NATIONAL ANNEX TO CYS EN 1990:2002 Eurocode - Basis of Structural Design

(Including Amendment A1:2005, Corrigendum AC:2010, and Annex A2: Application to Bridges)

CYPRUS ORGANISATION FOR STANDARDISATION

NATIONAL ANNEX

TO

CYS EN 1990:2002

Eurocode - Basis of Structural Design

(Including Amendment A1:2005,

Corrigendum AC:2010, and

Annex A2: Application to Bridges)

This National Annex has been approved by the Board of Directors of the Cyprus Organisation for Standardisation (CYS) on 11.10.2019.

This revised document of the National Annex incorporates National Annex Part 2 Application to Bridges in Clauses NA2.3.

INTRODUCTION

This National Annex has been prepared by the CYS TC 18 Standardisation Technical Committee of the Cyprus Organisation for Standardisation. (CYS)

NA 1 SCOPE

The scope of this document is to define the Nationally Determined Parameters for the clauses of CYS EN 1990:2002/ A1:2005/AC:2010 where National choice is allowed.

This National Annex is to be used together with CYS EN 1990:2002 Including A1:2005 and AC:2010.

This revised document of the National Annex incorporates National Annex Part 2 Application to Bridges in Clauses NA2.3.

*Note: In the following document where reference is made to CYS EN 1990, this means CYS EN 1990:2002/ A1:2005/AC:2010. References in Clauses i.e. A1.1- A1.4, A2, etc., mean the relevant clauses of CYS EN 1990:2002/A1:2005/AC2010. Sections, Clauses and Paragraphs of this National Annex have the prefix **NA**.*

This National Annex defines the Cyprus National Determined Parameters (NDP) as follows:

(a) The NDPs, for the following clause of CYS EN 1990, are applicable to buildings and civil engineering works (see Section NA 2.1).

- A1.1 (1)

(b) The NDPs, for the following clauses of CYS EN 1990, are applicable to buildings only (see Section NA 2.2).

- A1.2.1 (1)
- A1.2.2 (Table A.1.1)
- A1.3.1 (1) Table A1.2 (A) to (C)
- A1.3.1 (5)
- A1.3.2 (Table A.1.3)
- A1.4.2 (2)

(c) The NDPs, for the following clauses of CYS EN 1990, are applicable to bridges only (see Section NA 2.3).

General clauses

Clause	Item
A2.1 (1) NOTE 3	Use of Table 2.1 : Design working life
A2.2.1(2) NOTE 1	Combinations involving actions which are outside the scope of EN 1991
A2.2.6(1) NOTE 1	Values of ψ factors
A2.3.1(1)	Alteration of design values of actions for ultimate limit states
A2.3.1(5)	Choice concerning the use of Approach 1, 2 or 3
A2.3.1(7)	Definition of forces due to ice pressure
A2.3.1(8)	Values of γ_P factors for prestressing actions where not specified in the relevant design Eurocodes
A2.3.1 Table A2.4(A) NOTES 1 and 2	Values of γ factors
A2.3.1 Table A2.4(B)	- NOTE 1 : choice between 6.10 and 6.10a/b - NOTE 2 : Values of γ and ξ factors

Clause	Item
	- NOTE 4 : Values of γ_{Sd}
A2.3.1 Table A2.4(C)	Values of γ factors
A2.3.2(1)	Design values in Table A2.5 for accidental designs situations, design values of accompanying variable actions and seismic design situations
A2.3.2 Table A2.5 NOTE	Design values of actions
A2.4.1(1) NOTE 1 (Table A2.6) NOTE 2	Alternative γ values for traffic actions for the serviceability limit state Infrequent combination of actions
A2.4.1(2)	Serviceability requirements and criteria for the calculation of deformations

Clauses specific for road bridges

Clause	Item
A2.2.2 (1)	Reference to the infrequent combination of actions
A2.2.2(3)	Combination rules for special vehicles
A2.2.2(4)	Combination rules for snow loads and traffic loads
A2.2.2(6)	Combination rules for wind and thermal actions
A2.2.6(1) NOTE 2	Values of $\psi_{1,infq}$ factors

Clauses specific for footbridges

Clause	Item
A2.2.3(2)	Combination rules for wind and thermal actions
A2.2.3(3)	Combination rules for snow loads and traffic loads
A2.2.3(4)	Combination rules for footbridges protected from bad weather
A2.4.3.2(1)	Comfort criteria for footbridges

Clauses specific for railway bridges

Clause	Item
A2.2.4(1)	Combination rules for snow loading on railway bridges
A2.2.4(4)	Maximum wind speed compatible with rail traffic
A2.4.4.1(1) NOTE 3	Deformation and vibration requirements for temporary railway bridges
A2.4.4.2.1(4)P	Peak values of deck acceleration for railway bridges and associated frequency range
A2.4.4.2.2 – Table A2.7 NOTE	Limiting values of deck twist for railway bridges
A2.4.4.2.2(3)P	Limiting values of the total deck twist for railway bridges
A2.4.4.2.3(1)	Vertical deformation of ballasted and non ballasted railway bridges
A2.4.4.2.3(2)	Limitations on the rotations of non-ballasted bridge deck ends for railway bridges
A2.4.4.2.3(3)	Additional limits of angular rotations at the end of decks
A2.4.4.2.4(2) – Table A2.8 NOTE 3	Values of α_i and r_i factors
A2.4.4.2.4(3)	Minimum lateral frequency for railway bridges
A2.4.4.3.2(6)	Requirements for passenger comfort for temporary bridges

Note: In future amendments of the National Annex, Clause 2.4 will be applicable for Cranes and Machinery; Clause 2.5 for silos and tanks etc.

(d) Guidance on use of the Informative Annexes B, C and D for buildings and civil engineering works (see Section NA 3).

(e) References to non-contradictory complementary information applicable to buildings and civil engineering works (see Section NA 4)

NA 2 NATIONALLY DETERMINED PARAMETERS

NA 2.1.1 NATIONALLY DETERMINED PARAMETERS FOR BUILDINGS AND CIVIL ENGINEERING WORKS

NA 2.1.2 Clause A.1.1 Field of application

Table 2.1 (CYS) provides values for the design working life given in Table 2.1 of CYS EN 1990.

Table 2.1 (CYS): Indicative design working life

Design working life category	Indicative design working life (years)	Examples
1	10	Temporary structures(1)
2	10 to 25	Replaceable structural parts, e.g. gantry girders, bearings
3	15 to 30	Agricultural and similar structures
4	50	Building structures and other common structures
5	100	Monumental building structures, bridges, and other civil engineering structures

(1) Structures or parts of structures that can be dismantled with a view to being re-used should not be considered as temporary.
In the case of replaceable structural parts the design life for the statistical determination of loads should be the design life of the structure.

NA 2.2 NATIONALLY DETERMINED PARAMETERS FOR BUILDINGS (ANNEX A1)

NA 2.2.1 Clause A.1.2.1 Combination of Actions - General

(a) Regarding Clause A.1.2.1 (1), all effects of actions that can exist simultaneously should be considered together in combination of actions.

(b) Regarding Clause A.1.2.1 (1) Note 2 no modifications are allowed through the National Annex for A1.2.1 (2) and (3).

NA 2.2.2 Clause A.1.2.2 Values of ψ factors

Table A1.1 (CYS) provides values for the symbols of Table A1.1 of CYS EN 1990.

Table A1.1 (CYS): Values of ψ factors for buildings

Action	ψ_0	ψ_1	ψ_2
Imposed loads in buildings, category (see EN 1991-1-1)			
Category A : domestic, residential areas	0,7	0,5	0,3
Category B : office areas	0,7	0,5	0,3
Category C : congregation areas	0,7	0,7	0,6
Category D : shopping areas	0,7	0,7	0,6
Category E : storage areas	1,0	0,9	0,8
Category F : traffic area, vehicle weight ≤ 30kN	0,7	0,7	0,6
Category G : traffic area, vehicle weight ≤ 160kN	0,7	0,5	0,3
Category H : roofs*	0	0	0
Snow loads on buildings (see EN 1991-1-3)			
- for sites located at altitude H > 1000 m a.s.l.	0,7	0,5	0,2
- for sites located at altitude H ≤ 1000 m a.s.l.	0,5	0,2	0
Wind loads on buildings (see EN 1991-1-4)	0,6	0,2	0
Temperature (non-fire) in buildings (see EN 1991-1-5)	0,6	0,5	0
* See also EN 1991-1-1: Clause 3.3.2 (1) For ψ-factors during execution, see EN 1991-1-6 Annex A1.			

NA 2.2.3 Clause A.1.3 Ultimate limit states

NA 2.2.3.1 Clause A.1.3.1 (1) Values for the symbols of Table A1.2 (A)

Table A1.2 (A) (CYS) provides the NDP values for the symbol γ of Table A1.2 (A) of CYS EN 1990. The values chosen are:

$\gamma_{Gj,sup}$ = 1,10
$\gamma_{Gj,inf}$ = 0,90
$\gamma_{Q,1}$ = 1,50 where unfavourable (0 where favourable)
$\gamma_{Q,i}$ = 1,50 where unfavourable (0 where favourable)
Note: for ψ values see table A1.1 (CYS)

Table A1.2 (A) (CYS): Design values of actions (EQU) (Set A)

Persistent and transient design situations	Permanent actions		Leading variable action (*)	Accompanying variable actions (*)	
	Unfavourable	Favourable		Main (if any)	Others
(Eq. 6.10)	$1{,}10G_{kj,sup}$	$0{,}90G_{kj,inf}$	$1{,}50Q_{k,1}$ (0 when favourable)		$1{,}50\psi_{0,1}Q_{k,1}$ (0 when favourable)

(*) Variable actions are those considered in Table A1.1 (CYS)

In cases where the verification of static equilibrium also involves the resistance of structural members, as an alternative to two separate verifications based on Tables A1.2 (A) and A1.2 (B), a combined verification, based on Table A1.2 (A), should be adopted, with the following set of values:

$\gamma_{Gj,sup}$ = 1,35
$\gamma_{Gj,inf}$ = 1,15
$\gamma_{Q,1}$ = 1,50 where unfavourable (0 when favourable)
$\gamma_{Q,i}$ = 1,50 where unfavourable (0 when favourable)
provided that applying $\gamma_{Gj,inf}$ = 1,00 both to the favourable part and to the unfavourable part of permanent actions does not give a more unfavourable effect.

NA 2.2.3.2 Clause A1.3.1 (1) Values for the symbol *γ* of Table A1.2 (B)

Table A1.2 (B) (CYS) provides the values for the symbol γ of Table A1.2 (B) of CYS EN 1990:2002. The values chosen are

$\gamma_{Gj,sup}$ = 1,35
$\gamma_{Gj,inf}$ = 1,00
$\gamma_{Q,1}$ = 1,50 where unfavourable (0 when favourable)
$\gamma_{Q,i}$ = 1,50 where unfavourable (0 when favourable)
Note: for ψ values see table A1.1 (CYS)

Table A1.2 (B) (CYS): Design values of actions (STR/GEO) (Set B)

Persistent and transient design situations	Permanent actions		Leading variable action(*)	Accompanying variable actions(*)	
	Unfavourable	Favourable		Main (if any)	Others
(Eq. 6.10)	$1{,}35G_{kj,sup}$	$1{,}00G_{kj,inf}$	$1{,}50Q_{k,1}$ (0 when favourable)		$1{,}50\psi_{0,1}Q_{k,1}$ (0 when favourable)
(*) Variable actions are those considered in Table A1.1 (CYS) NOTE 1 Expression 6.10 should be used NOTE 3 The characteristic values of all permanent actions from one source are multiplied by $\gamma_{G,sup}$ if the total resulting action effect is unfavourable and $\gamma_{G,inf}$ if the total resulting action effect is favourable. For example, all actions originating from the self-weight of the structure may be considered as coming from one source; this also applies if different materials are involed. NOTE 4 For particular verifications, the values of γ_G and γ_Q may be subdivided into γ_g and γ_q and the model uncertainty factor γ_{Sd}. A value of γ_{Sd} of 1,15 can be used in most common cases.					

NA 2.2.3.3 Clause A1.3.1 (1) Values for the symbol *γ* of Table A1.2 (C)

Table A1.2 (C) (CYS) provides the values for the symbol γ of Table A1.2 (C) of CYS EN 1990:2002. The values chosen are

$\gamma_{Gj,sup}$ = 1,00
$\gamma_{Gj,inf}$ = 1,00
$\gamma_{Q,1}$ = 1,30 where unfavourable (0 when favourable)
$\gamma_{Q,i}$ = 1,30 where unfavourable (0 when favourable)
Note: for ψ values see table A1.1 (CYS)

Table A1.2 (C) (CYS): Design values of actions (STR/GEO) (Set C)

Persistent and transient design situations	Permanent actions		Leading variable action(*)	Accompanying variable actions(*)	
	Unfavourable	Favourable		Main (if any)	Others
(Eq. 6.10)	$1{,}00G_{kj,sup}$	$1{,}00G_{kj,inf}$	$1{,}30Q_{k,1}$ (0 when favourable)		$1{,}30\psi_{0,1}Q_{k,1}$ (0 when favourable)
(*) Variable actions are those considered in Table A1.1 (CYS)					

NA 2.2.3.4 Clause A1.3.1 (5)

Approach 2 should be used for the design of buildings.

NA 2.2.4 Clause A.1.3.2 Design values of actions in the accidental and seismic design situations

Table A1.3 (CYS) provides the values for the symbol γ of Table A1.3 of CYS EN 1990:2002. All γ factors are equal to 1,00. Coefficient $\psi_{1,1}$ is selected for the main accompanying variable action for the accidental design situations.
Note: For ψ values see Table A1.1 (CYS).

Table A1.3 (CYS): Design values of actions for use in accidental and seismic combinations of actions

Design situation	Permanent actions		Leading variable action(*)	Accompanying variable actions(**)	
	Unfavourable	Favourable		Main (if any)	Others
Accidental (Eq. 6.11 a/b)	$G_{kj,sup}$	$G_{kj,inf}$	A_d	$\psi_{1,1}Q_{k,1}$	$\psi_{2,i}Q_{k,i}$
Seismic (*) (Eq. 6.12 a/b)	$G_{kj,sup}$	$G_{kj,inf}$	$\gamma_I A_{Ek}$ or A_{Ed}		$\psi_{2,i}Q_{k,i}$
(*) For the seismic design situation see also EN 1998 (**) Variable actions are those considered in Table A1.1 (CYS)					

NA 2.2.5 Clause A1.4.2(2) Serviceability criteria

Clause A1.4.2 of CYS EN 1990, states that the serviceability criteria should be specified for each project and agreed with the client. In the absence of specific requirements in EN 1992 to EN 1999 or their National Annexes it is recommended that the following Combination of Action expression are used with particular serviceability requirements:

- For function and damage to structural and non-structural elements (e.g. partition walls etc) the characteristic combination (i.e. expression 6.14b of CYS EN 1990)
- For comfort to user, use of machinery, avoiding ponding of water etc, the frequent combination (i.e. expression 6.15b of CYS EN 1990)
- For appearance of the structure the quasi-permanent combination (i.e expression 6.15c of CYS EN 1990)

Separate consideration should be given to serviceability related to appearance and that related to user comfort which may be affected by structural deformation or vibration.

NA 2.3 NATIONALLY DETERMINED PARAMETERS FOR BRIDGES (ANNEX A2)

NA 2.3.1 Clause A2.1 Field of application

Table 2.1 (CYS) shall be used, so the design working life for bridges is 100 years. (Relevant clause of A2.1 (1) Note 3 regarding the use of Table 2.1: Design working life.)

NA 2.3.2 Clause A2.2.1 Combination of Actions – General

Regarding Clause A2.2.1(2) NOTE 1, combinations involving actions which are outside the scope of EN 1991 would be defined by the responsible authorities for the individual project.

NA 2.3.3 Clause A2.2.6 Values of ψ factors

Regarding Clause A2.2..6 (1) Note 1, the values of ψ factors for the groups of traffic loads and the more common other actions are given in :

- Table A2.1 for road bridges,
- Table A2.2 for footbridges, and
- Table A2.3 for railway bridges, both for groups of loads and individual components of traffic actions

Table A2.1 (CYS) – Values of ψ factors for road bridges

Action	Symbol		ψ_0	ψ_1	ψ_2
Traffic loads (see CYS EN 1991-2, Table 4.4)	gr1a (LM1+pedestrian or cycle-track loads) 1)	TS	0,75	0,75	0
		UDL	0,40	0,40	0
		Pedestrian+cycle-track loads 2)	0,40	0,40	0
	gr1b (Single axle)		0	0,75	0
	gr2 (Horizontal Forces)		0	0	0
	gr3 (Pedestrian loads)		0	0	0
	gr4 (LM4 – Crowd loading))		0	-	0
	gr5 (LM3 – Special vehicles))		0	-	0
Wind forces	F_{Wk} - Persistent design situations - Execution		0,6 0,8	0,2 -	0 0
	F_W^*		1,0	-	-
Thermal actions	T_k		0,6 3)	0,6	0,5
Snow loads	$Q_{Sn,k}$ (during execution)		0,8	-	-
Construction loads	Q_c		1,0	-	1,0

1) The recommended values of ψ_0 , ψ_1 , ψ_2 for gr1a and gr1b are given for roads with traffic corresponding to adjusting factors α_{Qi} , α_{qi} , α_{qr} and β_Q equal to 1. Those relating to UDL correspond to the most common traffic scenarios, in which an accumulation of lorries can occur, but not frequently. Other values may be envisaged for other classes of routes, or of expected traffic, related to the choice of the corresponding α factors. For example, a value of ψ_2 other than zero may be envisaged for the UDL system of LM1 only, for bridges supporting a severe continuous traffic. See also CYS EN 1998.

2) The combination value of the pedestrian and cycle-track load, mentioned in Table 4.4a of CYS EN 1991-2, is a "reduced" value. ψ_0 and ψ_1 factors are applicable to this value.

3) The recommended ψ_0 value for thermal actions may in most cases be reduced to 0 for ultimate limit states EQU, STR and GEO. See also the design Eurocodes.

NOTE 2 The values of $\psi_{1,infq}$ that shall be used are:

- 0,80 for gr1a (LM1), gr1b (LM2), gr3 (pedestrian loads), gr4 (LM4, crowd loading) and T (thermal actions),
- 0,60 for F_W in persistent design situations,
- 1,00 in other cases (*i.e.* the characteristic value is substituted for the infrequent value).

NOTE 3 The characteristic values of wind actions and snow loads during execution are defined in CYS EN 1991-1-6. Where relevant, representative values of water forces (F_{wa}) may be defined for the individual project.

Table A2.2 (CYS) – Values of ψ factors for footbridges

Action	Symbol	ψ_0	ψ_1	ψ_2
Traffic loads	gr1	0,40	0,40	0
	Q_{fwk}	0	0	0
	gr2	0	0	0
Wind forces	F_{Wk}	0,3	0,2	0
Thermal actions	T_k	0,6(1)	0,6	0,5
Snow loads	$Q_{Sn,k}$ (during execution)	0,8	-	0
Construction loads	Q_c	1,0	-	1,0
1) The recommended ψ_0 value for thermal actions may in most cases be reduced to 0 for ultimate limit states EQU, STR and GEO. See also the design Eurocodes.				

NOTE 4 For footbridges, the infrequent value of variable actions is not relevant.

Table A2.3(CYS) – Values of ψ factors for railway bridges

Actions		ψ_0	ψ_1	ψ_2 4)
Individual components of traffic actions 5)	LM 71	0,80	1)	0
	SW/0	0,80	1)	0
	SW/2	0	1,00	0
	Unloaded train	1,00	–	–
	HSLM	1,00	1)	0
	Traction and braking Centrifugal forces Interaction forces due to deformation under vertical traffic loads	Individual Components of traffic action including design situations where the traffic loads are considered as a single (multi directional) leading action and not as groups of loads should use the same values as the ψ factors adopted for the associated vertical loads		
	Nosing forces	1,00	0,80	0
	Non public footpaths loads	0,80	0,50	0
	Real trains	0,80	0,80	0
	Traffic load surcharge horizontal earth pressure	0,80	1)	0
	Aerodynamic effects	0,80	0,50	0

Actions			ψ_0	ψ_1	ψ_2 [4)]
NA 2.3.3.1.1 Main traffic actions (Groups of loads)	gr11 (LM71 + SW/0)	Max. vertical 1 with max. longitudinal	0,80	0,80	0
	gr12 (LM71 + SW/0)	Max. vertical 2 with max. transverse			
	gr13 (Braking/Traction)	Max. longitudinal			
	gr14 (Centrifugal/Nosing)	Max. lateral			
	gr15 (Unloaded train)	Lateral stability with "unloaded train"			
	gr16 (SW/2)	SW/2 with max. longitudinal			
	gr17 (SW/2)	SW/2 with max. transverse			
	gr21 (LM71 + SW/0)	Max. vertical 1 with max. longitudinal	0,80	0,70	0
	gr22 (LM71 + SW/0)	Max. vertical 2 with max transverse			
	gr23 (Braking/Traction)	Max. longitudinal			
	gr24 (Centrifugal/Nosing)	Max. lateral			
	gr26 (SW/2)	SW/2 with max. longitudinal			
	gr27 (SW2)	SW/2 with max. transverse			
	gr31 (LM71 + SW/0)	Additional load cases	0,80	0,60	0
Other operating actions	Aerodynamic effects		0,80	0,50	0
	General maintenance loading for non public footpaths		0,80	0,50	0
Wind forces [2)]	F_{Wk}		0,75	0,50	0
	F_W^{**}		1,00	0	0
Thermal actions [3)]	T_k		0,60	0,60	0,50
Snow loads	$Q_{Sn,k}$ (during execution)		0,8	-	0
Construction loads	Q_c		1,0	-	1,0

1) 0,8 if 1 track only is loaded
0,7 if 2 tracks are simultaneously loaded
0,6 if 3 or more tracks are simultaneously loaded.

2) When wind forces act simultaneously with traffic actions, the wind force $\psi_0 F_{Wk}$ should be taken as no greater than F_W^{**} (see CYS EN 1991-1-4) See A2.2.4(4)

3) See CYS EN 1991-1-5

4) If deformation is being considered, ψ_2 should be taken equal to 1,00 for rail traffic actions.

5) Minimum coexistent favourable vertical load with centrifugal, traction or braking individual components of rail traffic actions is 0,5LM71 etc.

NOTE 5 For specific design situations (*e.g.* calculation of bridge camber for aesthetics and drainage consideration, calculation of clearance, etc.) the requirements for the combinations of actions to be used may be defined for the individual project.

NOTE 6 For railway bridges, the infrequent value of variable actions is not relevant.

NA 2.3.4 Clause A2.3: Ultimate limit states

Referring to Clause A2.3.1(1), the requirements for design values of actions for ultimate limit, that shall be used, are stated in the following Tables A2.4(A) (CYS), A2.4(B) (CYS), A2.4(C) (CYS).

Table A2.4(A) (CYS) - Design values of actions (EQU) (Set A)

Persistent and Transient Design Situation	Permanent actions		Prestress	Leading variable action (*)	Accompanying variable actions (*)	
	Unfavourable	Favourable			Main (if any)	Others
(Eq. 6.10)	$\gamma_{Gj,sup} G_{kj,sup}$	$\gamma_{Gj,inf} G_{kj,inf}$	$\gamma_P P$	$\gamma_{Q,1} Q_{k,1}$		$\gamma_{Q,i} \psi_{0,i} Q_{k,i}$

(*) Variable actions are those considered in Tables A2.1 to A2.3.

NOTE 1 The following recomended γ values for the persistent and transient design situations shall be used.

For persistent design situations, the recommended set of values for γ are :
$\gamma_{G,sup}$ = 1,05
$\gamma_{G,inf}$ = 0,95(1)
γ_Q = 1,35 for road and pedestrian traffic actions, where unfavourable (0 where favourable)
γ_Q = 1,45 for rail traffic actions, where unfavourable (0 where favourable)
γ_Q = 1,50 for all other variable actions for persistent design situations, where unfavourable (0 where favourable).
γ_P = recommended values defined in the relevant design Eurocode.

For transient design situations during which there is a risk of loss of static equilibrium, $Q_{k,1}$ represents the dominant destabilising variable action and $Q_{k,i}$ represents the relevant accompanying destabilising variable actions.

During execution, if the construction process is adequately controlled, the recommended set of values for γ are :
$\gamma_{G,sup}$ = 1,05
$\gamma_{G,inf}$ = 0,95(1)
γ_Q = 1,35 for construction loads where unfavourable (0 where favourable)
γ_Q = 1,50 for all other variable actions, where unfavourable (0 where favourable)

(1) Where a counterweight is used, the variability of its characteristics may be taken into account, for example, by one or both of the following recommended rules:
– applying a partial factor $\gamma_{G,\text{inf}} = 0{,}8$ where the self-weight is not well defined (*e.g.* containers) ;
– by considering a variation of its project-defined location, with a value to be specified proportionately to the dimensions of the bridge, where the magnitude of the counterweight is well defined. For steel bridges during launching, the variation of the counterweight location is often taken equal to ± 1 m.

NOTE 2 For the verification of uplift of bearings of continuous bridges or in cases where the verification of static equilibrium also involves the resistance of structural elements (for example where loss of static equilibrium is prevented by stabilising systems or devices *e.g.* anchors, stays or auxiliary columns), as an alternative to two separate verifications based on Tables A2.4(A) and A2.4(B), a combined verification, based on Table A2.4(A), may be adopted with the following set of recommended values, which shall be used.

$\gamma_{G,sup}$ = 1,35
$\gamma_{G,inf}$ = 1,25
γ_Q = 1,35 for road and pedestrian traffic actions, where unfavourable (0 where favourable)
γ_Q = 1,45 for rail traffic actions, where unfavourable (0 where favourable)
γ_Q = 1,50 for all other variable actions for persistent design situations, where unfavourable (0 where favourable)
γ_Q = 1,35 for all other variable actions, where unfavourable (0 where favourable)
provided that applying $\gamma_{G,inf}$ = 1,00 both to the favourable part and to the unfavourable part of permanent actions does not give a more unfavourable effect.

Table A2.4(B) (CYS) - Design values of actions (STR/GEO) (Set B)

Persistent and Transient Design Situation	Permanent actions		Prestress	Leading variable action (*)	Accompanying variable actions (*)	
	Unfavourable	Favourable			Main (if any)	Others
(Eq. 6.10a)	$\gamma_{Gj,sup}G_{kj,sup}$	$\gamma_{Gj,inf}G_{kj,inf}$	$\gamma_P P$		$\gamma_{Q,1}\psi_{0,1}Q_{k,1}$	$\gamma_{Q,i}\psi_{0,i}Q_{k,i}$
(Eq. 6.10b)	$\xi\gamma_{Gj,sup}G_{kj,sup}$	$\gamma_{Gj,inf}G_{kj,inf}$	$\gamma_P P$	$\gamma_{Q,1}Q_{k,1}$		$\gamma_{Q,i}\psi_{0,i}Q_{k,i}$

(*) Variable actions are those considered in Tables A2.1 to A2.3.

NOTE 1 Equations 6.10a and 6.10b shall be used.

NOTE 2 The recommended γ and ξ values shall be used. The following values for γ and ξ are recommended when using expressions 6.10, or 6.10a and 6.10b :
$\gamma_{G,sup}$ = 1,35[1)]
$\gamma_{G,inf}$ = 1,00
γ_Q = 1,35 when Q represents unfavourable actions due to road or pedestrian traffic (0 when favourable)
γ_Q = 1,45 when Q represents unfavourable actions due to rail traffic, to groups of loads 11 to 31 (except 16, 17, 26[3)] and 27[3)]), load models LM71, SW/0 and HSLM and real trains, when considered as individual leading traffic actions (0 when favourable)
γ_Q = 1,20 when Q represents unfavourable actions due to rail traffic, to groups of loads 16 and 17 and SW/2 (0 when favourable)
γ_Q = 1,50 for other traffic actions and other variable actions [2)]
ξ = 0,925
γ_{Gset} = 1,20 in case of linear elastic analysis, and 1,35 in case of non linear analysis, for design situations where actions due to uneven settlements may have unfavourable effects. For design situations where actions due to uneven settlements may have favourable effects, these actions are not to be taken into account.
See also CYS EN 1991 to CYS EN 1999 for γ values to be used for imposed deformations.
γ_P = recommended values defined in the relevant design Eurocode.

[1)]This value covers : self-weight of structural and non structural elements, ballast, soil, ground water and free water, removable loads, etc.
[2)]This value covers : variable horizontal earth pressure from soil, ground water, free water and ballast, traffic load surcharge earth pressure, traffic aerodynamic actions, wind and thermal actions, etc.
[3)]For rail traffic actions for groups of loads 26 and 27 γ_Q = 1,20 may be applied to individual components of traffic actions associated with SW/2 and γ_Q = 1,45 may be applied to individual components of traffic actions associated with load models LM71, SW/0 and HSLM etc.

NOTE 3 The characteristic values of all permanent actions from one source are multiplied by $\gamma_{G,sup}$ if the total resulting action effect is unfavourable and $\gamma_{G,inf}$ if the total resulting action effect is favourable. For example, all actions originating from the self weight of the structure may be considered as coming from one source ; this also applies if different materials are involved. See however A2.3.1(2).

NOTE 4 For particular verifications, the values for γ_G and γ_Q may be subdivided into γ_g and γ_q and the model uncertainty factor γ_{Sd}. A value of γ_{Sd} in the range 1,0 - 1,15 shall be used in most common cases .

NOTE 5 Where actions due to water are not covered by CYS EN 1997 (*e.g.* flowing water), the combinations of actions to be used may be specified for the individual project.

Table A2.4(C) (CYS) - Design values of actions (STR/GEO) (Set C)

Persistent and Transient Design Situation	Permanent actions		Prestress	Leading variable action (*)	Accompanying variable actions (*)	
	Unfavourable	Favourable			Main (if any)	Others
(Eq. 6.10)	$\gamma_{Gj,sup}G_{kj,sup}$	$\gamma_{Gj,inf}G_{kj,inf}$	$\gamma_P P$	$\gamma_{Q,1}\ Q_{k,1}$		$\gamma_{Q,i}\psi_{0,i}Q_{k,i}$
(*) Variable actions are those considered in Tables A2.1 to A2.3						
NOTE The following recommended set of values for γ shall be used : $\gamma_{G,sup}$ = 1,00 $\gamma_{G,inf}$ = 1,00 γ_{Gset} = 1,00 γ_Q = 1,15 for road and pedestrian traffic actions where unfavourable (0 where favourable) γ_Q = 1,25 for rail traffic actions where unfavourable (0 where favourable) γ_Q = 1,30 for the variable part of horizontal earth pressure from soil, ground water, free water and ballast, for traffic load surcharge horizontal earth pressure, where unfavourable (0 where favourable) γ_Q = 1,30 for all other variable actions where unfavourable (0 where favourable) γ_{Gset} = 1,00 in case of linear elastic or non linear analysis, for design situations where actions due to uneven settlements may have unfavourable effects. For design situations where actions due to uneven settlements may have favourable effects, these actions are not to be taken into account. γ_P = recommended values defined in the relevant design Eurocode.						

NA 2.3.5 Clause A2.3.1(5): Choice concerning the use of Approach 1, 2 or 3

Unless it is not specified otherwise to CYS EN 1997-1 N.A., Approach 2 will be chosen.

NA 2.3.6 Clause A2.3.1(7): Definition of forces due to ice pressure

They would be defined by the responsible authorities for the individual project.

NA 2.3.7 Clause A2.3.1(8): Values of γP factors for prestressing actions where not specified in the relevant design Eurocodes

They would be defined by the responsible authorities for the individual project.

NA 2.3.8 Clause A2.3.2: Design values of actions in the accidental and seismic design situations

Referring to Clause A2.3.2 (1), design values of accompanying variable actions and seismic design situations the Factor ψ_2 stated in Table A2.5 (CYS) shall be used.

Table A2.5 (CYS) shall be used.

NA 2.3.9 Clause A2.3.2 Table A2.5 NOTE : Design values of actions

Factor ψ_2 shall be used in Table A2.5 (CYS).

Table A2.5 (CYS) - Design values of actions for use in accidental and seismic combinations of actions

Design Situation	Permanent actions		Prestress	Accidental or seismic action	Accompanying variable actions (**)	
	Unfavourable	Favourable			Main (if any)	Others
Accidental(*) (Eq. 6.11a/b)	$G_{kj,sup}$	$G_{kj,inf}$	P	A_d	$\psi_{1,1}Q_{k,1}$ or $\psi_{2,1}Q_{k,1}$	$\psi_{2,i}\ Q_{k,i}$
Seismic(***) (Eq. 6.12a/b)	$G_{kj,sup}$	$G_{kj,inf}$	P	$A_{Ed} = \gamma_I A_{Ek}$		$\psi_{2,i}\ Q_{k,i}$

(*) CYS EN 1991–1-2 and its National Annex.

(**) Variable actions are those considered in Tables A2.1 to A2.3.

(***) CYS EN 1991–1-2 and its National Annex. Unless it is defined otherwise by the responsible authorities, at railway bridges, only one rail shall be loaded and load model SW/2 could be ignored.

NOTE The recommended values are $\gamma = 1{,}0$ for all non-seismic actions.

NA 2.3.10 Clause A2.4. Serviceability and other specific limit state

Referring to Clause A2.4.1(1) NOTE 1, the design values are stated in Table A2.6 (CYS).

The recommended γ factor = 1,0 shall be used.

Table A2.6 (CYS) - Design values of actions for use in the combination of actions

Combination	Permanent actions G_d		Prestress	Variable actions Q_d	
	Unfavourable	Favourable		Leading	Others
Characteristic	$G_{kj,sup}$	$G_{kj,inf}$	P	$Q_{k,1}$	$\psi_{0,i}Q_{k,i}$
Frequent	$G_{kj,sup}$	$G_{kj,inf}$	P	$\psi_{1,1}Q_{k,1}$	$\psi_{2,i}Q_{k,i}$
Quasi-permanent	$G_{kj,sup}$	$G_{kj,inf}$	P	$\psi_{2,1}Q_{k,1}$	$\psi_{2,i}Q_{k,i}$

NA 2.3.11 Clause A2.4.1(2): Serviceability requirements and criteria for the calculation of deformations

Serviceability limit states during execution should be defined in accordance with CYS EN 1990 to CYS EN 1999 National Annexes, unless it is specified otherwise by the responsible authorities for the specific project.

Clauses specific for road bridges

NA 2.3.12 Clause A2.2.2 (1): Reference to the infrequent combination of actions

The infrequent values of variable actions would not be used for certain serviceability limit states of concrete bridges.

NA 2.3.13 Clause A2.2.2(3): Combination rules for special vehicles

Paragraph 4.2.1(2) of the Eurocode CYS EN 1991-2 National Annex shall be used.

NA 2.3.14 Clause A2.2.2(4): Combination rules for snow loads and traffic loads

This paragraph shall be used, unless it is defined otherwise by the responsible authorities.

NA 2.3.15 Clause A2.2.2(6): Combination rules for wind and thermal actions

This paragraph shall be used, unless it is defined otherwise by the responsible authorities.

NA 2.3.16 Clause A2.2.6(1) NOTE 2: Values of $\psi_{1,infq}$ factors

Infrequent values and combination of actions should not be used.

NA 2.3.17 Clause A2.2.6(1) NOTE 3: Values of water forces

They would be defined by the responsible authorities when it is necessary for the individual project.

Clauses specific for footbridges

NA 2.4 Clause A2.2.3(2): Combination rules for wind and thermal actions

This paragraph shall be used, unless it is defined otherwise by the responsible authorities.

NA 2.5 Clause A2.2.3(3): Combination rules for snow loads and traffic loads

This paragraph shall be used , unless it is defined otherwise by the responsible authorities.

NA 2.6 Clause A2.2.3(4): Combination rules for footbridges protected from bad weather

Combinations of actions should be similar to those for buildings, unless it is defined otherwise by the responsible authorities for the individual project. The imposed loads should be replaced by the relevant group of loads and the ψ factors for traffic actions should be in accordance with Table A2.2 (CYS).

NA 2.7 Clause A2.4.3.2(1): Comfort criteria for footbridges

The following recommended maximum values for accelerations (m/s^2) for any part of the deck shall be used:

- 0,7 for vertical vibrations,
- 0,2 for horizontal vibrations in normal use,
- 0,4 for exceptional crowd conditions.

Clauses specific for railway bridges

NA 2.8 Clause A2.2.4(1): Combination rules for snow loading on railway bridges

This paragraph shall be used, unless it is defined otherwise by the responsible authorities.

NA 2.9 Clause A2.2.4(4): Maximum wind speed compatible with rail traffic

Paragraph 8.1 from Eurocode CYS EN 1991-1-4 and its relevant National Annex shall be used unless it is defined otherwise by the responsible authorities.

The recommended maximum speed = 25 m/sec shall be used.

NA 2.10 A2.4.4.1(1) NOTE 3: Deformation and vibration requirements for temporary railway bridges

Paragraph A2.4.4.1.(2) shall be used , unless it is defined otherwise by the responsible authorities.

NA 2.11 Clause A2.4.4.2.1(4)P: Peak values of deck acceleration for railway bridges and associated frequency range

The following recommended values shall be used:

$\gamma_{bt} = 3,5\ m/s^2$

$\gamma_{df} = 5\ m/s^2$

NA 2.12 Clause A2.4.4.2.2 – Table A2.7 NOTE: Limiting values of deck twist for railway bridges

The following recommended values for the set of t shall be used:

$t_1 = 4,5$
$t_2 = 3,0$
$t_3 = 1,5$

NA 2.13 Clause A2.4.4.2.2(3)P: Limiting values of the total deck twist for railway bridges

The recommended value $t_T = 7,5$ mm/3m shall be used.

NA 2.14 Clause A2.4.4.2.3(1): Vertical deformation of ballasted and non ballasted railway bridges

Additional requirements for limiting vertical deformation for ballasted and non ballasted bridges would be defined by the responsible authorities for the specific project.

NA 2.15 Clause A2.4.4.2.3(2): Limitations on the rotations of non-ballasted bridge deck ends for railway bridges

Limitations on the rotations of ballasted bridge deck ends are implicit in CYS EN 1991-2, 6.5.4. Requirements for non ballasted structures would be defined by the responsible authorities for the specific project.

NA 2.16 Clause A2.4.4.2.3(3): Additional limits of angular rotations at the end of decks

The requirements for non ballasted structures would be defined by the responsible authorities for the specific project.

NA 2.17 Clause A2.4.4.2.4(2) – Table A2.8 NOTE 3 : Values of α_i and r_i factors

Table A2.8 (CYS) shall be used

Table A2.8 (CYS) - Maximum angular variation and minimum radius of curvature

Speed range V (km/h)	Maximum angular variation (radian)	Minimum radius of curvature (m)	
		Single deck	Multi-deck bridge
$V \leq 120$	α_1	R_1	r_4
$120 < V \leq 200$	α_2	r_2	r_5
$V > 200$	α_3	r_3	r_6

NOTE 1 The radius of curvature may be determined using :

$$R = \frac{L^2}{8\delta_h} \qquad \text{(A2.7)}$$

NOTE 2 The transverse deformation includes the deformation of the bridge deck and the substructure (including piers, piles and foundations).

NOTE 3 The values for the set of α_i and r_i may be defined in the National Annex. The recommended values are :
$\alpha_1 = 0{,}0035$; $\alpha_2 = 0{,}0020$; $\alpha_3 = 0{,}0015$;
$r_1 = 1700$; $r_2 = 6000$; $r_3 = 14000$;
$r_4 = 3500$; $r_5 = 9500$; $r_6 = 17500$

NA 2.18 Clause A2.4.4.2.4(3): Minimum lateral frequency for railway bridges

The recommended value f_{h0} =1,2 Hz. shall be used.

NA 2.19 Clause A2.4.4.3.2(6): Requirements for passenger comfort for temporary bridges

Paragraphs A2.4.4.3.1 and A2.4.4.3.2 shall be used, unless they are defined otherwise by the responsible authorities.

NA 3 GUIDANCE ON USING INFORMATIVE ANNEXES B, C AND D

NA 3.1 For buildings

NA 3.1.1 Annex B

Annex B may be used. If used it should be in accordance with the full reliability-based approach described in Annex C of CYS EN 1990:2002.

Annex B provides informative guidance relating to a number of the assumptions (see Clause 1.3 of CYS EN 1990:2002), and in particular on quality management and control measures in design, detailing and execution which aim to eliminate failures due to gross errors, and to achieve the resistance assumed in the design.

For this purpose the use of Clauses B4 and B5 of this Annex are recommended.

NA 3.1.2 Annex C

Annex C may be used for calibration purposes, and for cases of actions not covered by CYS EN 1991.

NA 3.1.3 Annex D

Annex D may be used

Note: Guidance on using Annexes B, C and D for bridges, cranes and machinery, silos and tanks, towers and masts etc will be given when available.

NA 4 REFERENCES TO NON-CONTRADICTORY COMPLEMENTARY INFORMATION

NA 4.1 For buildings

None

Note: References to any non-contradictory complementary information for bridges, cranes and machinery, silos and tanks, towers and masts etc will be given when available.

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NA to CYS EN 1990:2002 *(Including A1:2005 AC:2010 and Annex A2)*

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