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Implementation and Application of Eurocodes in the Slovak Republic

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1. Introduction

First building laws were published in Europe and in USA in second half of the nineteen century. The first national building codes were published in England, France, Germany, Austria and USA. Idea of common codes was developed and realised independently in Europe and in USA in different ways. Eurocodes published by CEN (Comité Européen de Normalisation, European Committee for Standardization) in Europe and International Codes (which are in fact US codes) published by ICC (International Code Council) in USA are not comparable.

1.1 Development of common structural codes in Europe

25. March 1957: Treaty of Rome

1974: The idea to develop models for an international set of Codes for structural design for the different materials used in construction and applicable to all kinds of structures was born in 1974 based on an agreement between several technical-scientific organisations.

10. March 1979: European Monetary System.

1975-1985: “Zero generation of Eurocodes” – publishing of European recommendations, manuals, etc. Some of them, very valuable till today, may be free download as pdf versions from www.eccspublications.eu.

12. July 1986: Unique Act New Approach with the objective to modify and complete the Treaty of Rome, in particular to improve the decision procedures (vote at the qualified majority). New European directives were established, defining only essential requirements and the development of standards based on these requirements was transferred to appropriate standardisation bodies. One of these directives, published in 1989, dealt with construction products [2].

1989: Construction Product Directive (CPD) 89/106 CEE [2]

May 1990: CEN created a new Technical Committee CEN/TC 250 Structural Eurocodes having subcommittees SC1 – SC9.

27. December 1991 – 22. September 1999: the set of 9 European prestandards (ENV Eurocodes: ENV 1991 – ENV 1999) consisting of 32 parts (22 parts without subparts, 10 parts having 38 subparts) and 2 Amendments was published. Altogether $22 + 38 + 2 = 62$ documents ENV Eurocodes give 4451 A4 format pages. Total price of the whole set in Slovakia is 928 EUR. ENV Eurocodes could be used in various countries only with 62 National Application Documents. ENV Eurocodes were published by CEN in English, French

and German language and consequently translated into various languages of CEN Member states.

24. April 2002 – May 2007: the set of 10 European standards (EN Eurocodes: EN 1990 – EN 1999) consisting of 30 parts (21 parts without subparts, 9 parts having 36 subparts) and 1 Amendment was published. Altogether $21 + 37 + 1 = 59$ documents give 5027 A4 format pages. EN Eurocodes contain 1172 clauses with national choice and they could be used in various countries only with 58 National Annexes. In June 2008 one more Amendment was published by CEN and another ones are in preparation. EN Eurocodes were published by CEN in English, French and German language and consequently translated into various languages of the following CEN Member states: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1. April 2010: only EN Eurocodes should be used in Member states.

1.2 Development of common model building codes in USA

There are three model code agencies in the United States – BOCA, ICBO and SBCCI. They are not a part of the government, but are private nonprofit institutions. Their primary role is to develop and maintain building codes which can be adopted by city and state governments around the country. Once the model codes are adopted by a local government, they become the law in that jurisdiction. All three model codes are “national codes” – that is they are designed for use anywhere in the US. However, the three tend to dominate different regions.

1862: the first real building code of New York City,

1875: the first building code in Chicago,

1892: new building code in Boston,

1900: beginning of various building codes publishing,

1905: National Board of Fire Underwriters (today: American Insurance Association) was founded and it published new widely accepted building code,

1915: BOCA was founded (originally Building Inspectors and Building Commissioners of the United States and the Dominion of Canada, later Building Official Conference of America, now Building Officials and Code Administrators International, Inc.),

1922: ICBO was founded (originally Pacific Coast Building Officials Conference, later International Conference of Building Officials),

1927: ICBO published 1st edition of Uniform Building Code,

1940: SBCCI was founded (Southern Building Code Congress),

1945: SBCCI published 1st edition of Standard Building Code,

1951: BOCA published 1st edition of Basic Building Code, renamed in 1987 into National Building Code,

1957: 1st attempt to coordinate activities of BOCA, ICBO and SBCCI under umbrella NCC (National Coordinating Council). NCC was abolished in 1968.

1972: 2nd attempt to coordinate activities of BOCA, ICBO and SBCCI. CABO (Council of American Building Officials) was founded.

1994: Successful umbrella organisations was founded: International Code Council (ICC).

1995: ICC published 1st editions of the first two common model codes of BOCA, ICBO and SBCCI: International Plumbing Code and International Private Sewage Disposal Code.

1996-1999: ICC published 1st editions of IZC (International Zoning Code), IPMC (International Property Maintenance Code), IECC (International Energy Conservation Code), IPC (International Plumbing Code), IPSDC (International Private Sewage Disposal Code), IMC (International

Mechanical Code), IFGC (International Fuel Gas Code) and (ICC EC (International Code Council Electrical Code).

2000: ICC published the whole set of 11 International Codes including 1st editions of International Building Code (IBC), IFC (International Fire Code), IRC (International Residential Code). IBC references to various special codes, e.g. Specification for Structural Steel Buildings (AISC – American Institute of Steel Construction, Inc., founded 1921), Design of Cold-Formed Steel Structural Members (American Iron and Steel Institute, founded in 1908), Building Code Requirements for Reinforced Concrete (American Concrete Institute, founded in 1905) and many others.

2003: ICC published the whole set of 2nd editions of International Codes.

2006: ICC published the whole set of 3rd editions of International Codes.

2009: ICC will publish the whole set of 4th editions of International Codes.

2. Backgrounds of Eurocodes [1]

The Eurocodes are a set of European Standards (EN) for the design of buildings and other civil engineering works and construction products. The Eurocodes cover, at present, 10 design areas: EN 1990 Basis of Design, EN 1991 Actions, EN 1992 Concrete, EN 1993 Steel, EN 1994 Composite Steel and Concrete, EN 1995 Timber, EN 1996 Masonry and EN 1999 Aluminium, together with EN 1997 Geotechnical design and EN 1998 Seismic design.

The Eurocodes system was developed to facilitate the application of the first European Public Procurement Directive (1971) in the field of design rules for buildings and civil engineering works. In 1975, the Commission of the European Community decided on an action programme based on Article 95 of the Treaty of Rome. The objective of the programme was the elimination of technical obstacles to trade and the harmonisation of technical specifications for construction works. The documents, which were not really standards at the origin, were based on the works of international scientific associations and were intended to be used as a reference for the judgement of public tenders. Publications of the following associations were published in the form of European recommendations and may be considered as zero generation of Eurocodes:

CEB – Euro-International Committee for Concrete,

CIB – International Council for Building Research,

ECCS – European Convention for Constructional Steelworks,

FIP – International Federation for Prestressed Concrete,

IABSE – International Association for Bridge and Structural Engineering,

ISSMFE – International Society for Soil Mechanics and Foundation Engineering,

JCCS – Joint Committee on Structural Safety,

RILEM – International Association of Testing and Research Laboratories for Materials and Constructions.

During 15 years, the Commission of the European Community, assisted by a steering committee composed of experts from EU Member States, oversaw the development of the Eurocodes programme, which led to the publication of a first generation of European codes in the 1980s which were immediately submitted to international inquiries. After the adoption of the European Unique Act (1986) with the objective to modify and complete the Treaty of Rome, in particular to improve the decision procedures (vote at the qualified majority), new European directives were established, defining only essential requirements and the development of standards based on these requirements was transferred to appropriate

standardisation bodies. One of these directives, published in 1989, dealt with construction products [2].

In 1989 the special agreement between the CEN and the European Commission transferred the preparation and publication of the Eurocodes to the CEN, thus providing the Eurocodes with a future status of European EN standards. The agreement specified that the Eurocodes were intended to serve as reference documents to be recognised by authorities of the Member States for the following purposes:

- a) as a means for enabling building and civil engineering works to comply with the “essential requirements” of the construction products directive (89/106/EEC), particularly the first two -mechanical resistance and stability, and safety in case of fire;
- b) as a basis for specifying public construction and related engineering service contracts. At that time, this related to Council Directive 93/37/EEC of 14 June 1993 concerning the co-ordination of procedures for the award of public works contracts, and the services directive (92/50/EEC). Since the 31st of March 2004, these two directives have been replaced by a unique directive [3] (2004/18/CE) of the Parliament and of the Council on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts;
- c) as a framework for drawing up harmonised technical specifications for construction products (ENs and ETAs - European Technical Approvals).

The benefits and opportunities of adopting the Eurocodes can be summarised as follows:

- a) to provide a common understanding regarding the design of structures between owners, operators and users, designers, contractors and manufacturers of construction products;
- b) to facilitate the exchange of construction services between European Member States;
- c) to facilitate the marketing and use of structural components and kits of parts in Member States;
- d) to be a common basis for research and development in the construction sector ;
- e) to allow the preparation of common design aids and software;
- f) to increase the competitiveness of the European civil engineering firms, contractors, designers and product manufacturers in their world-wide activities.

Finally, the Eurocodes are a set of common standards containing the European calculation methods to assess the mechanical resistance of structures or parts thereof and fire resistance as well. This set includes at present 58 documents (European standards) which were finalised and adopted through a formal vote before the end of 2006. All of them were published prior to June 2007.

The European Commission has formally recommended the 58 structural Eurocodes as “a suitable tool” for designing construction works, checking the mechanical resistance of components and checking the stability of structures. The Recommendation 2003/887/EC of 11 December 2003 says Member States should recognise that construction works designed using Eurocodes will conform with the essential requirements of mechanical resistance and stability, safety in use and safety in case of fire. Eurocodes are a state-of-the-art tool which will undoubtedly provide a higher level of safety than before for EU citizens.

The Eurocodes constitute a coherent EU-wide framework of common calculation methods with facilities to adapt their functioning to national settings and priorities through a set of Nationally Determined Parameters (NDPs). When taking the Eurocodes on board, the Member states are expected to define the NDPs to be observed on their territory taking into account justified differences in climate, geographic conditions (e.g. seismic risk), levels of safety, or traditions regarding the way of life prevailing in their territory.

To secure the harmonization efforts, the Commission Recommendation includes a suggestion that Member-States, acting in coordination under the direction of the Commission, compare the NDPs implemented by each Member-State and assess their impact as regards the technical differences for works or parts of work. The Commission has developed and made available a structure, including appropriate databases, to collect and compare the defined NDPs, thus enabling further harmonization work.

The Recommendation 2003/887/EC underlines the necessity to support the implementation on the ground through fully integrating the Eurocodes into all relevant education and training activities on national and regional level and it indicates that continuous efforts to maintain the Eurocodes at the forefront of engineering knowledge and developments in structural design are needed, with further research on MS and EU level facilitating uptake of the latest scientific knowledge and the development of the construction market, including new materials, products and construction methods.

All EU Member States have now initiated the full adoption of the Eurocodes as national design codes including the definition of the Nationally Determined Parameters (NDPs). Due to different regulatory systems and setups the process and the time for full implementation vary depending on the Member States.

Commission Recommendation of 11 December 2003 on the implementation and use of Eurocodes for construction works and structural construction products (2003/887/EC), Official Journal of the European Union, L 332/62, 19.12.2003.

According to the Public Procurement Directives (2004/17/EC and 2004/18/EC, adopted in 2004 and entered into force on 31 January 2006), the contracting authorities must during the transition period until 2010 allow the use of the Eurocodes in structural design aspects of tenders falling within the remit of these Directives. After 2010 the Eurocodes become the only possible design codes to use in publicly procured contracts.

3. Further evolution of Eurocodes

Document CEN/TC250 N 630 , dated February 2006, was the final report defining the main evolution axes of the Eurocodes for the future. It gave proposals from CEN/TC 250 with regard to its role in the implementation, use and development of Eurocodes by providing on a European level :

- a) Maintenance,
- b) Harmonization (convergence of the technical content of National Annexes),
- c) Promotion of the Eurocodes,
- d) Further developments.

3.1 Maintenance

This “internal policy” was needed to clarify the procedure:

- for providing comments and requests to the Commission, CEN/TC250 and its SCs,
- of dealing with comments in CEN/TC 250 and its SCs.
- for the publication of corrigenda and amendments.

The complexity of the maintenance of the Eurocodes is due to :

- the big number of standards (58 Parts, circa 5000 pages),

- the interrelationship between all these standards (several Eurocodes or Parts of Eurocodes may be concerned by a same amendment),
- the degree of progress in the processes of translation, implementation and development of National Annexes in the various Members States.

Maintenance cannot be reduced to simple corrections of mistakes and errors to be made available in accordance with the formal and rigid schedule defined in CEN internal rules and stated in document CEN/TC250/N778. The maintenance of the Eurocodes appears to be more and more a new technical and transparent activity aiming at the improvement of the current versions. For that reason, a big part of the maintenance activity should be considered as a component of what has been called “Further developments”.

3.2 Harmonization

Member States should, acting in coordination under the direction of the Commission, compare the nationally determined parameters implemented by each Member State and assess their impact as regards the technical differences for works or parts of works. Member States should, at the request of the Commission, change their nationally determined parameters in order to reduce divergence from the recommended values provided by the Eurocodes.

3.3 Promotion

3.3.1 Promotion in the EU

The objective of promoting the Eurocodes is the dissemination of the European technical culture in civil engineering outside the EU to support globally the European construction industry. Promotion cannot be disconnected from education, and many initiatives have been taken at national levels (evolution of teaching in universities, continuing education, workshops, etc.). Actions have been launched at the international level, generally with the participation of CEN/TC250 members and associated experts (visiting professors in foreign universities or lecturers in international conferences and workshops).

3.3.2 Promotion in Third Countries

Many countries outside the EU are revising their construction codes. They are generally interested in the European experience. Some of them do not hesitate to use European standards as reference documents in their public tenders, others ask assistance from CEN and the Commission to assist them in the drafting of their future codes. The major events on promotion of the Eurocodes in third countries are:

- The workshop “Eurocodes: Building the future in the Euro-Mediterranean area”, organized by the Commission and NATO, Varese 27-29 November 2006;
- The EU-China Conference on Standards and Energy Efficiency in Building, jointly organised by the Chinese Ministry of Construction and the Commission, Beijing, 29-30 January 2008;
- The Workshop “EU-Russia cooperation on standardisation for construction: the Eurocodes, a tool for building safety and reliability enhancement” jointly organised by the Russian Federal Agency on Technical Regulation and Metrology and the Commission, Moscow, 9-10 October 2008;
- The Seminar “Towards The Eurocodes Era – Backgrounds and its Applications”, Bangkok, 1st-2nd December 2008.

In addition to these promotion activities, it appears necessary to strengthen the capacity of developing countries to participate in CEN. For example, in the development of efficient procedures and tools, CEN and the Commission should ensure the ability of developing countries to adopt and use the European standardization system which may generate confidence in the importing countries that they are implementing best practices in their own

markets. This requires these countries to establish national mirror-committees, and link the activities of these mirror-committees with the development of national standards.

3.4 Further developments

Guidelines on new materials, with a priority for structural glass, structural applications of FRP (Fibre Reinforced Polymers) and very high performance concrete. These guidelines are intended to become additional rules to be incorporated to the existing Eurocodes, or additional standards to the family of Eurocodes. Review and development of existing rules in the context of the wider use of recycled or re-used materials and components.

- Structural glass:

Recent architectural trends and technological developments have brought changes in the use of glass in buildings. Many glass products and configurations may be used by structural engineers and architects, to be selected depending on various parameters, in particular actions and loads that construction works have to sustain.

- Fibre reinforced polymers (FRP):

Fibre reinforced polymers (FRP) have been used in the construction sector since the mid-1980s, mostly for the strengthening of existing buildings and bridges, and increasingly since the mid-1990s as pilot projects for new structures. The safe implementation of FRP composites and the need to promote the competitiveness of this emerging industrial sector are the main drivers quoted by representatives from the European construction associations.

- Ultra-high and self-compacting concrete:

High Strength/High Performance Concrete (HSC/HPC) is the object of particular interest and extensive research. Its use in construction is increasing, but clients and designers often express the wish of an introduction of models, rules and requirements in EN 1992 for this material, with an extension to ultra-high performance fibre reinforced concrete (UHPC) and to self-compacting concrete. Many studies and research has been performed by laboratories, universities and constructors. Recommendations have been already published by scientific and technical organizations, concerning mechanical properties, time effects, fatigue, temperature effects and contact with water. The information is rich and it should not be too difficult to define harmonized design rules and requirements.

Guidelines for the assessment of existing structures, excluding, at present, historical monuments.

Guidelines for the structural design of tensile surface (membrane) structures, which will be prepared in a network of stakeholders coordinated by the TensiNet Association.

Incorporation of some ISO standards to the Eurocodes family. Since many years, a discussion took place regularly during CEN/TC250/SC1 meetings on the time lines to incorporate some ISO standards, after conversion, to the Eurocodes family. In a first step, the relevant standards, both established by ISO/TC98/SC3 are :

- ISO 12494 : Atmospheric icing of structures, and
- ISO 21650 : Actions from waves and currents on coastal structures

These standards are very useful for structural engineers. They need to be re-drafted in a Eurocode style. Other ISO standards may be useful to complement the Eurocodes family. by the Eurocodes.

4. Implementation and application of Eurocodes in Slovak republic

There are 3 Faculties of Civil Engineers in Slovakia: in Bratislav, Košice and Žilina. Education of structural engineers at Slovak Faculties of Civil Engineers is based on Eurocodes more than 10 years. Technical Universities and Slovak Chamber of Civil Engineers organise continuously trainings and post-graduate courses for structural engineers

in practice. Several textbooks and handbooks based on Eurocodes were published for regular and post-graduate students.

In the period November 1998 – June 2004 all parts and subparts of ENV Eurocodes were translated into Slovak language. Relevant National Application Documents were created for all 62 documents of ENV Eurocodes too. Many rules of ENV Eurocodes were implemented into national standards. For example 50 % of content of Slovak standard STN 73 1401 Design of steel structures, published in 1998, is created on the basis of ENV 1993-1-1.

According to guidelines of Slovak Standards Institute in Bratislava till 1st December 2008 the engineers in practise could use in Slovakia in transition period three independent code systems based on: a) national standards STN, b) implemented European prestandards STN P ENV Eurocodes with National Application Documents, c) implemented European standards STN EN Eurocodes with National Annexes. The mixing of individual parts of different codes is forbidden. Starting from 1st December 2008 only a) and c) code systems may be used in Slovakia. Individual parts and subparts of EN Eurocodes are continuously translated into Slovak language and relevant National Annexes of all 58 documents of EN Eurocodes are continuously created. Starting from 1st April 2010 only STN EN Eurocodes may be used for design of structures in Slovakia.

References

- [1] The Eurocodes and construction industry. Medium-term strategy 2008-2013. CEN/TC 250 N 798, JRC European Commission, January 2009.
- [2] Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products, Official Journal of the European Union L 40, 11.2.1989.
- [3] Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts, Official Journal of the European Union L 134, 30.4.2004.

Free available publications and examples supporting using of Eurocodes:

- [E1] www.eccspublications.eu, click Bookstore, click View All, Get PDF Free if possible.
- [E2] <http://eurocodes.jrc.ec.europa.eu>, click Publications, click Background documents.
- [E3] www.access-steel.com