SLOVENSKI STANDARD

SIST EN 1990:2004/A1:2006

01-maj-2006

Evrokod - Osnove projektiranja

Eurocode - Basis of structural design

Eurocode - Grundlagen der Tragwerksplanung

Eurocode - Bases de calcul des structures

Ta slovenski standard je istoveten z: **EN 1990:2002/A1:2005**

ICS:

91.010.30 Tehniļ ni vidiki Technical aspects

SIST EN 1990:2004/A1:2006 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1990:2002/A1

December 2005

ICS 91.010.30

English Version

Eurocode - Basis of structural design

Eurocode - Bases de calcul des structures

Eurocode - Grundlagen der Tragwerksplanung

This amendment A1 modifies the European Standard EN 1990:2002; it was approved by CEN on 14 October 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This amendment exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 1990:2002/A1:2005: E

Contents

Foreword

This European Standard (EN 1990:2002/A1:2005) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI.

This Amendment to the EN 1990:2002 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2006, and conflicting national standards shall be withdrawn at the latest by June 2006.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Annex A2
(normative)
Application for bridges

National Annex for EN 1990 Annex A2

National choice is allowed in EN 1990 Annex A2 through the following clauses:

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 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 - 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 design 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
A2.2.6(1) NOTE 3	Values of water forces

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

A2.1 Field of application

A2.1.1 General

(1) This Annex A2 to EN 1990 gives rules and methods for establishing combinations of actions for serviceability and ultimate limit state verifications (except fatigue verifications) with the recommended design values of permanent, variable and accidental actions and ψ factors to be used in the design of road bridges, footbridges and railway bridges. It also applies to actions during execution. Methods and rules for verifications relating to some material-independent serviceability limit states are also given.

NOTE 1 Symbols, notations, Load Models and groups of loads are those used or defined in the relevant section of EN 1991-2.

NOTE 2 Symbols, notations and models of construction loads are those defined in EN 1991-1-6.

NOTE 3 Guidance may be given in the National Annex with regard to the use of Table 2.1 (design working life).

NOTE 4 Most of the combination rules defined in clauses A2.2.2 to A2.2.5 are simplifications intended to avoid needlessly complicated calculations. They may be changed in the National Annex or for the individual project as described in A2.2.1 to A2.2.5.

NOTE 5 This Annex A2 to EN 1990 does not include rules for the determination of actions on structural bearings (forces and moments) and associated movements of bearings or give rules for the analysis of bridges involving ground-structure interaction that may depend on movements or deformations of structural bearings.

(2) The rules given in this Annex A2 to EN 1990 may not be sufficient for:

- bridges that are not covered by EN 1991-2 (for example bridges under an airport runway, mechanically-moveable bridges, roofed bridges, bridges carrying water, etc.),
- bridges carrying both road and rail traffic, and
- other civil engineering structures carrying traffic loads (for example backfill behind a retaining wall).

A2.1.2 Symbols

For the purpose of this European Standard, symbols defined in EN1991-2 – Eurocode 1: General actions: Traffic loads on bridges, and the following complementary symbols apply:

Latin upper case letters

F_W	Wind force (general symbol)
F_{Wk}	Characteristic wind force
F_W^*	Wind force compatible with road traffic
F_W^{**}	Wind force compatible with railway traffic
G_{set}	Permanent action due to uneven settlements
Q_{Sn}	Snow load
T	Thermal climatic action (general symbol)
T_k	Characteristic value of the thermal climatic action

Latin lower case letters

d_{set} Difference of settlement of an individual foundation or part of a foundation compared to a reference level

Greek upper case letters

Δd_{set} Uncertainty attached to the assessment of the settlement of a foundation or part of a foundation

Greek lower case letters

γ_{bt} Maximum peak value of bridge deck acceleration for ballasted track

γ_{df} Maximum peak value of bridge deck acceleration for direct fastened track

γ_{Gset} Partial factor for permanent actions due to settlements, also accounting for model uncertainties

γ_I Importance factor for the seismic action (see EN 1998)

A2.2 Combinations of actions

A2.2.1 General

(1) Effects of actions that cannot occur simultaneously due to physical or functional reasons need not be considered together in combinations of actions.

(2) Combinations involving actions which are outside the scope of EN 1991 (e.g. due to mining subsidence, particular wind effects, water, floating debris, flooding, mud slides, avalanches, fire and ice pressure) should be defined in accordance with EN 1990, 1.1(3).

NOTE 1 Combinations involving actions that are outside the scope of EN 1991 may be defined either in the National Annex or for the individual project.

NOTE 2 For seismic actions, see EN 1998.

NOTE 3 For water actions exerted by currents and debris effects, see also EN 1991-1-6.

(3) The combinations of actions given in expressions 6.9a to 6.12b should be used when verifying ultimate limit states.

NOTE Expressions 6.9a to 6.12b are not for the verification of the limit states due to fatigue. For fatigue verifications, see EN 1991 to EN 1999.

(4) The combinations of actions given in expressions 6.14a to 6.16b should be used when verifying serviceability limit states. Additional rules are given in A2.4 for verifications regarding deformations and vibrations.

(5) Where relevant, variable traffic actions should be taken into account simultaneously with each other in accordance with the relevant sections of EN 1991-2.

(6)P During execution the relevant design situations shall be taken into account.

(7)P The relevant design situations shall be taken into account where a bridge is brought into use in stages.

(8) Where relevant, particular construction loads should be taken into account simultaneously in the appropriate combinations of actions.

NOTE Where construction loads cannot occur simultaneously due to the implementation of control measures they need not be taken into account in the relevant combinations of actions.

(9)P For any combination of variable traffic actions with other variable actions specified in other parts of EN 1991, any group of loads, as defined in EN 1991-2, shall be taken into account as one variable action.

(10) Snow loads and wind actions need not be considered simultaneously with loads arising from construction activity Q_{ca} (i.e. loads due to working personnel).

NOTE For an individual project it may be necessary to agree the requirements for snow loads and wind actions to be taken into account simultaneously with other construction loads (e.g. actions due to heavy equipment or cranes) during some transient design situations. See also EN 1991-1-3, 1-4 and 1-6.

(11) Where relevant, thermal and water actions should be considered simultaneously with construction loads. Where relevant the various parameters governing water actions and components of thermal actions should be taken into account when identifying appropriate combinations with construction loads.

(12) The inclusion of prestressing actions in combinations of actions should be in accordance with A2.3.1(8) and EN 1992 to EN 1999.

(13) Effects of uneven settlements should be taken into account if they are considered significant compared to the effects from direct actions.

NOTE The individual project may specify limits on total settlement and differential settlement.

(14) Where the structure is very sensitive to uneven settlements, uncertainty in the assessment of these settlements should be taken into account.

(15) Uneven settlements on the structure due to soil subsidence should be classified as a permanent action, G_{set}, and included in combinations of actions for ultimate and serviceability limit state verifications of the structure. G_{set} should be represented by a set of values corresponding to differences (compared to a reference level) of settlements between individual foundations or parts of foundations, $d_{set,i}$ (i is the number of the individual foundation or part of foundation).

NOTE 1 Settlements are mainly caused by permanent loads and backfill. Variable actions may have to be taken into account for some individual projects.

NOTE 2 Settlements vary monotonically (in the same direction) with time and need to be taken into account from the time they give rise to effects in the structure (i.e. after the structure, or a part of it, becomes statically indeterminate). In addition, in the case of a concrete structure or a structure with concrete elements, there may be an interaction between the development of settlements and creep of concrete members.

(16) The differences of settlements of individual foundations or parts of foundations, $d_{set,i}$, should be taken into account as best-estimate predicted values in accordance with EN 1997 with due regard for the construction process of the structure.

NOTE Methods for the assessment of settlements are given in EN 1997

(17) In the absence of control measures, the permanent action representing settlements should be determined as follows:

- the best-estimate predicted values $d_{set,i}$ are assigned to all individual foundations or parts of foundations,
- two individual foundations or parts of an individual foundation, selected in order to obtain the most unfavourable effect, are subject to a settlement $d_{set,i} \pm \Delta d_{set,i}$, where $\Delta d_{set,i}$ takes account of uncertainties attached to the assessment of settlements.

A2.2.2 Combination rules for road bridges

(1) The infrequent values of variable actions may be used for certain serviceability limit states of concrete bridges.

NOTE The National Annex may refer to the infrequent combination of actions. The expression of this combination of actions is:

$$E_d = E\{G_{k,j}\ ;\ P\ ;\ \psi_{1,\text{infq}} Q_{k,1}\ ;\ \psi_{1,i} Q_{k,i}\} \quad j \geq 1\ ;\ i > 1 \qquad \text{(A2.1a)}$$

in which the combination of actions in brackets { } may be expressed as:

$$\sum_{j\geq 1} G_{k,j} \text{"+"} P \text{"+"} \psi_{1,\text{infq}} Q_{\text{k,1}} \text{"+"} \sum_{i>1} \psi_{1,i} Q_{\text{k,i}} \qquad \text{(A2.1b)}$$

(2) Load Model 2 (or associated group of loads gr1b) and the concentrated load Q_{fwk} (see 5.3.2.2 in EN 1991-2) on footways need not be combined with any other variable non traffic action.

(3) Neither snow loads nor wind actions need be combined with:

– braking and acceleration forces or the centrifugal forces or the associated group of loads gr2,

– loads on footways and cycle tracks or with the associated group of loads gr3,
– crowd loading (Load Model 4) or the associated group of loads gr4.

NOTE The combination rules for special vehicles (see EN 1991-2, Annex A, Informative) with normal traffic (covered by LM1 and LM2) and other variable actions may be referenced as appropriate in the National Annex or agreed for the individual project.

(4) Snow loads need not be combined with Load Models 1 and 2 or with the associated groups of loads gr1a and gr1b unless otherwise specified for particular geographical areas.

NOTE Geographical areas where snow loads may have to be combined with groups of loads gr1a and gr1b in combinations of actions may be specified in the National Annex.

(5) No wind action greater than the smaller of F_W^* and $\psi_0 F_{Wk}$ should be combined with Load Model 1 or with the associated group of loads gr1a.

NOTE For wind actions, see EN1991-1-4.

(6) Wind actions and thermal actions need not be taken into account simultaneously unless otherwise specified for local climatic conditions.

NOTE Depending upon the local climatic conditions a different simultaneity rule for wind and thermal actions may be defined either in the National Annex or for the individual project.

A2.2.3 Combination rules for footbridges

(1) The concentrated load Q_{fwk} need not be combined with any other variable actions that are not due to traffic.

(2) Wind actions and thermal actions need not be taken into account simultaneously unless otherwise specified for local climatic conditions.

NOTE Depending upon the local climatic conditions a different simultaneity rule for wind and thermal actions may be defined either in the National Annex or for the individual project.

(3) Snow loads need not be combined with groups of loads gr1 and gr2 for footbridges unless otherwise specified for particular geographical areas and certain types of footbridges.

NOTE Geographical areas, and certain types of footbridges, where snow loads may have to be combined with groups of loads gr1 and gr2 in combinations of actions may be specified in the National Annex.

(4) For footbridges on which pedestrian and cycle traffic is fully protected from all types of bad weather, specific combinations of actions should be defined.

NOTE Such combinations of actions may be given as appropriate in the National Annex or agreed for the individual project. Combinations of actions similar to those for buildings (see Annex A1), the imposed loads being replaced by the relevant group of loads and the ψ factors for traffic actions being in accordance with Table A2.2, are recommended.