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 Subcommitee*
- *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 Commitee 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

- *In many National Annexes NCCI are used to help designers to avoid unnecessary computations and to highlight most important issues and detailing, particularly in those pertaining to bridges*
- *NDP are calibrated to conform to previous Croatian practice and to experience in response of executed structures*

Experience in work on defining NDP

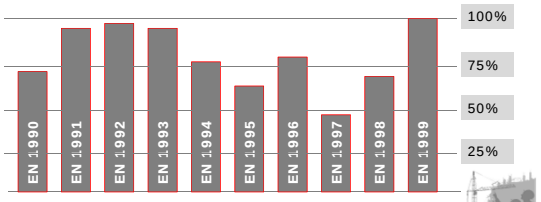
- *Scientific research in Croatia is scarce and hence mostly not included in defining NDP*
- *German National Annexes were of large influence, because Croatian standards had traditionally been based on DIN standards*

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:*



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*

Eurocode (EN 1990) - Important modified NDP

- *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 (EN 1990) - Important modified NDP

- *Snow and traffic loads are combined only for covered bridges*
- *Wind actions and thermal loads are combined*
- *Quasi-permanent traffic actions for railway bridges in Table A2.3 are specified with ψ=0.60-0,75 depending on Lφ (0.6 for $L_\varphi \geq 10m$; 0.75 for $L_\varphi \leq 5m$) with linear interpolation in-between*
- *For ballast on railway bridges partial factors for variable actions are applied*

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*

Eurocode 1 (EN 1991) - Important modified NDP

- ***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*

Eurocode 1 (EN 1991) - Important modified NDP

- ***Snow loads – HRN EN 1991-1-3/NA:***
- *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/m^2 up to 100m altitude above the sea*

Eurocode 1 (EN 1991) - Important modified NDP

- ***Snow loads – HRN EN 1991-1-3/NA:***

- *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*

Eurocode 1 (EN 1991) - Important modified NDP

- ***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*

Eurocode 1 (EN 1991) - Important modified NDP

- ***Wind actions – HRN EN 1991-1-4/NA:***
- *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 λ and end-effect factor ψ Table 7.16 is replaced by Table 3(HR) defining effective slenderness λ*

Eurocode 1 (EN 1991) - Important modified NDP

- ***Wind actions – HRN EN 1991-1-4/NA:***
- *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)*

Eurocode 1 (EN 1991) - Important modified NDP

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

Eurocode 1 (EN 1991) - Important modified NDP

- ***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)*

Eurocode 1 (EN 1991) - Important modified NDP

- ***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)*

Eurocode 1 (EN 1991) - Important modified NDP

- ***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*

Eurocode 1 (EN 1991) - Important modified NDP

- ***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 500kN laterally, not acting simultaneously*

Eurocode 1 (EN 1991) - Important modified NDP

- ***Traffic loads on bridges – HRN EN 1991-2/NA:***
- *Characteristic values of railway loading shall be multiplied by factor α=1.21, unless specified otherwise*
- *Dynamic factor of railway traffic is specified as Φ3 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 $A_{s,max}=0.022A_c$ ($0.04A_c$)*
- *partial fixity $\beta_1=0.25$ (0.15)*
- *Different value for $\rho_{w,min}$*
- *Detailed definition of maximum longitudinal spacing between shear assemblies $s_{l,max}$ 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*
- *$s_{t,max}$ in Table 9.2(HR)*
- *Solid slabs:*
- *Reduced spacing of bars $s_{max,slabs}$*

Eurocode 2 (EN 1992) - Important modified NDP

- ***General rules and rules for buildings – HRN EN 1992-1-1/NA:***
- *Columns:*
- *Longitudinal bars Φ_{min}=12mm (8mm)*
- *Total longitudinal reinforcement $A_{s,min}$ 50% more than recommended value*
- *Reduced maximum spacing of transverse reinforcement $s_{cl,tmax}$=12Φ (20Φ); 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 Φ_{min}=12mm (8mm)*
- *Wall and column footings - bars Φ_{min}=12mm (8mm); meshes Φ_{min}=8mm*

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=15m (6m) horizontally and y=5m (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 Anexes 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 γ_{M1} is specified as γ_{M1}=1.1 (1.0)*
- *In stability checks utilizing 2nd order theory cross-section resistances should be calculated by using γ_{M1}*
- *Table BB.1 of factor K_c 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*

Eurocode 3 (EN 1993) - Important modified NDP

- ***Design of joints – HRN EN 1993-1-8/NA:***
- *Partial factors γ_{Mi} 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*

Eurocode 3 (EN 1993) - Important modified NDP

- ***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*

Eurocode 3 (EN 1993) - Important modified NDP

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

Eurocode 3 (EN 1993) - Important modified NDP

- ***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 $f_u \leq 1860 N/mm^2$ in buildings and $f_u \leq 1770 N/mm^2$ in bridges*
- *Characteristic value of nominal tensile strength f_u for fully locked coil ropes in bridges is specified as $f_u \leq 1570 N/mm^2$*

Eurocode 3 (EN 1993) - Important modified NDP

- ***Design of structures with tension components – HRN EN 1993-1-11/NA:***
- *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 $\Delta\sigma_c = 112 N/mm^2$ and bundle of parallel round wires in category of structural detail $\Delta\sigma_c = 167 N/mm^2$*

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:***
- *Fatigue assessment should be undertaken using damage tolerant method*
- *Partial factor γ_{M5} for resistance of joints in hollow section lattice girders is specified as γ_{M5}=1.35 (1.1)*
- *Procedure with effective cross section properties of class 4 sections is limited to buckling verification of webs without longitudinal stiffeners*

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:***
- *Partial factors for fatigue resistance are specified:*
- *Road bridges γ_{Mf}=1.15 for main load-bearing elements and γ_{Mf}=1.0 for secondary elements*
- *Railway bridges γ_{Mf}=1.25 for main load-bearing elements (main girders, arch, hangers, etc) and γ_{Mf}=1.15 for non-ballasted track and for γ_{Mf}=1.0 for ballasted track for secondary elements (deck plate, longitudinal stiffeners, cross beams)*

Eurocode 3 (EN 1993) - Important modified NDP

- ***Steel Bridges – HRN EN 1993-2/NA:***
- *Fatigue stress spectra should not be used*
- *Thickness of deck plates and minimum stiffness of stiffeners in structural detailing of steel bridge decks of highway bridges are specified*
- *Fitting of stiffeners between webs is allowed only as an exception in road bridges with light traffic*
- *Procedures for calculations of orthotropic steel decks are provided in Article C.2.5(HR)*

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

- ***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 γ_{M1} is specified as γ_{M1}=1.1 (1.0)*
- *It may be assumed as simplification that all exposed surfaces are covered with ice 3cm thick of 7 kN/m^3 density*

Eurocode 3 (EN 1993) - Important modified NDP

- ***Towers, masts and chimneys – Towers and masts – HRN EN 1993-3-1/NA:***
- *Maximum displacement of lattice tower top during erection should not exceed f=0.01√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 γ_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 γ_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*

Eurocode 3 (EN 1993) - Important modified NDP

- ***Towers, masts and chimneys – Chimneys – HRN EN 1993-3-2/NA:***
- *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 γ_{M4} for resistance of shell wall to cyclic plasticity is specified as γ_{M4}=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 γ_F =1.35 (1.3) for flammable liquids and as γ_F =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 γ_{M0}=1.1 (1.0) and for resistance of shell wall to cyclic plasticity as γ_{M4}=1.1 (1.0)*

Eurocode 3 (EN 1993) - Important modified NDP

- ***Pipelines – HRN EN 1993-4-3/NA:***
- *Partial factors γ_F are specified as γ_{F1}=1.40 (1.39), γ_{F2}=1.60 (1.50), γ_{F3}=1.05 (1.82) with detailed description of pipelines belonging to each category 1-3*
- *Additional partial factor γ_{F4}=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_e is specified*

Eurocode 3 (EN 1993) - Important modified NDP

- ***Piling – HRN EN 1993-5/NA:***
- *Reduction factors β_D on effective flexural stiffness and β_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*

Eurocode 3 (EN 1993) - Important modified NDP

- ***Crane supporting structures – HRN EN 1993-6/NA:***
- *Partial factors for resistance γ_{Mi} are modified as follows:*
- *Resistance of members to instability assessed by member checks γ_{M1}=1.1 (1.0)*
- *Bearing resistance of injection bolts γ_{M4} to be provided in technical certificate but $\gamma_{M4}\geq$1.1 (1.0)*
- *Resistance of joints in hollow section lattice girders γ_{M5}=1.35 (1.0)*

Eurocode 3 (EN 1993) - Important modified NDP

- ***Crane supporting structures – HRN EN 1993-6/NA:***
- *Partial factors for resistance γ_{Mi} are modified as follows:*
- *Resistance of members to instability assessed by member checks γ_{M1}=1.1 (1.0)*
- *Bearing resistance of injection bolts γ_{M4} to be provided in technical certificate but ≥1.1 (1.0)*
- *Resistance of joints in hollow section lattice girders γ_{M5}=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 γ_V is specified as γ_V=1.25 if expression (6.18) is applied and as γ_V=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 $\gamma_{Mf,s}$=1.25 is specified*

Eurocode 4 (EN 1994) - Important modified NDP

- ***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 γ_P=1.0 and for unfavourable effects γ_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 4 (EN 1994) - Important modified NDP

- ***General rules and rules for bridges – HRN EN 1994-2/NA:***
- *Application rules for limitation of crack width are provided, including calculation expression, minimum reinforcement $A_{s,min}$ and limiting diameter of reinforcement bars for various stress levels*
- *NCCI: 11 clauses pertaining to tension elements, design stiffness and resistance and general calculation methods are given*

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

- ***General – Common rules and rules for buildings – HRN EN 1995-1-1/NA:***
- *Classification of timber structures into service classes is modified on the basis of more accurate definition of moisture content duration by using defined value of time duration period*
- *Partial factor γ_M for all timber materials is defined as γ_M=1.3 and for steel fasteners in connections subjected to tension and shear as γ_M=1.25*

Eurocode 5 (EN 1995) - Important modified NDP

- ***General – Common rules and rules for buildings – HRN EN 1995-1-1/NA:***
- *Limiting values for deflections of beams are extended to cover beams of different geometrical shape and/or use in the structure, secondary beams and floor beams*
- *For trusses with punched metal plate stiffeners permitted values of maximum bow $a_{bow,perm}$ and permitted values of maximum deviation $a_{dew,perm}$ are defined*

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 γ_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*

Eurocode 6 (EN 1996) - Important modified NDP

- ***General rules for reinforced and unreinforced masonry structures – HRN EN 1996-1-1/NA:***
- *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 – Structural fire design – HRN EN 1996-1-2/NA:***
- *Partial factor γ_{Glo} is specified as γ_{Glo}=3.0*

Eurocode 6 (EN 1996) - Important modified NDP

- ***Design consideration, selection of materials and execution of masonry – HRN EN 1996-2/NA:***
- *All recommended NDP-s are accepted*

Eurocode 6 (EN 1996) - Important modified NDP

- ***Simplified calculation methods for unreinforced masonry structures – HRN EN 1996-3/NA:***
- *Partial factors γ_M for material in ULS are specified in Table 2.3(2)P(HR)*

Eurocode 7 (EN 1997) - 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 ξ_3=1.6 and ξ_4=1.5 irrespective of the number of profiles of tests „n" (recommended values ξ_3=1.4-1.25, ξ_4=1.4-1.08 for n=1-10)*
- *Partial factors of pile resistance γ_b and γ_s are corrected by model factor of 1.5 (≥1.0)*

Eurocode 7 (EN 1997) - Important modified NDP

- ***Geotechnical design - Part 1: General rules – HRN EN 1997-1/NA:***
- *Partial resistance factor for pre-stressed anchorages is specified as $\gamma_{a,t}$=1.35 (1.1) for temporary anchorages and as $\gamma_{a,p}$=1.5 (1.1) for permanent anchorages*
- *NCCI: Annexes B, C, D, H, K, L and M are included to explain recommended design procedures, to specify limiting values of foundation settlement, etc*

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)*

Eurocode 8 (EN 1998) - Important modified NDP

- ***General rules, seismic actions and rules for buildings – HRN EN 1998-1/NA:***
- *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*

Eurocode 8 (EN 1998) - Important modified NDP

- ***General rules, seismic actions and rules for buildings – HRN EN 1998-1/NA:***
- *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 γ_I≤1.0*

Eurocode 8 (EN 1998) - Important modified NDP

- ***General rules, seismic actions and rules for buildings – HRN EN 1998-1/NA:***
- *Overstrength factor γ_d for resistance of horizontal diaphragms in design of buildings is specified as γ_d=1.0 (1.1) for ductile failure modes and as γ_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 ν=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 $\rho_{w,min}$ 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 directions 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 ≤ 10 years*
- *Category B comprises bridges of usual common proportions and imporance for design working life ≥ 50 years*
- *Category C comprises monumental bridges*

Eurocode 8 (EN 1998) - Important modified NDP

- ***Bridges – HRN EN 1998-2/NA:***
- *Importance factors γ_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):*
- *γ_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*

Eurocode 8 (EN 1998) - Important modified NDP

- ***Bridges – HRN EN 1998-2/NA:***
- *For shear resistance values of members outside the region of plastic hinges „alternative 2" - expression (5.8b) is specified*

Eurocode 8 (EN 1998) - Important modified NDP

- ***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*

Eurocode 8 (EN 1998) - Important modified NDP

- ***Assessment and retrofitting of buildings – HRN EN 1998-3/NA:***
- *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*

Eurocode 8 (EN 1998) - Important modified NDP

- ***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 v=1.0*

Eurocode 8 (EN 1998) - Important modified NDP

- ***Foundations, retaining structures and geotechnical aspects – HRN EN 1998-5/NA:***
- *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.***

CONCLUSIONS

- ***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.***