Experience in preparing the National Annexes in Croatia

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Organization of work on drafting Croatian National Annexes

- TO 548 Committee founded as mirror Committee in CEN
- Subcommittees founded for each of Eurocodes EC-1 to EC-9 (average 6-7 members in one Subcommittee)
- Working group founded within TO 548 for head code EC-0 (EN 1990)

Organization of work on drafting Croatian National Annexes

- Fully in compliance with CEN/CENELEC Internal Regulations – Part 3
- One institution/firm may have more members in Committee/Subcommittee, but only one vote
- Problem! Academic institutions are allocated only one vote the same as a firm with only one employee (democracy at work?)

Organization of work on drafting Croatian National Annexes

- The least number of members in Committee/Subcommittees came from industry and construction companies
- They also contributed the least to the process of enactment of National Annexes
- Most active members were prominent structural engineers and professors of academic institutions

Organization of work on drafting Croatian National Annexes

- Proposal for a National Annex is made within appropriate Subcommittee
- TO 548 Committee adopts or rejects a proposal for particular National Annex
- Public inquiry is held
- Study of comments/objections in Subcommittee
- Final adoption of NA takes place in TO 548 Committee

Time frame for drafting National Annexes

- Most important and time-consuming was the work in Subcommittees
- Lengthy period after final adoption of a National Annex (language-editing, text processing, announcement in Croatian Standards Institute (HZN) official paper, finally availability of a National Annex)
Time frame of drafting National Annexes

- Work on drafting National Annexes commenced with establishment of TO 548 Committee on 28/11/2006
- Firstly consensus was reached on Croatian Civil/Structural Engineering terminology
- First publicly available National Annex was to Eurocode (EN 1990) released on 31/08/2011
- Last publicly available National Annexes were to EC-2, EC-3 and EC-9 released on 30/04/2013

Contents and form of National Annexes

- Different EU member states have different National Annexes in respect to form and contents
- Some EU member states have very concise National Annexes, whilst others have very extensive ones including NCCI
- At first we collected and carefully studied all available National Annexes from various states (Austria, Italy, Germany, UK, etc)

Contents and form of National Annexes

- National Annexes in Croatia have the status of original Croatian standards
- Particular Croatian National Annexes vary extensively in regard to volume
- National Annexes have thus far been released only in Croatian language

Experience in work on defining NDP

- Scientific research in Croatia is scarce and hence mostly not included in defining NDP
- German National Annexes were of large influence, because Croatian standards had traditionally been based on DIN standards

Experience in work on defining NDP

- Recommended NDP are fully accepted in fields where we had the least experience (for example EC9 standards)
Experience in work on defining NDP

- Percentage of EC recommended NDP accepted in Croatian National Annexes:

<table>
<thead>
<tr>
<th>EC Code</th>
<th>Acceptance Percentage</th>
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<tbody>
<tr>
<td>EN 1990</td>
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<td>EN 1991</td>
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Eurocode (EN 1990) - Important modified NDP

- Basis of structural design – HRN EN 1990/NA:
  - Design working life:
  - Category 1 includes structures during construction, that need not be checked for earthquake actions if construction period is less than 2 years
  - Category 4 includes bridges and other engineering structures of common proportions and importance

- If self-weights of non-structural parts are unknown partial factors for variable actions are applied
- For combination of actions expression (6.10) is used
- For design of structural members involving geotechnical actions and the ground resistance most conservative Approach 3 is adopted
- Serviceability criteria for deformations and vibrations for buildings are defined

Eurocode 1 (EN 1991) - Important modified NDP

- Densities, self-weight, imposed loads for buildings – HRN EN 1991-1-1/NA:
  - Tables 6.1 & 6.2 are replaced by Table 6.1(HR)
  - Tables 6.4, 6.8, 6.10 & 6.12 on imposed loads are replaced by corresponding Tables 6.4(HR), 6.8(HR), 6.10(HR) and 6.12(HR), respectively

- Actions on structures exposed to fire – HRN EN 1991-1-2/NA:
  - All recommended NDP are accepted
**Eurocode 1 (EN 1991) - Important modified NDP**

**Snow loads – HRN EN 1991-1-3/NA:**
- Application to altitudes above 1500m
- Annex A is applied for all locations
- Annex B is not to be used
- Exceptional snow loads and exceptional snow drifts are not treated as accidental actions

**Characteristic value of snow load on the ground** is defined in snow zonation maps by Meteorological and Hydrological Service of Croatia (DHMZ) after lengthy discussions with Subcommittee members.

Division into 4 regions with characteristic snow load on the ground 0.50, 0.75, 1.00 and 1.25 kN/m² up to 100m altitude above the sea.

**Values from Table 1(HR) are used for higher altitudes**
- No reference is made to Annex C
- Possible rainfalls on the snow are already included in characteristic values

**Wind actions – HRN EN 1991-1-4/NA:**
- Extensive National Annex of 32 pages
- Contains 77 NDP clauses and 5 NCCI clauses
- Comprehensive work on wind velocities was produced by Meteorological and Hydrological Service of Croatia (DHMZ) after numerous objections from Subcommittee members.
- Wind zonation maps are provided by DHMZ - fundamental value of basic wind velocity 20–48 m/s

- Largest values of basic wind velocity is in regions of „bora“ wind on the Adriatic coast
- For vertical walls of rectangular plan buildings Table 7.1 is replaced by Table 1(HR)
- For effective slenderness \( \lambda \) and end-effect factor \( \psi \) Table 7.16 is replaced by Table 3(HR) defining effective slenderness \( \lambda \)

- Criteria and procedures for assessing whether a dynamic response procedure is needed for bridges are specified
- Simplified rules or wind effects on bridge piers are specified
- Annexes A, B, E (except clause E.1.5.3) and F may be used
- Annexes C and D are not to be used
Eurocode 1 (EN 1991) - Important modified NDP

- Thermal actions – HRN EN 1991-1-5/NA:
  - Zonation maps of maximum/minimum shade air temperatures are provided by DHMZ
  - Alternatively for the whole of Croatia maximum shade air temperature is specified as +40°C and minimum shade air temperature as -25°C (except for Adriatic islands where -10°C is specified)

- Actions during execution – HRN EN 1991-1-6/NA:
  - All recommended NDP are accepted

- Accidental actions – HRN EN 1991-1-7/NA:
  - Extensive National Annex of 28 pages
  - Contains 43 NDP clauses and 12 NCCI clauses
  - Categorization of buildings according to consequence classes is provided in Table 1(HR)
  - Design values for hard impact from road traffic are defined in Table 2(HR)
  - Criteria for classification of structures spanning across railway are specified in Table 3(HR)

- Accidental actions – HRN EN 1991-1-7/NA:
  - Provisions for temporary structures spanning across railway are specified in Table 4(HR)
  - Static equivalent forces for Class A structures spanning across railway are specified in detail in Tables 5-6(HR) and sacrificing layer and reinforcement detailing in Figure 3(HR)

- Accidental actions – HRN EN 1991-1-7/NA:
  - Reduction of values of frontal and lateral dynamic forces due to impact from river and canal traffic for larger distances between edge of waterway and piers are specified in Figure 4(HR)
  - Procedures for internal explosions including allowable types of tension ties and their design forces are specified

- Accidental actions – HRN EN 1991-1-7/NA:
  - NCCI: Annexes A, B, C and D (except D.2) should not be used
Eurocode 1 (EN 1991) - Important modified NDP

• Traffic loads on bridges – HRN EN 1991-2/NA:
  - Extensive National Annex of 28 pages
  - Contains 89 NDP clauses and 26 NCCI clauses
  - Load Model 3 is defined as special vehicle 3000/200 (3000 kN)
  - Vehicle collision forces on structural members beside the roadway are defined as 1000 kN frontally and 500 kN laterally, not acting simultaneously

Eurocode 1 (EN 1991) - Important modified NDP

• Characteristic values of railway loading shall be multiplied by factor $\alpha = 1.21$, unless specified otherwise
• Dynamic factor of railway traffic is specified as $\Phi 3$ for all railway lines in Croatia
• NCCI:
  - For fatigue assessment of railway structures heavy traffic mix with 25t axles is specified

Eurocode 1 (EN 1991) - Important modified NDP

• Actions induced by cranes and machinery – HRN EN 1991-3/NA:
  - All recommended NDP are accepted

Eurocode 1 (EN 1991) - Important modified NDP

• Silos and tanks – HRN EN 1991-4/NA:
  - All recommended NDP are accepted

Eurocode 2 (EN 1992) - Important modified NDP

• General rules and rules for buildings – HRN EN 1992-1-1/NA:
  - Beams:
    - reduced $A_{s,\text{max}} = 0.022A_c$ (0.04$A_c$)
    - partial fixity $\beta_2 = 0.25$ (0.15)
    - Different value for $\rho_{w,\text{min}}$
    - Detailed definition of maximum longitudinal spacing between shear assemblies $s_{l,\text{max}}$ in Table 9.1(HR)

Eurocode 2 (EN 1992) - Important modified NDP

• General rules and rules for buildings – HRN EN 1992-1-1/NA:
  - Detailed definition of transverse spacing of legs
  - $s_{t,\text{max}}$ in Table 9.2(HR)
  - Solid slabs:
    - Reduced spacing of bars $s_{\text{max,slabs}}$
Eurocode 2 (EN 1992) - Important modified NDP

• General rules and rules for buildings – HRN EN 1992-1-1/NA:
  • Columns:
    - Longitudinal bars $d_{min}=12$mm (8mm)
    - Total longitudinal reinforcement $A_{s,min}$ 50% more than recommended value
    - Reduced maximum spacing of transverse reinforcement $s_{l,max}=12\Phi$ (20\Phi); 30cm(40cm)

Eurocode 2 (EN 1992) - Important modified NDP

• General rules and rules for buildings – HRN EN 1992-1-1/NA:
  • Foundations:
    - Pile caps, tie beams and column footing on rock - longitudinal bars $d_{min}=12$mm (8mm)
    - Wall and column footings - bars $d_{min}=12$mm (8mm); meshes $d_{min}=8$mm

Eurocode 2 (EN 1992) - Important modified NDP

• General rules – Structural fire design – HRN EN 1992-1-2/NA:
  • In checks on adequate fire resistance of beams utilizing Tables 5.5 to 5.7 web thickness is defined as class WC

Eurocode 2 (EN 1992) - Important modified NDP

• Concrete bridges – Design and detailing rules – HRN EN 1992-2/NA:
  • Minimum strength classes $C_{min}$ are defined for various bridge structural parts in detail
  • All exposed concrete surfaces are directly affected by de-icing salts within $x=15$m (6m) horizontally and $y=5$m (6m) vertically from carriageway

Eurocode 2 (EN 1992) - Important modified NDP

• Concrete bridges – Design and detailing rules – HRN EN 1992-2/NA:
  • In non-linear analysis where failure is due to loss of stability of whole structure global safety factor of 1.5 on resistance is specified
  • For avoidance of brittle failure caused by failure of prestressing tendons only method “b” of providing minimum reinforcement shall be used

Eurocode 2 (EN 1992) - Important modified NDP

• Concrete bridges – Design and detailing rules – HRN EN 1992-2/NA:
  • Limiting calculated crack width $w_{max}$, definition of decompression and its application for use are defined in Table 7.101(N)(HR)
  • Bundle of bars should contain maximum 3 bars
  • Value of $X\%$ of tendon couplers is defined
  • Openings and pockets on upper side of carriageway slabs to apply prestress to tendons are forbidden
Eurocode 2 (EN 1992) - Important modified NDP

- Concrete bridges – Design and detailing rules – HRN EN 1992-2/NA:
- Additional rules for minimum thickness and reinforcement of structural elements, with minimum bar diameters and maximum bar spacing are specified in detail
- NCCI: Informative Annex B contains extensive additional rules for design of concrete bridges in Croatia

Eurocode 3 (EN 1993) - Important modified NDP

- General:
  - Extensive numerical case studies were done to modify NDP, so that the same level of reliability is achieved as by using previous Croatian standards
  - Croatian National Annexes rely heavily on German National Annexes, following the tradition
  - All modified NDP are on the safe side in respect to EC recommended ones

Eurocode 3 (EN 1993) - Important modified NDP

- General rules and rules for buildings – HRN EN 1993-1-1/NA:
  - Partial factor $\gamma_M$ is specified as $\gamma_M = 1.1 \ (1.0)$
  - In stability checks utilizing 2nd order theory cross-section resistances should be calculated by using $\gamma_M$
  - Table BB.1 of factor $K_\varsigma$ considering moment type distribution and type of restraint for continuous torsional restraint is replaced by Table BB.1(HR)

Eurocode 3 (EN 1993) - Important modified NDP

- General rules – Structural fire design – HRN EN 1993-1-2/NA:
  - General rules – Supplementary rules for cold-formed members and sheeting – HRN EN 1993-1-3/NA:
  - General rules – Supplementary rules for stainless steels – HRN EN 1993-1-4/NA:
  - All recommended NDP are accepted

Eurocode 3 (EN 1993) - Important modified NDP

- Plated structural elements – HRN EN 1993-1-5/NA:
  - For plate girders with corrugated webs expressions to calculate stiffnesses for trapezoidal and sinusoidal corrugated webs are specified

Eurocode 3 (EN 1993) - Important modified NDP

- Strength and Stability of Shell Structures – HRN EN 1993-1-6/NA:
  - Procedure for calculation of buckling of spherical shells and domes under constant radial loading is added in Annex E(HR)
Eurocode 3 (EN 1993) - Important modified NDP

- **Strength and stability of planar plated structures subject to out of plane loading – HRN EN 1993-1-7/NA:**
  - All recommended NDP are accepted

- **Design of joints – HRN EN 1993-1-8/NA:**
  - Partial factors γ_M are modified as follows:
    - Injection bolts γ_M4=1.1 (1.0); resistance of joints in hollow section lattice girder γ_M5=1.35 (1.0)
  - Bolt classes 4.8, 5.8 and 6.8 are forbidden for use in steel structures; bolt class 4.6 is allowed for use only in non-bearing structural parts
  - For preloaded bolts various procedures for preloading are specified

- **Fatigue – HRN EN 1993-1-9/NA:**
  - Fatigue assessment should be undertaken using damage tolerant method
  - Partial factors γ_MF for fatigue resistance given in Table 3.1(HR) should be used, with values depending on consequence classes CC1-CC3

- **Material toughness and through-thickness properties – HRN EN 1993-1-10/NA:**
  - Lowest air temperature with a specified return period T_{ref} used in expression for reference temperature T_{ed} at potential fracture location is specified for various steel structures (bridges, buildings, etc)

- **Design of structures with tension components – HRN EN 1993-1-11/NA:**
  - Characteristic value of nominal tensile strength f_u for bundle of parallel round wires is specified as f_u≤1860N/mm² in buildings and f_u≤1770N/mm² in bridges
  - Characteristic value of nominal tensile strength f_u for fully locked coil ropes in bridges is specified as f_u≤1570N/mm²
  - Pedestrian and cycle bridges are treated as buildings
  - Cable systems for bridges are classified as exposure class 5
  - Fully locked coil ropes are classified in category of structural detail Δσ=112N/mm² and bundle of parallel round wires in category of structural detail Δσ=167N/mm²
Eurocode 3 (EN 1993) - Important modified NDP

- Additional rules for the extension of EN 1993 up to steel grades S 700 – HRN EN 1993-1-12/NA:
  - All recommended NDP are accepted

Eurocode 3 (EN 1993) - Important modified NDP

- Steel Bridges – HRN EN 1993-2/NA:
  - Provisions for hybrid connections are specified
  - Hybrid connections are not allowed in railway bridges, except in reconstruction of existing ones
  - Conditions based on appropriate detailing are specified to avoid fatigue assessment of road bridges

Eurocode 3 (EN 1993) - Important modified NDP

- Steel Bridges – HRN EN 1993-2/NA:
  - Thorough analysis of hangers of through arch bridges is provided in Annex F(HR)

Eurocode 3 (EN 1993) - Important modified NDP

- Steel Bridges – HRN EN 1993-2/NA:
  - Partial factors for fatigue resistance are specified:
    - Road bridges $\gamma_{Mf}=1.15$ for main load-bearing elements and $\gamma_{Mf}=1.0$ for secondary elements
    - Railway bridges $\gamma_{Mf}=1.25$ for main load-bearing elements (main girders, arch, hangers, etc) and $\gamma_{Mf}=1.15$ for non-ballasted track and for $\gamma_{Mf}=1.0$ for ballasted track for secondary elements (deck plate, longitudinal stiffeners, cross beams)
Eurocode 3 (EN 1993) - Important modified NDP

- Towers, masts and chimneys – Towers and masts – HRN EN 1993-3-1/NA:
  - For important towers and masts design working life is 50 years and for other towers and masts 30 years.
  - Partial factor $\gamma_M$ is specified as $\gamma_M = 1.1 \ (1.0)$.
  - It may be assumed as simplification that all exposed surfaces are covered with ice 3cm thick of 7 kN/m² density.

- Maximum displacement of lattice tower top during erection should not exceed $f = 0.01 \sqrt{h}$.

Eurocode 3 (EN 1993) - Important modified NDP

- Towers, masts and chimneys – Chimneys – HRN EN 1993-3-2/NA:
  - Partial factors for unfavourable effect of actions $\gamma_G$ are specified as 1.5 (1.2), 1.3(1.1) and 1.1 (1.0) for reliability classes 3, 2 and 1 respectively and $\gamma_Q$ are specified as 1.9 (1.6), 1.5(1.4) and 1.3 (1.2) for reliability classes 3, 2 and 1, respectively.
  - Fatigue assessment is not necessary if certain specified conditions are fulfilled.
  - Minimum quality level for welds of shells subjected to fatigue is quality level B (C).
  - Requirements for inspections of chimneys are specified in Annex F(HR).

Eurocode 3 (EN 1993) - Important modified NDP

- Silos – HRN EN 1993-4-1/NA:
  - Partial factor $\gamma_M$ for resistance of shell wall to cyclic plasticity is specified as $\gamma_M = 1.1 \ (1.0)$.

Eurocode 3 (EN 1993) - Important modified NDP

- Tanks – HRN EN 1993-4-2/NA:
  - Partial factors for actions for variable actions of liquids in design situation of liquid induced loads during operation are specified as $\gamma = 1.35 \ (1.3)$ for flammable liquids and as $\gamma = 1.35 \ (1.2)$ for other liquids.
  - Partial factor for cross-sectional resistance of welded or bolted shell wall to plastic limit state is specified as $\gamma_M = 1.1 \ (1.0)$ and for resistance of shell wall to cyclic plasticity as $\gamma_M = 1.1 \ (1.0)$. 
Eurocode 3 (EN 1993) - Important modified NDP

- **Pipelines – HRN EN 1993-4-3/NA:**
  - Partial factors $\gamma_F$ are specified as $\gamma_F^1=1.40$ (1.39), $\gamma_F^2=1.60$ (1.50), $\gamma_F^3=1.05$ (1.82) with detailed description of pipelines belonging to each category 1-3
  - Additional partial factor $\gamma_F^4=2.20$ is introduced for gas pipelines under highways and railway lines and in inhabited localities
  - Minimum radius for bends of pipeline section $x_D$ is specified

- **Piling – HRN EN 1993-5/NA:**
  - Reduction factors $\beta_D$ on effective flexural stiffness and $\beta_B$ on design resistance of sheet piling made of U-piles, accounting for possible reduction due to insufficient shear force transmission in interlocks, are specified in detail in Table 1(HR)
  - Buckling verification may be omitted only if tube is filled to the top by cohesionless soil or concrete

- **Crane supporting structures – HRN EN 1993-6/NA:**
  - Partial factors for resistance $\gamma_M$ are modified as follows:
    - Resistance of members to instability assessed by member checks $\gamma_M^1=1.1$ (1.0)
    - Bearing resistance of injection bolts $\gamma_M^2$ to be provided in technical certificate but $\gamma_M^2\geq1.1$ (1.0)
    - Resistance of joints in hollow section lattice girders $\gamma_M^5=1.35$ (1.0)

Eurocode 4 (EN 1994) - Important modified NDP

- **General rules and rules for buildings – HRN EN 1994-1-1/NA:**
  - Partial factors for design shear resistance of headed stud connectors $\gamma_V$ is specified as $\gamma_V^1=1.25$ if expression (6.18) is applied and as $\gamma_V^1=1.5$ if expression (6.19) is applied
  - In accidental design situations above values are increased by 1.25%
  - For fatigue verification of headed studs partial factor $\gamma_M^5=1.25$ is specified

- **General rules – Structural fire design – HRN EN 1994-1-2/NA:**
  - All recommended NDP are accepted
Eurocode 4 (EN 1994) - Important modified NDP

- General rules and rules for bridges – HRN EN 1994-2/NA:
  - For pre-stress by controlled imposed deformations for favourable effects $\gamma_p = 1.0$ and for unfavourable effects $\gamma_p = 1.1$
  - For fatigue verification of headed studs partial factor $\gamma_{Mf,s} = 1.25$ is specified
  - If provided detailing is used, effects of bending moments in cross frames need not be computed

Eurocode 5 (EN 1995) - Important modified NDP

- General – Common rules and rules for buildings – HRN EN 1995-1-1/NA:
  - Of total 48 NDP, that may be nationally modified, 18 NDP are modified
  - Action assignment to load-duration classes is done in Table 2.2(HR) in more detail than recommended

Eurocode 5 (EN 1995) - Important modified NDP

- Bridges – HRN EN 1995-2/NA:
  - Limiting values for deflections of beams, plates and trusses due to characteristic traffic loads and pedestrian loads and low traffic loads are modified
Eurocode 6 (EN 1996) - Important modified NDP

- General rules for reinforced and unreinforced masonry structures – HRN EN 1996-1-1/NA:
  - Partial factors $\gamma_M$ for material in ULS are specified in Table 2.4.3(HR)
  - Mixtures for mortars for masonry structures are defined by volume ratios to attain corresponding compressive strengths

- Procedures for defining characteristic strengths in compression, shear and bending are specified

- Procedures for defining secant short-time modulus $E$ are specified

Eurocode 6 (EN 1996) - Important modified NDP

- General rules for reinforced and unreinforced masonry structures – HRN EN 1996-1-1/NA:
  - Partial factors $\gamma_{G,0}$ is specified as $\gamma_{G,0}=3.0$

Eurocode 6 (EN 1996) - Important modified NDP

- Geotechnical design - Part 1: General rules – HRN EN 1997-1/NA:
  - Design approach 3 is generally adopted, most conservative if characteristic soil parameters are well defined (adequate soil investigations)
  - In design of axially loaded piles and anchorages design approaches 2 and 3 are adopted
  - In verification of design resistances partial factors are applied to ground properties (X)
**Eurocode 7 (EN 1997) - Important modified NDP**

- **Geotechnical design - Part 1: General rules – HRN EN 1997-1/NA:**
  - Ultimate ground resistance of axially loaded piles from ground test results is calculated by utilizing correlation factors $\xi_3=1.6$ and $\xi_4=1.5$ irrespective of the number of profiles of tests $n$ (recommended values $\xi_3=1.4-1.25$, $\xi_4=1.4-1.08$ for $n=1-10$)
  - Partial factors of pile resistance $\gamma_b$ and $\gamma_s$ are corrected by model factor of 1.5 ($\geq 1.0$)

**Eurocode 8 (EN 1998) - Important modified NDP**

- **General rules, seismic actions and rules for buildings – HRN EN 1998-1/NA:**
  - Seismic zonation maps of reference peak ground acceleration (PGA) on type A ground for return periods of 475 years and 95 years, respectively, were prepared by the relevant Authority, Zagreb University Faculty of Science, Department of Geophysics (Annex B)
  - Max PGA 0.38g (475 years); 0.20g (95 years)
  - Additional ground investigations may be omitted for all structures belonging to importance classes I and II and for structures of importance class III under certain specified conditions
  - Additional ground investigations and/or geological studies shall be performed for all structures of importance class IV

- **Elastic response spectrum 1 is specified for horizontal and vertical seismic actions**
- **Linear-elastic analysis using two planar models may performed in design of buildings when importance factor $\gamma_I \leq 1.0$**

- **Overstrength factor $\gamma_d$ for resistance of horizontal diaphragms in design of buildings is specified as $\gamma_d=1.0$ (1.1) for ductile failure modes and as $\gamma_d=1.3$ (1.3) for brittle failure modes (shear)**
- **Return period of Damage Limitation (DL) is defined as 95 years and reduction factor for limitation of interstorey drift is specified as $\nu=1.0$**
Eurocode 8 (EN 1998) - Important modified NDP

• General rules, seismic actions and rules for buildings – HRN EN 1998-1/NA:
  • Minimum shear reinforcement ratio of large lightly reinforced walls $\rho_{w,\text{min}}$ is increased
  • In masonry buildings only joints fully grouted with mortar are allowed
  • Unreinforced masonry following only provisions of EN 1996 is allowed only in regions of very small seismicity

Eurocode 8 (EN 1998) - Important modified NDP

• General rules, seismic actions and rules for buildings – HRN EN 1998-1/NA:
  • Behaviour factors $q$ for various masonry types of construction are specified bigger than recommended lower limits of Table 9.1
  • Rules for simple masonry buildings, including allowable number of storeys and minimum total cross-sectional area of walls in each orthogonal direction are specified in Table 9.3(HR)

Eurocode 8 (EN 1998) - Important modified NDP

• General rules, seismic actions and rules for buildings – HRN EN 1998-1/NA:
  • Annex D:
    • Stiffness properties may be taken for uncracked elements or obtained by more accurate analysis of cracked elements?
    • Effects of permanent and live loads obtained on models with uncracked elements are combined with seismic effects obtained on cracked element models

Eurocode 8 (EN 1998) - Important modified NDP

• General rules, seismic actions and rules for buildings – HRN EN 1998-1/NA:
  • Annex D:
    • Deformability of foundation with adverse overall influence on structural response shall be taken into account
    • Effects of permanent and live loads shall be computed with static linear elastic soil modulus and seismic effects with dynamic linear elastic soil modulus at least 5 times larger

Eurocode 8 (EN 1998) - Important modified NDP

• Bridges – HRN EN 1998-2/NA:
  • Bridges are classified in importance classes:
    • Class II comprises all bridges not belonging to classes III and IV
    • Class III comprises road and railway bridges where traffic interruption requires emergency interventions
    • Class IV comprises bridges of critical importance for maintaining communications

Eurocode 8 (EN 1998) - Important modified NDP

• Bridges – HRN EN 1998-2/NA:
  • Bridges are classified in categories:
    • Category A comprises temporary bridges and bridges during construction for design working life $\leq 10$ years
    • Category B comprises bridges of usual common proportions and importance for design working life $\geq 50$ years
    • Category C comprises monumental bridges
Eurocode 8 (EN 1998) - Important modified NDP

- Bridges – HRN EN 1998-2/NA:
  - Importance factors $\gamma_I$ are defined in Table 1(HR) for categories A-C for each of importance classes II-IV, specifically for LS of Near Collapse (NC) and LS of Damage Limitation (DL):
  - $\gamma_I$ values for LS (NC) for importance class III(IV) are 0.65(0.65) for category A, 1.15(1.30) for category B and 1.45(1.60) for category C.

- For shear resistance values of members outside the region of plastic hinges “alternative 2” - expression (5.8b) is specified.

- Assessment and retrofitting of buildings – HRN EN 1998-3/NA:
  - Limit states of Significant Damage (SD) and Damage Limitation (DL) shall be checked.
  - Return period of Significant Damage (SD) is defined as 475 years, corresponding to probability of exceedance of 10% in 50 years.
  - Return period of Damage Limitation (DL) is defined as 95 years, corresponding to probability of exceedance of 10% in 10 years.
  - Informative Annexes A, B and C may be applied.

- Silos, tanks and pipelines – HRN EN 1998-4/NA:
  - Seismic zonation map for return period of 95 years is used and reduction factor for design seismic action referred to Damage Limitation (DL) is defined as $\nu=1.0$.

- Informative Annexes A, B, C, D and F may be applied.
**Eurocode 8 (EN 1998) - Important modified NDP**

- Towers, masts & chimneys - HRN EN 1998-6/NA:
  - All recommended NDP are accepted

**Eurocode 9 (EN 1999) - Important modified NDP**

- Design of aluminium structures: HRN EN 1999-1-1/NA to HRN EN 1999-1-5/NA
  - All recommended NDP are accepted

**CONCLUSIONS**

- An immense amount of work was done in drafting Croatian National Annexes to Eurocodes by all parties involved.
- Nationally Determined Parameters were tailored to conform to previous design practice and experience in response of executed structures in Croatia.

- Summary of most important modified NDP to Eurocodes to be used in Croatia is given.
- Almost all modified Nationally Determined Parameters in Croatia are on the safe side in comparison to the recommended ones by Eurocodes.