



# **Present and Future of the Eurocodes**

**Gerhard  
Breitschaft  
Vice-Chairman  
CEN/TC 250**



# Agenda

- 1. Introduction*
- 2. Present Situation*
- 3. Structure of CEN/TC 250*
- 4. Evolution of Structural Eurocodes*
- 5. Future developments*



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# Introduction

- *Objective today is to provide an overview on the present situation about the Eurocodes, on recent developments and future plans*
- *To support the adoption and implementation of the Eurocodes in the Balkan Region*
- *Non-technical presentation*



# Introduction

- *The construction industry is hugely significant to the European economy. It is generally accepted that it accounts for some 6-7 % of total European Gross Domestic Product and employs approaching 15 million people.*
- *Analysis reported by the European Commission in impact assessment SEC (2008) 1900 has identified the total annual value of the European construction market as over 1,800 €Billion, with design services making up 75 €Billion*



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# Present situation

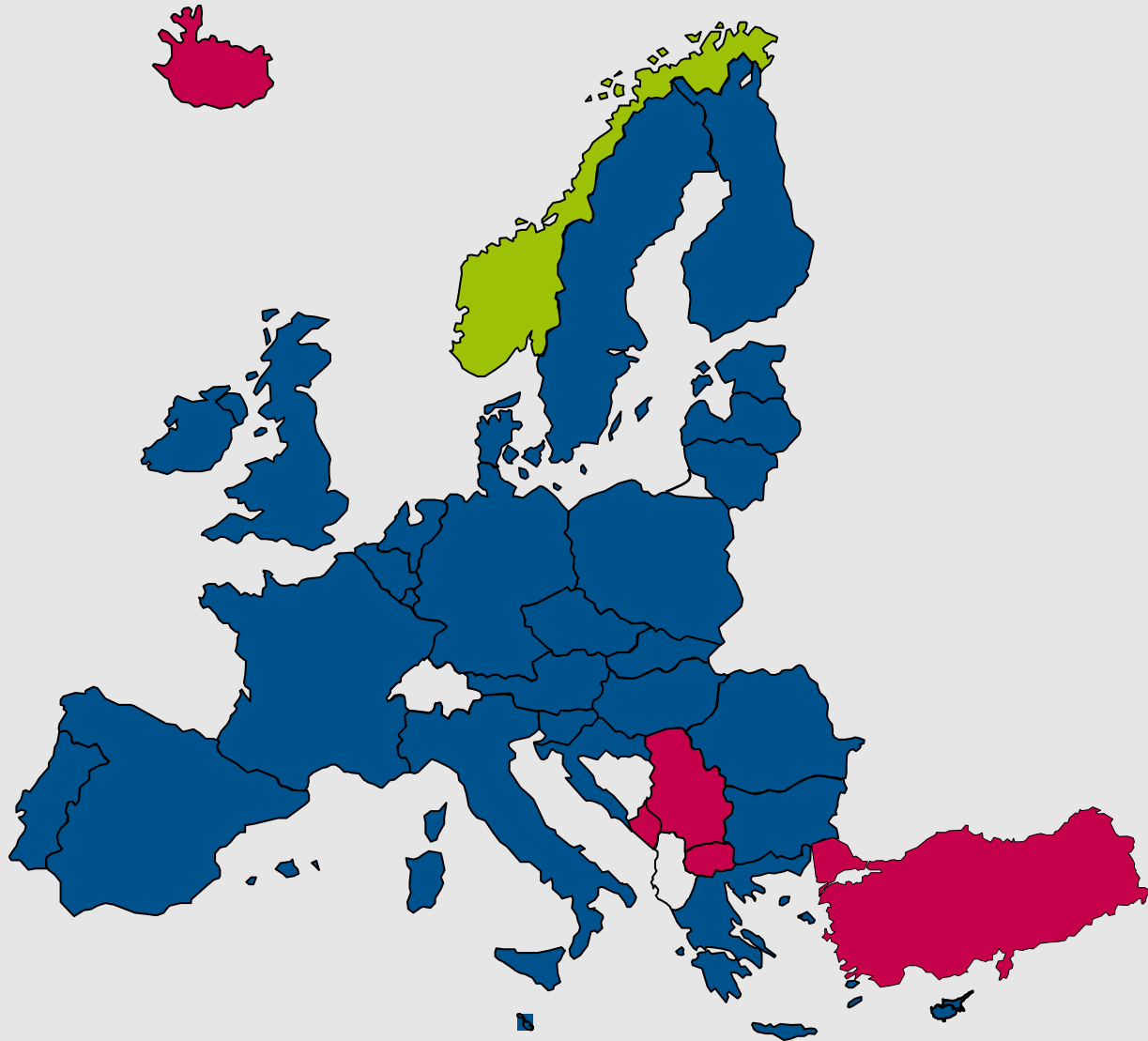
Europe

## Eurocodes

- *Agreed on all over Europe*
- *technically up-to-date*
- *comprehensive*

*Uniformity in working procedures shall be made possible for planners, performers and building owners in Europe.*

**The best available design standards**



# Present situation

*Harmonized European product standards (hENs) shall bindingly be respected via the Construction Products Regulation*

*Whether the Eurocodes must be applied, will have to be decided by the Member States, because they are responsible for the erection of safe construction works.*

*Legal implementation of Eurocodes in some Member States.*

*National standard bodies withdraw conflicting national standards*

## legal aspects





# Present situation

since 20 years



*The ENV versions of the Eurocodes have been applied for concrete construction, steel construction, composite construction and timber construction for years in parallel with the national standards*

*Sony Center in Berlin,  
Designed in the 1990th according to  
Eurocodes (ENV)  
Opening 2000*



# Present situation EN1990, EN1991, EN1998

*Basis of structural Design*  
*EN 1990,*

*Actions on Structures*

*EN 1991-1-1,*  
*EN 1991-1-2,*  
*EN 1991-1-3.*  
*EN 1991-1-4,*  
*EN 1991-1-5,*  
*EN 1991-1-6*  
*EN 1991-1-7*  
*EN 1991-2*  
*EN 1991-3,*  
*EN 1991-4*



*Design of structures for earthquake resistance*

*EN 1998-1, EN 1998-2, EN 1998-3, EN 1998-4, EN 1998-5, EN 1998-6*



# Present situation

EN1992

*Concrete Structures*

*EN 1992-1-1,*

*EN 1992-1-2,*

*EN 1992-2,*

*EN 1992-3.*





# Present situation

EN1993

## *Steel structures*

*EN 1993-1-1,  
EN 1993-1-2,  
EN 1993-1-3,  
EN 1993-1-4,  
EN 1993-1-5,  
EN 1993-1-6,  
EN 1993-1-7,  
EN 1993-1-8,  
EN 1993-1-9,  
EN 1993-1-10,  
EN 1993-1-11,  
EN 1993-1-12,  
EN 1993-2,  
EN 1993-3-1,  
EN 1993-3-2,  
EN 1993-4-1,  
EN 1993-4-2,  
EN 1993-4-3,  
EN 1993-5,  
EN 1993-6.*



# Present situation

EN1994

## *Composite Structures*

*EN 1994-1-1,*

*EN 1994-1-2*

*EN 1994-2.*



# Present situation

EN1995

*Timber Structures*  
*EN 1995-1-1,*  
*EN 1995-1-2,*  
*EN 1995-2*





# Present situation

EN1996

*Masonry Structures*

*EN 1996-1-1,*

*EN 1996-1-2,*

*EN 1996-2*

*EN 1996-3*



# Present situation

EN1997

*Geotechnical Design*  
*EN 1997-1,*  
*EN 1997-2*





# Present situation

EN1999

## *Aluminium Structures*

*EN 1999-1-1,*

*EN 1999-1-2,*

*EN 1999-1-3,*

*EN 1999-1-4,*

*EN 1999-1-5.*



# Present situation

a lot of paper



- EN 1990, 1 part, 76 pages
- EN 1991, 10 parts, 779 pages
- EN 1992, 4 parts, 477 pages
- EN 1993, 20 parts, 1471 pages
- EN 1994, 3 parts, 339 pages
- EN 1995, 3 parts, 247 pages
- EN 1996, 4 parts, 276 pages
- EN 1997, 2 parts, 374 pages
- EN 1998, 6 parts, 595 pages
- EN 1999, 5 parts, 585 pages
- Σ 58 parts, 5219 pages

(without National Annexes)



# Present situation

*Sometimes a little tricky*

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	plastic cross-sectional properties class 1, class 2
$k_{yy}$	$C_{my} C_{mLT} \frac{\mu_y}{1 - \frac{N_{Ed}}{N_{cr,y}}}$	$C_{my} C_{mLT} \frac{\mu_y}{1 - \frac{N_{Ed}}{N_{cr,y}}} \frac{1}{C_{yy}}$
$k_{yz}$	$C_{mz} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,z}}}$	$C_{mz} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,z}}} \frac{1}{C_{yz}} 0,6 \sqrt{\frac{w_z}{w_y}}$
$k_{zy}$	$C_{my} C_{mLT} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,y}}}$	$C_{my} C_{mLT} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,y}}} \frac{1}{C_{zy}} 0,6 \sqrt{\frac{w_y}{w_z}}$
$k_{zz}$	$C_{mz} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,z}}}$	$C_{mz} \frac{\mu_z}{1 - \frac{N_{Ed}}{N_{cr,z}}} \frac{1}{C_{zz}}$

Auxiliary terms:

$$\mu_y = \frac{1 - \frac{N_{Ed}}{N_{cr,y}}}{1 - \chi_y \frac{N_{Ed}}{N_{cr,y}}}$$

$$\mu_z = \frac{1 - \frac{N_{Ed}}{N_{cr,z}}}{1 - \chi_z \frac{N_{Ed}}{N_{cr,z}}}$$

$$w_y = \frac{W_{pl,y}}{W_{el,y}} \leq 1,5$$

$$w_z = \frac{W_{pl,z}}{W_{el,z}} \leq 1,5$$

$$n_{pl} = \frac{N_{Ed}}{N_{Rk} / \gamma_{M1}}$$

$C_{my}$  see Table A.2

$$a_{LT} = 1 - \frac{I_y}{I_z} \geq 0$$

$$C_{yy} = 1 + (w_y - 1) \left[ \left( 2 - \frac{1,6}{w_y} C_{my}^2 \bar{\lambda}_{max} - \frac{1,6}{w_y} C_{my}^2 \bar{\lambda}_{max}^2 \right) n_{pl} - b_{LT} \right] \geq \frac{W_{el,y}}{W_{pl,y}}$$

with  $b_{LT} = 0,5 a_{LT} \frac{\bar{\lambda}_0^2}{\chi_{LT}} \frac{M_{y,Ed}}{M_{pl,y,Ed}} \frac{M_{z,Ed}}{M_{pl,z,Ed}}$

$$C_{yz} = 1 + (w_z - 1) \left[ \left( 2 - 14 \frac{C_{mz}^2 \bar{\lambda}_{max}^2}{w_z^3} \right) n_{pl} - c_{LT} \right] \geq 0,6 \sqrt{\frac{w_z}{w_y}} \frac{W_{el,z}}{W_{pl,z}}$$

with  $c_{LT} = 10 a_{LT} \frac{\bar{\lambda}_0^2}{5 + \bar{\lambda}_z^4} \frac{M_{y,Ed}}{C_{my} \chi_{LT} M_{pl,y,Ed}}$

$$C_{zy} = 1 + (w_y - 1) \left[ \left( 2 - 14 \frac{C_{my}^2 \bar{\lambda}_{max}^2}{w_y^3} \right) n_{pl} - d_{LT} \right] \geq 0,6 \sqrt{\frac{w_y}{w_z}} \frac{W_{el,y}}{W_{pl,y}}$$

with  $d_{LT} = 2 a_{LT} \frac{\bar{\lambda}_0^2}{0,1 + \bar{\lambda}_z^4} \frac{M_{y,Ed}}{C_{my} \chi_{LT} M_{pl,y,Ed}} \frac{M_{z,Ed}}{C_{mz} M_{pl,z,Ed}}$

$$C_{zz} = 1 + (w_z - 1) \left[ \left( 2 - \frac{1,6}{w_z} C_{mz}^2 \bar{\lambda}_{max} - \frac{1,6}{w_z} C_{mz}^2 \bar{\lambda}_{max}^2 \right) n_{pl} - e_{LT} \right] \geq \frac{W_{el,z}}{W_{pl,z}}$$

with  $e_{LT} = 1,7 a_{LT} \frac{\bar{\lambda}_0^2}{0,1 + \bar{\lambda}_z^4} \frac{M_{y,Ed}}{C_{my} \chi_{LT} M_{pl,y,Ed}}$



# Present situation

Ease of Use

- *Is it a matter of number of pages only?*
- *How much simplification should be made in the standards without important methods and insights getting lost?*
- *Shall only basics and principles be stated in the standards?*
- *How many (textbook-like) explanations are necessary in standards?*
- *Can complicated coherences also be presented simpler?*
- *Are constructive and arithmetical details required in standards - and, if so, for each special case?*
- *Do we have sufficient creative freedom for well-trained engineers?*
- *Shall the standard cover every complicated construction or is it enough if only 80% of the constructions can be calculated with that?*



# Present situation

open question

- *Are, in principle, several alternative design possibilities to be provided for?*
- *Will another (an old) safety concept be required, in order to make the Eurocodes easier?*
- *Are all specifications really already state of the art or have some been taken over from the research sector without sufficient practical experience?*
- *Are calculated results stable in respect to the rough reality on site?*
- *Do we need easy formulas for calculations without computer programs?*
- *Is it necessary to see the mechanical background behind formulas?*
- *How many NDPs are really required in order to consider national characteristics?*



# Present situation

NDP

*All in all approx. 1500 parameters to be determined nationally (NDP)*

*24% for Eurocode 1,  
15 % for Eurocode 2 and  
28% for Eurocode 3*

*Many of the NDPs and the many alternatives when calculating, are justified by lacking harmonization.*

*But they allow to guarantee any possible safety level for each country.*

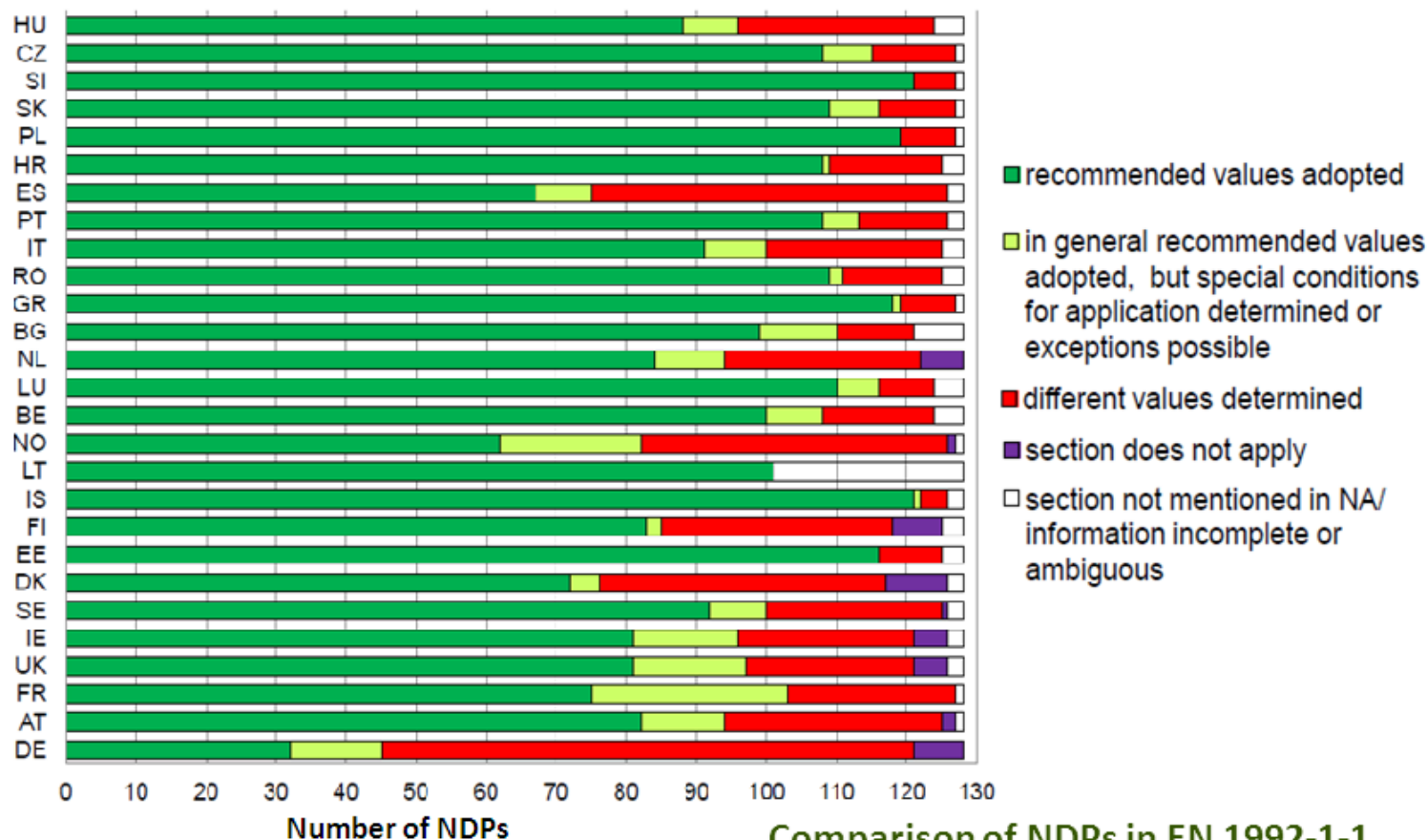
*The big number of NDP was necessary to get acceptance to this first generation of the Eurocodes in all countries implementing them.*





# Present situation

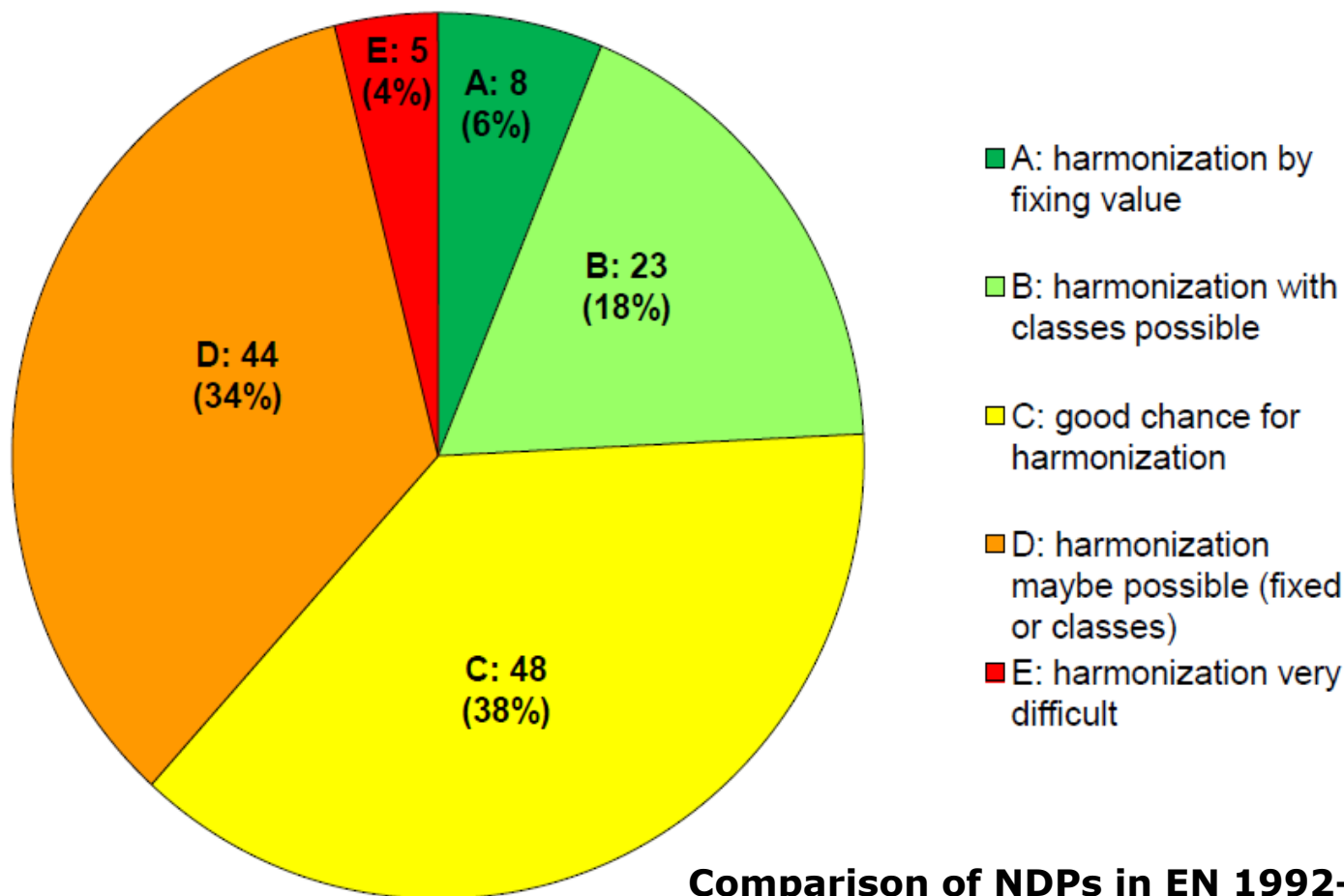
NDP, EN 1992



# Present situation

Potential of  
harmonization

**Potential of harmonization of NDPs in EN 1992-1-1  
(27 countries analysed)**



**Comparison of NDPs in EN 1992-1-1  
done by A Ignatiadis, DAfStb**





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# Newest Developments in Organisation of TC250

- *Appointment of new Chairman Steve Denton UK,*
- *Vice Chairmen Michael Fardis GR,  
Gerhard Breitschaft DE*
- *Management Group*
- *Advisory Panels*



## Management Group

Chairman: S Denton

## TC 250 Structural Eurocodes

Chairman: S Denton  
Vice Chairmen: G Breitschaft, M Fardis  
Secretary: T Wilkins [BSI]  
CEN PM: Gonalo Ascensao

## TC 250 Coordination Group

Chairman: S Denton  
Secretary: T Wilkins [BSI]

Chairman's  
advisory panel(s)

### Horizontal Group Bridges

Convenor: S Denton\*

### Horizontal Group Fire

Convenor: B Zhao

### WG1 – Policy and guidelines

Convenor: J Moore

## SC/WG for Existing Eurocodes

### WG7 – EN 1990

Convenor: P Formichi  
Secretary: \*to be confirmed

### SC5 – EN 1995

Chairman: A Jorissen  
Secretary: J Brundin [SIS]

### SC1 – EN 1991

Chairman: N Malakatas  
Secretary: A Schleifer [DIN]

### SC6 – EN 1996

Chairman: R Van der Pluijm  
Secretary: Peter Rauh [DIN]

### SC2 – EN 1992

Chairman: G Mancini  
Secretary: A Schleifer [DIN]

### SC7 – EN 1997

Chairman: A Bond  
Secretary: M Lurvink [NEN]

### SC3 – EN 1993

Chairman: U Kuhlmann  
Secretary: B Borchert [BSI]

### SC8 – EN 1998

Chairman: E Carvalho  
Secretary: E Coelho [IPQ]

### SC4 – EN 1994

Chairman: G Couchman  
Secretary: B Borchert [BSI]

### SC9 – EN 1999

Chairman: F Mazzolani  
Secretary: R Saegrov [SN]

## Other WG

### WG2 – Existing Structures

Convenor: P L chinger [SNV]

### WG3 – Structural Glass

Convenor: M Feldmann [DIN]

### WG4 – Fibre reinforced polymer

Convenor: L Ascione [UNI]

### WG5 – Membrane Structures

Convenor: M Mollaert [NBN]

### WG6 – Robustness

Convenor: R Van der Pluijm [NEN]

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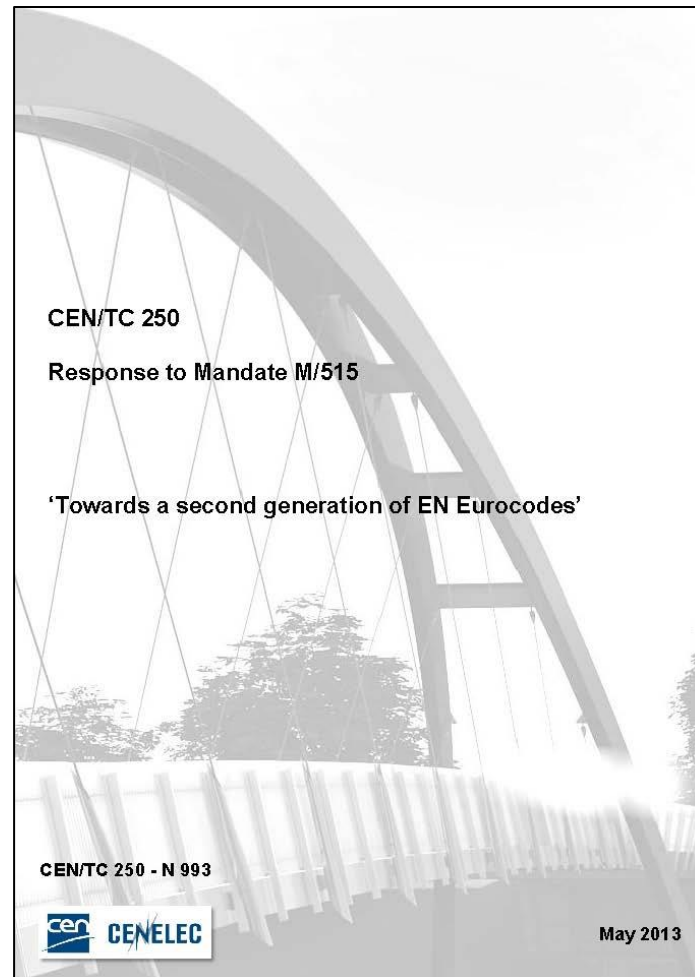
# Evolution of Structural Eurocodes

- *European Commission (EC) issues programming mandate M/466 EN to CEN in May 2010*
- *Response was issued to EC in June 2011*
- *EC issued specific mandate M/515 EN in Dec 2012*
- *Technical response prepared, issued to EC in May 2013:*
  - ***'Towards a second generation of EN Eurocodes'***
- *Technical response agreed, contractual quotation in preparation*



# Response to mandate M/515 EN

- *Detailed document prepared by TC 250*
- *Defines detailed work programme*
- *Explains how work will be done*
- *138 pages*



TCEN1990

Response to Mandate M/515 EN: Structural Eurocodes

<b>Task Ref:</b>	<b>TCEN1990.T1</b>	<b>Task Name:</b>	Evolution of EN1990 – General
<b>Proposed Task Phase:</b>	<b>P1</b>	<b>Deliverable:</b>	A new version of EN 1990 with an increased scope reflecting needs identified by National Standard Bodies and the other Eurocodes, together with background information for all changes and new material, excluding new version of Annex A2 for bridges and new Annex Es relating to bearings and expansion joints.
<b>Outline Task Scope:</b>		Revision of EN 1990 to incorporate comments from the EN 1990, 5 year review and requirements from other Eurocodes for principle guidance on fatigue, non-linear analysis etc with the Specific Mandate Section 5 from Mandate for amending existing Eurocodes and extending the scope of structural Eurocodes (Document Doc 28/2012 – EN, Brussels, 13th July 2012). Scope does not include specific work relating to Bridges which is included in Task TCEN1990.T2.	
<b>Starting documents:</b>		EN 1990: Basis of Structural Design	
<b>Justification for inclusion in Phase 1:</b>		EN 1990 is the head Eurocode, setting the rules for achieving safety, serviceability, robustness and durability as well as Reliability and Quality Management for the other 57 parts of the Structural Eurocode suite and CEN structural product standards. It is the cornerstone for all other Structural Eurocodes and serves as a template for the development of new parts as well as revision of existing standards. The items identified by the CEN/TC250/Expert Group for the revision of EN 1990 described in this proposal have been developed collaboratively with a representative cross section of stakeholders and need to be given priority. The selected tasks will further support and strengthen harmonisation, the development of an EU Internal Market in the design and construction sector. The work takes into account market and research developments in materials, products, construction techniques and design methods in the sector. It also reflects new societal needs and demands as linked to structural design of buildings and other construction works. Therefore EN 1990 as the head code needs to be updated at the earliest convenience so as to form a basis for the work of the other sub-committees. As full a draft as possible must be made available at end of Phase 1.	

Sub-task Ref.	Sub-task name	Brief description, background and reasons for the work (including any additional comments / notes)	Interdependencies  Identify known Task (sub-tasks) that must be substantially completed before this sub-task can commence.  (Interdependencies within individual Tasks do not need to be identified)	Key benefits	Output (e.g. new Eurocode part; new or modified clauses in existing Eurocode part)	Priority item for EC contract
1	Reduction in number of National Choices (NDPs)	Review the contents of all Countries' National Annexes and supporting documents, where they provide information needed to implement the Eurocode Part. Compare the values or choices made by all Countries in their relevant National Annex, using if possible, the JRC database of collected National values and choices. Where little or no variation exists between Countries, eliminate the NDP; where there is good consensus, but not unanimity, seek to persuade those not using that value or choice to adopt it. In cases of wide variation between Countries, seek the reasons for them and try to eliminate them so that consensus can be achieved, for example by use of international studies and research.				✓
2	Enhanced ease of use	Enhance ease of use by improving clarity, simplifying routes through the Eurocode, avoiding or removing rules of little practical use in design and avoiding additional and/or empirical rules for particular structure or structural-element types, all to the extent that it can be technically justified whilst safeguarding the core of essential technical requirements. Take into account feedback from users of the Eurocode.				✓
3	Transfer of Basis of Design rules from EN 1991-1-6, EN 1991-3, EN 1991-4, EN 1993-3-1, EN 1993-3-2 and EN 1991-7.	There are a number of Basis of Design clauses at present included in EN 1991, such as EN 1991-1-6, EN 1991-3 and EN 1991-4, and EN 1993-3-1 and EN 1993-3-2 on Towers and Masts and EN 1991-7. These parts, including y factors will be moved to EN 1990, to guarantee consistency with general rules and harmonisation. (N.B. as this is a maintenance activity no resources have been allowed for it).	All work to provide information completed	All Basis of Design information will be in EN 1990 thus avoiding mixed responsibilities that can lead to inconsistency.	New Annexes A3, A4 and A5 in EN 1990.	
4	Evolution of management of structural reliability of construction works (Annex B)	Adapt EN 1990 by establishing and implementing control procedures for design and execution in agreement with the principles of the standard, on a national level recognizing differences between the various countries. Making Annex B of EN 1990 more comprehensive by increasing its scope to construction works with higher consequences of failure than Consequence Class 3 and recognizing complexity of design. Improving alignment with Execution Standards (EN 1090 and EN 13670) and appropriate material Eurocodes.	EN 1990 as the head code needs to be updated first so as to form a basis for the work on reliability differentiation of the other SCs and WGs and CEN Committees developing Execution Standards	The evolution of Annex B, which is expected to be kept informative, will assist NSBs in helping ensure that the assumptions in the Eurocodes relating to quality management during design and execution are fulfilled and thus leading to increased levels of safety. EN 1990 as the Head code will ensure alignment with related annexes in material parts together with consistent approach.	Revised Annex B and revisions to Section 2.	✓
5	Robustness	Review and update as necessary the requirements for Robustness in Section 2 of EN 1990 in the light of recent published cost action (COST Action TU0601, 2011) report. It is expected that work will also include moving some information from EN 1991-1-7 to EN 1990 and further developing these rules. This will be in liaison with WG6: Robustness.	In liaison with WG6: Robustness	Ensure that the requirements for robustness reflect the latest state of the art.	Updated Section 2 of EN 1990. Based on the recommendations of WG6 the inclusion of new clauses into EN 1990, based on content currently included in other Eurocodes.	✓
6	Sustainability	Update EN 1990 to include aspects of sustainability relevant to the scope of the Eurocodes, responding to the relevant requirements for Sustainability developed by e.g. TC 350. At the present time any amendment will be Section 2 Requirements.	EN 1990 as the head code needs to be updated first so as to form a basis for the work of the other SCs and WGs.	EN 1990 will address the new Requirement the "Sustainable use of natural resources" in particular as it addresses durability in the CPR.	New and modified clauses in EN 1990.	✓

File name: EN1990 Template 3 draft 4.0

Draft/Final version of: 26/04/2013

TC EN 1990 – page: 1 of 3

File name: EN1990 Template 3 draft 4.0

Draft/Final version of: 26/04/2013

TC EN 1990 – page: 2 of 3

File name: EN1990 Template 3 draft 4.0

Draft/Final version of: 26/04/2013

TC EN 1990 – page: 3 of 3

File name: SC1 Template 3 draft 4.0

Draft/Final version of: 26/04/2013

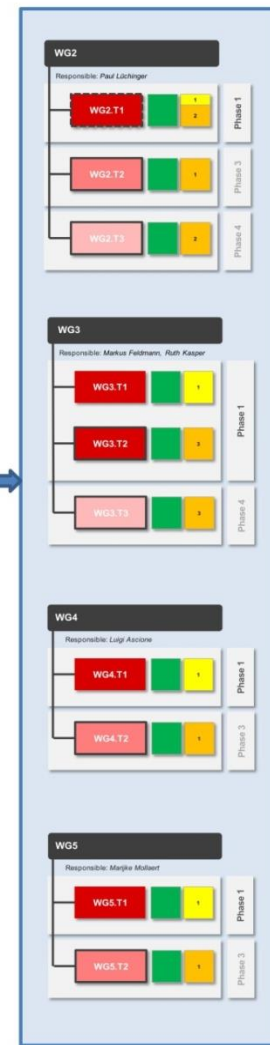
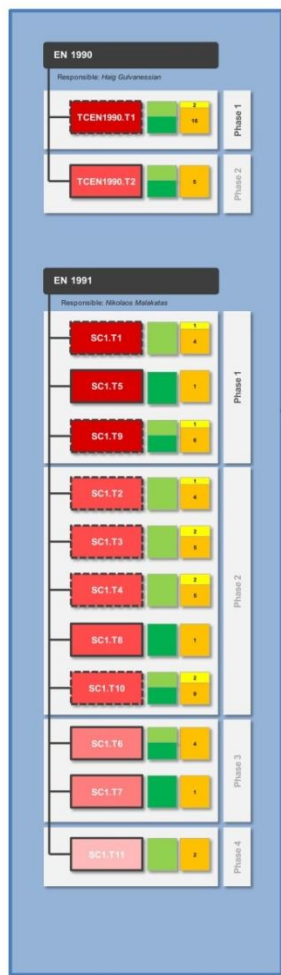
SC 1 – page: 1 of 14



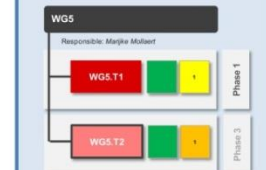
# Annex 2



European  
Commission



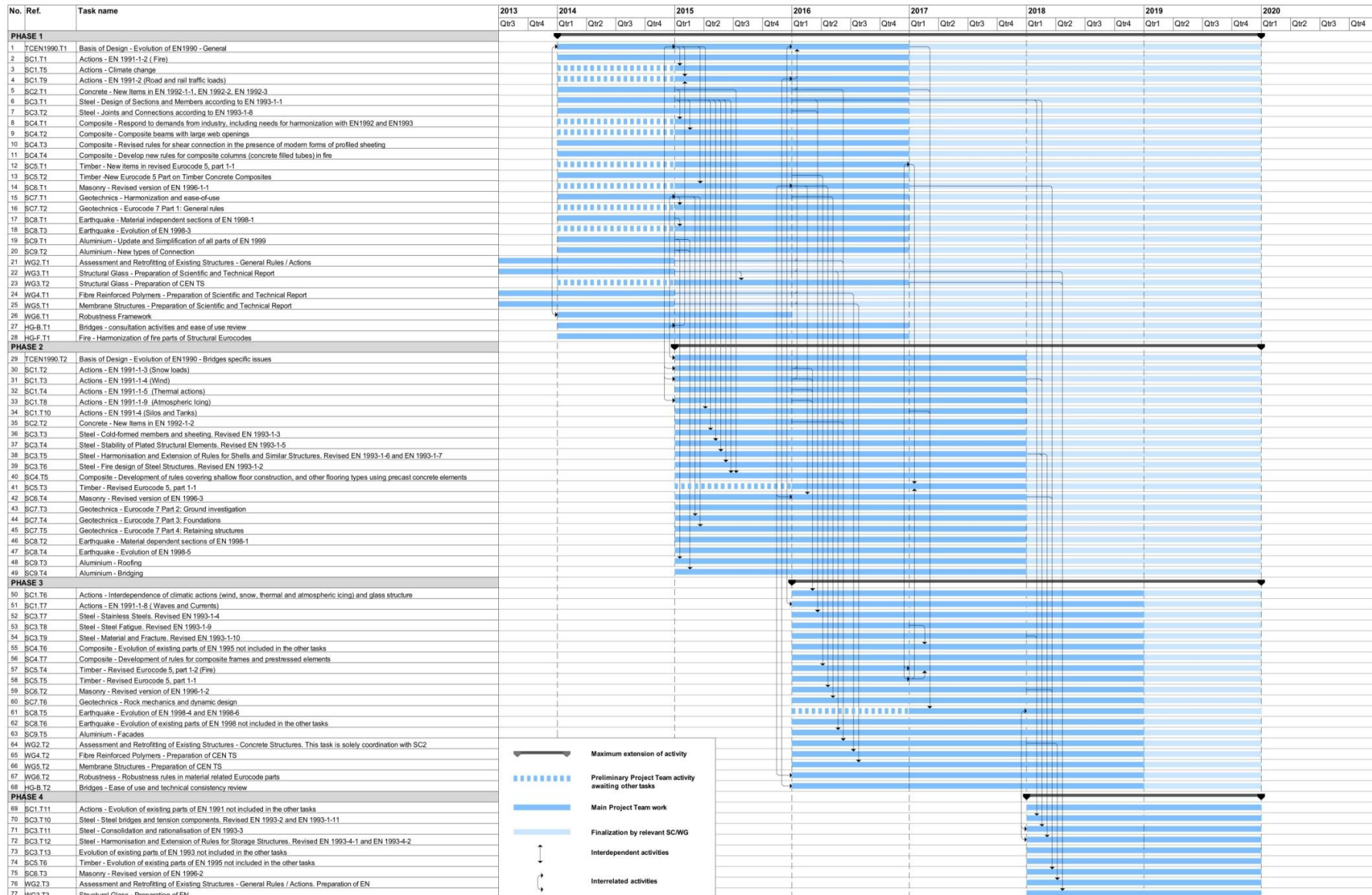




# Annex 3.1



European  
Commission



Draft 4.0 - April 2013

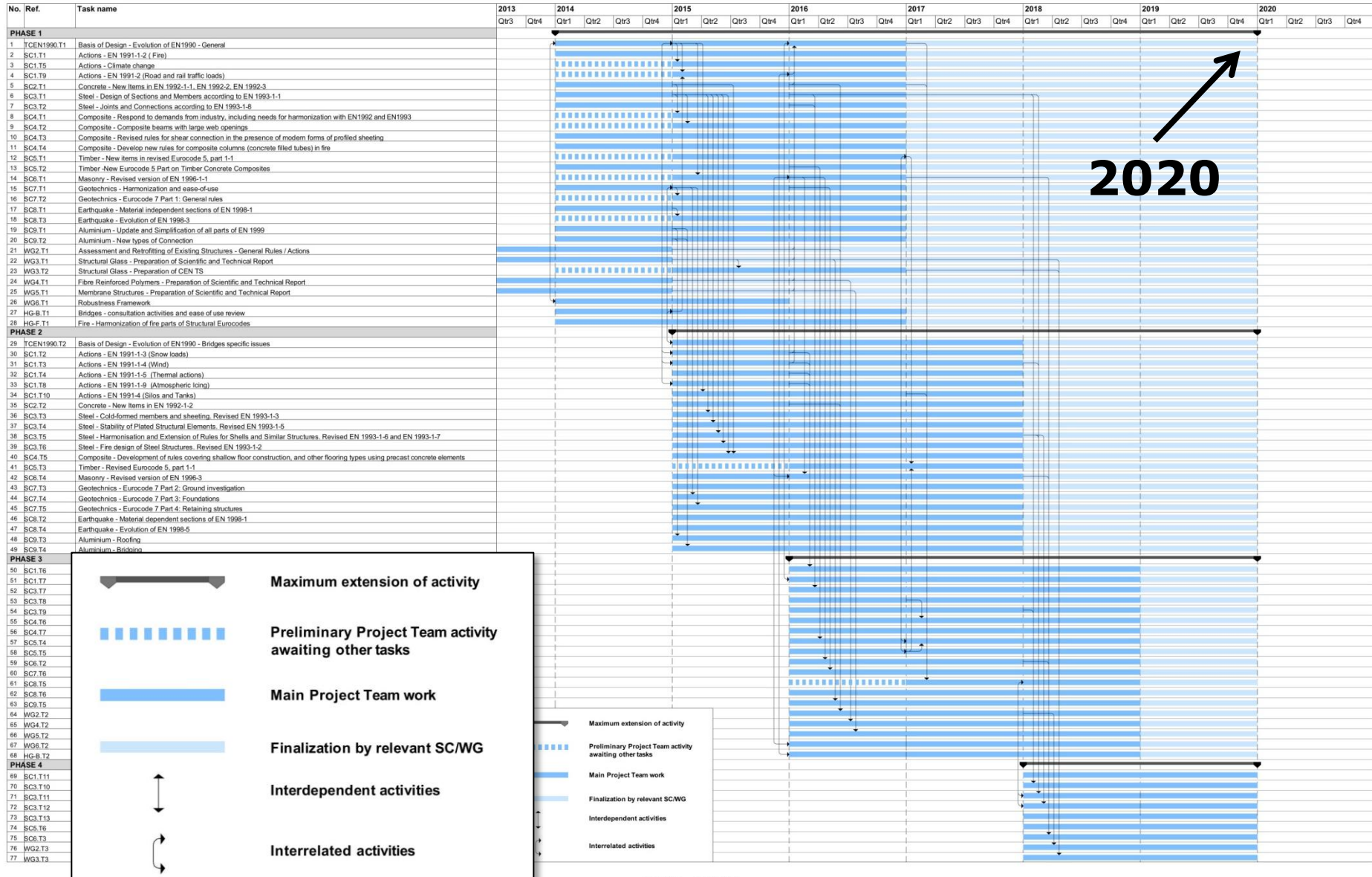
**ADOPTION OF THE EUROCODES IN THE BALKAN REGION**  
**5-6 December, 2013**



# Annex 3.1



European  
Commission



Draft 4.0 - April 2013



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# Future Developments

*The  
Eurocodes  
are like a  
huge  
buffet...*



# Future Developments

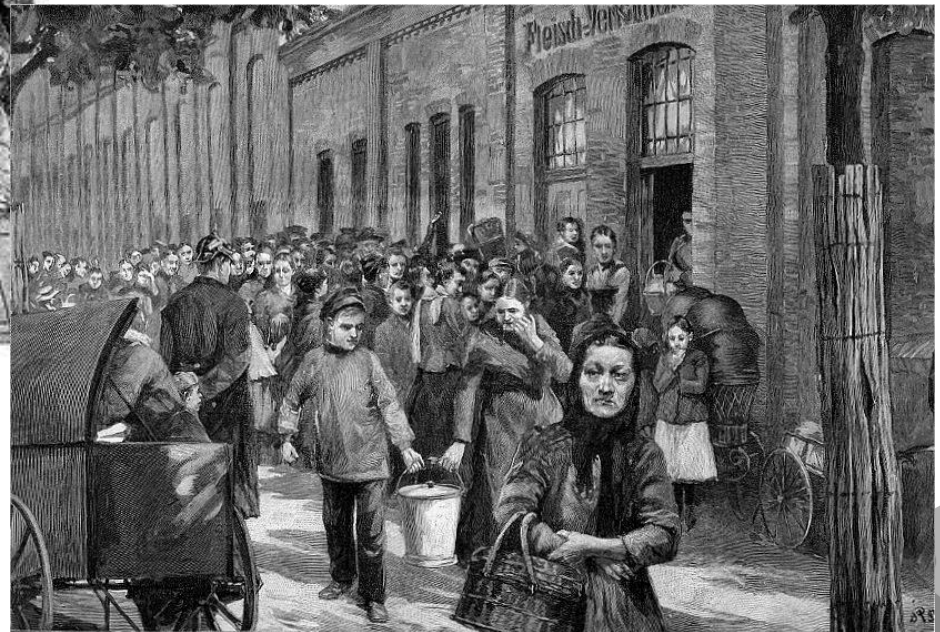
*...prepared by various very good chiefs...*





# Future Developments

*...for many  
different guests.*



Berliner Bilder: Verkauf von gekochtem Fleisch auf dem Zentralviehhof an arme Leute. Nach dem Leben gezeichnet von Karl Storch.



# Future Developments

*Some of the code users like it ...*



*...very delicious and don't fear complications*





# Future Developments

*Some of our users like only easy codes*



*Simple but tasty*



# Vision for future Developments

- *Enhance 'ease of use' is a key priority*
- *Greater harmonisation – reduction in NDPs*
- *Some extension of scope*
  - *New Eurocodes*
  - *New Parts*
  - *New Content*



# Future Developments

## Business Plan

### **"Benefits**

*The benefits of the Structural Eurocodes include: providing a common understanding regarding the design of structures between owners, operators and users, designers, contractors and manufacturers of construction products; facilitating the exchange of construction services between Member States; providing a common basis for research and development in the construction sector; allowing the preparation of common design aids and software; and increasing the competitiveness of the European civil engineering firms, contractors, designers and product manufacturers in their world-wide activities."*



# Business Plan

## **"Priorities**

*This work includes the development of a new Structural **Eurocode on Glass** and revisions to the existing codes to cover:*

***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.***

*The work programme also includes the incorporation of ISO Standards for atmospheric icing and actions from **waves and currents on coastal structures** in the Eurocodes family, and the steps towards the development of new Eurocodes on **membrane structures** and structural applications of **Fibre Reinforced Polymers (FRP).**"*



# Business Plan

## *Impact*

User confidence in Eurocodes retained as they remain state-of-the-art documents

Improved efficiency of design processes and reduced barriers to entry through enhanced user friendliness

## *Benefit*

This is an essential underpinning requirement for the Eurocodes to remain credible standards of the highest reputation, promoting confidence in their use within Europe and adoption elsewhere around the world. Increased user-friendliness in comparison with the first generation of Eurocodes will reflect best practice in standards development.

The design market has an annual worth of 75€Billion. Every 0.1% efficiency saving in design processes would therefore yield a 75€Million annual saving. Enhanced user friendliness will reduce barriers to entry and aid opportunities for small and medium sized enterprises.



# Business Plan

## *Impact*

Improved harmonization across member states, through e.g. reduction in NDPs and different design methods

Use of new methods and new materials. Enhanced coverage of robustness

## *Benefit*

Improved harmonization will reduce barriers to trade of products and services.

This will enable the latest technologies and knowledge to be applied in a way that is acceptable for practitioners, promoting cost effectiveness and sustainability in design, and innovation.





# Business Plan

## *Impact*

*Relevant sustainability consideration incorporated within design requirements*

*Climate change consideration embraced within Eurocodes*

*Incorporation of initial requirements for assessment and retrofit of existing structures*

## *Benefit*

This supports European Community objectives, including those for energy saving and waste accrual.

This will provide increased resilience of long-life infrastructure assets to potential climatic changes. It is very cost effective to address such risks at the design stage rather than through later retrofitting. Such an approach also reduces user disruption and environmental impacts.

This supports the effective and sustainable management of existing infrastructure, providing a consistent technical framework across member states as a platform for future R&D and appropriate harmonization, enabling the sustainable life extension of existing assets.



**Many thanks for  
your attention!**



**Presentation by  
Dipl.-Ing. Gerhard Breitschaft**

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**Vice chairman CEN TC 250**

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