table 4.5N (prestressing steel).*
- ***GR NA :*** *For the structural classes the recommended values of the first para of the Note in combination with the recommended values of Table 4.3N will be applied*

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- ***4.4.1.2 Minimum cover, c_{min} (cont.)***

- *The recommended values of **$c_{min,dur}$** given in Table 4.4N (for reinforcing steel) and Table 4.5N (for prestressing steel) will be applied*

- *Note : In Tables 4.4N and 4.5N the values of **$c_{min,dur}$** given for exposure classes XS1 and XS2 are to be applied in the following cases :*
- *In case of use of cement of type I and II/B-LL (according to ELOT EN 197-1) for minimum concrete strength class C30/37 (see also Annex E of the present document)*
- *In case of use of cement of type II (except B-LL), III and IV (according to ELOT EN 197-1) for minimum concrete strength class C26/32 (see also Annex E of the present document) or, alternatively, for minimum concrete strength class C25/30 but with simultaneous increase of **$c_{min,dur}$** by 5 mm.*

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- ***5.10 Prestressed members and structures***
- ***5.10.1 General***
- *(6) Brittle failure should be avoided by one or more of the following methods:*

  Method A:……

  Method B:……

  Method C:……

  Method D:…..

  Method E:…..
- ***Note:*** *The selection of Methods to be used in a Country may be found in its National Annex.*

- ***GR NA :*** *Brittle failure should be avoided by using one of methods A, B, D (wherein as 'satisfactory evidence' are deemed appropriate technical approval certificates) and E of this section*

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- ***6.2.3 Members requiring design shear reinforcement***

- *(2) The angle θ should be limited.*
- ***Note:*** *The limiting values of cotθ for use in a Country may be found in its National Annex. The recommended limits are given in Expression (6.7N).*

  $1 \leq \cot\theta \leq 2,5$ (6.7N)

- ***GR NA :*** *The value of cotθ is:*

  $1 \leq \cot\theta \leq \cot\theta_a \leq 2.5$

  i.e. $45.0^o \geq \theta \geq \theta_a \geq 21.8^o$

  where

$$\cot\theta_a = \frac{1.2 - 1.4\sigma_{cd} / f_{cd}}{1 - V'_{Rd,c} / V_{Ed}} \leq 2.5$$

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- ***6.2.3 Members requiring design shear reinforcement (cont.)***

$$V'_{Rd,c} = \beta_{ct}\, 0.10\, f_{ck}^{\ 1/3}\, (1+1.2\ )\, b_w\, z$$

with $\beta_{ct} = 2.4$

$\sigma_{cd} = N_{ed}/A_c$ *(in MPa)*

N_{Ed} *= Design axial loading in the sections, due to external actions or prestress (*$N_{Ed} < 0$ *for compressive force)*

- *For reasons of simplicity, the value of* $\cot\theta$ *can be taken as in the following:*

  pure bending : $\cot\theta = 1.2$

  bending with compressive axial force : $\cot\theta = 1.2$

  bending with tensile axial force : $\cot\theta = 1.0$

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- ***6.2.4 Shear between web and flanges***

(4) The transverse reinforcement per unit length A_{sf}/s_f may be determined as follows:

$$(A_{sf}.f_{yd}/s_f) \geq v_{Ed} \cdot h_f /\cot\theta_f \qquad (6.21)$$

- *To prevent crushing of the compression struts in the flange, the following condition should be satisfied:*

$$v_{Ed} \leq v_{fcd}.\sin\theta_f.\cos\theta_f \qquad (6.22)$$

- ***Note:*** *The permitted range of the values for $\cot\theta_f$ for use in a country may be found in its National Annex.*
- *The recommended values in the absence of more rigorous calculation are:*

  $1,0 \leq \cot\theta_f \leq 2,0$ for compression flanges ($45° \geq \theta_f \geq 26,5°$)

  $1,0 \leq \cot\theta_f \leq 1,25$ for tension flanges ($45° \geq \theta_f \geq 38,6°$)
- ***GR NA :*** *The expressions given in section 6.2.3(2) apply, but subject to the limiting values for $\cot\theta_f$ recommended in the present section. The evaluation of θ_a is performed with the values of N_{Ed} and A_c corresponding to the web considered.*

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- ***ANNEX C (Normative)***
- ***Properties of reinforcement suitable for use with this Eurocode***
- ***C.1 General***

- *(3) EN10080 does not specify the quantile value for characteristic values, nor the evaluation of test results for individual test units.*
- *In order to be deemed to comply with the long term quality levels in Table C.1, the following limits on test results should be applied:*
- *……….*
- ***Note 1:*** *The value of a for use in a Country may be found in its National Annex. The recommended value for f_{yk} is 10 MPa and for both k and ε_{uk} is 0.*
- ***Note 2:*** *The minimum and maximum values of f_{yk}, k and ε_{uk} for use in a Country may be found in its National Annex. The recommended values are given in Table C.3N.*

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- ***ANNEX C (Normative)***
- ***Properties of reinforcement suitable for use with this Eurocode***
- ***C.1 General (cont.)***

Table C.3N. Absolute limits on test results

Performance characteristic	Minimum value	Maximum value
Yield strength	f_{yk} 0,97 x minimum C_v	1,03 x maximum C_v
k	f_{yk} 0,98 x minimum C_v	1,02 x maximum C_v
E_{uk}	f_{yk} 0,80 x minimum C_v	Not applicable

- ***GR NA :*** *The upper and lower limiting values for the parameters f_{yk}, k and ε_{uk} , as well as the corresponding values of the margin a are taken from the relevant standards ELOT 1421-1, -2 and -3*

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- ***Annex E (Informative)***
- ***Indicative strength classes for durability***
- ***E.1 General***
- *(2) When the chosen strength is higher than that required for structural design the value of f_{ctm} should be associated with the higher strength in the calculation of minimum reinforcement according to 7.3.2 and 9.2.1.1 and crack width control according to 7.3.3 and 7.3.4.*
- ***Note:** Values of indicative strength classes for use in a Country may be found in its National Annex. The recommended values are given in Table E.1N.*
- ***GR NA :** The minimum concrete strength classes for durability will be chosen from Table F.1 of ELOT EN 206-1 as a basis, which is considered to correspond to reinforced concrete structures with a design life of 50 years and a structural class S4 according to Table 4.4N of ELOT EN 1992-1-1, with appropriate reference, where necessary, according to Table 4.3N of ELOT EN 1992-1-1.*

Table F1-Recommended limiting values for composition and properties of concrete

		Exposure classes															
		No risk of corro-sion or attack	Carvonation-induced corrosion				Chloride-induced corrsion										
							Sea water								Chloride other than from sea water		
							Cement II, III, IV (except B-LL)					**Cement I (+ II / B-LL)**					
	Exposure class	X0	XC1	XC2	XC3	XC4	**XS1**		**XS2**		**XS3**	**XS1**	**XS2**	**XS3**	XD1	XD2	XD3
1	max N/T	---	0,65	0,60	0,55	0,50	**0,50**		**0,50**		**0,45**	**0,50**	**0,50**	**0,45**	0,55	0,50	0,45
2	min strength class	C 12/15	C 20/25	C 25/30	C 25/30	C 30/37	**C 25/30**	**C 26/32**	**C 25/30**	**C 26/32**	**C 30/37**	**C 30/37**	**C 30/37**	**C 35/45**	C 30/37	C 32/40	C 35/45
3	min cement content (kg/m$^{3)}$	---	280	300	300	320	**330**	**330**	**330**	**330**	**350**	**330**	**330**	**350**	330	330	350
4	**min cover for durability (mm)**		**25**	**25**	**35**	**35**	**45**	**40**	**45**	**40**	**50**	**40**	**40**	**50**	**35**	**40**	**50**
5	min air content (%)	---	---	---	---	---	**---**		**---**		**---**	**---**	**---**	**---**	---	---	---
6	Other require-ments	Note : Plain con-crete					**Note : Near the sea (< 1,5 km)**		**Note : Permanently in the sea**		**Note: Splashing zones**						

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Table F1-Recommended limiting values for composition and properties of concrete (cont.)

Exposure classes (cont.)

	Freeze/thaw attack						Chemical attack			(Friction / Abrasion)		
Exposure class	XF1	XF2		XF3		XF4	XA1	XA2	XA3	**XT1**	**XT2**	**XT3**
max N/T	0,55	0,55	0,50	0,55	0,50	0,50	0,55	0,50	0,45	**0,50**	**0,45**	**0,40**
min strength class	C 28/35	C 25/30	C 32/40	C 25/30	C 35/45	C 30/37	C 28/35	C 30/37	C 35/45	**C35/45 (C32/40)**	**C40/50 (C35/45)**	**C50/60 (C45/55)**
min cement content (kg/m^3)	320	300	320	300	320	320	320	340	360	**320 (300)**	**340 (320)**	**360 (320)**
min cover for durability (mm)							**35**	**35**	**35**			
min air content (%)	---	4,0[a]	---	4,0[a]	---	4,0[a]	---	---	---			
Other require-ments	**Aggregates in accordance with EN 12620 with sufficient freeze/thaw resistance**							**Sulfate resisting cement**		**LA ≤ 27 (LA≤20)**	**LA ≤ 25 (LA≤20)**	**LA ≤ 22 (LA≤20)**

Table F.1 — Recommended limiting values for composition and properties of concrete

	Exposure classes																	
	No risk of corrosion or attack	Carbonation-induced corrosion				Chloride-induced corrosion						Freeze/thaw attack				Aggressive chemical environments		
						Sea water			Chloride other than from sea water									
	X0	XC 1	XC 2	XC 3	XC 4	XS 1	XS 2	XS 3	XD 1	XD 2	XD 3	XF 1	XF 2	XF 3	XF 4	XA 1	XA 2	XA 3
Maximum *w/c*[c]	–	0,65	0,60	0,55	0,50	0,50	0,45	0,45	0,55	0,55	0,45	0,55	0,55	0,50	0,45	0,55	0,50	0,45
Minimum strength class	C12/15	C20/25	C25/30	C30/37	C30/37	C30/37	C35/45	C35/45	C30/37	C30/37	C35/45	C30/37	C25/30	C30/37	C30/37	C30/37	C30/37	C35/45
Minimum cement content[c] (kg/m^3)	–	260	280	280	300	300	320	340	300	300	320	300	300	320	340	300	320	360
Minimum air content (%)	–	–	–	–	–	–	–	–	–	–	–	–	4,0[a]	4,0[a]	4,0[a]	–	–	–
Other requirements	–	–	–	–	–	–	–	–	–	–	–	Aggregate in accordance with EN 12620 with sufficient freeze/thaw resistance				–	Sulfate-resisting cement[b]	

[a] Where the concrete is not air entrained, the performance of concrete should be tested according to an appropriate test method in comparison with a concrete for which freeze/thaw resistance for the relevant exposure class is proven.

[b] Where sulfate in the environment leads to exposure classes XA2 and XA3, it is essential to use sulfate-resisting cement conforming to EN 197-1 or complementary national standards.

[c] Where the *k*-value concept is applied the maximum *w/c* ratio and the minimum cement content are modified in accordance with 5.2.5.2.

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ELOT EN 1992-1-2/NA

Adoption of all recommended choices (16 out of 16)

ELOT EN 1992-2/NA

Adoption of recommended choices (26 out of 35)

- ***3.1 Concrete***
- ***3.1.2 Strength***
- *(102)P The strength classes (C) in this code are denoted by the characteristic cylinder strength f_{ck} determined at 28 days with a minimum value of C_{min} and a maximum value of C_{max}.*
- ***NOTE :****The values of C_{min} and C_{max} for use in a Country may be found in its National Annex. The recommended values are C30/37 and C70/85 respectively.*

ELOT EN 1992-2/NA

- ***3.1.2 Strength (cont.)***

- ***GR NA :*** *The values for C_{min} και C_{max} είναι:*

Prestressed concrete
C_{min}: C30/37
C_{max}: C50/60

Reinforced concrete
C_{min}: C20/25
C_{max}: C50/60

- *Following approval by the Competent Authority the use of strength class up to C70/85 may be allowed*

ELOT EN 1992-2/NA

- ***3.1.6 Design compressive and tensile strengths***
- *(1)P The value of the design compressive strength is defined as*

  $f_{cd} = \alpha_{cc} f_{ck} / \gamma_C$ (3.15)

  where:

  γ_C is the partial safety factor for concrete, see 2.4.2.4, and

  α_{cc} is the coefficient taking account of long term effects on the compressive strength and of unfavorable effects resulting from the way the load is applied.
- ***Note:*** *The value of α_{cc} for use in a Country should lie between 0,8 and 1,0 and may be found in its National Annex. The recommended value is 0,85.*
- ***GR NA :*** *The value of α_{cc} is taken α_{cc}= 0.85 for bending verifications, with or without axial force, according to clause 6.1 of ELOT EN 1992-1-1. For all the other cases where α_{cc} is used in evaluating f_{cd}, including all verifications required by all parts of ELOT EN 1998 the value of α_{cc} is to be taken taken α_{cc}= 1,0*

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- ***3.2 Reinforcing steel***
- ***3.2.4 Ductility characteristics***

- *(101)P The reinforcement shall have adequate ductility as defined by the ratio of tensile strength to the yield stress, $(f_t/f_y)_k$ and the elongation at maximum force, ε_{uk}.*

- ***NOTE :** The classes of reinforcement to be used in bridges in a Country may be found in its National Annex. The recommended classes are Class B and Class C*

- ***GR NA :** The class of reinforcement to be used in Greece is Class C*

ELOT EN 1992-2/NA

- ***5.5 Linear elastic analysis with limited redistribution***

(104) In continuous beams or slabs which:

a) are predominantly subject to flexure and

b) have the ratio of the lengths of adjacent spans in the range of 0,5 to 2 redistribution of bending moments may be carried out without explicit check on the rotation capacity, provided that:

$\delta \geq k_1 + k_2.x_u/d$ *for* $f_{ck} \leq 50$ *MPa* (5.10a)

$\delta \geq k_3 + k_4.x_u/d$ *for* $f_{ck} > 50$ *MPa* (5.10b)

$\delta \geq k_5$ *where Class B and Class C reinforcement is used (see Annex C)*

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- ***5.5 Linear elastic analysis with limited redistribution (cont.)***

  where:

  δ is the ratio of the redistributed moment to the elastic bending moment

  x_u is the depth of the neutral axis at the ultimate limit state after redistribution

  d is the effective depth of the section

- ***NOTE 1:*** *The values of k_1, k_2, k_3, k_4 and k_5 for use in a Country may be found in its National Annex. The recommended value for k_1 is 0,44, for k_2 is 1,25(0,6+0,0014/ε_{cu2}), for k_3 is 0,54, for k_4 is 1,25(0,6+0,0014/ ε_{cu2}) and for k_5 is 0,85.*

- ***GR NA :*** *The values for k_1, k_2, k_3, k_4 and k_5 are :*

  k_1 = 0.64, k_2 = 0.80, k_3 = 0.64, k_4 = 0.80, k_5 = 0.85

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- ***6.2.3 Members requiring design shear reinforcement***

NOTE 2 : *The value of v_1 and α_{cw} for use in a Country may be found in its National Annex.*

- **GR NA :** *The values for v_1 and α_{cw} are:*

$v_1 = 0.6\ [1 - f_{ck}/250]$ *(f_{ck} σε MPa)*

$\alpha_{cw} = 1.0$	(non prestressed structures)
$\alpha_{cw} = 1+\sigma_{cp} / f_{cd}$	for $0 < \sigma_{cp} < 0.25 f_{cd}$
$\alpha_{cw} = 1.20$	for $0.25 f_{cd} < \sigma_{cp} < 0.5 f_{cd}$
$\alpha_{cw} = 2.5\ (1 - \sigma_{cp} / f_{cd})$	for $0.5 f_{cd} < \sigma_{cp} < 1.0 f_{cd}$

where

σ_{cp} : mean compression stress

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- ***8.9 Bundled bars***
- ***8.9.1 General***
- *(101) Unless otherwise stated, the rules for individual bars also apply for bundles of bars. In a bundle, all the bars should be of the same characteristics (type and grade). Bars of different sizes may be bundled provided that the ratio of diameters does not exceed 1,7.*
- ***NOTE :*** *Details of restrictions on the use of bundled bars for use in a Country may be found in its National Annex. No additional restrictions are recommended in this standard.*

- ***GR NA :*** *Bundles of bars may be used only following approval by the Owner*

ELOT EN 1992-2/NA

- ***9.5 Columns***
- ***9.5.3 Transverse reinforcement***
- *(101) The diameter of the transverse reinforcement (links, loops or helical spiral reinforcement) should not be less than $Ø_{min}$ or one quarter of the maximum diameter of the longitudinal bars, whichever is the greater.*
- *The diameter of the wires of welded mesh fabric for transverse reinforcement should not be less than $Ø_{min,mesh}$.*
- ***NOTE:*** *The minimum diameter of transverse reinforcement for use in a Country may be found in its National Annex. The recommended values are $Ø_{min}$ = 6 mm and $Ø_{min,mesh}$ = 5 mm.*
- ***GR NA :*** *The minimum diameter of transverse reinforcement for use in Greece are:*

  $Ø_{min}$ = 10mm

  $Ø_{min}$ = 12mm for longitudinal bars with $Ø > 28mm$

ELOT EN 1992-2/NA

- ***9.7 Deep beams***
- *(102) The distance between two adjacent bars of the mesh should not exceed s_{mesh}.*
- ***NOTE:*** *The maximum spacing of adjacent bars for use in a Country may be found in its National Annex. The recommended value of s_{mesh} is the lesser of the web thickness or 300 mm.*

- ***GR NA :*** *The maximum spacing of adjacent bars is recommended not to exceed :*

  - The web thickness
  - 200mm

  (whichever is the lesser)

ELOT EN 1992-2/NA

- ***11.9 Detailing of members and particular rules***
- *(101) The diameter of bars embedded in LWAC should not normally exceed 32 mm. For LWAC bundles of bars should not consist of more than two bars and the equivalent diameter should not exceed 45 mm.*
- ***NOTE:*** *The use of bundled bars may be restricted by the National Annex.*
- ***GR NA :*** *Bundles of bars may be used only following approval by the Owner*

ELOT EN 1992-3/NA

Adoption of all recommended choices (4 out of 4)

European Commission

THANK YOU FOR YOUR ATTENTION