Towards the second generation of Eurocodes

Paolo FORMICHI

Chairman of CEN/TC250/SC10 Basis of Structural Design
University of Pisa

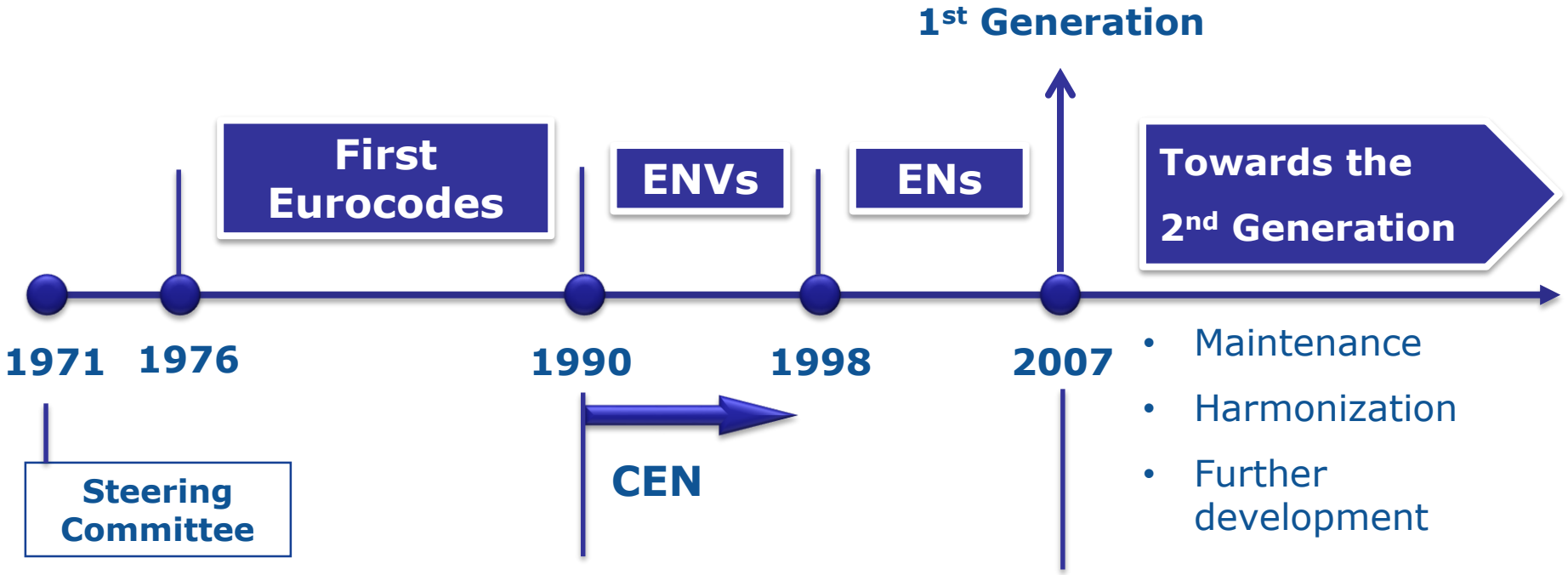
The EUROCODEs

The European Commission's objective is for:

"The Eurocodes to establish a set of common technical rules for the design of buildings and civil engineering works which will ultimately replace the differing rules in the various Member States"

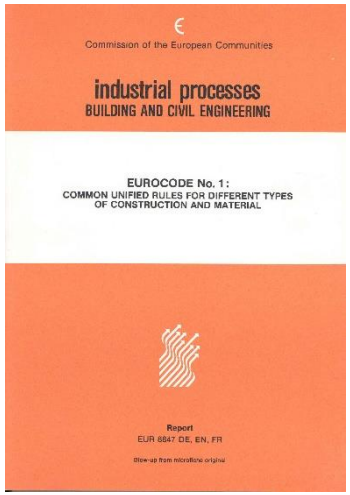
"Elimination of technical obstacles to trade and the harmonisation of technical specifications"

EUROCODE Story

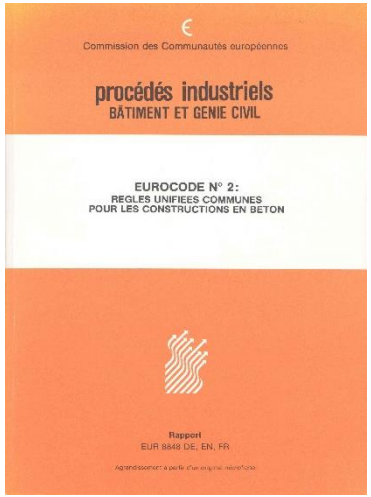


The first EC drafts

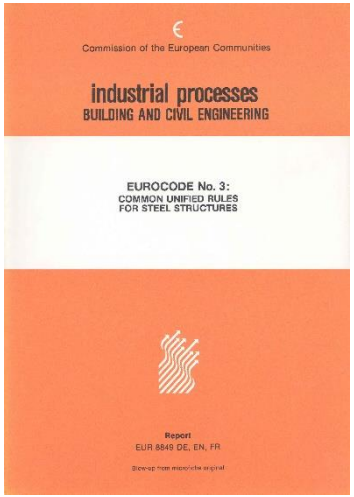
1980's



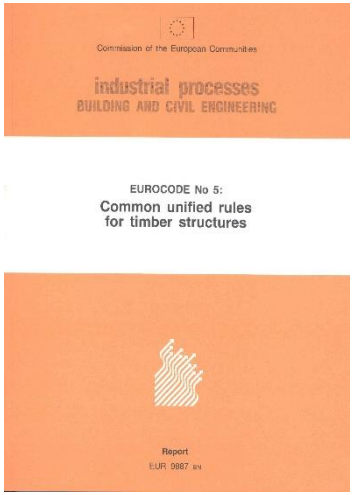
EC 1
Common Unified Rules
For different types of construction and material



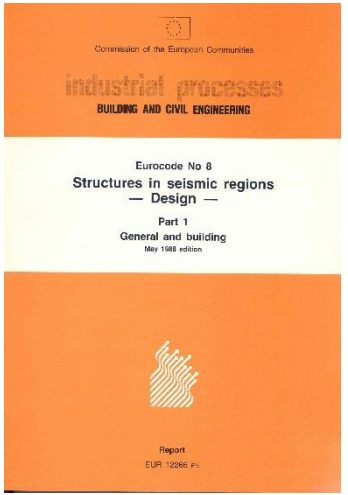
EC 2
Common Unified Rules
for r.c. constructions



EC 3
Common Unified Rules
for steel constructions



EC 5
Common Unified Rules
for timber structures



EC 8
Structures in seismic regions
Design

The ENVs

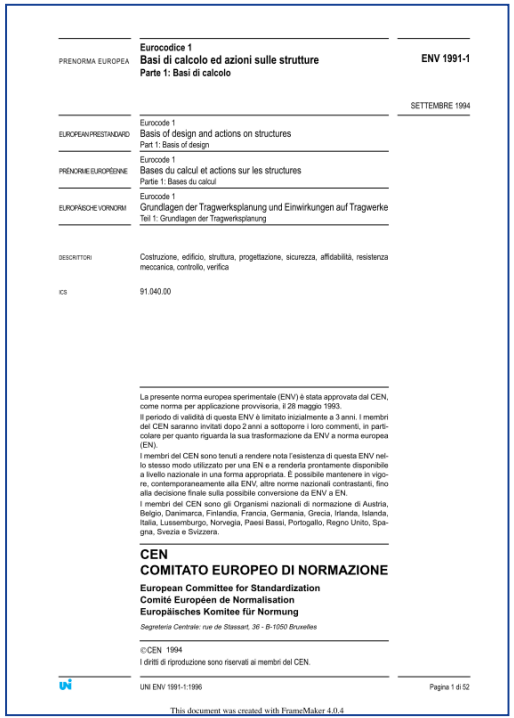
1990's

EC 1
Eurocode 1

EUROPEAN PRESTANDARD

Basis of design and actions on structures

Part 1: Basis of design



PRENORMA EUROPEA

Eurocodice 1
Basi di calcolo ed azioni sulle strutture
Parte 1: Basi di calcolo

ENV 1991-1

SETTEMBRE 1994

EUROPEAN PRESTANDARD
Eurocode 1
Basis of design and actions on structures
Part 1: Basis of design

PRÉNORME EUROPÉENNE
Eurocode 1
Bases du calcul et actions sur les structures
Partie 1: Bases du calcul

EUROPÄISCHE VORNORM
Eurocode 1
Grundlagen der Tragwerksplanung und Einwirkungen auf Tragwerke
Teil 1: Grundlagen der Tragwerksplanung

DESCRITTORI
Costruzione, edificio, struttura, progettazione, sicurezza, affidabilità, resistenza meccanica, controllo, verifica

ICS
91.040.00

La presente norma europea sperimentale (ENV) è stata approvata dal CEN, come norma per applicazione provvisoria, il 28 maggio 1993.
Il periodo di validità di questa ENV è limitato inizialmente a 3 anni. I membri del CEN saranno invitati dopo 2 anni a sottoporre i loro commenti, in particolare per quanto riguarda la sua trasformazione da ENV a norma europea (EN).
I membri del CEN sono tenuti a rendere nota l'esistenza di questa ENV nello stesso modo utilizzato per una EN e a renderla prontamente disponibile a livello nazionale in una forma appropriata. È possibile mantenere in vigore, contemporaneamente alla ENV, altre norme nazionali contrastanti, fino alla decisione finale sulla possibile conversione da ENV a EN.
I membri del CEN sono gli Organismi nazionali di normazione di Austria, Belgio, Danimarca, Finlandia, Francia, Germania, Grecia, Irlanda, Islanda, Italia, Lussemburgo, Norvegia, Paesi Bassi, Portogallo, Regno Unito, Spagna, Svezia e Svizzera.

CEN
COMITATO EUROPEO DI NORMAZIONE
European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung
Segreteria Centrale: rue de Stassart, 36 - B-1050 Bruxelles

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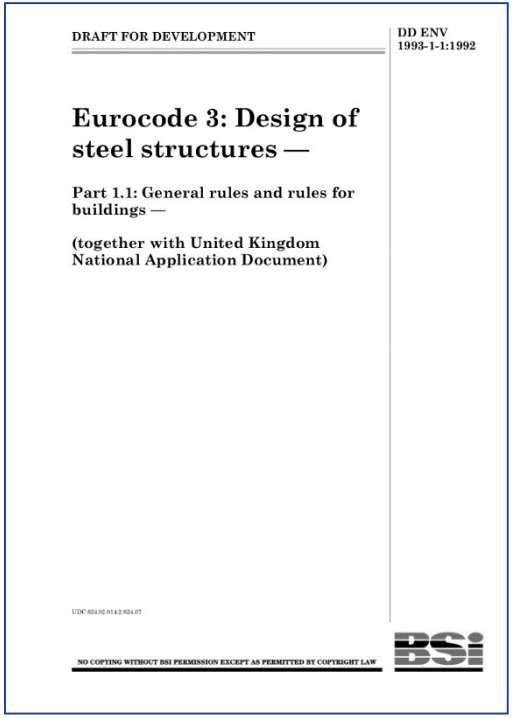
EC 3
Eurocode 3

EUROPEAN PRESTANDARD

Design of steel structures

Part 1.1: general rules and rules for buildings



DRAFT FOR DEVELOPMENT

DD ENV
1993-1-1:1992

Eurocode 3: Design of steel structures —

Part 1.1: General rules and rules for buildings —

(together with United Kingdom National Application Document)

UDC 624.92.014.2:624.07

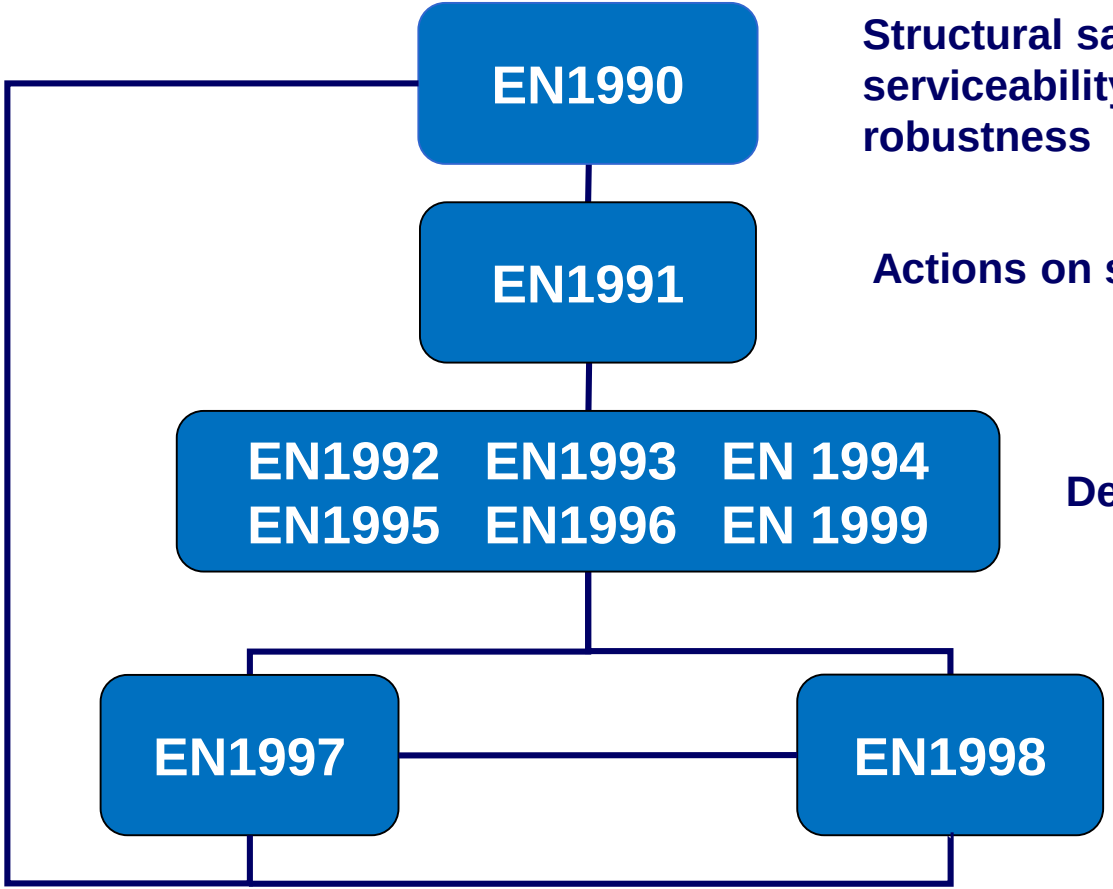
BSi

The "1st generation"

2007

EN Number	The Structural Eurocodes (58 parts)	N° of Parts
EN 1990	**Eurocode: Basis of structural design**	**1**
EN 1991	Eurocode 1: Actions on structures	10
EN 1992	Eurocode 2: Design of concrete structures	4
EN 1993	Eurocode 3: Design of steel structures	20
EN 1994	Eurocode 4: Design of composite steel and concrete structures	3
EN 1995	Eurocode 5: Design of timber structures	3
EN 1996	Eurocode 6: Design of masonry structures	5
EN 1997	Eurocode 7: Geotechnical design	3
EN 1998	Eurocode 8: Design of structures for earthquake resistance	6
EN 1999	Eurocode 9: Design of aluminium structures	3

The ECs



Structural safety, serviceability, durability and robustness

Actions on structures

Design and detailing

Geotechnical design

Seismic design

The 1st generation of Eurocodes

- **A tremendous achievement**: "*the most comprehensive and technically advanced suite of standards for structural and geotechnical design in the world*"
- **33 CEN countries** (EU + EFTA)
- **1'800 €** billion – annual value of the European construction market (~6-7% if the European GDP)
- **75 € billion** annual value of the EU market for design services
- **500'000 engineers**

The "1st generation" of Eurocodes

- a **complete set** of design standards that cover all principal construction materials, all major fields of structural engineering and a wide range of types of structures
- **flexible**, offering the possibility for each country to choose the levels of safety and specific data or methods through the Nationally Determined Parameters (~1'100)
- a major tool for the successful **removal of trade barriers** for construction products and services
- contribute to the **safety and protection of the people** in the built environment, on the basis of the best possible scientific advice
- a **common basis** for technical and scientific collaboration

The ECs are intended:

- As a means for enabling building and civil engineering works **to comply with the Basic Requirements for Construction Works 1, 2 and 4** of the Construction Products Regulation (EU/305/2011), **mechanical resistance and stability, safety in case of fire and safety in use**
- As **a basis for specifying public construction and related engineering service contracts**.
- As a **framework** for drawing up harmonised technical specifications for construction products.

CEN/TC250 Business plan 2017

The "1st generation"

Publication of National Annexes

Implementation and use

1st Generation

ENs

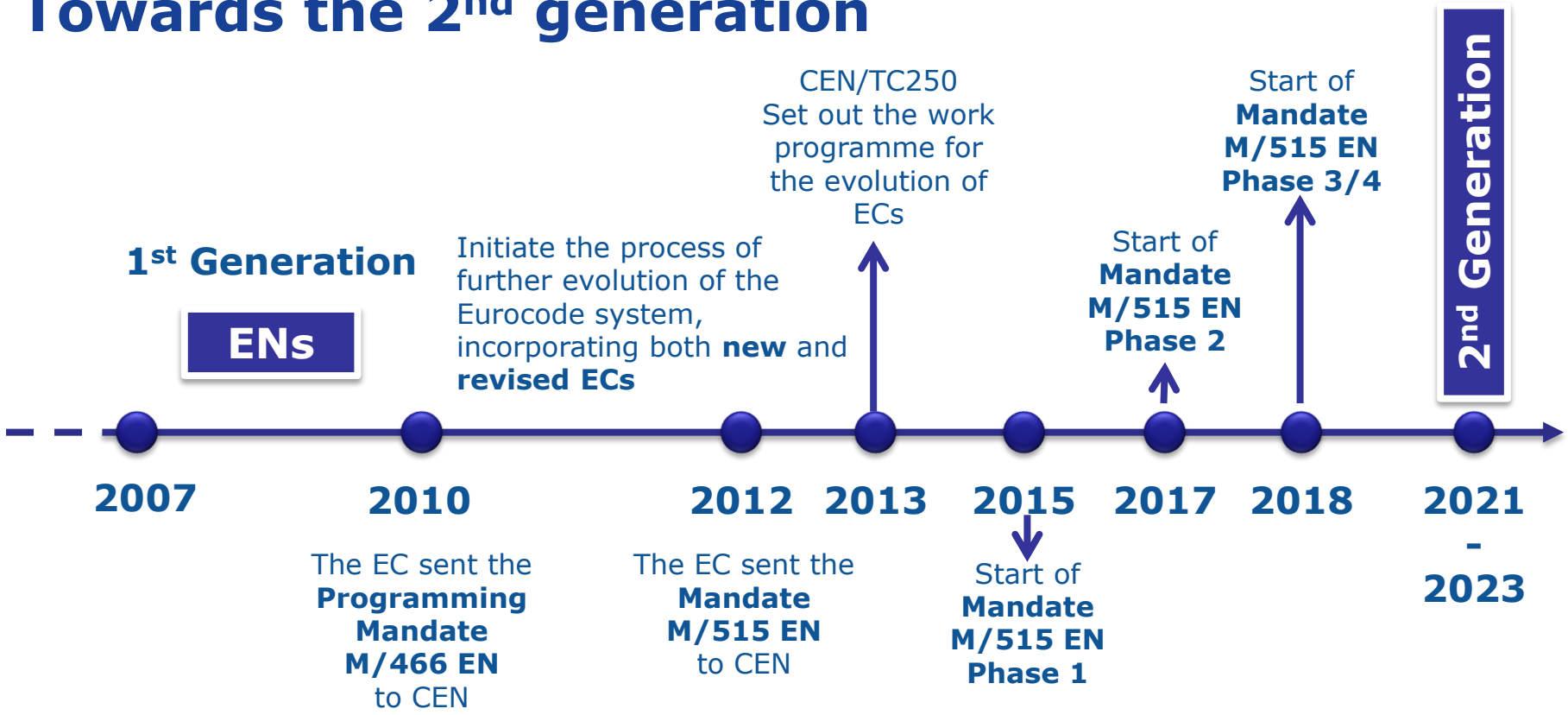
2007 **2010**

Withdrawal of conflicting national standards

Evolution of the ECs:

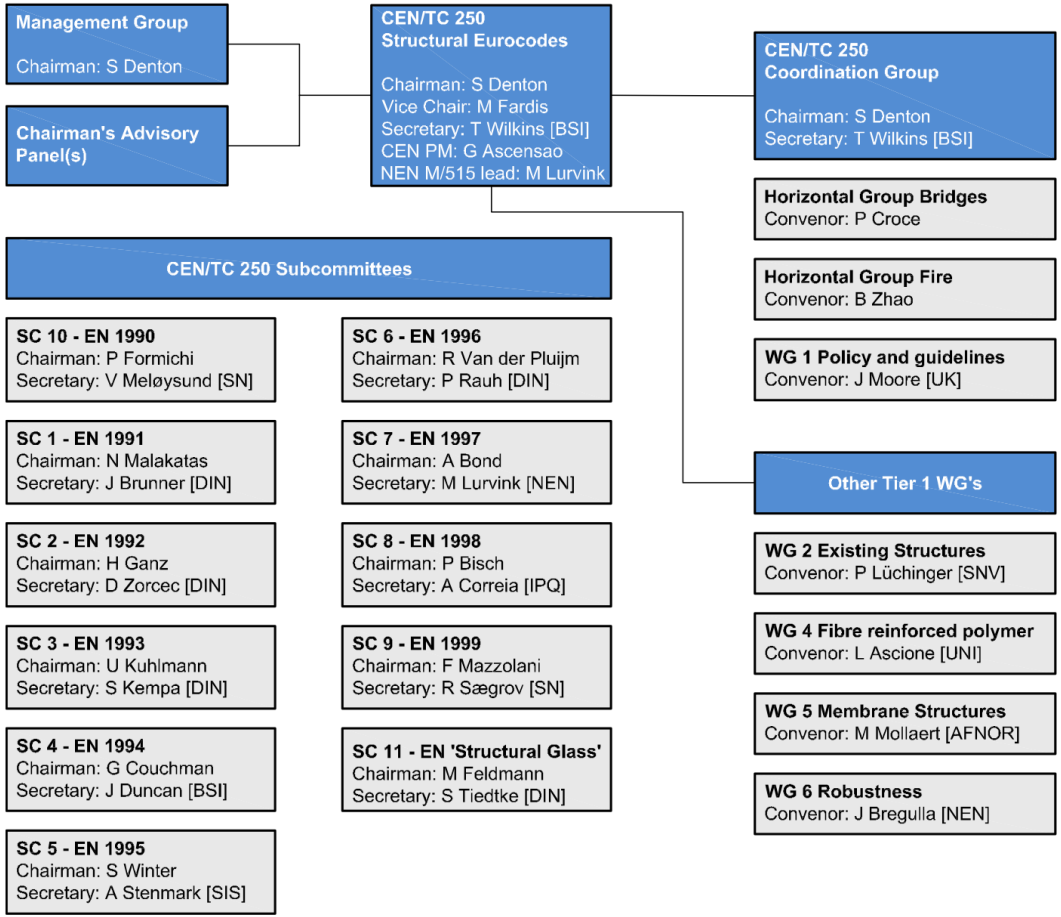
- It is widely recognised that **long-term confidence** in the codes requires the Eurocodes to evolve in an appropriate manner
- The M/515 work programme focuses on ensuring the standards remain fully up to date through embracing **new methods**, **new materials**, and **new regulatory and market requirements**
- **further harmonisation** and a major effort to **improve the ease of use** of the suite of standards for practical users

Towards the 2nd generation



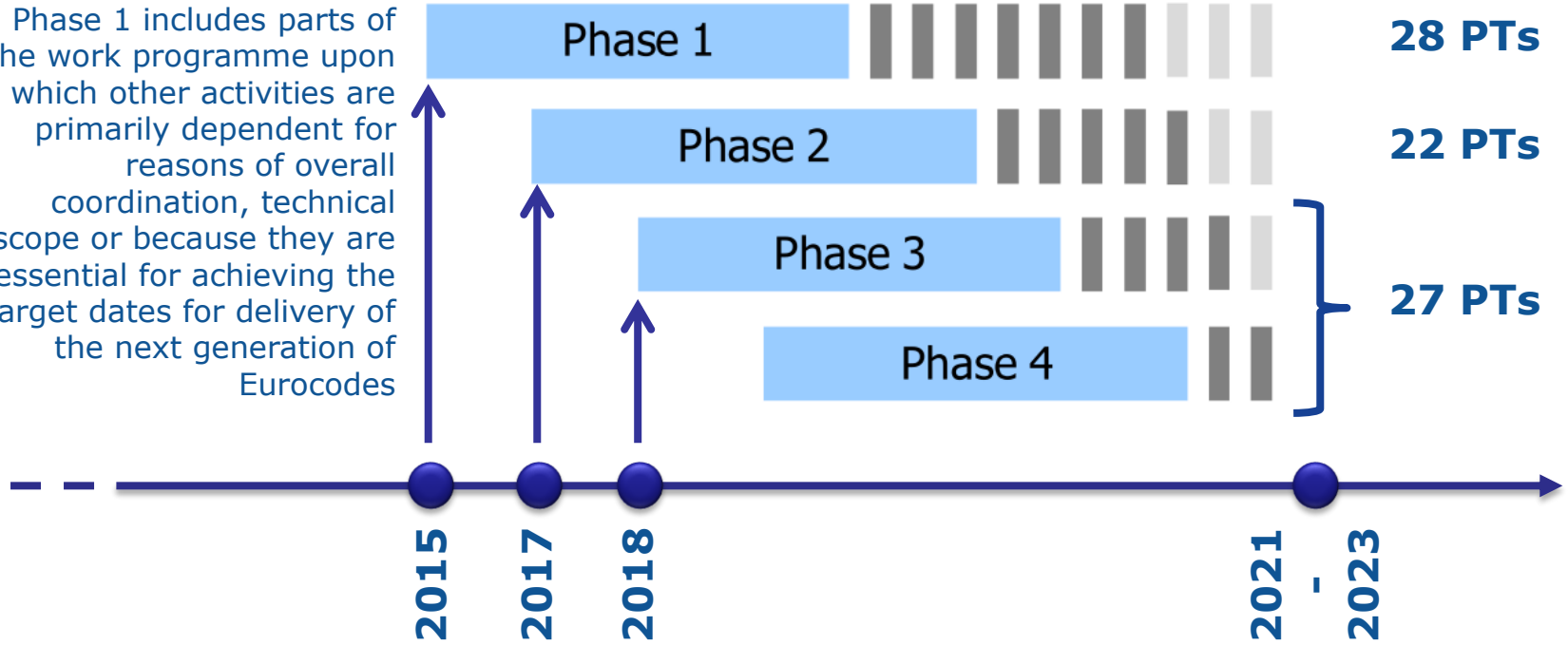
CEN/TC250

- 11 SCs
- 5 WGs
- 2 HGs
- 77 discrete tasks
- over 1'000 experts involved

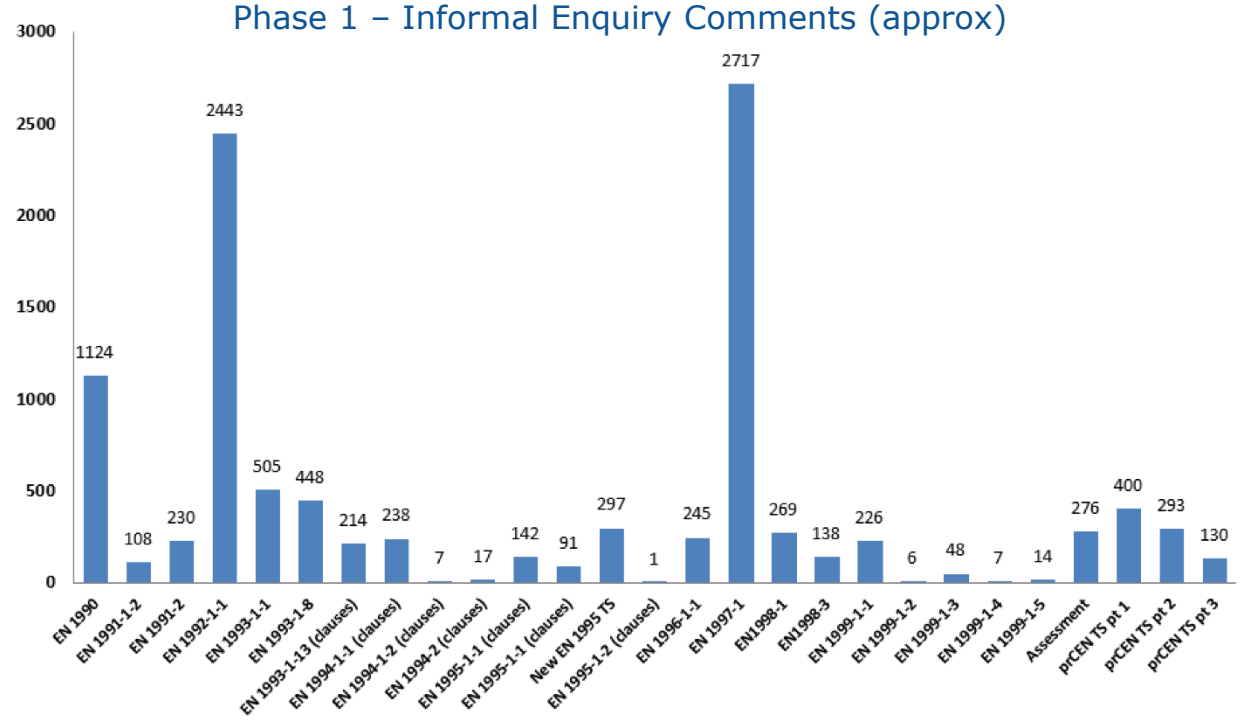


Phasing of work

Phase 1 includes parts of the work programme upon which other activities are primarily dependent for reasons of overall coordination, technical scope or because they are essential for achieving the target dates for delivery of the next generation of Eurocodes



Evolution of ECs, a transparent process



Evolution of ECs, key objectives

Evolution of ECs, key objectives:

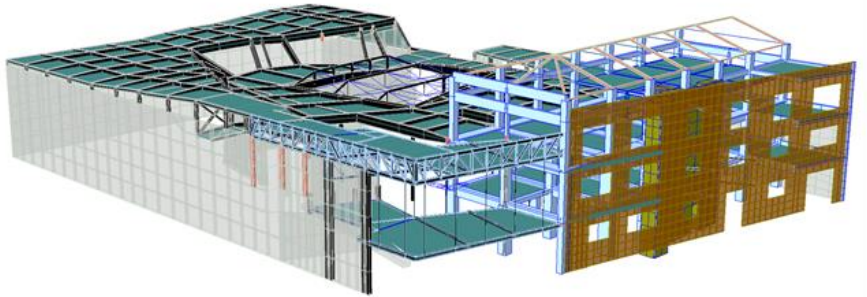
- Aspects of the assessment, re-use and retrofitting of **existing structures**

M515 WG2.T1

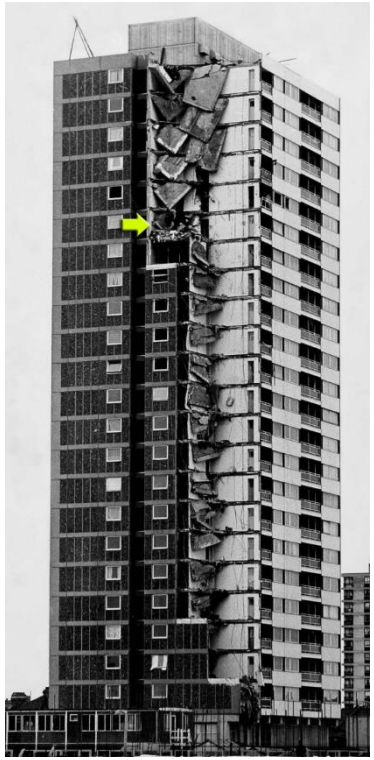
Assessment of Existing Structures

The Final Draft of TS
October 2017

Contents



Evolution of ECs, key objectives:



Ronan Point - UK (16.05.1968)

- Strengthening of the requirements for **robustness**

Pipers Row Car Park, Wolverhampton, UK, progressive collapse, punching shear (1997)

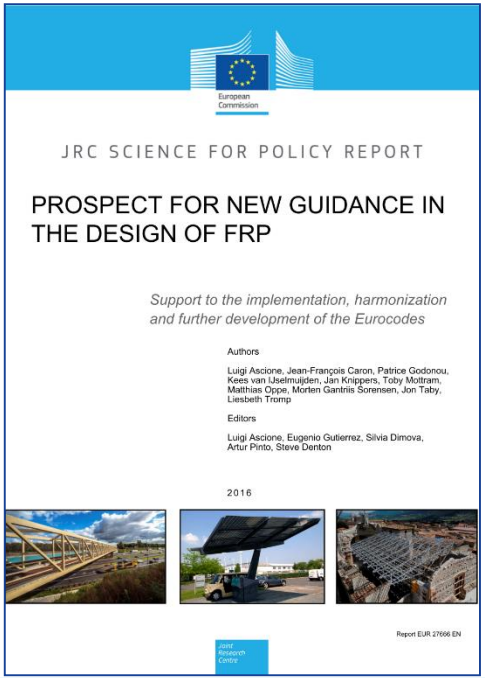
CDG Airport collapse of terminal 2E Paris (2004)

Evolution of ECs, key objectives:

- Development of a new Structural Eurocode on **Glass Structures**

Evolution of ECs, key objectives:

- Steps towards the development of new Eurocodes on **membrane structures** and **structural applications of Fibre Reinforced Polymers**



Nelson Mandela Bridge in Alkmaar (NL)
FRP movable deck

Evolution of ECs, key objectives:

- Increase the coverage of EC1 on actions on structures:
  - **Atmospheric Icing**
  - **Actions from Waves and Currents**

Atmospheric Icing
[ISO 12494, …..]

Waves and Currents [ISO 21650, …..]

Evolution of ECs, key objectives:

- Provide answers to the **Systematic Reviews** of the 58 parts: users' confidence in Eurocodes retained as they remain state-of-the-art documents
- Relevant **sustainability** consideration incorporated within design requirements, supporting the EC objectives, including those for energy saving and waste accrual
- **Climate change** consideration embraced within Eurocodes, to provide increased resilience of long-life infrastructure assets
- It is a fundamental requirement of TC 250 that all the M/515 work, including revisions to existing parts and preparation of new parts, will be accompanied by **background documents** that are to be made available to users of the Eurocodes

Evolution of ECs, key objectives:

- **Improving the ease of use** of the Eurocodes, particularly for day-to-day calculations
- **Increased harmonisation** through a reduction in National Determined Parameters, or convergence of values used
- Aspects of the assessment, re-use and retrofitting of **existing structures**
- Strengthening of the requirements for **robustness**
- Development of a new Structural Eurocode on **Glass Structures**
- Steps towards the development of new Eurocodes on **membrane structures** and **structural applications of Fibre Reinforced Polymers**
- Increase the coverage of EC1 on actions on structures (Atmospheric Icing, Actions from Waves and Currents)

Simplification

After the publication of the 1st generation (2007) the discussion about the "simplification" of ECs initiated:

- ECs academically based and therefore designers need to be more competent in the background rules before application
- Different approaches from the consolidated national practices
- Need to cater for complexity and at the same time provide rules for the every day "simple" application cases
- "Simplification" of rules not "simplistic rules"

BS EN 1993-1-1:2005
EN 1993-1-1:2005 (E)

Annex A [informative] – Method 1: Interaction factors k_{ij} for interaction formula in 6.3.3(4)

Table A.1: Interaction factors k_{ij} (6.3.3(4))

Interaction factors	Design assumptions: elastic cross-sectional properties class 3, class 4	Design assumptions: plastic cross-sectional properties class 1, class 2
k_{yy}	$C_{my} C_{mLT} \frac{\mu_y}{1 - \frac{N_{Ed}}{N_{cr,y}}}$	$C_{my} C_{mLT} \frac{\mu_y}{1 - \frac{N_{Ed}}{N_{cr,y}}} \frac{1}{C_{yy}}$
k_{yz}	$C_{mz} \frac{\mu_y}{1 - \frac{N_{Ed}}{N_{cr,z}}}$	$C_{mz} \frac{\mu_y}{1 - \frac{N_{Ed}}{N_{cr,z}}} \frac{1}{C_{yz}} 0{,}6 \sqrt{\frac{w_z}{w_y}}$
k_{zy}	$C_{my} C_{mLT} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,y}}}$	$C_{my} C_{mLT} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,y}}} \frac{1}{C_{zy}} 0{,}6 \sqrt{\frac{w_y}{w_z}}$
k_{zz}	$C_{mz} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,z}}}$	$C_{mz} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,z}}} \frac{1}{C_{zz}}$
Auxiliary terms:		
$\mu_y = \frac{1 - \frac{N_{Ed}}{N_{cr,y}}}{1 - \chi_y \frac{N_{Ed}}{N_{cr,y}}}$	$C_{yy} = 1 + (w_y - 1)\left[\left(2 - \frac{1{,}6}{w_y} C_{my}^2 \bar{\lambda}_{max} - \frac{1{,}6}{w_y} C_{my}^2 \bar{\lambda}_{max}^2\right) n_{pl} - b_{LT}\right] \geq \frac{W_{el,y}}{W_{pl,y}}$ with $b_{LT} = 0{,}5\, a_{LT}\, \bar{\lambda}_0^2 \frac{M_{y,Ed}}{\chi_{LT} M_{pl,y,Rd}} \frac{M_{z,Ed}}{M_{pl,z,Rd}}$	
$\mu_z = \frac{1 - \frac{N_{Ed}}{N_{cr,z}}}{1 - \chi_z \frac{N_{Ed}}{N_{cr,z}}}$	$C_{yz} = 1 + (w_z - 1)\left[\left(2 - 14 \frac{C_{mz}^2 \bar{\lambda}_{max}^2}{w_z^5}\right) n_{pl} - c_{LT}\right] \geq 0{,}6 \sqrt{\frac{w_z}{w_y}} \frac{W_{el,z}}{W_{pl,z}}$ with $c_{LT} = 10\, a_{LT} \frac{\bar{\lambda}_0^2}{5 + \bar{\lambda}_z^4} \frac{M_{y,Ed}}{C_{my} \chi_{LT} M_{pl,y,Rd}}$	
$w_y = \frac{W_{pl,y}}{W_{el,y}} \leq 1{,}5$	$C_{zy} = 1 + (w_y - 1)\left[\left(2 - 14 \frac{C_{my}^2 \bar{\lambda}_{max}^2}{w_y^5}\right) n_{pl} - d_{LT}\right] \geq 0{,}6 \sqrt{\frac{w_y}{w_z}} \frac{W_{el,y}}{W_{pl,y}}$ with $d_{LT} = 2\, a_{LT} \frac{\bar{\lambda}_0}{0{,}1 + \bar{\lambda}_z^4} \frac{M_{y,Ed}}{C_{my} \chi_{LT} M_{pl,y,Rd}} \frac{M_{z,Ed}}{C_{mz} M_{pl,z,Rd}}$	
$w_z = \frac{W_{pl,z}}{W_{el,z}} \leq 1{,}5$		
[AS2] $n_{pl} = \frac{N_{Ed}}{N_{Rk} / \gamma_{M0}}$ [AS2]	[AS2] $C_{zz} = 1 + (w_z - 1)\left[2 - \frac{1{,}6}{w_z} \cdot C_{mz}^2 \bar{\lambda}_{max} - \frac{1{,}6}{w_z} \cdot C_{mz}^2 \bar{\lambda}_{max}^2 - e_{LT}\right] n_{pl} \geq \frac{W_{el,z}}{W_{pl,z}}$ [AS2]	
C_{my} see Table A.2	with $e_{LT} = 1{,}7\, a_{LT} \frac{\bar{\lambda}_0}{0{,}1 + \bar{\lambda}_z^4} \frac{M_{y,Ed}}{C_{my} \chi_{LT} M_{pl,y,Rd}}$	
$a_{LT} = 1 - \frac{I_T}{I_y} \geq 0$		

Simplification

TC250 meeting in Helsinki June 2010 – Resolution N. 280

Subject: CEN/TC 250 – simplification of Eurocodes

CEN/TC 250 acknowledges the challenge established in the Programming Mandate M/466 addressed to CEN in the field of the Structural Eurocodes to examine the potential for simplification of rules in the further development of the Eurocodes.

CEN/TC 250 agrees to work towards achieving such simplification in the further development of the Eurocodes to support the **ease of their use** by designers through:

(i) improving the clarity;
(ii) simplifying routes through the Eurocodes;
(iii) limiting, where possible, the inclusion of alternative application rules;
(iv) avoiding or removing rules of little practical use in design;

CEN/TC 250 agrees that such simplification should be **limited to the extent that it is technically justified** and should seek to avoid additional and/or empirical rules for particular structure or structural-element types.

From “Simplification” to “Ease of Use”

2015

CEN/TC 250 Position paper on enhancing ease of use of the Structural Eurocodes

*“…Whilst respecting the achievements of the past, our vision for the second generation of Structural Eurocodes is to create **a more user-orientated suite of design standards** that are recognised as the most trusted and preferred in the world.”*

Enhancing Ease of Use

1. Statements of intent to meet users' needs
2. Principles and related priorities
3. Examples
4. Strategic performance measures
5. Management, governance and support

5 pillars to enhance the Ease of Use of the Eurocodes

Enhancing Ease of Use

1. Statements of intent to meet users' needs
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5 pillars to enhance the Ease of Use of the Eurocodes

1. Statements of intent to meet users' needs

CATEGORIES OF EUROCODES' USERS	CEN/TC 250 STATEMENTS OF INTENT
Practitioners – Competent engineers [Primary target audience]	We will aim to produce Standards that are suitable and clear for all common design cases without demanding disproportionate levels of effort to apply them
Practioners – Graduates	We will aim to produce Eurocodes that can be used by Graduates where necessary supplemented by suitable guidance documents and textbooks and under the supervision of an experienced practitioner when appropriate
Expert specialists	We will aim not to restrict innovation by providing freedom to experts to apply their specialist knowledge and expertise
Product Manufacturers	Working with other CEN/TCs we will aim to eliminate incompatibilities or ambiguities between the Eurocodes and Product Standards
Software developers	We will aim to provide unambiguous and complete design procedures. Accompanying formulae will be provided for charts and tables where possible
Educators	We will aim to use consistent underlying technical principles irrespective of the intended use of a structure (e.g. bridge, building, etc.) and that facilitate the linkage between physical behaviour and design rules
National regulator	We will endeavour to produce standards that can be referenced or quoted by National Regulations
Private sectors businesses	We will continue to promote technical harmonization across European markets in order to reduce barriers to trade
Clients	We will produce Eurocodes that enable the design of safe, serviceable, robust and durable structures, aiming to promoting cost effectiveness throughout their whole life cycle, including design, construction and maintenance
Other CEN/TCs	We will engage proactively to promote effective collaboration with those other CEN/TCs that have shared interests

Enhancing Ease of Use

1. Statements of intent to meet users' needs
2. **Principles and related priorities**
3. Examples
4. Strategic performance measures
5. Management, governance and support

5 pillars to enhance the Ease of Use of the Eurocodes

General principles (primary)	
1	Improving clarity and understandability of technical provisions of the Eurocodes
2	Improving accessibility to technical provisions and ease of navigation between them
3	Improving consistency within and between the Eurocodes
4	Including state-of the-art material the use of which is based on commonly accepted results of research and has been validated through sufficient practical experience
5	Considering the second generation of the Eurocodes as an “evolution” avoiding fundamental changes to the approach to design and to the structure of the Eurocodes unless adequately justified

Specific principles (secondary)	
6	Providing clear guidance for all common design cases encountered by typical competent practitioners in the relevant field
7	Omitting or providing only general and basic technical provisions for special cases that will be very rarely encountered by typical competent practitioners in the relevant field
8	Not inhibiting the freedom of experts to work from first principles and providing adequate freedom for innovation
9	Limiting the inclusion of alternative application rules
10	Including simplified methods only where they are of general application, address commonly encountered situations, are technically justified and give more conservative results than the rigorous methods they are intended to simplify
11	Improving consistency with product standards and standards for execution
12	Providing technical provisions that are not excessive sensitive to execution tolerances beyond what can be practically achieved on site

Enhancing Ease of Use

1. Statements of intent to meet users' needs
2. Principles and related priorities
3. **Examples**
4. Strategic performance measures
5. Management, governance and support

5 pillars to enhance the Ease of Use of the Eurocodes

Annex D. Common clauses for EN Eurocode Parts

D1 Common structure of EN Eurocode Parts

(1) The following common structure shall be used for Eurocode material parts, unless it is agreed that this will not be appropriate. Other Eurocodes shall utilise those components of the common structure that are relevant.

European Foreword[1]
Introduction[2]
1 Scope
  1.1 Scope of EN XXXX
  1.2 Scope of EN XXXX-X-X[3]
  1.3 Assumptions[3]
2 Normative references
3 Terms, definitions and symbols
  3.1 Terms and definitions
  3.2 Symbols and abbreviations
4 Basis of Design[4]
5 Materials
6 Durability (or Groundwater[3])
7 Structural (or Geotechnical[3]) Analysis
8 Ultimate Limit States
9 Serviceability Limit States

Additional optional clauses may be added as needed. Where they are relevant, the following sequence and naming of clauses should generally be used:

- Fatigue
- Detailing
- Joints and connections
- <other special requirements relevant to Eurocode part given appropriate clause name>
- Design assisted by testing (or Testing[3])
- Reporting
- Annexes (Normative)
- Annexes (Informative)

[1] see D3 for more details
[2] see D4 for more details
[3] use as appropriate, particularly for EN 1997
[4] see D5 for more details

N 1250 version 7a 2018.08.31 25

Common clauses for ECs parts

Simpler formulae

EN 1992-1-1 (2004)	Proposal
5.8 Analysis of second order effects with axial load **5.8.3 Simplified criteria** **5.8.3.1 Slenderness criterion for isolated members** (1) As an alternative to 5.8.2 (6), second order effects may be ignored if the slenderness λ (as defined in 5.8.3.2) is below a certain value λ_{lim}. **Note:** The value of λ_{lim} for use in a Country may be found in its National Annex. The recommended value follows from: $\lambda_{lim} = 20 \cdot A \cdot B \cdot C / \sqrt{n}$ (5.13N) where: $A = 1 / (1+0{,}2\varphi_{ef})$; $B =$, $C = 1{,}7 - r_m$ φ_{ef} effective creep ratio; see 5.8.4; $\omega = A_s f_{yd} / (A_c f_{cd})$; mechanical reinf. ratio; A_s total area of longitudinal reinforcement $n = N_{Ed} / (A_c f_{cd})$; relative normal force $r_m = M_{01} / M_{02}$; moment ratio M_{01}, M_{02} are the first order end moments	**5.8 Analysis of second order effects with axial load** **5.8.3 Simplified criteria** **5.8.3.1 Slenderness criterion for isolated members** (1) As an alternative to 5.8.2 (6), second order effects may be ignored if the slenderness λ (as defined in 5.8.3.2) is below the limit value: $\lambda_{lim} = 11 / \sqrt{n}$ for $n < 0{,}41$ (5.13) where: $n = N_{Ed} / (A_c f_{cd})$.

Improving accessibility to technical provisions and ease of navigation between them

Examples form EN1990

CEN/TC 250
Date: 2018-04
prEN 1990:2018
CEN/TC 250
Secretariat: BSI

Eurocode — Basis of structural and geotechnical design

Eurocode — Grundlagen der Tragwerksplanung

Eurocodes — Bases de calcul des structures

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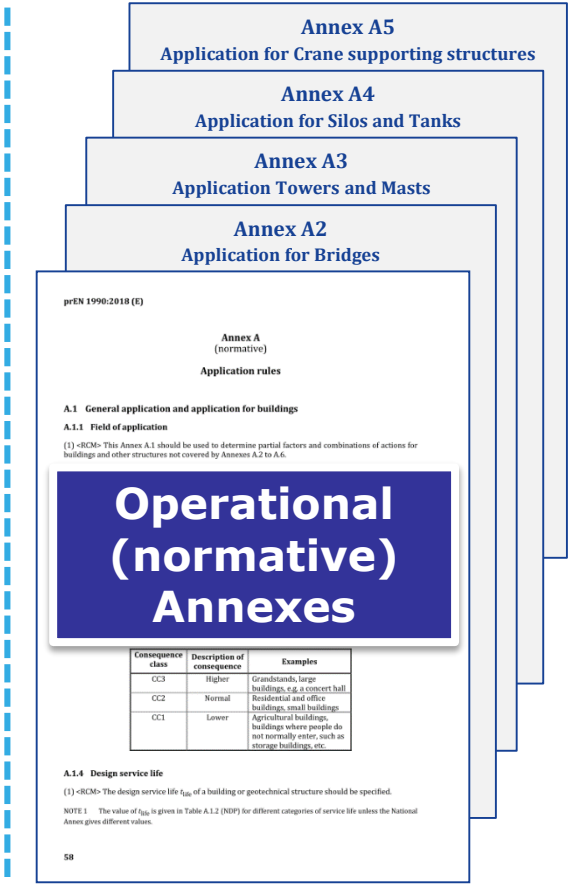
Main text



prEN 1990:2018 (E)

Annex A
(normative)

Application rules

A.1 General application and application for buildings

A.1.1 Field of application

(1) <RCM> This Annex A.1 should be used to determine partial factors and combinations of actions for buildings and other structures not covered by Annexes A.2 to A.6.

Consequence class	Description of consequence	Examples
CC3	Higher	Grandstands, large buildings, e.g. a concert hall
CC2	Normal	Residential and office buildings, small buildings
CC1	Lower	Agricultural buildings, buildings where people do not normally enter, such as storage buildings, etc.

A.1.4 Design service life

(1) <RCM> The design service life t_{dg} of a building or geotechnical structure should be specified.

NOTE 1 The value of t_{dg} is given in Table A.1.2 (NDP) for different categories of service life unless the National Annex gives different values.

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Annex A5
Application for Crane supporting structures

Annex A4
Application for Silos and Tanks

Annex A3
Application Towers and Masts

Annex A2
Application for Bridges

Operational (normative) Annexes

Annex E
(informative)
Additional robustness provisions for buildings

Annex D
(informative)
Design Assisted by Testing

Annex C
(informative)
Reliability analysis and code calibration

Annex B
(informative)
Management measures to achieve the intended structural reliability

Specialist (informative) Annexes

EN1990 Combination of actions – (Annex A1 - Buildings)

Table A.1.3 — Combinations of actions for ultimate limit states when using Formula (8.20)

Design situation	Fundamental (persistent/ transient)[a]	Accidental[b]	Seismic[c]	Fatigue[e]
General formula for effects of actions	(8.4)			
Formula for combination of actions	(8.20)	(8.23)	(8.24)	(8.25)
Permanent ($G_{d,i}$)	$\gamma_{G,i} G_{k,i}$	$G_{k,i}$	$G_{k,i}$	$G_{k,i}$
Leading variable ($Q_{d,1}$)	$\gamma_{Q,1} Q_{k,1}$	$\psi_{1,1} Q_{k,1}$ or $\psi_{2,1} Q_{k,1}$	$\psi_{2,j} Q_{k,j}$	$\psi_{2,j} Q_{k,j}$
Accompanying variable ($Q_{d,j}$)	$\gamma_{Q,j} \psi_{0,j} Q_{k,j}$	$\psi_{2,j} Q_{k,j}$		
Prestress (P_d)[d]	$\gamma_P P_k$	P_k	P_k	P_k
Accidental (A_d)	-	A_d	-	-
Seismic (A_{Ed})	-	-	$A_{Ed,ULS}$	-
Fatigue (Q_{fat})	-	-	-	Q_{fat}

[a] For persistent and transient design situations, when $\gamma_{Q,j}\psi_{0,j} \approx 1$ the design value of the accompanying variable action can be approximated by its characteristic value.

[b] In accidental design situations, the choice between ψ_1 and ψ_2 depends on details of the design situation, e.g. impact, fire, or survival after an accidental event or situation. Further guidance is given in the other Eurocodes and in the National Annex.

[c] Depending on the magnitude of $A_{Ed,ULS}$, the seismic combination of actions covers both the near collapse (NC) and significant damage (SD) ultimate limit states defined in EN 1998.

[d] The characteristic value of pre-stress P_k can be an upper, lower, or mean value, as specified in the other Eurocodes.

[e] See 8.3.7.2 for conditions of use.

Enhancing Ease of Use

1. Statements of intent to meet users' needs
2. Principles and related priorities
3. Examples
4. Strategic performance measures
5. Management, governance and support

5 pillars to enhance the Ease of Use of the Eurocodes

4. Strategic performance measures

5. Management, governance and support

Technical Reviewer

General principles (primary)		Key questions in terms of ease of use	Relevant activities	
1	Improving clarity and understandability of technical provisions of the Eurocodes	• Is the final outcome (i.e. what we want the designer to do) unambiguous, clearly presented and easy to understand? • Is it clear how the identified outcome is expected to be achieved?	1.1	Clarify the status of each clause (including formulae and tables) by using the appropriate verbal forms for requirements (shall), recommendations (should), permissions (may) or statements of facts (can).
			1.2	Clearly define scope and limitations in the application of the clauses.
			1.3	Use language that can be easily understood by competent engineers (i.e. the target audience).
			1.4	Make clauses as independent as possible, i.e. avoid readers to read an entire section to understand a concept.

2. Specific issues related to the content of the clauses

Specific issues related to the content of the clauses have been grouped into the following areas and are examined in detail:

1. Project-specific criteria
2. Contract-neutral clauses
3. Tables and figures in notes
4. Additional guidance on NDPs
5. Formulae
6. Style of conditional expressions
7. Alternative application rules
8. Reference to Product standards
9. Figures' quality
10. Making clear cross-references
11. Presenting definitions in the main text
12. Presenting assumptions
13. Improving accessibility of technical provisions
14. Focusing on the primary target audience

Detailed check on specific issues

Detailed review to meet the objectives

Evolution of ECs, key objectives:

- **Improving the ease of use** of the Eurocodes, particularly for day-to-day calculations
- **Increased harmonisation** through a reduction in National Determined Parameters, or convergence of values used
- Aspects of the assessment, re-use and retrofitting of **existing structures**
- Strengthening of the requirements for **robustness**
- Development of a new Structural Eurocode on **Glass Structures**
- Steps towards the development of new Eurocodes on **membrane structures** and **structural applications of Fibre Reinforced Polymers**
- Increase the coverage of EC1 on actions on structures (Atmospheric Icing, Actions from Waves and Currents)

National Standards implementing Eurocodes
National Annex

European Commission recognises the responsibility of regulatory Authorities in each EU member state in the determination of ***values related to safety matters*** at national level through a **National Annex**.

Increased harmonization

0.3 National standards implementing the Eurocodes

The National Standards implementing the Eurocodes will comprise the full text of the Eurocodes (including any annexes), as published by CEN, and can be preceded by a National title page and National foreword and followed by a National Annex.

A National Annex can only contain information on those parameters, known as Nationally Determined Parameters (NDPs), that are left open in the Eurocodes for national choice. These NDPs are to be used for the design of buildings and civil engineering works to be constructed in the country concerned, i.e.:

- values and/or classes where alternatives are given in the Eurocodes;
- values to be used where a symbol only is given in the Eurocodes;
- country specific data (geographical, climatic, etc.), e.g. snow map;
- the procedure to be used where alternative procedures are given in the Eurocodes.

The National Annex can also contain:

- decisions on the application of informative annexes;
- references to non-contradictory complementary information (NCCI) to assist the user in applying the Eurocodes.

Increased harmonization

Values and/or classes where alternatives are given in the Eurocodes

NOTE 1 Table 4.1 (NDP) gives the classification of consequence classes with reference to indicative qualification of consequnces, unless the National Annex gives different qualifications.

Table 4.1 (NDP) — Qualification of consequence classes

Consequence class	Indicative qualification of consequences	
	Loss of human life or personal injury[a]	Economic, social or environmental consequences[a]
CC4 – Highest	Extreme	Huge
CC3 – Higher	High	Very great
CC2 – Normal	Medium	Considerable
CC1 – Lower	Low	Small
CC0 – Lowest	Very low	Insignificant

[a] The consequence class is chosen based on the more severe of these two columns.

Increased harmonization

Values to be used where a symbol only is given in the Eurocodes

4.5 Design service life

(1) <RCM> The design service life t_{life} of the structure should be specified.

NOTE Indicative values of t_{life} are given in Table 4.2 (NDP) for different categories of structures, unless the National Annex gives different values.

Table 4.2 (NDP) —Indicative design service life for different categories of structures

Category of structures	Design service life, t_{life} years
Monumental building structures, bridges, and other civil engineering structures	100
Building structures and other common structures not covered by another category	50
Agricultural, industrial and similar structures Replaceable structural parts	25
Temporary structures[a]	≤ 10

[a] For specific temporary structural elements, such as anchors, $t_{life} \leq 2$ years may be considered.

Increased harmonization

Country specific data (geographical, climatic, etc.), e.g. snow map

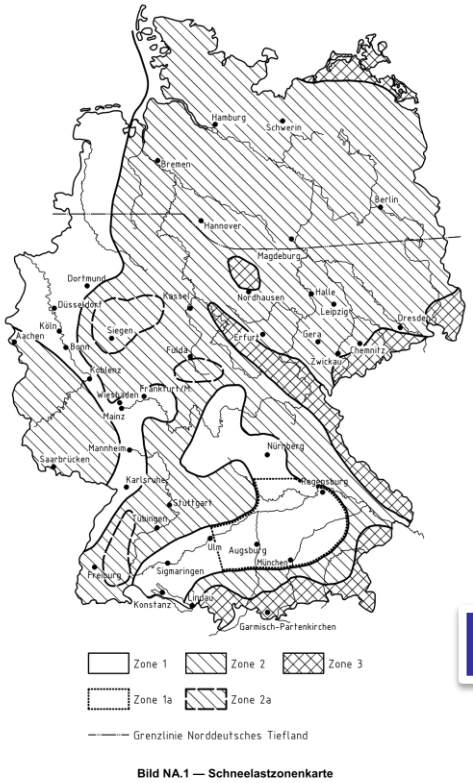
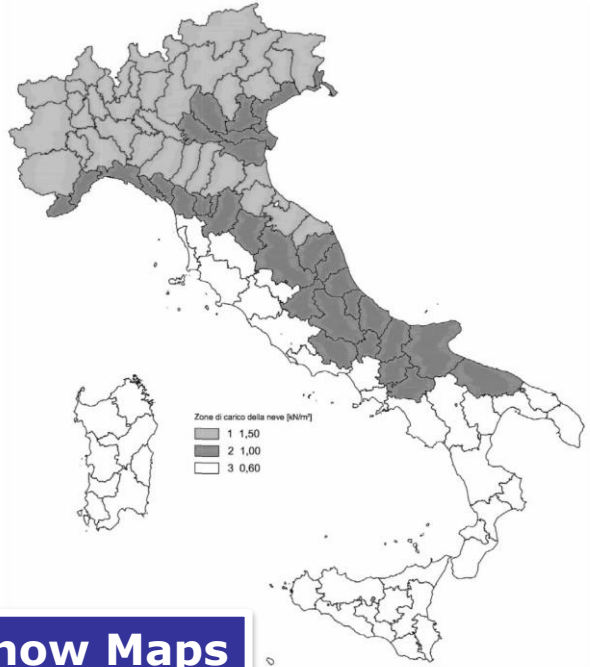


Bild NA.1 — Schneelastzonenkarte



Snow Maps

Increased harmonization

The procedure to be used where alternative procedures are given in the Eurocodes

$$\sum F_d = \sum_i \gamma_{G,i} G_{k,i} + \gamma_{Q,1} Q_{k,1} + \sum_{j>1} \gamma_{Q,j} \psi_{0,j} Q_{k,j} + (\gamma_P P_k) \quad (8.20)$$

or

$$\sum F_d = \begin{cases} \sum_i \gamma_{G,i} G_{k,i} + \gamma_{Q,1} \psi_{0,1} Q_{k,1} + \sum_{j>1} \gamma_{Q,j} \psi_{0,j} Q_{k,j} + (\gamma_P P_k) & (8.21a) \\ \sum_i \xi_i \gamma_{G,i} G_{k,i} + \gamma_{Q,1} Q_{k,1} + \sum_{j>1} \gamma_{Q,j} \psi_{0,j} Q_{k,j} + (\gamma_P P_k) & (8.21b) \end{cases}$$

or

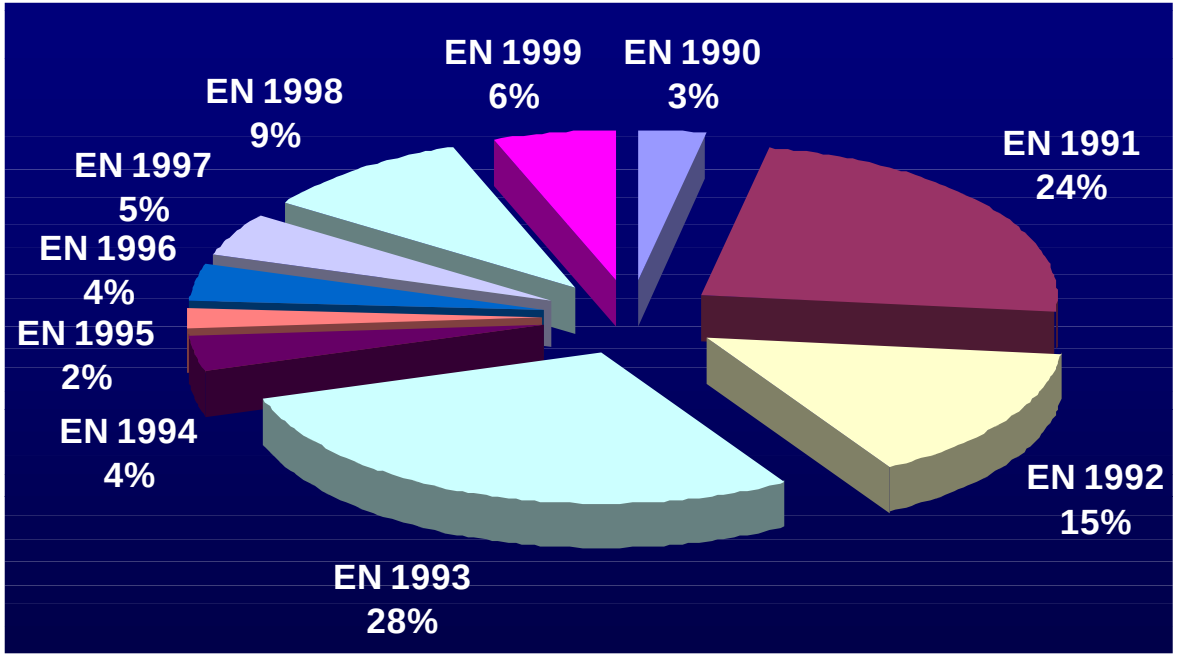
$$\sum F_d = \begin{cases} \sum_i \gamma_{G,i} G_{k,i} + (\gamma_P P_k) & (8.22a) \\ \sum_i \xi_i \gamma_{G,i} G_{k,i} + \gamma_{Q,1} Q_{k,1} + \sum_{j>1} \gamma_{Q,j} \psi_{0,j} Q_{k,j} + (\gamma_P P_k) & (8.22b) \end{cases}$$

NOTE 1 The formula to be used is Formula (8.20) unless the National Annex gives a different choice.

Reducing NDPs

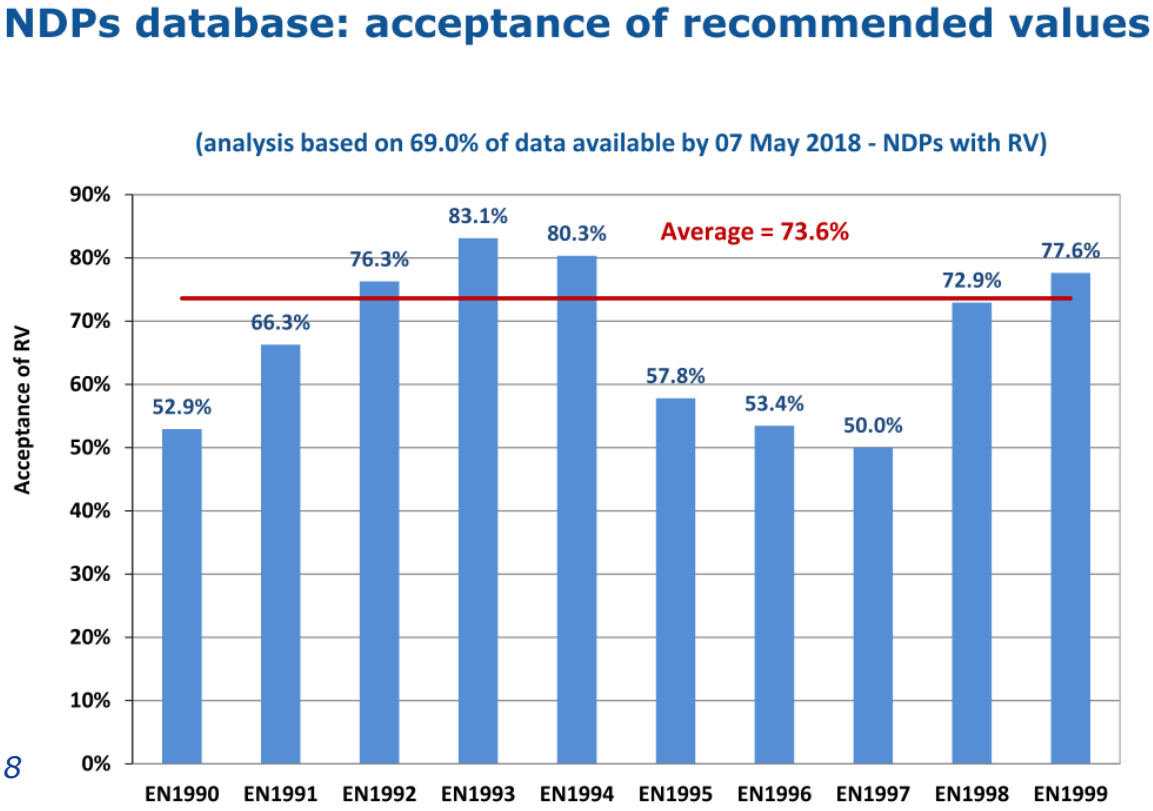
Nationally Determined Parameters (NDPs)

~1’100 NDPs in the Eurocode suite



Increased harmonization

…through a reduction in National Determined Parameters, or convergence of values used



Source JRC, May 2018

Increased harmonization

Contents

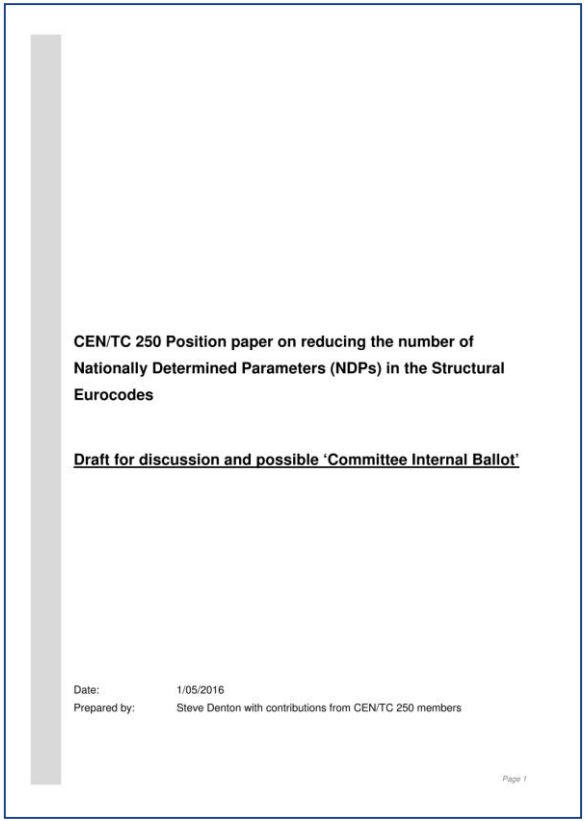
Scope:

- To analyse the **state of harmonized use** of the Eurocodes by EU and EFTA Member States
- To update the **statistical analysis** with the new NDPs **uploaded by MS** in the Database

Source JRC, May 2018

European Commission

Increased harmonization



CEN/TC 250 Position paper on reducing the number of Nationally Determined Parameters (NDPs) in the Structural Eurocodes

Draft for discussion and possible 'Committee Internal Ballot'

Date: 1/05/2016
Prepared by: Steve Denton with contributions from CEN/TC 250 members

Page 1

Primary Objectives

1. To reduce the number of National Determined Parameters
2. To develop Standards that can be implemented by CEN members
3. To maintain consensus, evidenced through positive formal votes by CEN members

Principles

1. The development of the second generation of the Eurocodes is an 'evolution', thus the approach to reviewing NDPs should build from the basis for them set out in Guidance Paper L (see Annex A)
2. Some parameters must be NDPs, even if all countries agree on a specific value or choice
3. Some parameters are subject to variation for geographic or climatic reasons; these must be NDPs although the Eurocodes should be as clear as possible on how they are to be determined
4. Effort should be made to limit the number of other NDPs, but this must be done pragmatically and respectfully of national positions

Increased harmonization

4.1 Step 1: Identification of parameters that must be NDPs

In the first step, all parameters that must be NDPs are to be identified. Such ‘essential NDPs’ are:

- partial factors for materials and actions,
- the probability of the design seismic action being exceeded in a structure’s design reference period,
- the time of fire exposure,
- design accidental actions,
- classification of structures in Consequences Classes corresponding to different Reliability Classes and levels, taking into account quality management requirements

Increased harmonization

4.2 Step 2: Review of other NDPs

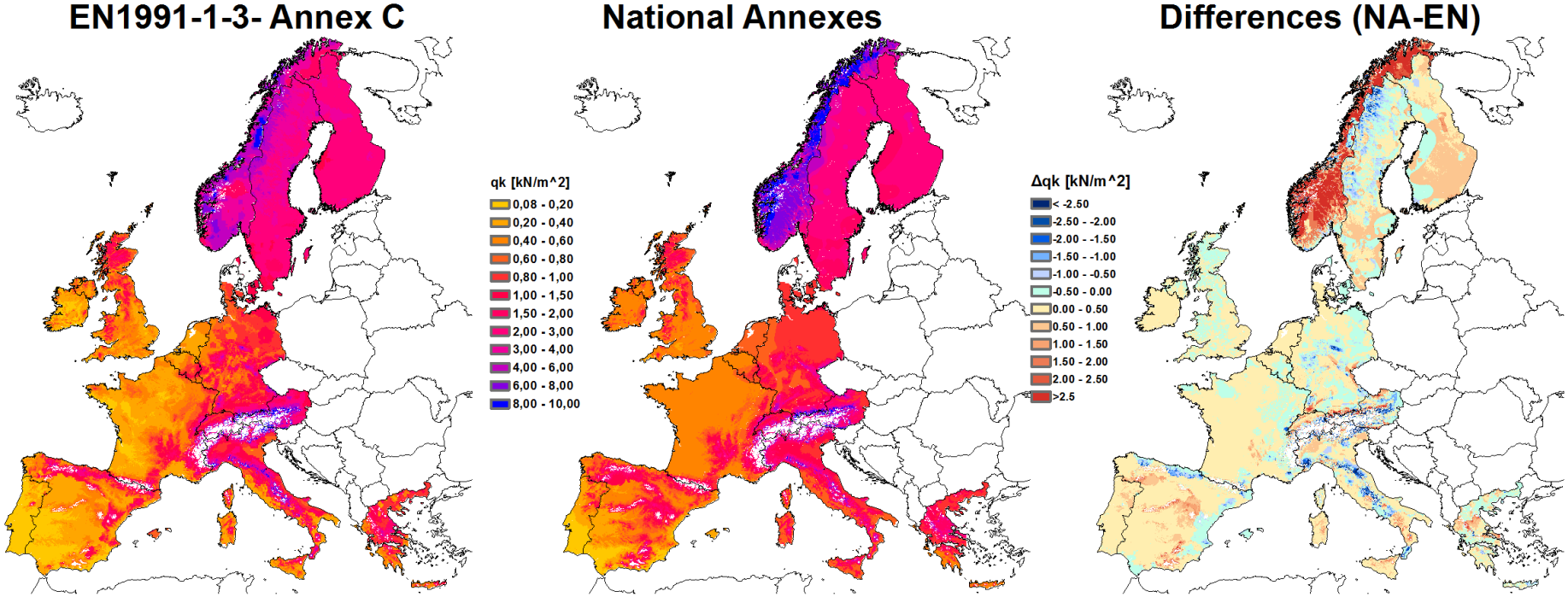
All NDPs that are not classified as essential in Step 1 shall be reviewed in an effort to try to reduce their number. This review should be undertaken pragmatically, respecting the position of different CEN Members and seeking to understand why different opinions are held.

In undertaking this review, NDPs relating to the following are discouraged:

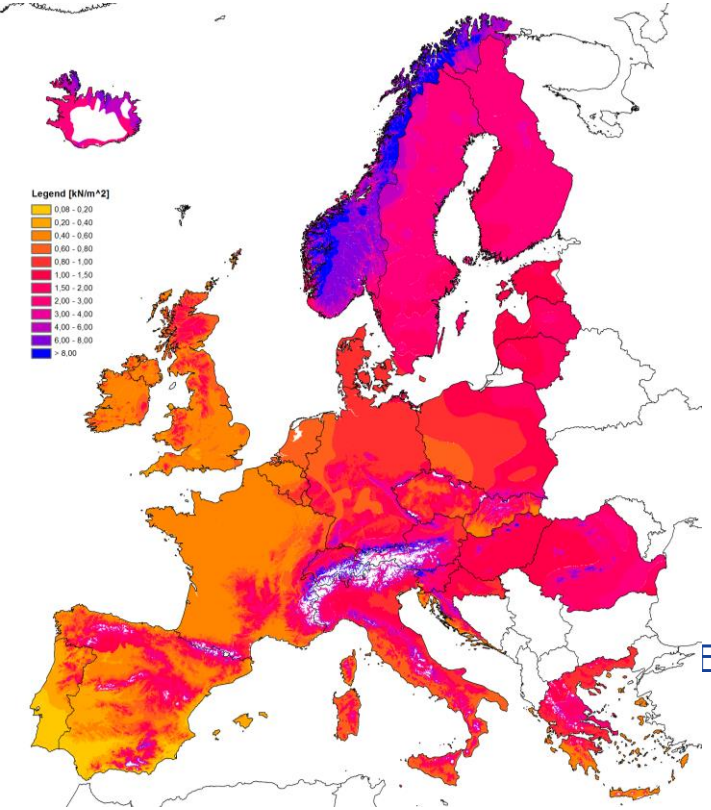
- technical issues, such as the choice of one mechanical model versus another, or one coefficient versus another in a resistance formulation,
- limits on geometric or similar parameters (e.g., size of cross section, upper or lower limits on reinforcement ratio or density) which have to do with limits of applicability of mechanical models,
- choice between advanced and simplified methods.

Increased harmonization

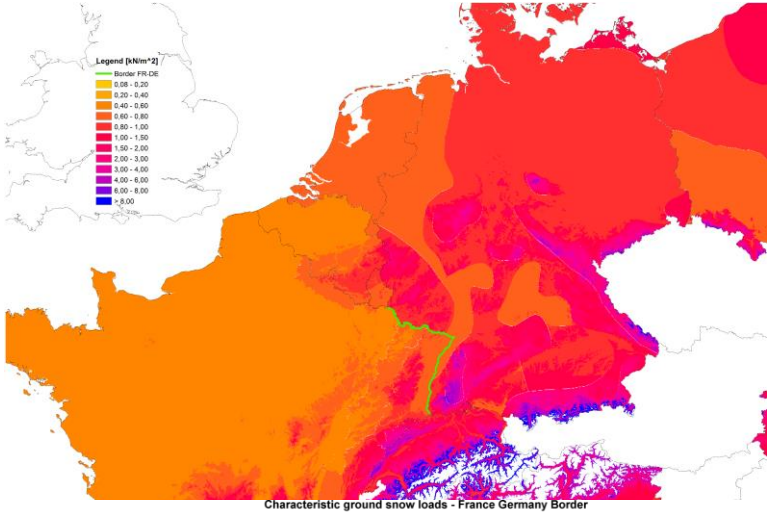
Example: Snow Maps in NAs



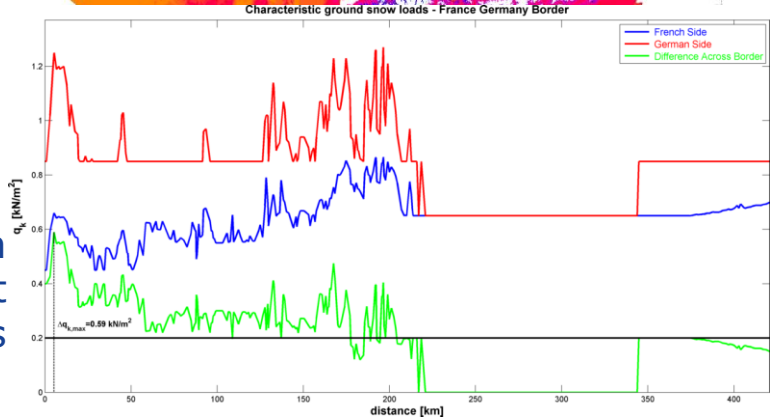
Increased harmonization



29 Maps from National Annexes Out of 30 NAs available



Example: Comparison of NAs Snow Maps at Borders



Thank you for your attention!

Stay in touch

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