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Specific Challenges of Adopting Eurocodes in Latvia

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Abstract

This paper provides an overview of the history and current situation of implementation of Eurocodes in Latvia. The specific challenges of using Eurocodes in the structural design industry and academic education are highlighted in the work. Based on examples of application of Eurocodes, some essential differences are analysed that have to be considered by the National Technical Committee during the National Annexes development process. The procedures established to support further maintenance of the Eurocodes are explained and the plans for future Eurocode development are described.

Keywords: structural building codes, standardization body, SNiP, Latvian building codes, National Annexes.

1. Introduction

One of the aspects related to the improvement of construction specialists' competitiveness worldwide is a full and well-implemented transfer to the design methodology specified in Eurocodes. This involves all parties connected with the construction process: state institutions, designers, manufacturers of construction products and education institutions.

The Eurocodes are a series of 10 European Standards, EN 1990 – EN 1999, providing a common approach for the design of buildings and other civil engineering works and construction products. Each Eurocode consists of several parts. There are 58 parts in all. They are the recommended means of giving a presumption of conformity with the essential requirements of the Construction Products Directive (CPD) for construction works and products 89/106/EEC of 21 December 1988 that bear the CE Marking, as well as the preferred reference for technical specifications in public contracts. The Eurocodes are expected to contribute to the establishment and functioning of the internal market for construction products and engineering services by eliminating the disparities that hinder their free circulation within the Community. Further, they are meant to lead to more uniform levels of safety in construction in Europe.

The work with the Eurocodes started in 1957 as a result of the Treaty of Rome. The first publications came in the mid 1980s. By 2007 the EN Eurocode parts were expected to be published. The Eurocodes were expected to be fully implemented and to replace all national standards by 2010.

Some of the aims and benefits of the Eurocodes are: to provide common design criteria and methods; to provide a common understanding of construction products; to facilitate the exchange of construction services; to serve as a common basis for research and development; to allow the preparation of common design aids and software; to increase the competitiveness of the European civil engineering firms, contractors, designers and product manufacturers in their world-wide activities (Guadance paper L, 2003).

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The basic standards of the Eurocodes are designed to be easily adapted to the legal framework of the member state by providing the recommended values that ensure a sufficient safety margin for structural design in all Europe. In the Eurocodes, many parameters are left in the competence of the member states. These parameters are called Nationally Determined Parameters, or NDP. When adopting a Eurocode, it must be supplemented with a National Annex that has been developed and legally introduced in the specific member state and that includes the NDP values, indicates the status of the informative annexes and provides references to non-contradictory complementary information (NCCI) to support the users in their application of the Eurocodes.

The aim of the National Annex and the determination of NDP values is to adjust the Eurocode to the national conditions of each separate member state so as to avoid a decline of the structure safety level and a significant increase of construction costs, as well as to take into consideration the national construction traditions and local climate conditions once the structural design industry transfers from the national design regulations to the Eurocode system.

The National Annexes are prepared by a technical committee of standardization (TC), which then adopts the standard into the national system of standards.

2. The historical background

In accordance with EU Commission Recommendation 2003/887/EEC of 11th December 2003 on the implementation and use of Eurocodes for construction works and structural construction products, in 2003 the competent authorities in Latvia started the implementation of structural design requirements corresponding with the Eurocodes. Several Cabinet Regulations were issued and a dual approach transition period was started in the design industry – a parallel application of Latvian construction standards and the Eurocodes.

The Eurocodes' dual approach transition period will continue in Latvia until the Eurocode design standards are adopted and Cabinet Regulations determine that design works in the particular field must be carried out in compliance with only the Eurocode standards. Until then the customer of the building project and the author of the design can choose whether to design the structures in accordance with the currently applicable Latvian construction standards (in case of steel structures – in accordance with the former Soviet SNiP Construction Codes and Regulations system), or to apply Eurocodes.

It's necessary to note that the procedure for loads statistical analysis in Eurocodes is different from the procedure proposed in the SNiP system, which is the basis of the Latvian construction standard. Therefore, it is not permissible to use one method for determining the results of separate interim calculations if the basis is determined using the other method.

The next step in the implementation of Eurocodes was the Twinning project LV/2005-IB/EC/01 financed by the European Transition facilities funds. The Project was put into effect in June 2006 and carried out by one of the leading European applied research institutions – Deutsches Institut für Bautechnik (German Institute of Construction Technology). The project included training of Latvian experts by the leading German experts, preparation of methodological brochures and drafting of the first national annexes to the Eurocode standards. The following phase was training of the Latvian structural designers by the Latvian experts trained by the German experts. Next, practical training built on lectures prepared by the Latvian experts for Latvian structural designers took place. Detailed information about results of this project is available on the Ministry of Economics' homepage.

In order to ensure the adoption of the Eurocode standards in the regulatory enactment system applicable to construction, to support free movement of design services within the European Union and to improve the national construction standards system of Latvia, the Cabinet of Ministers issued a decree No. 455 "Regarding the national implementation plan of Eurocode standards for 2008–2011" of 29th July 2008, which supports the national implementation plan of Eurocode standards for 2008–2011.

Due to an emergency with the state budget and lack of funding, on September 30th, 2009 the Decree of the Cabinet of Ministers No. 455 was amended and some implementation activities were cancelled.

Nevertheless, in October 2010 the Eurocodes Sub-Committee was established at the technical committee LVS/TC30 "Construction" of the Latvian national standardisation body. The main tasks of this Sub-Committee are the drafting of National Annexes to the Eurocode standards, as well as a revision of some previous Eurocode translations in Latvian.

3. Current situation of Eurocode implementation in Latvia

At the moment, 36 of 58 Eurocodes are translated, adopted and included in the system of the Latvian national standardisation body (LVS). One translated standard not registered by LVS is being clarified in the Eurocodes Sub-Committee of LVS/STK 30 "Construction.In addition to the primary standard documents, 47 corrigenda and seven amendments have been issued in the last few years and adopted in the status of a Latvian standard. Of these, 19 corrigenda and two amendments have been translated and registered in LVS.

According to the Latvian Law on Standardization, the application of standards is voluntary, and the Cabinet of Ministers can establish which Latvian national standards are mandatory. Therefore, a standard must be adopted in the status of a Latvian national standard. From the requirements of the Law on Standardization, as well as of the Latvian Constitution, the Official Language Law and the Law on Official Publications and Legal Information, it follows that when including the Eurocode standards into the regulated sphere and making their application mandatory, an obligatory requirement is translation of these standards into Latvian. The current situation with standards translation in Latvia is presented in Fig. 1.

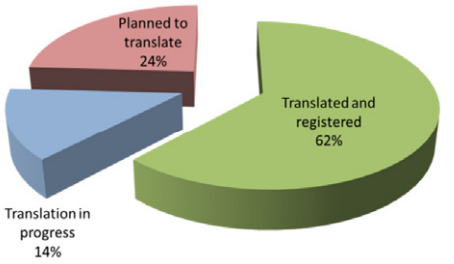

Fig. 1. Current situation with standards translation in Latvia (January 2013)

In order to provide full adoption of the Eurocodes into the system of regulatory enactments applicable in construction and to improve the national construction standardization system of Latvia by implementing the EU Commission Recommendation 2003/887/EEC on the implementation and use of Eurocodes for construction works and structural construction products, the Ministry of Economics in close cooperation with the Technical Committee for Standardization LVS/TC30 “Construction” has developed the new Eurocode national implementation plan for 2013–2014 of 17th May 2012, which provides for measures that have not been implemented during the previous Eurocode implementation period.

The plan stipulates that by the end of 2014 it is necessary to translate and register in the LVS system 17 standards, 31 corrigenda and 5 amendments, as well as to develop 26 National Annexes, to prepare amendments in legislation providing for design works in accordance with the Eurocode standards, and to educate the structural design specialists about the specifics of design as regulated by the Eurocode standards. The overall progress of NA development and implementation in Latvia is shown in the diagram below (Fig. 2).

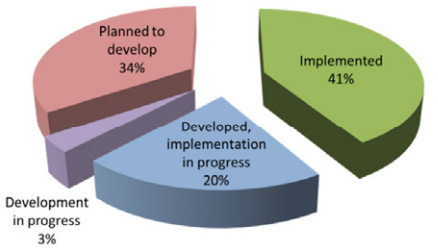

Fig. 2. The overall progress of NA development and implementation in Latvia (January 2013)

The following diagram provides a more detailed overview of the current situation of NA development and implementation by standard number (Fig. 3).

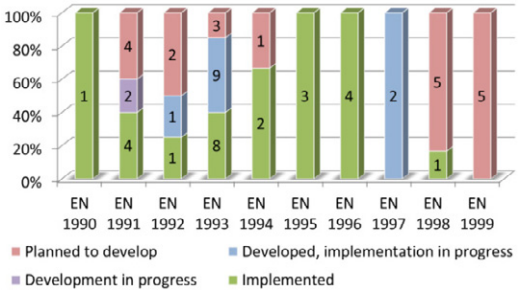

Fig. 3. Detailed situation of NA development and implementation in Latvia (January 2013)

The national parameters of the Eurocodes developed by LVS/TC30 in compliance with the EU Commission Recommendation 2003/887/EEC must be entered into the Joint Research Centre (JRC) data base [7]. In addition, the National Standardization Authority must set up a contact point so that all interested parties could receive information and clarification about the Eurocode standards (provision of cooperation with JRC, CEN/TC 250 and the Technical Standardization Committee of Latvia).

During the implementation of the plan it is necessary to amend or replace the existing structural design construction standards (LBN and SNiP). The Cabinet of Ministers will issue regulations about the design of steel structures, wood structures, concrete, steel and concrete composite structures, masonry structures, seismic structures, aluminium structures, and geotechnical design to be performed in compliance with the Eurocode design standards. This would not only substitute the existing structural design requirements but also expand this regulation by covering several spheres of design that were not regulated before: steel and concrete composite structures, aluminium structures and seismic structures. In the previously mentioned Cabinet regulations there will be indicated essential requirements for each structural design procedure and references to the relevant Eurocode standards and their National Annexes that in accordance with the Law on Standardization have been adopted in the status of a Latvian National Standard. These regulations, however, will not provide detailed technical solutions and calculation methods that would duplicate or contradict the content of the Eurocodes. For cases specified in the Eurocodes, the regulations will determine requirements for quality control and market surveillance.

4. Specific challenges of adopting Eurocodes in Latvia

CEN standards are always issued in three main languages: English, German and French. The text is usually translated from the English version, sometimes from German. In text translation and practical application there often are problems related to the polysemantic nature of the English language: one term in English can have up to ten different meanings. For this reason, the practical implementation of translations requires technical editing by a design specialist.

Since the Eurocodes are based on relatively new scientific studies resulting in the new materials and calculation methods, many new terms are coined that cannot be found in the Latvian technical dictionaries. In order to provide a translation that is closer to the original language of the Eurocodes, the Technical Committee had to expand the Latvian terminology and to start compilation of a special glossary of technical terms used in Eurocodes.

Practice shows that the texts of the Eurocode standards can be difficult to interpret both for design professionals, and for the students, because the original text utilises different traditions or technical terminology. For example, two-way slab or slab acting in two directions – (slab supported by outline, [plātne balstītā pa kontūru] in Latvian), beams with tension/compression reinforcement – (beams with simple/double reinforcement [sijas ar vienkāršo/divkāršo stiegrojumu] in Latvian). Some terms cannot be translated at all and need additional clarification or even illustrations, because the relevant structures or technologies have been rarely if ever used in the Latvian construction industry until now. Such terms include, for example, “confined masonry”, “shell bedded masonry”, “cavity wall”, “rainflow” and “reservoir” particular cycle counting methods, etc.

The verification procedures of the Eurocodes are based on the physical and mechanical properties of the used materials, and these properties are determined in accordance with harmonized EU testing standards. However, the majority of these standards do not correspond with the previous generation of standards, and it is not permissible to base calculations on testing data that has been obtained from still-existing LBN and SNiP standards. In addition, all these testing standards, same as Eurocodes, are available in the major European languages, therefore, to facilitate their application, they also need to be translated into the national language. The total amount of texts to be translated is much larger than the Eurocodes.

The problem with Eurocode 3 and Eurocode 9 is in consideration that there are no applicable Latvian construction standards on design of steel and aluminium structures. There are still former Soviet SNiPs applied in parallel to the relevant Eurocode standards. The new construction standards should replace the former Soviet SNiP codes.

Transition from the national LBN construction standards to the Eurocode will cause no conceptual problems in Latvia as both are based on the limit state method. The difference is in more detailed partial factors method and reference period of loads. In LBN system and in SNiP system used in the former Soviet Union the statistical reference period for snow loads is 10 years instead of 50 years in the Eurocode and for wind loads it is 5 years instead of also 50 years. Due to climate changes, the SNiP approach to dealing with snow loads is becoming inapplicable, as demonstrated by an increased number of roofs having collapsed under snow loads in the recent years; see Fig. 4. Therefore, the nationally determined parameters (NDP) must be adjusted. A detailed comparison of all three codes is presented in author’s earlier publication [8].

For the determination of NDP, EU member states may consider their existing design practice and design rules in order to maintain their traditional level of safety. Latvia as a member state has the advantage that the partial safety factor system for the design of structures has been already in use for many years by using SNiPs during the Soviet time. These standards were

later incorporated into the LBN system. The disadvantage, however, is that the existing LBN system is not exactly fitting to the Eurocode partial factor system, which makes the adjustment of the LBN system to the new one somewhat difficult. Further in this article there are highlighted some essential differences that have to be considered in the process of adoption of Eurocodes when discussing the values of NDPs at the responsible technical committees.

Fig. 4. A supermarket roof collapsed under snow load in 2012, by Girts Gertsons. Retrieved from the http://girtsons.blogspot.com

Among design professionals that have started becoming acquainted with the Eurocodes or to apply them, there is some discontent due to the “recommending” nature of the Eurocodes, which is unusual for the experienced users of the mandatory LBN and SNiP standards. This “recommending” nature can be explained by the fact that, first of all, the Eurocodes are meant for all member states of the European Union, the traditions of which in some cases can be very different, therefore, the Eurocodes were agreed by way of coordination. Another reason is that, in the member states of the European Union, the final responsibility for the overall safety of the structure usually remains with the designer, even if the solutions have not been covered by Eurocode procedures. The tradition of the Soviet SNiP system is different: the designer is no longer responsible, if all requirements of the applicable standard have been observed.

Some difficulties in the introduction and application of the Eurocodes, as well as in the development of NDP, are related to the fact that Eurocodes were developed later than SNiP and LBN standards. As a result, the information to be processed by the designers is much broader and extensive than the one included in the previous standards. For several specific materials, procedures and phenomena, there are no direct analogies in the LBN and SNiP standards, for example, “shade air temperature”, “shear lag”, etc.

Some materials, structures and methods, on the contrary, were considered non-effective by the Eurocode designers in the initial stages of standard development, and as a result, they have not been included in the final text of the Eurocodes. For example, the Eurocodes do not provide verification procedures for such structures as rubble natural stone masonry and masonry reinforced by horizontal steel mesh. However, such structures are widely used in Latvia, and the lack of appropriate verification procedures causes significant problems during inspection and reconstruction works.

It is also worth noting that the Eurocodes mostly use more complicated structural analysis calculation models than LBN and SNiP, which causes difficulties during the studies, as they require advanced knowledge of mathematics and strength of material, for example, plates, shells and subframes instead of the simple or continuous beams widely used in LBN.

When applying the Eurocodes more extensively, it becomes evident that part of the verification procedures cannot be executed without the use of special computer software. For example, even medium-complexity buildings have such a high number of load combinations, that it is physically impossible to use manual calculations. The design rules for the joints of steel structures are also so time consuming that it is not possible to execute the calculations by hand.

In structural design, the procedures, same as terminology, are based on the traditions and experience of other countries (not Latvia), which means different approaches to the build-up of the structures. For example, rolled sections for steel structures are made according to different criteria and requirements, which in turn result in joint design principles and calculation methods that are completely different from the ones specified in the LBN standards and that are not familiar to the Latvian specialists.

Serious problems will be encountered when preparing the National Annexes to EN 1997 group of standards “Geotechnical design”. Eurocode 7 standards are very general and do not contain verification methods of serviceability (e.g. settlement of foundations), which is a determining criterion for the Latvian grounds, and in numerous cases allow application of national design and testing methods. The national annexes to the above standard will be drafted in parallel with the amendments to the Latvian construction standards LBN 207-01 “Building Foundations and Grounds”, LBN 214-03

“Pile Foundations and Grounds” and LBN 005-99 "Geotechnical investigation and testing" that will remain in force after implementation of the Eurocode standards. It means that the Geotechnical Eurocode (EN 1997) will be used together with the National Annex and the above LBN standards.

During the development of the National Annex, the Technical Committee for Standardization LVS/TC30 is closely cooperating with representatives of the industry and non-governmental organizations (LBPA 2011) by taking into account their opinion and practical experience.

In the main Latvian universities that prepare Civil Engineering specialists (Riga Technical University (RTU) and Latvia University of Agriculture (LLU)), the Eurocodes were fully incorporated into the study programmes and subjects starting from the academic year 2007/2008. When preparing the study materials, RTU professors are widely using the modern E-learning Management System (Moodle), which allows the professors to conveniently create courses, prepare and upload tasks for the students, as well as to automatically test the students and process the results. For quality assesment purposes, an anonymous student questionnaire is organized at the end of each semester in relation to each study course and each professor. This allows quick incorporation of any necessary changes into the course programme.

The authors would like to note that the initial, deceptive assumption of Eurocode advocates in Latvia – that a transition to Eurocodes would require only a change of element verification methods and that the rest would remain the same – has not come true. This assumption was based on the idea that the basic science of structural analysis cannot change (Strength of materials and Structural mechanics) and that the materials remain the same (steel, concrete or timber). However, the changes are much deeper. The Eurocodes require different building design methods and a deeper understanding of the behaviour of materials and structures. In the last two years, the professors of structural engineering have had to change almost all visual aids used at the lectures, as well as to re-write the practical tasks.

In spite of the fact that the introduction of the Eirocodes in Latvia is taking long time, some significant structures have already been designed in compliance with the Eurocodes, and these projects are currently under construction. Examples include the Latvian National Library project “Castle of Light” (LNB 2005), the “Z-Towers” multifunctional high-rise building [11], the reconstruction of Riga Motor Museum (RMM 2011) and Riga South Bridge, with the longest span reaching 110 m (Riga City Council 2012).

5. Maintenance and future development of the Eurocodes

With the translation and implementation finishing, the standards will be subject to ongoing maintenance and evolution. There are three forms of updates that can be made to CEN standards; these are corrigendum, amendment and revision. It is the responsibility of thr Technical Committees to ensure that all standards are reviewed periodically at intervals not exceeding 5 years. The result of this activity can either be issue an amendment, revised standards issued as a new edition with a new date, or in to withdrawing of the standard. It remains very important for the designers to be sure, that they are using the latest versions of the Eurocodes [14].

It has been agreed by the members of CEN/TC 250 that there should be a period of stability following the adoption of the standards and the revised second generation of EN Eurocodes will not be published until 2015 in accordance with the European Commission Programming Mandate (M/466EN 2010)]. However, considering realistic timescales it is unlikely that a second generation of EN Eurocodes will be published before 2018 [15].

Based on the framework mandate M/466 EN, it is planned that at least one additional structural Eurocode and substantial additions to the existing codes, shall be developed as part of the action at European level. In the CEN Programming Mandate (M/515EN 2012) the detailed standardization work programme for the developing of the Eurocodes was set out. It recognizes the potential needs to develop new Eurocodes or Eurocode parts and also to develop further the existing Eurocodes.

The Mandate provides the extension of existing rules for the assessment of the existing buildings and structures and their strengthening; extension of the existing horizontal rules for robustness; and development of additional structural Eurocodes covering structural glass members, FRP and tensile surface structures. In addition to the existing Eurocodes, it includes the assessment of all existing Eurocodes concerning the possibility to significantly reduce the number of Nationally Determined Parameters (NDPs); refinement to improve the usability of Eurocodes by practical users. The Mandate incorporates recent results of international studies and the practical experience from scientific and technical associations; it provides for the adoption of relevant ISO standards to supplement the Eurocodes family (concerning atmospheric icing of structures and actions from waves and currents on coastal structures); the development of auxiliary guidance documents to facilitate feedback from stakeholders and the local implementation practice. It aims to provide a clear and complete list of background documents used during the standardization process, as well as simplification of rules for limited and well-identified fields of application.

6. Conclusions

Considering the European harmonization trends, as well as the fact that for Latvia it would not be easy or even ossible to maintain and update the LBN standards or to develop its own independent system of national building regulations, pLatvia has no alternative but to participate in the harmonized normative base of the European Economic Area.

In order to harmonize the construction industry, a more considerable financial and non-financial support is needed from state institutions, not only for the translation of the standards, but also for their quicker and more intensive introduction in practice. It is necessary to support the development of clarifying methodology materials in Latvian. In Latvia there are no large structural design companies, manufacturers of structural elements, or computer software developers interested in it and ready to participate and sponsor the introduction of Eurocodes, like it was in the United Kingdom and Germany. Unfortunately, the last time book publishing in the field of structural engineering was supported by state, was during the Soviet Union period in the end of the 1980s.

The fact that the dual approach transition period has been so prolonged, negatively affects both the education process, and the students who are already graduating with knowledge of Eurocodes but are not yet sought after in the design industry, as the majority of the previous generation of specialists are using only the old LBN/SNiP system and are not familiar with the new system.

A step in the implementation of Eurocodes was the Twinning project LV/2005-IB/EC/01 financed by the European Transition facilities funds. However, this project did not fully reach the goal due to fact that the German colleagues were not properly introduced to the design traditions existing at that time in Latvia.

Considering the fact that the design approach used in the Eurocode standards is different from the structural design methodology specified in the current construction standards, as well as the interest of structural design professionals regarding the application of the Eurocode design standards, it is necessary to develop and implement of client strategies and the definition of their requirements and a wide programme of activities to support the profession.

The introduction of Eurocodes serves as an impetus for expanding and developing the Latvian technical terminology. As a result of the activities of the Technical Committee, a glossary of Eurocodes' technical terminology will be developed. It will be used in their professional activities by both structural design specialists, and university professors preparing the next generation of specialists conforming to the contemporary requirements of the Latvian and European design markets.

Acknowledgements

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