

***NATIONAL ANNEX  
TO  
CYS EN 1992-2:2005  
(Including AC:2008)***

***Eurocode 2: Design of  
concrete structures***

***Part 2: Concrete  
bridges***



**NATIONAL ANNEX**  
**TO**  
**CYS EN 1992-2:2005+AC:2008**  
**Eurocode 2: Design of concrete structures**  
**Part 2: Concrete bridges**

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## INTRODUCTION

This National Annex has been prepared by the CYS TC 18 National Standardisation Technical Committee of Cyprus organisation for standardisation

## NA 1 SCOPE

This National Annex is to be used together with CYS EN 1992-2:2005+AC:2008. Any reference in the rest of this text to CYS EN 1992-2:2005 means the above document.

This National Annex gives:

(a) Nationally determined parameters for the following clauses of CYS EN 1992-2:2005+AC:2008 where National choice is allowed (see Section NA 2)

- 3.1.2 (102) P
- 3.1.6 (101) P
- 3.1.6 (102) P
- 3.2.4 (101) P
- 4.2 (105)
- 4.2 (106)
- 4.4.1.2 (109)
- 5.1.3 (101)P
- 5.2 (105)
- 5.3.2.2 (104)
- 5.5 (104)
- 5.7 (105)
- 6.1 (109)
- 6.1 (110)
- 6.2.2 (101)
- 6.2.3 (103)
- 6.2.3 (107)
- 6.2.3 (109)
- 6.8.1 (102)
- 6.8.7 (101)
- 7.2 (102)
- 7.3.1 (105)
- 7.3.3 (101)
- 7.3.4 (101)
- 8.9.1 (101)
- 8.10.4 (105)
- 8.10.4 (107)
- 9.1 (103)
- 9.2.2 (101)
- 9.5.3 (101)
- 9.7 (102)
- 9.8.1 (103)
- 11.9 (101)
- 113.2 (102)
- 113.3.2 (103)

- (b) Decisions on the use of the Informative Annexes A, B, D, F, G, H, J, KK, LL, NN, OO, and PP (see Section NA 3)
- (c) References to non-contradictory complementary information to assist the user to apply CYS EN 1992-2:2005. In this National Annex such information is provided for the following clauses in CYS EN 1992-2:2005 (see Section NA 4)

## **NA 2 NATIONALLY DETERMINED PARAMETERS**

### **NA 2.1 Clause 3.1.2 (102)P Materials - Concrete - Strength**

The values of  $C_{min}$  and  $C_{max}$  are specified as C30/37 and C70/85 respectively.

### **NA 2.2 Clause 3.1.6 (101)P Design compressive and tensile strengths**

The value of  $\alpha_{cc}$  is specified as 0,85.

### **NA 2.3 Clause 3.1.6 (102)P Design compressive and tensile strengths**

The value of  $\alpha_{ct}$  is specified as 1,0.

### **NA 2.4 Clause 3.2.4 (101)P Reinforcing Steel - Ductility characteristics**

The classes of reinforcement to be used in bridges are Class B and Class C.

### **NA 2.5 Clause 4.2 (105) Durability and cover Reinforcement - Environmental conditions**

The exposure class for surfaces protected by waterproofing is XC3.

### **NA 2.6 Clause 4.2 (106) Environmental conditions**

The value for distance  $x$  is set to 6m and the value for distance  $y$  is set to 6m.

The exposure classes for surfaces directly affected by de-icing salts are XD3 and XF2 or XF4, as appropriate, with covers given in Tables 4.4(CYS) and 4.5(CYS) for XD classes (CYS EN 1992-1-1:2004).

### **NA 2.7 Clause 4.4.1.2 (109) Concrete cover - Minimum cover, $c_{min}$**

Provided that the following conditions are met, the cover needs only satisfy the requirements for bond (see 4.4.1.2 (3) of CYS EN 1992-1-1:2004):

- The existing concrete surface has not been subject to an outdoor environment for more than 28 days.
- The existing concrete surface is rough.
- The strength class of the existing concrete is at least C25/30.

### **NA 2.8 Clause 5.1.3 (101)P Structural Analysis - Load cases and combinations**

No simplifications to the load arrangements for use are given in this National Annex.

### **NA 2.9 Clause 5.2(105) Geometric imperfections**

The value of  $\theta_0$  is specified as 1/200.

### **NA 2.10 Clause 5.3.2.2 (104) Geometric data - Effective span of beams and slabs**

The value of  $t$  is specified as the breadth of the bearing.

### NA 2.11 Clause 5.5(104) Linear elastic analysis with limited redistribution

The values of  $k_1$ ,  $k_2$ ,  $k_3$ ,  $k_4$  and  $k_5$  are specified as follows:

$$k_1 = 0,44$$

$$k_2 = 1,25(0,6+0,0014/\varepsilon_{cu2})$$

$$k_3 = 0,54$$

$$k_4 = 1,25(0,6+0,0014/\varepsilon_{cu2})$$

$$k_5 = 0,85$$

### NA 2.12 Clause 5.7 (105) Non-linear analysis

The details of acceptable methods for non-linear analysis and safety format to be used are as follows:

When using non-linear analysis the following assumptions shall be made:

- For reinforcing steel, the stress-strain diagram to be used shall be based on Figure 3.8, curve A (CYS EN 1992-1-1:2004). In this diagram,  $f_{yk}$  and  $kf_{yk}$  shall be replaced by  $1,1f_{yk}$  and  $1,1kf_{yk}$
- For prestressing steel, the idealised stress-strain diagram given in 3.3.6 (Figure 3.10, curve A, (CYS EN 1992-1-1:2004)) shall be used. In this diagram  $f_{pk}$  shall be replaced with  $1.1 f_{pk}$
- For concrete, the stress-strain diagram shall be based on expression (3.14) in 3.1.5. (CYS EN 1992-1-1:2004). In this expression, and in the k-value,  $f_{cm}$  shall be replaced by  $\gamma_{cf}.f_{ck}$  with  $\gamma_{cf} = 1,1.\gamma_s / \gamma_c$ .

The following design format shall be used:

- The resistance shall be evaluated for different levels of appropriate actions which shall be increased from their serviceability values by incremental steps, such that the value of  $\gamma_G.G_k$  and  $\gamma_Q.Q_k$  are reached in the same step. The incrementing process shall be continued until one region of the structure attains the ultimate strength, evaluated taking account of  $\alpha_{cc}$ , or there is global failure of the structure. The corresponding load is referred to as  $q_{ud}$ .
- Apply an overall safety factor  $\gamma_0$  and obtain the corresponding strength  $R\left(\frac{q_{ud}}{\gamma_0}\right)$ ,
- One of the following inequalities shall be satisfied:

$$\gamma_{Rd}E(\gamma_G G + \gamma_Q Q) \leq R\left(\frac{q_{ud}}{\gamma_0}\right) \quad (5.102.aCYS)$$

or

$$E(\gamma_G G + \gamma_Q Q) \leq R\left(\frac{q_{ud}}{\gamma_{Rd} \cdot \gamma_0}\right) \quad (5.102.bCYS)$$

$$(i.e.) \quad R\left(\frac{q_{ud}}{\gamma_{0'}}$$

or

$$\gamma_{Rd} \gamma_{Sd} E (\gamma_g G + \gamma_q Q) \leq R \left( \frac{q_{ud}}{\gamma_o} \right) \quad (5.102.cCYS)$$

Where:

- $\gamma_{Rd}$  is the partial factor for model uncertainty for resistance,  $\gamma_{Rd} = 1,06$ ,
- $\gamma_{Sd}$  is the partial factor for model uncertainty for action / action effort,  $\gamma_{Sd} = 1,15$ ,
- $\gamma_o$  is the overall safety factor,  $\gamma_o = 1,20$ .

Refer to Annex PP for further details.

When model uncertainties  $\gamma_{Rd}$  and  $\gamma_{Sd}$  are not considered explicitly in the analysis (i.e.  $\gamma_{Rd} = \gamma_{Sd} = 1$ ),  $\gamma_o = 1,27$  shall be used..

### NA 2.13 Clause 6.1 (109) Bending with or without axial force

Any one of the methods (a, b and c) is applicable and can be used.

- In method a, (iii) of CYS EN 1992-2:2005 the ultimate bending resistance shall be calculated using the material safety factors for accidental design situations given in Table 2.1(CYS) of 2.2.2.4 (CYS EN 1992-1-1:2004).
- In method b, the value of  $f_{ctx}$  is set equal to  $f_{ctm}$ .

### NA 2.14 Clause 6.1 (110) Bending with or without axial force

In case where method (b) in 6.1(109) of CYS EN 1992-2:2005 is chosen, the values of  $k_{cm}$  and  $k_p$  are specified as 2,0 and 1,0 respectively.

### NA 2.15 Clause 6.2.2 (101) Shear – Members not requiring design shear reinforcement.

The value of  $C_{Rd,c}$  is specified as  $0,18/\gamma_c$ , and that for  $k_1$  is set equal to 0,15. The value for  $v_{min}$  is given by Expression 6.3(CYS).

$$v_{min} = 0,035 k^{3/2} \cdot f_{ck}^{1/2} \quad (6.3CYS)$$

### NA 2.16 Clause 6.2.3 (103) Shear – Members requiring design shear reinforcement.

The value of the strength reduction factor for concrete cracked in shear,  $v_1$ , is set equal to  $v$  where  $v$  is given by Expression 6.6(CYS) of CYS EN 1992-1-1:2004.

- If the design stress of the shear reinforcement is below 80% of the characteristic yield stress  $f_{yk}$ ,  $v_1$  may be taken as:

$$v_1 = 0,6 \quad \text{for } f_{ck} \leq 60 \text{ MPa} \quad (6.10.aCYS)$$

$$v_1 = 0,9 - f_{ck} / 200 > 0,5 \quad \text{for } f_{ck} \geq 60 \text{ MPa} \quad (6.10.bCYS)$$

The value of  $\alpha_{cw}$  is specified as follows:

$$\alpha_{cw} = 1 \quad \text{for non-prestressed structures}$$

$$\alpha_{cw} = (1 + \sigma_{cp} / f_{cd}) \quad \text{for } 0 < \sigma_{cp} \leq 0,25 f_{cd} \quad (6.11.aCYS)$$

$$\alpha_{cw} = 1,25 \quad \text{for } 0,25 f_{cd} < \sigma_{cp} \leq 0,5 f_{cd} \quad (6.11.bCYS)$$

$$\alpha_{cw} = 2,5 (1 - \sigma_{cp}/f_{cd}) \quad \text{for } 0,5 f_{cd} < \sigma_{cp} < 1,0 f_{cd} \quad (6.11.cCYS)$$

where:

$\sigma_{cp}$  is the mean compressive stress, measured positive, in the concrete due to the design axial force. This shall be obtained by averaging it over the concrete section taking account of the reinforcement. The value of  $\sigma_{cp}$  need not be calculated at a distance less than  $0.5d \cot \theta$  from the edge of the support.

### NA 2.17 Clause 6.2.3 (107) Shear – Members requiring design shear reinforcement.

No additional guidance on the superposition of different truss models is given in this National Annex.

The guidance given in this National Annex is as follows:

- In the case of bonded prestressing, located within the tensile chord, the resisting effect of prestressing may be taken into account for carrying the total longitudinal tensile force. In the case of inclined bonded prestressing tendons in combination with other longitudinal reinforcement/tendons the shear strength may be evaluated, by a simplification, superimposing two different truss models with different geometry (Figure. 6.102CYS); a weighted mean value between  $\theta_1$  and  $\theta_2$  may be used for concrete stress field verification with Expression (6.9) of CYS EN 1992-2:2005.

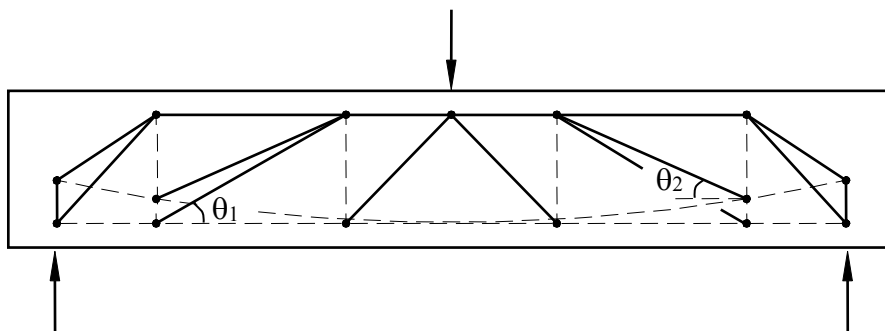


Figure 6.102(CYS): Superimposed resisting model for shear

### NA 2.18 Clause 6.2.3 (109) Shear – Members requiring design shear reinforcement.

The absolute minimum value for  $h_{red}$  is specified as  $0,5h$ .

### NA 2.19 Clause 6.8.1 (102) Fatigue – Verification conditions

No additional rules for fatigue verification are defined in this National Annex.

**NA 2.20 Clause 6.8.7 (101) Fatigue – Verification of concrete under compression or shear**

The value of  $k_1$  is specified as 0,85.

**NA 2.21 7.2 Stresses**

The value of  $k_1$  is specified as 0,6 and the maximum increase in the stress limit above  $k_1 f_{ck}$  in the presence of confinement is set to 10%.

**NA 2.22 Clause 7.3.1 (105) Crack control - General considerations**

The value for  $w_{max}$  and the application of the decompression limit are given in Table 7.101(CYS). The definition of decompression is noted in the text under the Table.

**Table 7.101(CYS) Values of  $w_{max}$  and relevant combinations rules**

Exposure Class	Reinforced members and prestressed members with unbonded tendons	Prestressed members with bonded tendons
	Quasi-permanent load combination	Frequent load combination
X0, XC1	0,3 <sup>a</sup>	0,2
XC2, XC3, XC4	0,3	0,2 <sup>b</sup>
XD1, XD2, XD3 XS1, XS2, XS3		Decompression
<sup>a</sup> For X0, XC1 exposure classes, crack width has no influence on durability and this limit is set to guarantee acceptable appearance. In the absence of appearance conditions this limit may be relaxed. <sup>b</sup> For these exposure classes, in addition, decompression shall be checked under the quasi-permanent combination of loads.		

The decompression limit requires that all concrete within a certain distance of bonded tendons or their ducts shall remain in compression under the specified loading.

The value of the distance considered to be used is set equal to 100 mm.

**NA 2.23 Clause 7.3.3 (101) Control of cracking without direct calculation**

Details of a simplified method for control of cracking without calculation are given in 7.3.3(2) to (4) of CYS EN 1992-1-1:2004.

**NA 2.24 Clause 7.3.4 (101) Calculation of crack widths**

A recognised method for crack width control is given in detailing in 7.3.4 of CYS EN 1992-1-1:2004.



**NA 2.25 Clause 8.9.1 (101) Bundled bars – General**

No additional restrictions on the use of bundled bars are given in this National Annex.

**NA 2.26 Clause 8.10.4 (105) Anchorages and couplers for prestressing tendons**

The values of  $X$  and the maximum percentage of tendons to be coupled at a section are specified as 50 % and 67 % respectively.

The value of the distance “ $a$ ” is given in Table 8.101(CYS).

**Table 8.101(CYS): Minimum distance between sections at which tendons are joined with couplers**

Construction depth $h$	Distance $a$
$\leq 1,5$ m	1,5 m
$1,5$ m $< h < 3,0$ m	$a = h$
$\geq 3,0$ m	3,0 m

**NA 2.27 Clause 8.10.4 (107) Anchorages and couplers for prestressing tendons**

No additional rules relating to the provision of openings and pockets on the upper side of carriageway slabs are recommended in this National Annex.

**NA 2.28 Clause 9.1 (103) General**

No additional rules concerning the minimum thickness of structural elements and the minimum reinforcement for all surfaces of members in bridges, with minimum bar diameter and maximum bar spacing for use are recommended in this National Annex.

**NA 2.29 Clause 9.2.2 (101) Beams – Shear Reinforcement**

The forms of shear reinforcement permitted for use are:

- Links enclosing the longitudinal tension reinforcement and the compression zone (see Figure 9.5 of CYS EN 1992-1-1:2004);
- A combination of links and bent-up bars.

**NA 2.30 Clause 9.5.3 (101) Columns – Transverse reinforcement**

The values of minimum diameter of transverse reinforcement are specified as  $\phi_{\min} = 8\text{mm}$  and  $\phi_{\min, \text{mesh}} = 8\text{mm}$  respectively.

**NA 2.31 Clause 9.7 (102) Deep beams**

The maximum spacing of adjacent bars  $s_{\text{mesh}}$  is specified as the lesser of the web thickness or 300mm.

**NA 2.32 Clause 9.8.1(103) Foundations – Pile caps**

The value of the minimum bar diameter  $d_{\min}$  is specified as 12mm.

**NA 2.33 Clause 11.9 (101) Lightweight aggregate concrete structures -  
Detailing of members and particular rules**

The use of bundled bars in LWAC shall be avoided.

**NA 2.34 Clause 113.2 (102) Design of the execution stages – Actions during  
execution**

The value of  $x$  is set equal to  $200 \text{ N/m}^2$ .

**NA 2.35 Clause 113.3.2 (103) Design of the execution stages – Serviceability  
limit states**

The value of  $k$  is specified as 1,0.

**NA 3 DECISION ON USE OF THE ANNEXES**

**NA 3.1 Annex A**

Annex A may be used

**NA 3.2 Annex B**

Annex B may be used

**NA 3.3 Annex D**

Annex D may be used

**NA 3.4 Annex F**

Annex F may be used

**NA 3.5 Annex G**

Annex G may be used

**NA 3.6 Annex H**

Annex H may be used

**NA 3.7 Annex J**

Annex J may be used

**NA 3.8 Annex KK**

Annex KK may be used

**NA 3.9 Annex LL**

Annex LL may be used

**NA 3.10 Annex NN**

Annex NN may be used

**NA 3.11 Annex OO**

Annex OO may be used

**NA 3.12 Annex PP**

Annex PP may be used

## **NA 4 REFERENCES TO NON-CONTRADICTORY COMPLEMENTARY INFORMATION**

None



**NA to  
CYS EN  
1992-2:2005  
(Including  
AC:2008)**

**CYPRUS ORGANISATION FOR STANDARDISATION**

Limassol Avenue and Kosta Anaxagora 30,  
2<sup>nd</sup> & 3<sup>rd</sup> Floor, 2014 Strovolos, Cyprus  
P.O.BOX.16197, 2086 Nicosia, Cyprus  
Tel: +357 22 411411 Fax: +357 22 411511

E-Mail: [cystandards@cys.org.cy](mailto:cystandards@cys.org.cy)

Website: [www.cys.org.cy](http://www.cys.org.cy)