Towards the second generation of Eurocodes

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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”
The way forward for the Eurocodes implementation in the Balkans, 10-11 October 2018, Tirana

EUROCODES Story

1971 1976
First Eurocodes

ENVs ENs

1st Generation

Towards the 2nd Generation

- Maintenance
- Harmonization
- Further development

Steering Committee

CEN
The first EC drafts

- **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

**EC 1**
**Eurocode 1**
**EUROPEAN PRESTANDARD**
Basis of design and actions on structures

Part 1: Basis of design

**1990’s**

**EC 3**
**Eurocode 3**
**EUROPEAN PRESTANDARD**
Design of steel structures

Part 1.1: general rules and rules for buildings

“The way forward for the Eurocodes implementation in the Balkans”, 10-11 October 2018, Tirana
## The “1st generation”

2007

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

EN1990: Structural safety, serviceability, durability and robustness
EN1991: Actions on structures
EN1992: Design and detailing
EN1993: Geotechnical design
EN1994: Seismic design
EN1995
EN1996
EN1997
EN1998
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”

1st Generation

- Publication of National Annexes
- Implementation and use
- 2007
- 2010
- Withdrawal of conflicting national standards

ENs

- Millau bridge (FR) [EC3]
- Railway Station (Guillemins) – Liège, Belgium [EC2/3]
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 2\textsuperscript{nd} generation

\textbf{1\textsuperscript{st} Generation ENs}

- 2007
  - The EC sent the Programming Mandate M/466 EN to CEN

- 2010
  - CEN/TC250 Set out the work programme for the evolution of ECs

- 2012
  - The EC sent the Mandate M/515 EN to CEN

- 2013
  - Start of Mandate M/515 EN Phase 1

\textbf{2\textsuperscript{nd} Generation}

- 2015
  - Start of Mandate M/515 EN Phase 2

- 2017
  - Start of Mandate M/515 EN Phase 3/4

- 2018

- 2021

- 2023

"The way forward for the Eurocodes implementation in the Balkans", 10-11 October 2018, Tirana
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.

2015 - 2017 - 2018 - 2021 - to 2023

- Phase 1
- Phase 2
- Phase 3
- Phase 4

- 28 PTs
- 22 PTs
- 27 PTs
Evolution of ECs, a transparent process

Phase 1 – Informal Enquiry Comments (approx)
Evolution of ECs, key objectives
Evolution of ECs, key objectives:

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

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**New European Technical Rules for the Assessment and Retrofitting of Existing Structures**

**Authors:**
Paul Leuschner, Ivana Markovic, Gero Krieger, Marilena Markou, Peter Tamaz, Ruth Lefebvre, Giuseppe Mantica, Camilla Karl, Dovine Demar, Joop Esselber

**Editors:**
S. Bimuna, A. Pissis, P. Leuschner, S. Doros

**Published:** 30th October 2014

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- 1. General
  - 1.1 Scope
  - 1.2 Definitions
- 2. General requirements
  - 2.1 Objectives
  - 2.2 Principles of assessment
  - 2.3 Target reliability level
  - 2.4 Cultural and societal aspects
- 3. General framework of assessment
  - 3.1 Overview
  - 3.2 Procedures
  - 3.3 Basis of assessment
  - 3.4 Conditions survey
  - 3.5 Structural analysis and verifications
  - 3.6 Recommendations
- 4. Basic variables and updating
  - 4.1 General
  - 4.2 Structural systems
  - 4.3 Actions and influences
  - 4.4 Material properties
  - 4.5 Structural behaviour
- 5. Structural analysis
  - 5.1 Structural analysis for assessment
  - 5.2 Selection of structural analysis methodology
  - 5.3 Testing and monitoring
- 6. Verification
  - 6.1 General
  - 6.2 Verification methods
  - 6.3 Partial factor method
  - 6.4 Assessment value method
  - 6.5 Probabilistic method
  - 6.6 Risk assessment method

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*“The way forward for the Eurocodes implementation in the Balkans”, 10-11 October 2018, Tirana*
Evolution of ECs, key objectives:

- Strengthening of the requirements for robustness

Ronan Point - UK (16.05.1968)

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

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”
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”

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
2. Principles and related priorities
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5 pillars to enhance the Ease of Use of the Eurocodes
### 1. Statements of intent to meet users' needs

<table>
<thead>
<tr>
<th>CATEGORIES OF EUROCODES' USERS</th>
<th>CEN/TC 250 STATEMENTS OF INTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practitioners – Competent engineers [Primary target audience]</td>
<td>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</td>
</tr>
<tr>
<td>Practitioners – Graduates</td>
<td>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</td>
</tr>
<tr>
<td>Expert specialists</td>
<td>We will aim not to restrict innovation by providing freedom to experts to apply their specialist knowledge and expertise</td>
</tr>
<tr>
<td>Product Manufacturers</td>
<td>Working with other CEN/TCs we will aim to eliminate incompatibilities or ambiguities between the Eurocodes and Product Standards</td>
</tr>
<tr>
<td>Software developers</td>
<td>We will aim to provide unambiguous and complete design procedures. Accompanying formulae will be provided for charts and tables where possible</td>
</tr>
<tr>
<td>Educators</td>
<td>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</td>
</tr>
<tr>
<td>National regulator</td>
<td>We will endeavour to produce standards that can be referenced or quoted by National Regulations</td>
</tr>
<tr>
<td>Private sectors businesses</td>
<td>We will continue to promote technical harmonization across European markets in order to reduce barriers to trade</td>
</tr>
<tr>
<td>Clients</td>
<td>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</td>
</tr>
<tr>
<td>Other CEN/TCs</td>
<td>We will engage proactively to promote effective collaboration with those other CEN/TCs that have shared interests</td>
</tr>
</tbody>
</table>
## 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)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Improving clarity and understandability of technical provisions of the Eurocodes</td>
</tr>
<tr>
<td>2</td>
<td>Improving accessibility to technical provisions and ease of navigation between them</td>
</tr>
<tr>
<td>3</td>
<td>Improving consistency within and between the Eurocodes</td>
</tr>
<tr>
<td>4</td>
<td>Including state-of-the-art material the use of which is based on commonly accepted</td>
</tr>
<tr>
<td></td>
<td>results of research and has been validated through sufficient practical experience</td>
</tr>
<tr>
<td>5</td>
<td>Considering the second generation of the Eurocodes as an “evolution” avoiding</td>
</tr>
<tr>
<td></td>
<td>fundamental changes to the approach to design and to the structure of the Eurocodes</td>
</tr>
<tr>
<td></td>
<td>unless adequately justified</td>
</tr>
<tr>
<td>Specific principles (secondary)</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td></td>
</tr>
<tr>
<td>6 Providing clear guidance for all common design cases encountered by typical competent practitioners in the relevant field</td>
<td></td>
</tr>
<tr>
<td>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</td>
<td></td>
</tr>
<tr>
<td>8 Not inhibiting the freedom of experts to work from first principles and providing adequate freedom for innovation</td>
<td></td>
</tr>
<tr>
<td>9 Limiting the inclusion of alternative application rules</td>
<td></td>
</tr>
<tr>
<td>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</td>
<td></td>
</tr>
<tr>
<td>11 Improving consistency with product standards and standards for execution</td>
<td></td>
</tr>
<tr>
<td>12 Providing technical provisions that are not excessive sensitive to execution tolerances beyond what can be practically achieved on site</td>
<td></td>
</tr>
</tbody>
</table>
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
### 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.

<table>
<thead>
<tr>
<th>Common clauses for ECs parts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>European Eurocodes</strong></td>
</tr>
<tr>
<td>Introduction</td>
</tr>
<tr>
<td>1. Scope</td>
</tr>
<tr>
<td>1.1 Scope of EN 2002-1</td>
</tr>
<tr>
<td>1.2 Scope of EN 2002-1 EC 3</td>
</tr>
<tr>
<td>1.3 Aims and scope</td>
</tr>
<tr>
<td>2. Normative references</td>
</tr>
<tr>
<td>3. Terms, definitions and symbols</td>
</tr>
<tr>
<td>3.1 Terms and definitions</td>
</tr>
<tr>
<td>3.2 Symbols and abbreviations</td>
</tr>
<tr>
<td>4. Basis of Design</td>
</tr>
<tr>
<td>5. Materials</td>
</tr>
<tr>
<td>6. Limit state</td>
</tr>
<tr>
<td>7. Structural (or Geotechnical) Analysis</td>
</tr>
<tr>
<td>8. Limit state</td>
</tr>
<tr>
<td>9. Serviceability limit states</td>
</tr>
</tbody>
</table>

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

- Fatigue
- Corrosion
- Joint connections
- Other special requirements relevant to Eurocode part given appropriate class names
- Design assisted by testing (or Testing?)
- Rating
- Assess (or Evaluate)
- Assessment (or Assessment)

For EC 03 for more details
For EC 04 for more details
For EC 05 for more details
For EC 06 for more details
## 3. Examples

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5.8 Analysis of second order effects with axial load</td>
<td>5.8 Analysis of second order effects with axial load</td>
</tr>
<tr>
<td>5.8.3 Simplified criteria</td>
<td>5.8.3 Simplified criteria</td>
</tr>
<tr>
<td>5.8.3.1 Slenderness criterion for isolated members</td>
<td>5.8.3.1 Slenderness criterion for isolated members</td>
</tr>
<tr>
<td>(1) As an alternative to 5.8.2 (6), second order effects may be ignored if the slenderness ( \lambda ) (as defined in 5.8.3.2) is below a certain value ( \lambda_{\text{lim}} ).</td>
<td>(1) As an alternative to 5.8.2 (6), second order effects may be ignored if the slenderness ( \lambda ) (as defined in 5.8.3.2) is below the limit value: ( \lambda_{\text{lim}} = 11 / \sqrt{n} ) for ( n &lt; 0.41 )</td>
</tr>
</tbody>
</table>

**Note:** The value of \( \lambda_{\text{lim}} \) for use in a Country may be found in its National Annex. The recommended value follows from:

\[
\lambda_{\text{lim}} = 20 \cdot A \cdot B \cdot C / \sqrt{n} \quad (5.13N)
\]

where:

- \( A = 1 / (1+0.2 \varphi_{\text{ef}}) \);
- \( B = \text{effective creep ratio; see 5.8.4;} \)
- \( \varphi_{\text{ef}} \text{ effective creep ratio; see 5.8.4;} \)
- \( \omega = A_s f_{yd} / (A_c f_{cd}) \); mechanical reinf. ratio;
- \( A_s \text{ total area of longitudinal reinforcement} \)
- \( n = N_{\text{Ed}} / (A_c f_{cd}) \); relative normal force
- \( r_m = M_{01} / M_{02} \); moment ratio
- \( M_{01}, M_{02} \text{ are the first order end moments} \)
Improving accessibility to technical provisions and ease of navigation between them

### Examples form EN1990

- **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

<table>
<thead>
<tr>
<th>Annex</th>
<th>Description of content</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.5</td>
<td>Design service life</td>
<td></td>
</tr>
</tbody>
</table>

- **Annex E**: Additional robustness provisions for buildings (informative)
- **Annex D**: Design Assisted by Testing (informative)
- **Annex C**: Reliability analysis and code calibration (informative)
- **Annex B**: Management measures to achieve the intended structural reliability (informative)

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

<table>
<thead>
<tr>
<th>Design situation</th>
<th>Fundamental (persistent/transient)(^a)</th>
<th>Accidental(^b)</th>
<th>Seismic(^c)</th>
<th>Fatigue(^e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General formula for effects of actions</td>
<td>(8.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formula for combination of actions</td>
<td>(8.20)</td>
<td>(8.23)</td>
<td>(8.24)</td>
<td>(8.25)</td>
</tr>
<tr>
<td>Permanent ((G_d,i))</td>
<td>(\gamma G_j G_k, i)</td>
<td>(G_k, i)</td>
<td>(G_k, i)</td>
<td>(G_k, i)</td>
</tr>
<tr>
<td>Leading variable ((Q_d,1))</td>
<td>(\gamma Q_{0,1} Q_k, 1)</td>
<td>(\psi_{1,1} Q_{k,1}) or (\psi_{2,1} Q_{k,1})</td>
<td>(\psi_{2,j} Q_{k,j})</td>
<td>(\psi_{2,j} Q_{k,j})</td>
</tr>
<tr>
<td>Accompanying variable ((Q_d,j))</td>
<td>(\gamma Q_{0,j} Q_{0,1} Q_k, j)</td>
<td>(\psi_{2,j} Q_{k,j})</td>
<td></td>
<td>(\psi_{2,j} Q_{k,j})</td>
</tr>
<tr>
<td>Prestress ((P_d))(^d)</td>
<td>(\gamma_P P_k)</td>
<td>(P_k)</td>
<td>(P_k)</td>
<td>(P_k)</td>
</tr>
<tr>
<td>Accidental ((A_d))</td>
<td>-</td>
<td>(A_d)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Seismic ((A_{Ed}))</td>
<td>-</td>
<td>-</td>
<td>(A_{Ed,ULS})</td>
<td>-</td>
</tr>
<tr>
<td>Fatigue ((Q_{fat}))</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(Q_{fat})</td>
</tr>
</tbody>
</table>

\(^a\) 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 \(\psi_1\) and \(\psi_2\) 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
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5 pillars to enhance the Ease of Use of the Eurocodes
4. Strategic performance measures

5. Management, governance and support

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

Technical Reviewer

<table>
<thead>
<tr>
<th>General principles (primary)</th>
<th>Key questions in terms of ease of use</th>
<th>Relevant activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Improving clarity and understandability of technical provisions of the Eurocodes</td>
<td>• 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?</td>
<td>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).</td>
</tr>
</tbody>
</table>

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)
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 consequences, unless the National Annex gives different qualifications.

<table>
<thead>
<tr>
<th>Consequence class</th>
<th>Indicative qualification of consequences</th>
<th>Economic, social or environmental consequences$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC4 – Highest</td>
<td>Extreme</td>
<td>Huge</td>
</tr>
<tr>
<td>CC3 – Higher</td>
<td>High</td>
<td>Very great</td>
</tr>
<tr>
<td>CC2 – Normal</td>
<td>Medium</td>
<td>Considerable</td>
</tr>
<tr>
<td>CC1 – Lower</td>
<td>Low</td>
<td>Small</td>
</tr>
<tr>
<td>CC0 – Lowest</td>
<td>Very low</td>
<td>Insignificant</td>
</tr>
</tbody>
</table>

$^a$ The consequence class is chosen based on the more severe of these two columns.
Increased harmonization

4.5 Design service life

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

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

<table>
<thead>
<tr>
<th>Category of structures</th>
<th>Design service life, $t_{\text{life}}$ years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monumental building structures, bridges, and other civil engineering structures</td>
<td>100</td>
</tr>
<tr>
<td>Building structures and other common structures not covered by another category</td>
<td>50</td>
</tr>
<tr>
<td>Agricultural, industrial and similar structures Replaceable structural parts</td>
<td>25</td>
</tr>
<tr>
<td>Temporary structures$^a$</td>
<td>$\leq 10$</td>
</tr>
</tbody>
</table>

$^a$ For specific temporary structural elements, such as anchors, $t_{\text{life}} \leq 2$ years may be considered.
Increased harmonization

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

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

\[
\sum F_d = \left\{ \begin{array}{l}
\sum_i \gamma_{G_i} G_{k,i} + \gamma_{Q,1} \psi_{0,1} Q_{k,1} + \sum_{j>1} \gamma_{Q,j} \psi_{0,j} Q_{k,j} + (\gamma_P P_k) \\
\sum_i \xi_i \gamma_{G_i} G_{k,i} + \gamma_{Q,1} Q_{k,1} + \sum_{j>1} \gamma_{Q,j} \psi_{0,j} Q_{k,j} + (\gamma_P P_k) 
\end{array} \right. \quad (8.21a)
\]

or

\[
\sum F_d = \left\{ \begin{array}{l}
\sum_i \gamma_{G_i} G_{k,i} + (\gamma_P P_k) \\
\sum_i \xi_i \gamma_{G_i} G_{k,i} + \gamma_{Q,1} Q_{k,1} + \sum_{j>1} \gamma_{Q,j} \psi_{0,j} Q_{k,j} + (\gamma_P P_k) 
\end{array} \right. \quad (8.22a)
\]

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 1990</td>
<td>3%</td>
</tr>
<tr>
<td>EN 1991</td>
<td>24%</td>
</tr>
<tr>
<td>EN 1992</td>
<td>15%</td>
</tr>
<tr>
<td>EN 1993</td>
<td>28%</td>
</tr>
<tr>
<td>EN 1994</td>
<td>4%</td>
</tr>
<tr>
<td>EN 1995</td>
<td>2%</td>
</tr>
<tr>
<td>EN 1996</td>
<td>4%</td>
</tr>
<tr>
<td>EN 1997</td>
<td>9%</td>
</tr>
<tr>
<td>EN 1998</td>
<td>6%</td>
</tr>
<tr>
<td>EN 1999</td>
<td>3%</td>
</tr>
<tr>
<td>EN 1999</td>
<td>6%</td>
</tr>
</tbody>
</table>
Increased harmonization

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

NDPs database: acceptance of recommended values

(analysis based on 69.0% of data available by 07 May 2018 - NDPs with RV)

Average = 73.6%

Source JRC, May 2018
Increased harmonization

Contents

1. Introduction ........................................................................................................................................
2. The Nationally Determined Parameters Database .......................................................................... 
3. Statistical analysis of the NDPs available in the NDPs Database ....................................................
4. Conclusions ........................................................................................................................................
Annexes ...................................................................................................................................................

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
Increased harmonization

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
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

EN1991-1-3- Annex C

National Annexes

Differences (NA-EN)
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

http://eurocodes.jrc.ec.europa.eu/