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STATE OF HARMONIZED USE OF THE EUROCODES NATIONALLY DETERMINED PARAMETERS RELEVANT TO THE DEFINITION OF CLIMATIC AND SEISMIC ACTIONS

Maria Luísa SOUSA[1], Silvia DIMOVA[2], Artur PINTO[3], Adamantia ATHANASOPOULOU[4]

ABSTRACT

Nationally Determined Parameters (NDPs) are those parameters that were left open in the Eurocodes to take into account different requirements for safety levels, different design cultures and procedures for structural analysis, as well as differences in geographical, geological or climatic conditions.
The objective of the present paper is to analyse the state of harmonized use of the Eurocodes NDPs relevant to the definition of climatic and seismic actions, based on the information uploaded in the European Commission NDPs Database by the Member States (MS) of the European Union (EU) and of the European Free Trade Association (EFTA).
The analysis focuses on the harmonized use of NDPs and in particular, on the acceptance of NDPs that are related to the definition of climatic and seismic actions. It is also addressed the acceptance rate of NDPs defined as numeric pre-determined parameters, in order to analyse in more detail harmonized patterns and divergences in the NDPs related to the definition of climatic and seismic actions.
Finally, seismic zone maps were chosen as an example to illustrate the state of cross-border harmonization of the maps adopted by MS in their National Annexes. The collected maps present dissimilar layouts and reveal discontinuities of the reference ground acceleration levels at countries borderlines.

Keywords: Eurocodes; NDPs; harmonization; seismic actions, climatic actions

1. INTRODUCTION

The European Committee of Standardization (CEN) produced the EN Eurocodes that are a set 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.
The on-going implementation of the Eurocodes in the Member States (MS) of the European Union (EU) and of the European Free Trade Association (EFTA) does enhance the functioning of the Internal Market for construction products and services by removing the obstacles arising from different national practices. Further, the Eurocodes are meant to lead to more uniform levels of safety in construction in Europe. The Eurocodes are the product of a long procedure of bringing together and harmonizing the different design traditions in EU and EFTA MS, but at the same time, they safeguard the right of the regulatory authorities in each MS to determine values related to regulatory safety matters at a national level. In fact, they include the Nationally Determined Parameters (NDPs), which are those parameters that were left open in the Eurocodes to take into account different requirements for safety levels,

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[1] Project officer, European Commission, Joint Research Centre (JRC), Directorate for Space, Security and Migration, Ispra, Italy, luisa.sousa@ec.europa.eu
[2] Project leader, European Commission, Joint Research Centre (JRC), Directorate for Space, Security and Migration, Ispra, Italy. silvia.dimova@ec.europa.eu
[3] Head of Unit, European Commission, Joint Research Centre (JRC), Directorate for Space, Security and Migration, Ispra, Italy, artur.pinto@ec.europa.eu
[4] Project officer, European Commission, Joint Research Centre (JRC), Directorate for Space, Security and Migration, Ispra, Italy, adamantia.athanasopoulou@ec.europa.eu

different design cultures and procedures for structural analysis, as well as differences in geographical, geological or climatic conditions.
The set of the NDPs comprises: (i) values and/or classes where alternatives are given in the Eurocodes, (ii) values to be used where a symbol only is given in the Eurocodes, (iii) country specific data, e.g., seismic zone maps, snow maps, wind maps, isotherm maps, etc., and (iv) alternative procedures to be chosen.
Since March 2005, the Joint Research Centre (JRC) provides scientific and technical support to the Directorate General Internal Market, Industry, Entrepreneurship, and Small and Medium Enterprises (DG GROW) of the European Commission in the frame of Administrative Arrangements on the Eurocodes, supporting policies and standards for sustainable construction.
In this framework, and in view of achieving the concerned Parts of the European Commission Recommendation of 11 of December, 2003 (2003/887/EC) on the implementation and use of Eurocodes for construction works and structural construction products, the JRC has developed and is maintaining a Database populated with the NDPs adopted in the EU and EFTA countries that are applying the EN Eurocodes. The NDPs Database has restricted access, acts as a platform of notification by the MS to the European Commission on the adopted values of the NDPs and constitutes the basis for the analysis of the NDPs, contributing to the definition of strategies supporting further harmonization of the Eurocodes.
The next goal of the European Union is to keep the Eurocodes as the most advanced state of the art codes for structural design in the world. A project aiming to develop the second generation of the Eurocodes is currently underway and is expected to be completed by 2020 (M/515 EN (2012)). Among the basic principles of the project, further harmonization of the Eurocodes is aimed at, through reducing the number of the NDPs. The assessment of the potential to significantly reduce their number, shall be done in collaboration with the JRC using the NDPs uploaded in the NDPs Database.
The objective of the present paper is to analyse the state of harmonized use of the Eurocodes NDPs relevant to the definition of climatic and seismic actions, based on the NDPs uploaded in the JRC Database. The analysis will focus on the availability of data in the NDPs Database per MS and Eurocode and the harmonized use of NDPs, especially those related to the definition of climatic and seismic actions. It is also discussed the acceptance rate of NDPs per Eurocode Part, and the acceptance of the NDPs defined as numeric pre-determined parameters, with the view to analysing harmonized patterns and divergences in the NDPs adopted by MS.
Finally, seismic zone maps were chosen as example to illustrate the harmonization state of the maps adopted by MS in their National Annexes (NAs). The state of harmonization acceleration values at countries borders and the maps layout are also addressed.

2. STATISTICAL ANALYSIS OF THE NDPs RELEVANT TO THE DEFINITION OF CLIMATIC AND SEISMIC ACTIONS

2.1 Data related to the definition of climatic and seismic actions

The JRC has considered 142 NDPs relevant to the definition of climatic and seismic actions for structural design with the Eurocodes (Sousa *et al.*, 2016). The NDPs are distributed in Parts 1-3, 1-4 and 1-5 of Eurocode 1 and in Parts 1 and 3 of Eurocode 8, as shown in Table 1. Figures shown in the second column of Table 1 also count the number of NCCI (Non-Contradictory Complementary Information) in the concerned Eurocodes Parts, alongside the number of NDPs. Appendix A lists the NDPs used in the analysis performed in this paper for the Eurocode 8.
Data used in the statistical analysis of the acceptance of NDPs related to the definition of climatic and seismic actions were extracted from the JRC Database by November 2017. By that date, the EU Member States and the EFTA Member States, Norway and Switzerland, have uploaded in the Database a total of 25,808 NDPs, representing 66.5% of the NDPs that are expected to be uploaded. Among them, 2,672 NDPs are related to the definition of climatic and seismic actions, representing 68.7% of the NDPs that are expected to be uploaded for this specific set. According to the published National Annexes, the number of countries expected to upload data for the three concerned parts of Eurocode 1 is 28, whereas for Parts 1 and 3 of Eurocode 8 that number is 21 and 18, respectively. By November 2017, the number of countries that has uploaded data on Parts 1-3, 1-4 and 1-5 of Eurocode 1 was 21, 20 and 21,

respectively, whereas data on Parts 1 and 3 of Eurocode 8 were uploaded by 16 and 12 countries, respectively. The average percentage of uploading, by Eurocode Part, concerning the 142 NDPs relevant to the definition of climatic and seismic actions is also presented in Table 1.

Table 1. Number and percentage of uploading of the NDPs related to the definition of climatic and seismic actions - by EN Part.

Eurocode and Part	NDPs Number	Percentage of uploading
EN 1991: Actions on structures Part 1-3: General Actions - Snow loads	33	68%
EN 1991: Actions on structures Part 1-4: General Actions - Wind actions	68	67%
EN 1991: Actions on structures Part 1-5: General Actions - Thermal actions	29	69%
EN 1998: Design of structures for earthquake resistance Part 1: General rules, seismic actions and rules for buildings	11	73%
EN 1998: Design of structures for earthquake resistance Part 3: Assessment and retrofitting of buildings	1	67%
Total	**142**	**69%**

2.2 Statistical analysis of the acceptance of NDPs

In the following, a statistical analysis of the NDPs related to the definition of climatic and seismic actions is performed per Eurocode Part and NDP type. Two different sets of NDPs are considered in the analysis:

i. The *NDPs with Recommended Values* (*RV*) *given*. There are 79 NDPs within this group that have an average acceptance rate of 67.6%, almost 7 percentage points lower than the average percentage of acceptance for the complete set of NDPs with RV, that is 74.3%. This result is not surprising, because the NDPs related to the definition of climatic and seismic actions accounts for specific geographical, geological or climatic conditions of the Member States. This group includes several different types of NDPs, for instance, pre-determined numeric parameters, alternative choice from given options, recommended procedures or approaches, diagrams. The group is thereafter identified as set "i" and called "with RV" in Table 2 and in Figure 1.
ii. The *NDPs type 1.1*, i.e., pre-determined parameters with RV, which is a subset of the previous group. A specific analysis of the statistics on the convergence of the national choices for the NDPs of this type is made. Among the 142 NDPs relevant for the definition of climatic and seismic actions there are 31 NDPs within this group, which have an average acceptance rate of 72.0%. This group is thereafter identified as set "ii" and called "type 1.1" in Table 2 and in Figure 1.

Table 2 summarizes the status of uploading and the Recommended Values acceptance for the two groups of NDPs aforementioned and Figure 1 presents, for the five Parts concerned, the average percentage of acceptance of the NDPs per Eurocode Part.

Table 2. Number of NDPs, per Eurocode and Part, related to the definition of climatic and seismic actions.

Set	NDPs	No. CEN NDPs	No. uploaded NDPs	No. accepted NDPs	Percentage of acceptance
i	with RV	79	1,498	1012	67.6%
ii	type 1.1	31	601	433	72.0%

Table 2 and Figure 1 show that, in average, the NDPs of type 1.1 (shown in red in the Figure) have an average acceptance rate higher than the average acceptance rate of the others NDPs with RV (shown in blue in the Figure) relevant for the definition of climatic and seismic actions. However, this acceptance rate is still lower than the average acceptance rate of 74.3% for the complete set of NDPs with RV in all Eurocodes Parts. In fact, Figure 1 reveals that a good consensus (≥ 60%) was achieved for NDPs of type 1.1 for all Eurocodes Parts analysed. In addition, a good consensus among the countries was achieved for the NDPs with RV belonging to Parts 1-4 and 1-5 of Eurocode 1. The NDPs showing the lowest percentage of acceptance (50%) belong to Part 3 of Eurocode 8 and to the set of NDPs with RV. Note that in this Part 3 only one NDP with RV was considered, so its own percentage of acceptance is shown in Figure 1.

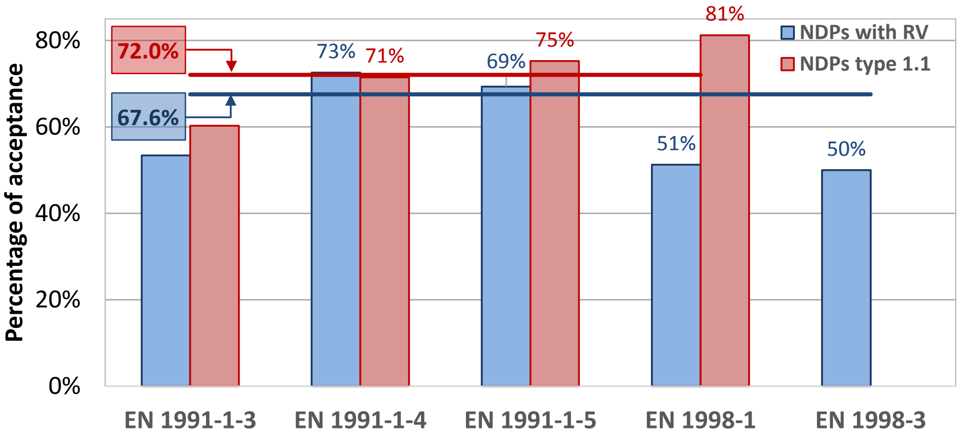

Figure 1. Percentage of acceptance of NDPs relevant to the definition of climatic and seismic actions, per Eurocode Part

Table 2 presents the number of NDPs with RVs distributed by 7 different classes of percentage of acceptance. The Figure shows that, among the 79 NDPs in these conditions, there are 41 NDPs (53%) that have been accepted by more than 70% of the uploading countries and 7 NDPs (9%) that reached a consensus by more than 90% of the countries. Among them there is 1 NDP (1.3%) that have been accepted by all (100%) uploading countries, as it will be seen in Table 3 in more detail.

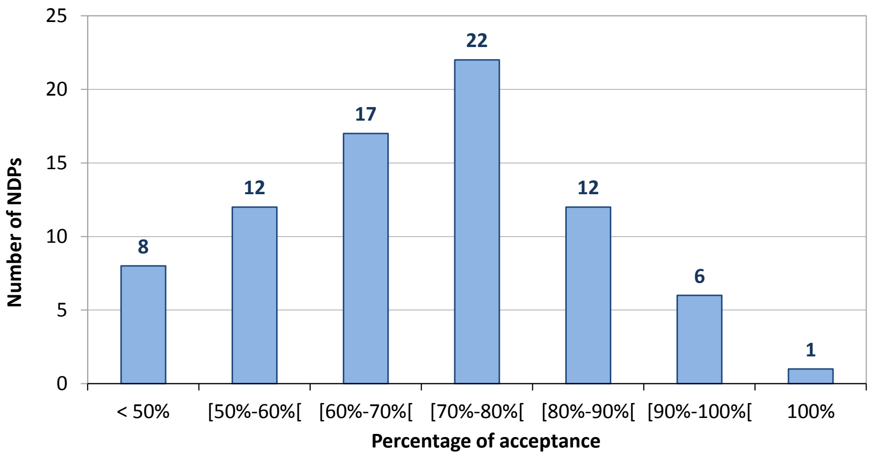

Figure 2. Number of NDPs relevant to the definition of climatic and seismic actions per percentage acceptance

Table 3 identifies the NDPs that have the lowest and the highest percentage of acceptance, for the NDPs with RVs relevant to the definition of climatic and seismic actions. The type of each NDP is also present in Table 3. The table shows that there is a NDP, belonging to Part 1-4 of Eurocode 1, "7.6 (1) NOTE 1 *The values of the reduction factor for square sections with rounded corners*, ψ_r" that have been accepted by 100% of the uploading countries. This NDP is represented in Eurocode 1 by a diagram. The lowest acceptance rate is 20% and belongs to the NDP "3.2.1 (4) *Governing parameter (identification and value) for threshold of low seismicity*" in Part 1 of Eurocode 8. This NDP is represented in Eurocode 8 by a recommended procedure or approach, in flexible tabular form, allowing the introduction of a new procedure or approach.

Table 3. NDPs with related to the definition of climatic and seismic actions with the highest and lowest rate of acceptance.

EN	Part	Accept. (%)	NDP	NDP type	Min % accept.	Max % accept.
1991	1-3	53	Annex A (1) Table A.1 Definition of exceptional conditions and definition of design situations which apply for the particular local effects described in Section 6 for cases B1 and B3	Recommended procedure or approach, in flexible tabular form, allowing the introduction of a new one	**26.3**	
			5.3.5 (1) NOTE 1 The upper value of μ_3	Predetermined Parameters with RV		**80.0**
			5.3.6 (1) NOTE 2 A restriction for the drift length, l_s	Predetermined Parameters with RV		**80.0**
	1-4	73	4.3.2 (1) The procedure for determining the roughness factor, $c_r(z)$	Recommended procedure or approach allowing the introduction of new one	**52.6**	
			7.6 (1) NOTE 1 The values of the reduction factor for square sections with rounded corners, ψ_r	Diagram		**100**
	1-5	69	Annex A.1 (1) NOTE 2 The adjustment procedure on the values of shade air temperature	Recommended procedure or approach allowing the introduction of new one	**50.0**	
			7.5(4) The value of the difference of temperature	Predetermined Parameters with RV		**84.2**
1998	1	51	3.2.1 (4) Governing parameter (identification and value) for threshold of low seismicity	Recommended procedure or approach, in flexible tabular form, allowing the introduction of a new one	**20.0**	
			3.2.2.5(4) Lower bound factor β on design spectral values	Predetermined Parameters with RV		**93.8**
	3	50	2.1 (3) Return period of seismic actions under which the Limit States should not be exceeded	Recommended procedure or approach, in flexible tabular form, allowing the introduction of a new one	50.0	50.0

Minimum ( ) and maximum ( ) percentage of acceptance. Percentage of acceptance for a single NDP ( ).

Table 4 lists and numbers sequentially the parameters of type 1.1 related to the definition of climatic actions that belong to Parts 1-3, 1-4 and 1-5 of Eurocode 1. The NDPs that have more than one parameter are shown in a common shaded box in that table.

Table 4. Parameters of type 1.1 related to the definition of climatic actions in Eurocode 1.

#	EN 1991 Part	Section	Clause
1	1-3	4.3	1
2	1-3	5.3.5	1 NOTE 1
3	1-3	5.3.6	1 NOTE 1
4	1-3	5.3.6	1 NOTE 1
5	1-3	5.3.6	1 NOTE 2
6	1-3	5.3.6	1 NOTE 2

#	EN 1991 Part	Section	Clause
7	1-4	4.2	2 NOTE 2
8	1-4	4.2	2 NOTE 3
9	1-4	4.2	2 NOTE 5
10	1-4	4.2	2 NOTE 5
11	1-4	4.3.1	1 NOTE 1
12	1-4	4.4	1 NOTE 2
13	1-4	4.5	1 NOTE 2
14	1-4	7.4.3	2
15	1-4	7.7	1 NOTE 1
16	1-4	8.1	4
17	1-4	8.1	5
18	1-4	8.3.4	1
19	1-4	8.3.4	1
20	1-4	Annex E.1.3.3	1
21	1-4	E.1.5.2.6	1 NOTE 1
22	1-4	Annex E.1.5.3	2 NOTE 1

#	EN 1991 Part	Section	Clause
23	1-5	6.1.4.3	1
24	1-5	6.1.4.4	1
25	**1-5**	**6.1.5**	**1**
26	1-5	6.1.5	1
27	1-5	6.1.6	1
28	1-5	6.1.6	1
29	1-5	6.1.6	1
30	1-5	6.2.2	1
31	1-5	6.2.2	2
32	1-5	7.5	3
33	1-5	7.5	4
34	1-5	Annex A.1	3
35	1-5	Annex A.2	2
36	1-5	Annex A.2	2
37	1-5	Annex A.2	2
38	1-5	Annex A.2	2

NDPs with more than 1 parameter are shown in common shaded areas

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In Eurocode 1, the parameter of type 1.1 with the highest ratio of NDP value to Recommended Value (*NDP/RV*) is the one numbered 25 and it is highlighted in bold in Table 5. It is one of the two parameters of the NPD 6.1.5 (1) of Part 1-5. This parameter is described as a *reduction factor of uniform temperature component for combination with temperature difference component* (ω_N). It was found that among 20 countries uploading values, only one country uploaded a very different value from the RV. The country uploaded 0.8 instead of the recommended 0.35, causing the largest divergence identified.

Figure 3 presents the mean value of the parameters of type 1.1 in Eurocode 1, normalized with respect to their Recommended Values, i.e., $\overline{NDP/RV} = \overline{NDP}/RV$. The standard deviation of the variable *NDP/RV*, is summed, with positive or negative signs, to its mean value, and it is illustrated by red points in Figure 3, i.e., $\overline{NDP}/RV \pm \sigma_{NDP/RV}$. For each NDP, the range between the maximum and minimum value of NDP/RV is shown by a red line in the Figure.

Figure 4 presents the statistical analysis of type 1.1 parameters in Part 1 of Eurocode 8, as uploaded in the Database. The parameters are described in Table 6. The Figure shows that the type 1.1 parameter with the highest ratio of NDP value to Recommended Value (*NDP*/*RV*) corresponds to a NPD of the Section 2.1, Clause 1, NOTE 1 of Part 1 of Eurocode 8. This NDP is described as the *Reference return period* T_{NCR} *of seismic action for no-collapse requirement* or, equivalently, the *Reference probability of exceedance in 50 years*, P_{NCR}, and has two parameters, the value of P_{NCR} (%), numbered 1 and the value of T_{NCR} (years), numbered 2 in Figure 4 and in Table 6. The parameter with the highest ratio of NDP value to Recommended Value (*NDP*/*RV*) was found to be the Reference return period T_{NCR} of seismic action for no-collapse requirement, being highlighted in bold in Table 6.

Table 5. NDP of type 1.1 with the highest maximum value of *NDP*/*RV* in Eurocode 1, among the NDPs related to the definition of climatic actions in Eurocode 1.

#	Part	Section & clause	NDP Description	Parameter Description
25	1-5	6.1.5 (1)	Numerical values of ω_N and ω_M	**ω_N-reduction factor of uniform temperature component for combination with temperature difference component**
26	1-5	6.1.5 (1)	Numerical values of ω_N and ω_M	ω_M- reduction factor of temperature difference component for combination with uniform temperature component

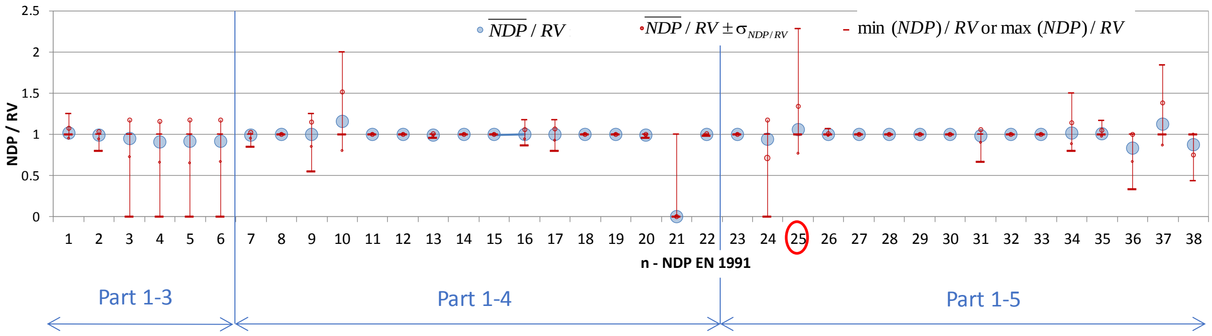

Figure 3. Mean value, standard deviation, maximum and minimum value of NDP/RV; NDPs of type 1.1 related to the definition of climatic actions in Eurocode 1

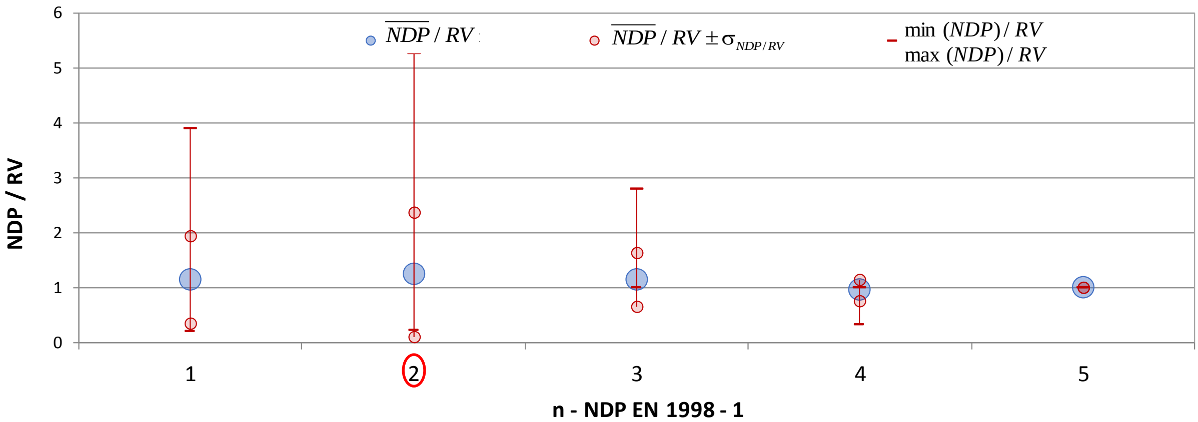

Figure 4. Mean value, standard deviation, maximum and minimum value of NDP/RV; NDPs of type 1.1 related to the definition of seismic actions in Part 1 of Eurocode 8

The causes of the highest divergence found in the NDP parameter numbered 2 in Part 1 of Eurocode 8 were investigated, showing that two countries, among 16 uploading countries, have uploaded values equal to100 and 2500 years instead of the recommended 475 years return period for the no-collapse requirement.

Table 6. NDPs of type1.1 related to the definition of seismic actions in Eurocode 8, Part 1.

#	Section	Clause	NDP Description	NDP Parameter
1	2.1	(1) NOTE 1	Reference return period T_{NCR} of seismic action for no-collapse requirement or, equivalently, reference probability of exceedance in 50 years, P_{NCR}	The value of P_{NCR} (%)
2	2.1	(1) NOTE 1	Reference return period T_{NCR} of seismic action for no-collapse requirement or, equivalently, reference probability of exceedance in 50 years, P_{NCR}	**The value of T_{NCR} (years)**
3	2.1	(1) NOTE 3	Reference return period T_{DLR} of seismic action for the damage limitation requirement or, equivalently, reference probability of exceedance in 10 years, P_{DLR}	The value of P_{DLR} (%)
4	2.1	(1) NOTE 3	Reference return period T_{DLR} of seismic action for the damage limitation requirement or, equivalently, reference probability of exceedance in 10 years, P_{DLR}	The value of T_{DLR} (years)
5	3.2.2.5	4	Lower bound factor, β on design spectral values	The value of lower bound factor, β

NDPs with more than 1 parameter are shown in common shaded cells

2.3 Seismic zone maps adopted by EU Member States

Seismic zone maps uploaded, or referred to, by the MS in the NDP Database were chosen as an example to illustrate the layout and the state of cross-border harmonization of the maps adopted by Member States in their National Annexes. Figure 5 and Figure 6 present the NDP 3.2.1 (2) *Seismic zone maps and reference ground accelerations therein* (in Part 1 of Eurocode 8) for two groups of neighbouring countries and Figure 7 shows the seismic zone maps for the remaining countries.

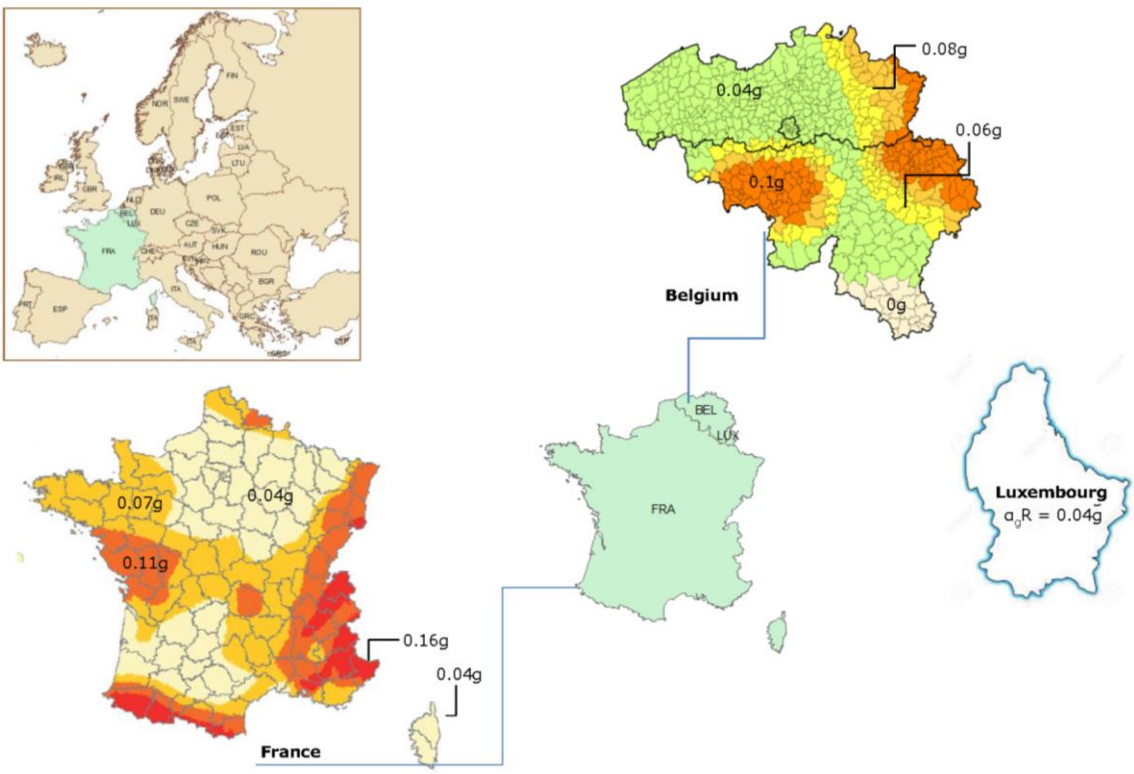

Figure 5. Seismic zone maps for neighbouring countries: Belgium (© NBN), France (Article D563, 2015 © République Française) and Luxembourg

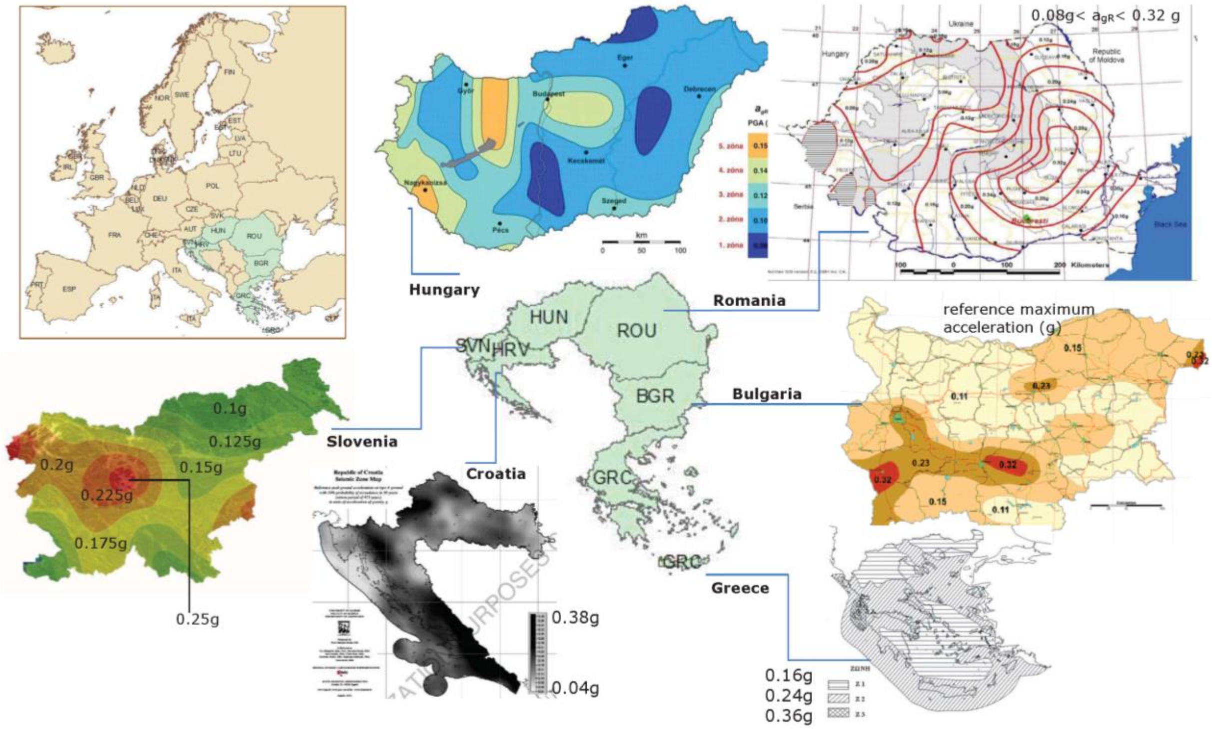

Figure 6. Seismic zone maps for neighbouring countries: Bulgaria (© BDS; БДС, 2015), Croatia (© HZN), Greece (© NQIS/ELOT), Hungary (© MSZT), Romania (© ASRO, 2015) and Slovenia (© SIST; ARSO, 2015)

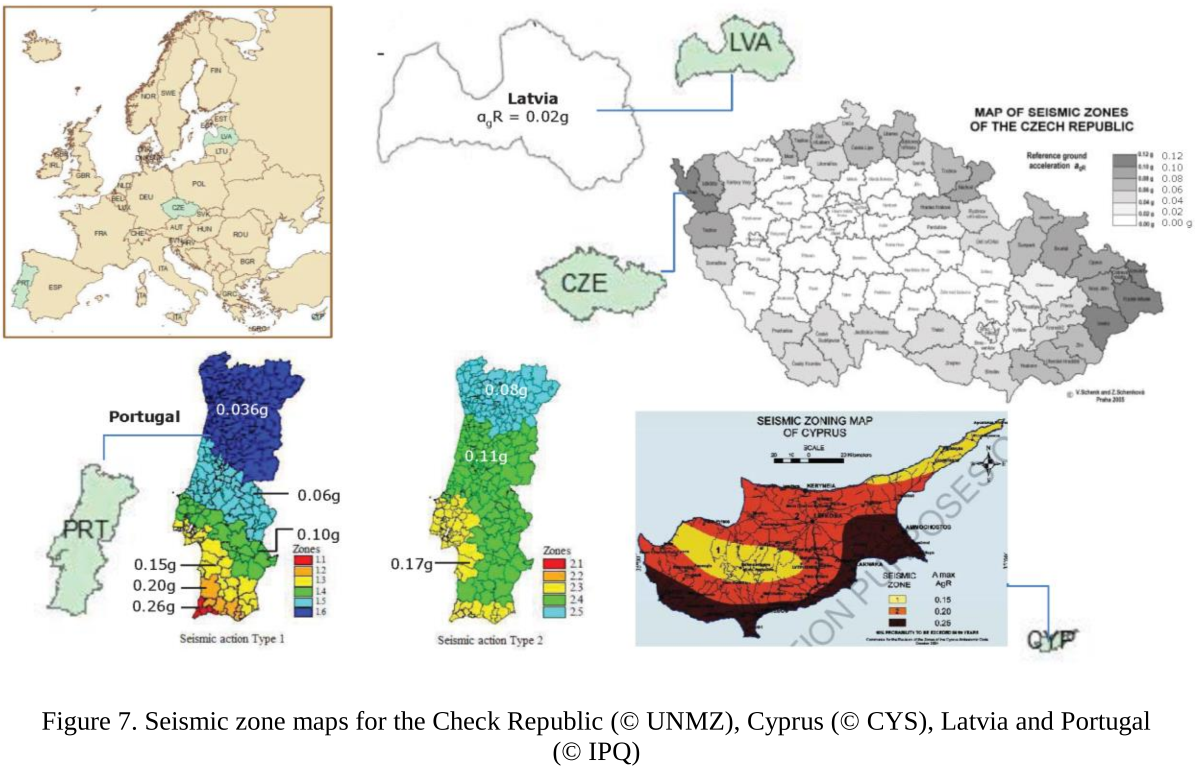

Figure 7. Seismic zone maps for the Check Republic (© UNMZ), Cyprus (© CYS), Latvia and Portugal (© IPQ)

Most of the countries have drawn the seismic zones as acceleration contour maps, except Belgium, the Czech Republic and Portugal that have adopted constant levels of reference ground acceleration for the administrative units of the country.

Regarding the details of the cross-border harmonization, Figure 5 shows that Belgium has adopted five different seismic zones in the neighbourhood of France, whereas France shows a less disaggregated zonation, comprising three seismic zones. Yet, the seismic acceleration reference level in the border area of both countries is consistently low, ranging from 0.04g to 0.11g in France and from 0g to 0.1g in Belgium. Similar observations apply to the border area of Belgium and Luxembourg, where the former shows a more disaggregated zonation, but a level of acceleration consistent with the latter. Finally, France and Luxembourg have exactly the same level of reference ground acceleration (0.04g) in the border area.

Figure 6 shows that the comparison of seismic zone maps in the border area of Croatia and Slovenia is not an easy task, because the representation adopted in the Croatian seismic zone map does not facilitate the differentiation of reference acceleration levels. In general, the acceleration level in the Croatian side seems higher than in the Slovenia side of the border. The same difficulties arise when comparing the border area of Croatia and Hungary, although herein the hazard levels seem more consistent. The reference ground acceleration on the border area between Hungary and Romania varies between 0.10g and 0.12g in the Hungarian side, and between 0.08g and 0.20g in the Romanian territory, meaning that the acceleration levels on the northwest border of Romania are doubled compared to the ones adopted in the neighbouring Hungary. It is noted that Romania has chosen a different return period from the other countries, so the seismic hazard underlying its seismic map is not directly comparable with the other countries seismic hazard. In the Romanian side of the border area with Bulgaria, four different seismic zones are shown, with reference acceleration levels ranging between 0.12g and 0.20g. On the other hand, on the Bulgarian side of the border, two different seismic zones are drawn with acceleration levels of 0.11g and 0.15g.

Finally, Figure 6 shows that in the border area between Greece and Bulgaria, the former having adopted two different seismic zones with reference acceleration levels of 0.16 g and 0.24g and the latter having implemented lower acceleration values varying between 0.11g and 0.23g. It is clear that there is a partial match on the reference acceleration levels in these neighbouring regions, since zone Z2 in Greece (0.24g) is nearby a Bulgarian zone with a reference acceleration level of 0.15g, and zone Z1 in Greece (0.16g) is close to Bulgarian seismic zones with 0.15g and 0.11g.

As discussed previously, there are still a lot of differences in the seismic zone maps adopted in Part 1 of Eurocode 8 by the EU Member States. Note that the national seismic provisions were produced in different times and this may have contributed to the different layouts of the seismic maps (Pinto *et al.*, 2011). Additionally, as a result of different national practices, the seismic zone maps show discontinuities in the seismic levels at countries borderlines, making it difficult to harmonise the use of Eurocodes in neighbouring areas of different Member States.

Seismic zonation and the definition of the seismic action are key elements for all Parts of EN 1998 and advancements towards a more harmonized seismic zonation, still enabling the Member States to establish their own safety levels, are a matter of priority in the next generation of Eurocodes.

3. CONCLUSIONS

By November 2017, the 28 EU Member States and the EFTA Member States, Norway and Switzerland, have uploaded in the Database 67% of the expected NDPs. In the analysis presented in this paper, the JRC has considered 142 NDPs relevant to the definition of climatic and seismic actions for structural design with the Eurocodes, distributed by Part 1-3, 1-4 and 1-5 of Eurocode 1 and by Parts 1 and 3 of Eurocode 8. For this specific set, Member States have uploaded 69% of the expected NDPs.

The analysis of the data points out to the following main results:

- Based on the available data, the average acceptance rate of the Recommended Values NDPs related to the definition of climatic and seismic actions is 68%, while for all Eurocodes Parts it is 74%. A good consensus is achieved among the countries on the NDPs with RV that belong to Part 1-4 of Eurocode 1 on wind actions, with an average acceptance rate of 73%;
- The NDP with the lowest rate of acceptance in Eurocode 1 is in Part 1-3 on snow loading, reaching an acceptance of 26%. The NDP is *Annex A (1) Table A.1 - Definition of exceptional conditions and definition of design situations which apply for the particular local effects described in Section 6 for cases B1 and B3*. The NDP with the highest rate of acceptance in Eurocode 1 is in Part 1-4, achieving consensus (100%) among all uploading countries. The NDP is *7.6 (1) NOTE 1 - The values of the reduction factor for square sections with rounded corners, ψ_r*. In Eurocode 8, the rate

of acceptance varies between a minimum of 20% for the *NDP 3.2.1 (4) - Governing parameter (identification and value) for threshold of low seismicity* and a maximum of 94% for the *NDP 3.2.2.5(4) - Lower bound factor β on design spectral values*.
- Within the set of NDPs with RV given, related to the definition of climatic and seismic actions, a broader consensus (71%) emerged on the acceptance of NDPs of type 1.1, *i.e.*, NDPs consisting of pre-determined parameters with RV given;
- The largest divergences in the accepted values of the NDPs of type 1.1 are caused by the non-acceptance of the RVs by one EU MS in case of Eurocode 1 and by two EU MS in case of Eurocode 8.

Finally, the seismic zone maps were chosen as an example to illustrate the harmonization state of the maps adopted by Member States in their National Annexes. The harmonization state of acceleration values and maps layout at countries' border was addressed. The collected maps present dissimilar layouts and reveal discontinuities in the levels of the reference ground acceleration at countries borderlines. Thus, advancement towards an enhanced harmonized seismic zonation is a matter of priority in the next generation of Eurocodes.
The above results clearly show, that the divergence of the accepted NDPs is caused not only by the differences in the local seismic and climatic conditions, but also by different approaches and technical considerations, which fact steel leaves room for further harmonization of the National implementation of the Eurocodes.

4. ACKNOWLEDGMENTS

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APPENDIX A - LIST OF NDPs RELATED TO MAPS FOR SEISMIC ACTIONS

Table 7. NDPs related to the definition of seismic actions in Part 1 and 3 of Eurocode 8.

EN 1998 -Part 1: General rules, seismic actions and rules for buildings. Chapters 2 & 3: Ground conditions and seismic action
2.1 (1 NOTE 1) Reference return period T_{NCR} of seismic action for no-collapse requirement (or, equivalently, reference probability of exceedance in 50 years, P_{NCR})
2.1 (1 NOTE 3) Reference return period T_{DLR} of seismic action for the damage limitation requirement. (or, equivalently, reference probability of exceedance in 10 years, P_{DLR})
3.1.1 (4) Conditions under which ground investigations additional to those necessary for design for non-seismic actions may be omitted and default ground classification may be used
3.1.2 (1) Ground classification scheme accounting for deep geology, including values of parameters S, T_B, T_C and T_D defining horizontal and vertical elastic response spectra in accordance with 3.2.2.2 and 3.2.2.3.
3.2.1 (2) Seismic zone maps and reference ground accelerations therein
3.2.1 (4) Governing parameter (identification and value) for threshold of low seismicity
3.2.1 (5) Governing parameter (identification and value) for threshold of very low seismicity
3.2.2.1 (4 NOTE 1) The selection of the shapes of the elastic response spectra
3.2.2.2 (2) Parameters S, T_B, T_C and T_D defining shape of horizontal elastic response spectra
3.2.2.3 (1) Parameters a_{vg} T_B, T_C and T_D defining shape of vertical elastic response spectra
3.2.2.5 (4) Lower bound factor β on design spectral values
EN 1998. Part 3: Assessment and retrofitting of buildings
2.1 (3) Return period of seismic actions under which the Limit States should not be exceeded