IMPLEMENTATION OF EUROCODE STANDARDS IN LATVIA

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ABSTRACT

History and the current situation of implementation of Eurocode in Latvia is analyzed. Short information regarding collaboration with Deutsches Institut für Bautechnik (German Institute of Construction Technology) and about the results of the Twinning project LV/2005-IB/EC/01 financed by the European Transition facilities funds is given. On examples of application of Eurocode 0 and Eurocode 6 some essential differences are analyzed which have to be considered by the responsible Technical committees for standardization when discussing the values of Nationally determined parameters (NDP).

Key words: Implementation of Eurocode, partial factors, verification of Eurocode and Latvian Building codes and SNiP

INTRODUCTION

Despite of the difficult economic situation in Latvia, the implementation of Eurocode standards according to the Recommendations 2003/887/EEC of the EU Commission form December the 12th of 2003 is proceeding. The Latvian Eurocode National Implementation plan for 2008-2011 was accepted by the Cabinet of Ministers in July, 2008 (Decree No.455 from July the 29th, 2008). Having regard of European Harmonization trends, as well as the fact, that for Latvia it would be not easy or even impossible to develop its own and independent National Building Regulation system, Latvia should be interested in the development of harmonized Normative Base of European Economic area, such as it is developed in the standardization area.

PROGRESS IN IMPLEMENTATION

Transition period

It was planned, that till the end of 2009 there will be withdrawn or amended Latvian Building codes (LBN), which regulate the procedure of structural design and are based on the principles taken from the former Soviet SNiP system, wherewith construction design in Latvia will be allowed only according to the requirements of Eurocode standards. It is a serious task not only for the state governmental institutions – the Building department of the Ministry of Economics and the Latvian standardization system in the person of the Technical Committee for Standardization LVS/STK 30 “Construction” as well as for the structural designers and both universities – the Riga Technical University and the Latvia University of Agriculture that are training civil engineers and structural designers.
The transition to application of the Eurocode standard system in Latvia is effected in two phases. The first step was already taken by adopting LNB 214-03 “Geotechnics. Pile foundations and sub base” and by adoption of amendments to LNB 207-01 “Geotechnics. Construction foundations and sub base” and LNB 003-01 “Building climatology”.
According to the first phase of the National Implementation plan, amendments were made to the Latvian Building codes, by which the transition period of structural design of relevant structures started. During this transition period dual approach is on place - it is allowed for structural designers to apply either approved in the end of the nineties of the last century LBNs or apply the Eurocode standards. Referring to steel structures the new Building codes should replace the former Soviet SNiP codes. At the end of the transition period the Eurocode system as the only method should be used for the structural design of buildings and bridges in Latvia. The amendments for the following Latvian Building codes LBN 203-97; LBN 205-97; LBN 206-99, LBN 207-01 and LBN 214-03 were announced at the end of 2007 and beginning of 2008.

Current situation

Currently all Eurocode basic standards have been adapted as Latvian National standards. 26 of them are translated in Latvian. To 16 Eurocodes Latvian National annexes are elaborated. For other Eurocode standards Latvian Building codes prescribe to use the recommended values of Nationally determined parameters.
Due to emergency with the state budget and lack of financing on September the 30th, 2009 the Decree of the Cabinet of Ministers No.455 was amended and some activities of implementation were reduced. Nevertheless, in October of 2010 the subcommittee of the “Eurocodes” was established at the LVS/TC 30 “Construction”. The main tasks for this

subcommittee are drafting of National annexes to the Eurocode standards as well as revision of Latvian texts of some translated earlier Eurocode standards.

Problems

Serious problems shall be encountered preparing the National Annexes to EN 1993 "Design of steel structures" and EN 1997 group of standards "Geotechnical design".
Eurocode 7 standards are general and in numerous cases allow application of national design and testing methods. The national annexes to the above standards shall be drafted in parallel with the amendments to the Latvian Building codes LNB 207-01 and LNB 214-03 that shall remain in force with slight amendments after implementation of the Eurocode standards. It means that the Geotechnical Eurocode (EN 1997) shall be used together with the National Annex and the above mentioned LBN.
The problem with Eurocode 3 and Eurocode 9 is in consideration that there are not acting Latvian Building codes on design of steel and alumina structures. There are still former Soviet SNiPs in use parallel to the relevant Eurocode standards. Due to lack of financing the planned LBN 204 "Design of steel structures" is not elaborated.

COMPARISON OF LBN AND EUROCODE APPROACH

Transition from the national building codes LBN 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 being used in the former Soviet Union the reference period is 5 or 10 years but in the Eurocode – 50 years.
Therefore, the nationally determined parameters (NDP) shall be adjusted. 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 was already in use since many years by using SNiPs during the Soviet occupation time and inherited after in LBNs.
The disadvantage, however, is that the existing LBN system is not exactly fitting to the Eurocode partial factor system what makes the adoption of the LBN system to the new one somewhat difficult. In the following there are given some essential differences which have to be considered in the process of adaption of Eurocodes when discussing the values of NDPs at the responsible technical committees.

Examples

According to formula (6.10) of EN 1990:21002 the design value of the effect of actions is to be determined by the expression for the load combination for permanent and accompanying variable situations:

$$E_d = E\left\{\sum_{j\geq 1}\gamma_{G,j}\cdot G_{k,j} + \gamma_{Q,1}\cdot Q_{k,1} + \sum_{i>1}\gamma_{Q,j}\cdot \psi_{0,i} Q_{k,i}\right\}$$

If the recommended values for ψ_0 are taken from table A1.1, e.g.: ψ_0 =0,7 (for non storage areas) and the recommended values for γ_G and γ_Q from table A1.2(A), NOTE 2: γ_G = 1,35; γ_Q = 1,5
The equation reads:

$$E_d = E\left\{\sum_{j\geq 1} 1{,}35\cdot G_{k,j} + 1{,}5\cdot Q_{k,1} + \sum_{i>1} 1{,}5\cdot 0{,}7\cdot Q_{k,i}\right\} \quad (1)$$

Verification

Since the design value of the effect of actions must be less than or equal to the design value of the resistance which is the characteristic value of the resistance divided by the partial factor for material properties γ_M

$$E_d \leq R_d \ ; \qquad R_d = \frac{R_k}{\gamma_M}$$

the verification equation can be expressed as

$$E_d \leq \frac{R_k}{\gamma_M}$$

where:
E_d - design value of the effect of actions such as internal force, moment or a vector representing several internal forces or moments;
R_d - design value of the corresponding resistance.
R_k - characteristic value of the corresponding resistance.

<u>According to EN 1996-1-1:</u>
The factor γ_M is taken from the table in paragraph 2.4.3 of EN 1996-1-1 (the lowest value is: γ_M = 1.5 for material A and class 1, the highest one is: γ_M = 3.0 for material C and class 5)
The verification equation then reads:

$$E_d \leq \frac{R_k}{1{,}5 -> 3} \qquad (2)$$

According to LBN or SNiP 2.01.07-85, paragraphs 1.10 to 1.13 there are verification equations for four cases.
Basic combination - load combination for permanent and accompanying variable situations

$$E_d = E\left\{\psi_G \cdot \sum_{j\geq 1}\gamma_{G,j} \cdot G_{k,j} + \sum_{i>1}\gamma_{Q,j} \cdot \psi_{Q,i} \cdot Q_{k,i}\right\} \quad (3)$$

ψ_G = 1,0 for permanent loads;

$\psi_{Q,i}$ = 0,9 (0,95) for continuous (transient) imposed loads.

If only one life load is acting:

$$E_d = E\left\{\psi_G \sum_{j\geq 1}\gamma_{G,j} \cdot G_{k,j} + \psi_{Q,1} \cdot \gamma_{Q,1} \cdot Q_{k,1}\right\} \quad (4)$$

ψ_G = 1,0 for permanent loads;
$\psi_{Q,1}$ = 1,0 for imposed loads.

In case of additional load combination when three and more imposed loads will be considered:

$$E_d = E\left\{\psi_G \sum_{j\geq 1}\gamma_{G,j} \cdot G_{k,j} + \sum_{i>1}\gamma_{Q,j} \cdot \psi_{Q,i} \cdot Q_{k,i}\right\} \quad (5)$$

ψ_G = 1,0 for permanent loads;
$\psi_{Q,1}$ = 1,0 for the first imposed load;
$\psi_{Q,2}$ = 0,8 for the second load;
$\psi_{Q,j}$ = 0,6 for all other loads.

In case of specific load combination:

$$E_d = E\left\{\psi_G \sum_{j\geq 1}\gamma_{G,j} \cdot G_{k,j} + \sum_{i>1}\gamma_{Q,j} \cdot \psi_{Q,i} \cdot Q_{k,i}\right\} \quad (6)$$

ψ_G =1,0 for permanent loads;

$\psi_{Q,1}$ = 0,95 (0,8) for continuous (transient) imposed loads.

The verification equation is based on SNiP II-22-81 table 14, γ_M = 2,0:

$$E_d \leq \frac{R_u}{2{,}0} \quad (7)$$

R_u in SNiP corresponds to R_k in Eurocode 0.

Recommendations for partial factors in National annex to LVS EN 1990

For comparison of safety levels both sides of the verification equation, loads and actions as well as the resistance, have to be considered.
The Eurocode en 1990 for actions distinguishes only between permanent actions: dead loads and variable actions: life loads. The Latvian Building code (SNiP) sets also different partial factors for different materials and the way of production: on site or prefabricated.

In the following tables the recommended partial combination and safety factors of EN 1990 for actions are compared with the Latvian code.

Table 1

National choice Design values of actions

Latvian code/former Soviet code SNiP 2.01.07-85 (Table 1)		EN 1990 Recommended values	
Permanent actions			
Dead load	γ_f	Dead load	1,35
Metal (steel)	1,05		
Concrete, masonry, wood etc.	1,1		
Layers, pre fabricated	1,2		
Layers, made on site	1,3		
Accompanying Variable actions			
Life load	γ_f	Life load incl. snow, wind etc.	1,5
< 2,0 kN/m²	1,3		
≥ 2,0 kN/m²	1,2		
Snow loads	1,4		
Return period 10 years			
Wind load	1,4		
Return period 5 years	(1,6)		

$$E_d = E\left\{\sum_{j\geq 1}\gamma_{G,j} \cdot G_{k,j} + \gamma_{Q,1} \cdot Q_{k,1} + \sum_{i>1}\gamma_{Q,j} \cdot \psi_{0,i} Q_{k,i}\right\}$$

Table 2

Basic load combination factors for permanent and accompanying variable situation according to EN 1990 (Table A1.1)

Action	ψ0
Imposed loads in buildings	0,7
Snow loads on buildings (see EN 1991-1-3)	0,7(-0,5)
Wind loads on buildings (see EN 1991-1-4)	0,6
Temperature (non-fire) in buildings (see EN 1991-1-5)	0,6

The table is not complete (excerpt).

Comparison of both methods

The given situation is to design the same building with the same loads (LBN 003 /LBN 004) by using loads according to SNiP and EC 0.
For a qualitative comparison the expressions for only one life load (< 2,0 kN/m² for LBN) are

chosen:

$$E_d = E\left\{\sum_{j\geq 1}\gamma_{G,j}\cdot G_{k,j} + \gamma_{Q,1}\cdot Q_{k,1}\right\} \quad (4)$$

with $\gamma_G = 1{,}1$ and $\gamma_Q = 1{,}3$ according to LBN (SNiP).

$$E_d = E\left\{\sum_{j\geq 1}1{,}1\cdot G_{k,j} + 1{,}3\cdot Q_{k,1}\right\} \quad (4a)$$

and

$$E_d = E\left\{\sum_{j\geq 1}1{,}35\cdot G_{k,j} + 1{,}5\cdot Q_{k,1}\right\} (1a)$$

according to EN 1990.
By comparison of expression (7) with (2) the resistance is for LBN (SNiP):

$$R_d = \frac{R_u}{2{,}0} \leq E\left\{\sum_{j\geq 1}1{,}1\cdot G_{k,j} + 1{,}3\cdot Q_{k,1}\right\}$$

for EN 1990.

$$R_d = \frac{R_k}{(1{,}5 \div 3{,}0)} \leq E\left\{\sum_{j\geq 1}1{,}35\cdot G_{k,j} + 1{,}5\cdot Q_{k,1}\right\}$$

or for LBN (SNiP)

$$R_u \geq E\left\{\sum_{j\geq 1}2{,}2\cdot G_{k,j} + 2{,}6\cdot Q_{k,1}\right\}$$

for EC 1990.

$$R_k \geq E\left\{\sum_{j\geq 1}2{,}03\cdot G_{k,j} + 2{,}25\cdot Q_{k,1}\right\} \quad \text{with}$$

γ_M = 1.5.

That means that even for this simple case and for the same loads it is not possible to state in general that the one or the other verification is safer or more or less economic because the result depends on the ratio of life load and dead load. For this purpose the design has to be performed in any case.
Taking into account that in the case of SNiP the basic information on the statistical evaluation is not available and that the return period for snow loads is 10 years instead of 50 years in the Eurocode design and for wind loads 5 years instead of also 50 years it is proposed to take the recommended values for ψ and γ from EC 0 and EC 6 for the National Annex of Latvia.

INTERNATIONAL COOPERATION

A serious step in 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 methodical booklets and drafting of the first national annexes to the Eurocode standards.
The next step was training of the Latvian structural designers by the Latvian experts trained by the German experts. Next practical trainings built on lectures prepared by the Latvian experts for Latvian structural designers took place. Detailed information about results of this Project is available on www.em.gov.lv → Darbības jomas → Būvniecība → Noderīgi → Eirokodeksa standartu ieviešana.

CONCLUSIONS

Despite of the difficult economic situation in Latvia, the implementation of Eurocode standards according to the Latvian Eurocode National Implementation plan and the Recommendations 2003/887/EEC of the EU Commission form December the 12th of 2003 with some delay is proceeding.
A serious step in implementation of Eurocodes was the Twinning project LV/2005-IB/EC/01 financed by the European Transition facilities funds.
The Latvian Building codes of structural design (and SNiP) are not exactly fitting to the Eurocode partial factor system what makes the adoption of the Eurocode somewhat difficult in sense of designation of NDP and elaboration of National annexes.

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