12 marzo 2019

ore 13:00-17:30

Workshop

Affidabilità e codici per le costruzioni

presso il Consiglio Nazionale degli Ingegneri

via XX Settembre, 5 (Roma)

Evoluzione della EN1990 - Basis of Structural Design per la seconda generazione degli Eurocodici

Paolo Formichi

Chairman of CEN/TC250/SC10 Basis of Structural Design

Dipartimento di Ingegneria Civile e Industriale dell'Università di Pisa

CONSIGLIO NAZIONALE DEGLI INGEGNERI

ENTE ITALIANO DI NORMAZIONE

reluis

EUROCODES
BUILDING THE FUTURE

500’000 Ingegneri Strutturisti

75 MLD € Servizi di Ingegneria EU

34 Paesi CEN

Oltre 2’000 esperti coinvolti nei lavori del CEN/TC250

CEN/TC250

11 SCs

5 WGs

2 HGs

Evoluzione ed aggiornamento degli Eurocodici esistenti (EoU / Harmonization)

Nuovo Eurocodice sulle Strutture in Vetro

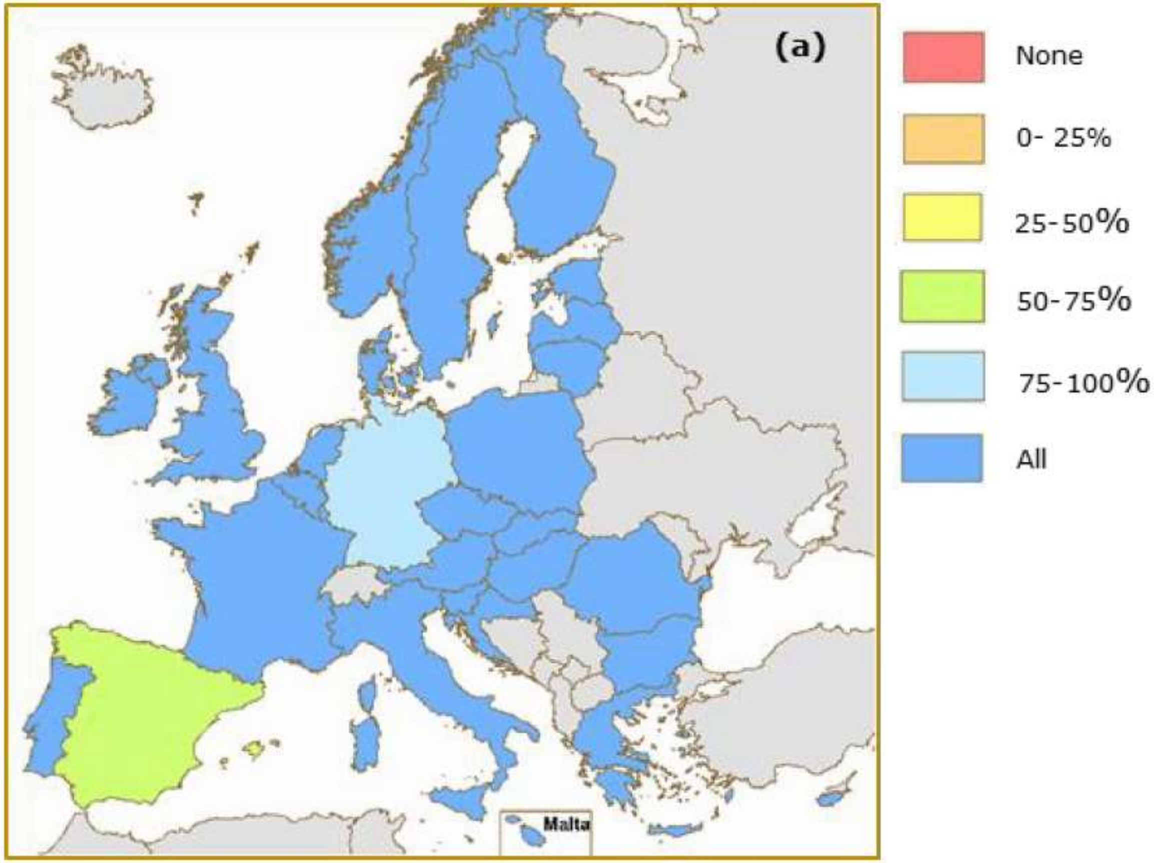
Nuovo Eurocodice sulle Strutture Esistenti

Studi per un Nuovo Eurocodice sulle Strutture in FRP

Studi per un Nuovo Eurocodice sulle Strutture Membranali

Mandato M515 European Commission → CEN
"Evoluzione degli Eurocodici" (verso la 2° Generazione)

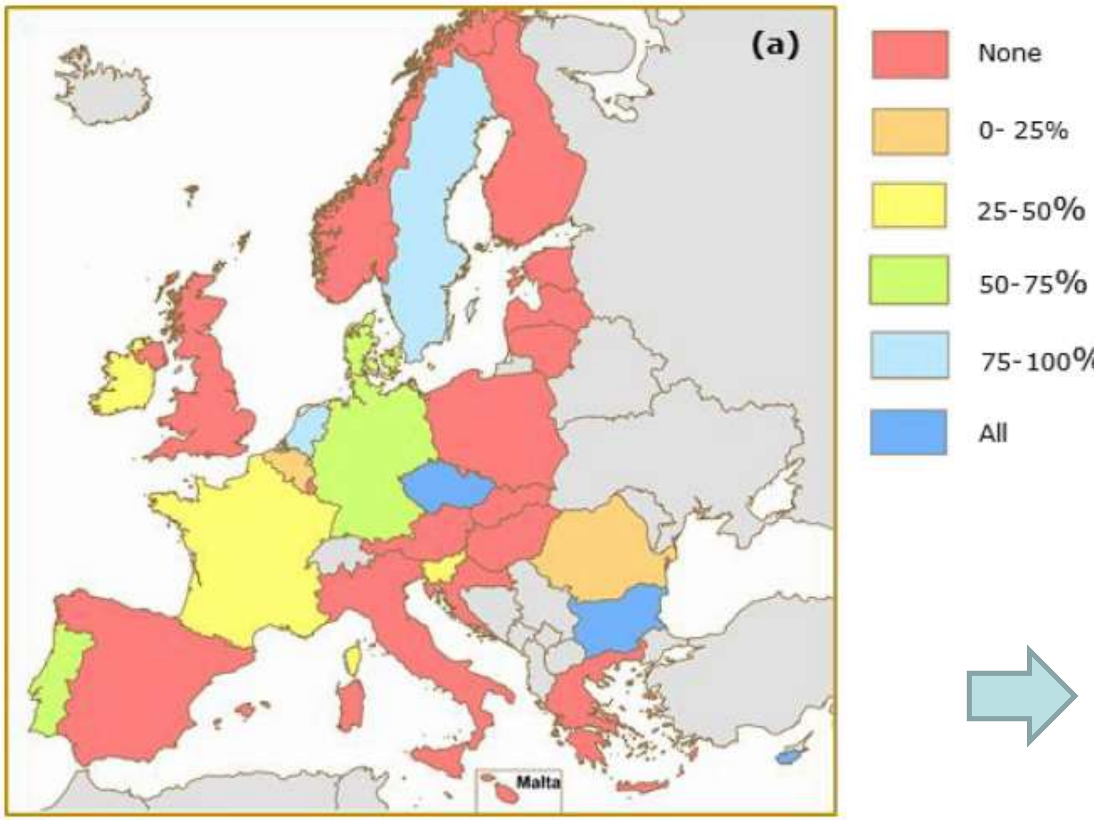
Percentuali di pubblicazione degli Eurocodici come codici nazionali nei Paesi CEN



Fonte European Commission JRC (2019)

Mandato M515 European Commission → CEN
“Evoluzione degli Eurocodici” (verso la 2° Generazione)

Percentuale delle parti degli Eurocodici in uso obbligatorio nei Paesi CEN



Fonte European Commission JRC (2019)

«Ease of Use»

*“… In __**Italy**__ and Romania the regulatory environment posed considerable restrictions to the implementation of the Eurocodes.”*

Mandato M515 European Commission → CEN
"Evoluzione degli Eurocodici" (verso la 2° Generazione)

«Ease of Use»

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

80%

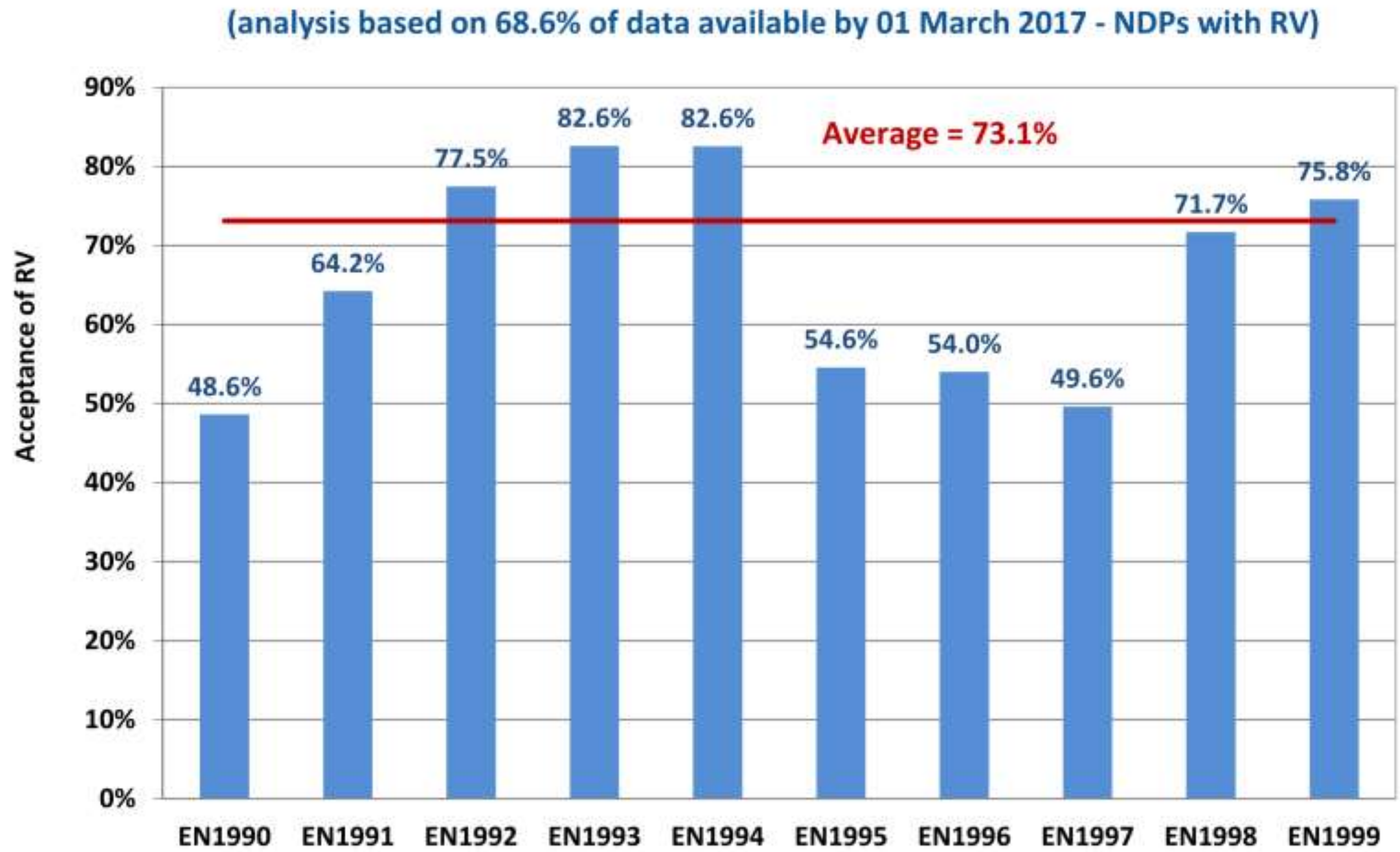
20%

Mandato M515 European Commission → CEN
“Evoluzione degli Eurocodici” (verso la 2° Generazione)

«Ease of Use»

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

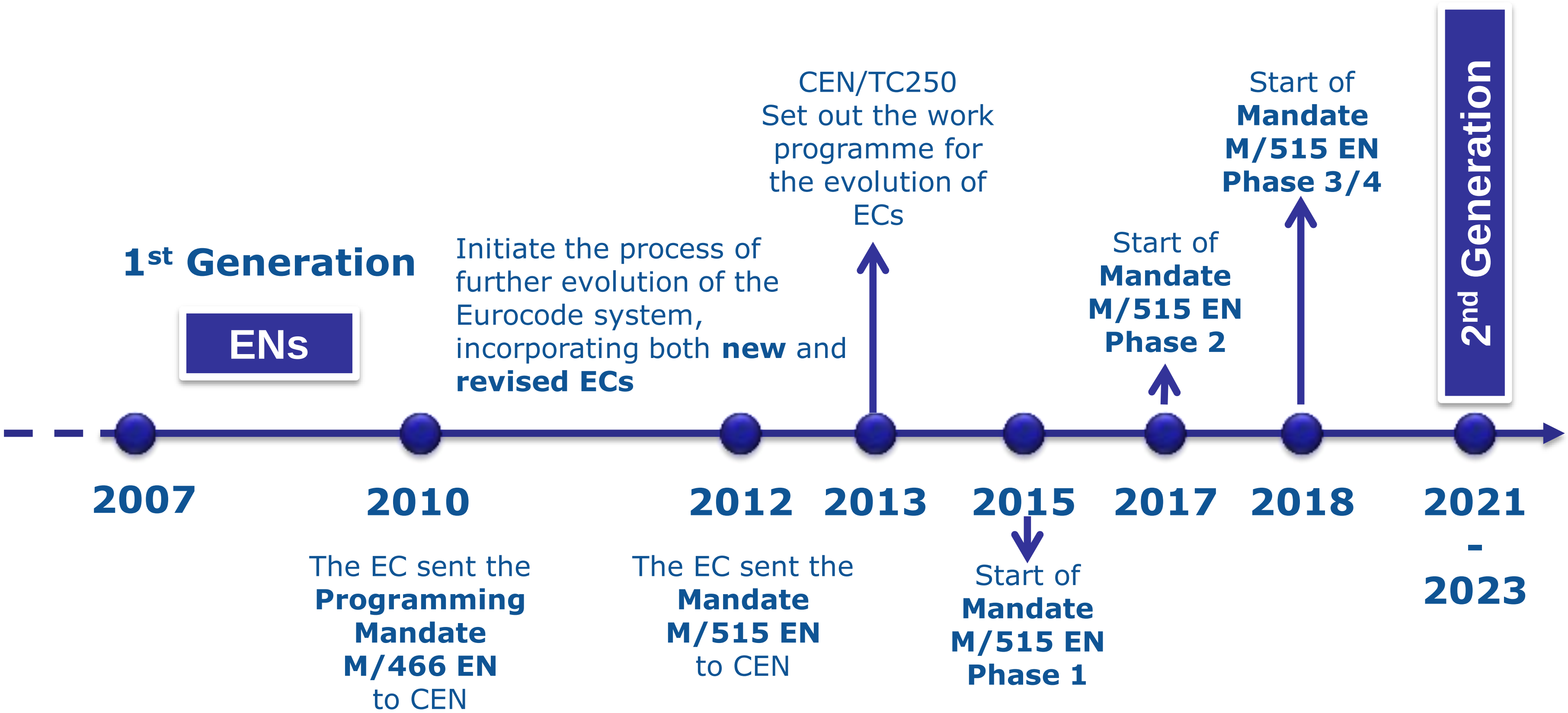
NDPs database: acceptance of recommended values



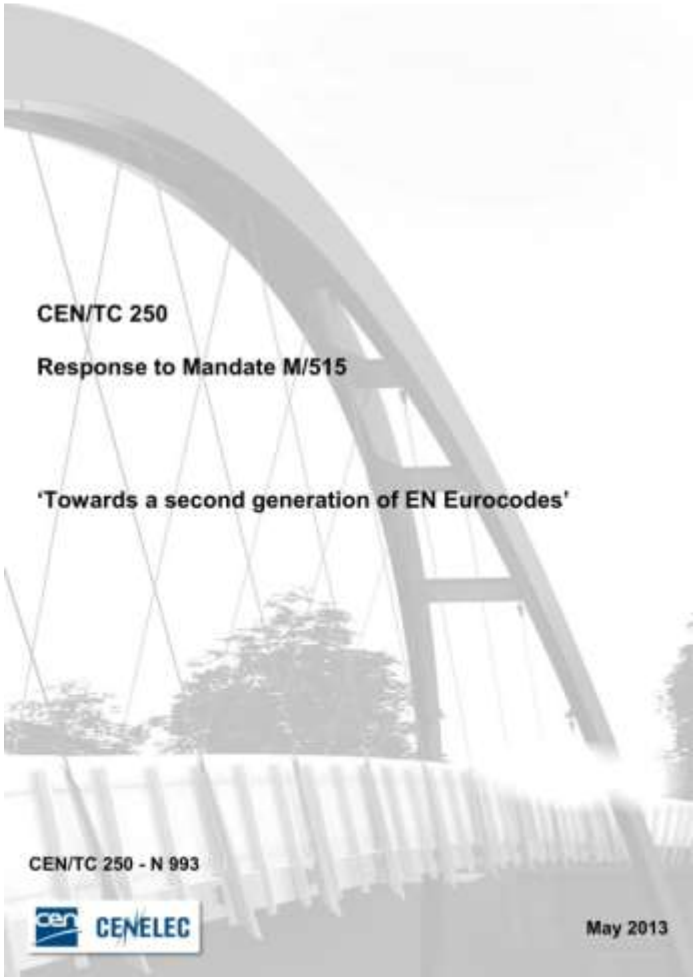
Mandato M515 European Commission → CEN
OBIETTIVO: Riduzione degli NDP

European Commission

Mandato M515 European Commission → CEN
"Evoluzione degli Eurocodici" (verso la 2° Generazione)



Mandato M515 European Commission → CEN
"Evoluzione degli Eurocodici" (verso la 2° Generazione)


CEN/TC 250

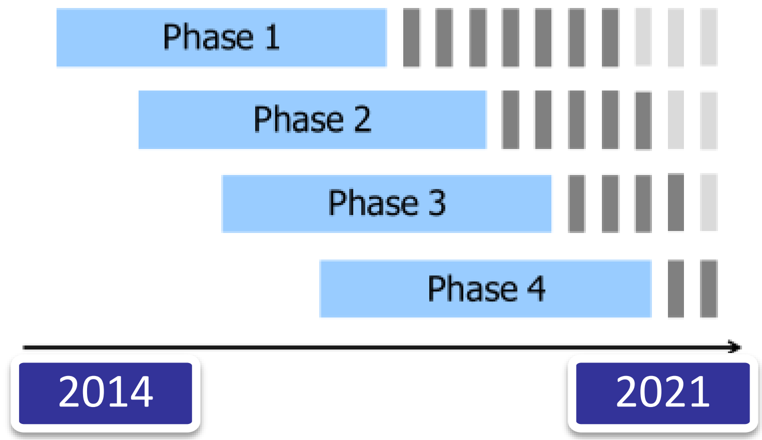
Response to Mandate M/515

'Towards a second generation of EN Eurocodes'

CEN/TC 250 - N 993

CENELEC

May 2013



73 Project Teams in totale (~400 Esperti)
11 MLN € finanziati dalla Commissione Europea

Fase 1: 25 PT – Conclusa (gen. 2015 – giu. 2018)
Fase 2: 22 PT attivi (gen. 2017 – giu. 2020)
Fase 3: **18 PT attivi** (gen. 2018 – giu. 2021)
Fase 4: 8 PT attivi (giu. 2018 – giu. 2021)

"evolution" , not a "revolution"

Evolution of EN1990 – General

Sub-Tasks
Reduction in number of National Choices (NDPs)
Enhanced ease of use
Transfer of Basis of Design rules from EN 1991-1-6, EN 1991-3, EN1991-4, EN 1993-3-1, EN 1993-3-2 and EN 1991-7.
Evolution of management of structural reliability of construction works (Annex B)
Robustness
Sustainability
Evolution of Annex C with additional material on Material and Resistance Factors; Load and Combination Factors
Serviceability of buildings
Fatigue verification
Ultimate Limit States

M/515 - 18 Sub-tasks

Evolution of EN1990 – General

Sub-Tasks
Non-linear analysis
Basis of Design information for New Eurocodes (assessment, glass, FRP and membrane structures)
Individual technical comments as they arise from practitioners which EG consider important for inclusion in EN 1990
Foreword
Design assisted by testing
Climate change
Alignment with EN 1997
Loading requirements relating to atmospheric icing and current and waves

M/515 - 18 Sub-tasks

Evolution of EN1990 – General

EN1990 Main Text

- A1 Buildings
- A2 Bridges
- A3 Towers and Masts
- A4 Silos and Tanks
- A5 Crane Supporting Structures
- A6 Structures exposed to waves and currents
- B Management
- C Reliability Bases
- D Design assisted by testing
- E Robustness
- F Bearings and Expansion Joints
- G Vibrations in Footbridges

Evolution of EN1990 – General

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- A1 Buildings
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- A6 Structures exposed to waves and currents
- B Management
- C Reliability Bases
- D Design assisted by testing
- E Robustness
- F Bearings and Expansion Joints
- G Vibrations in Footbridges

1st Package

2nd Package

Evolution of EN1990 – General

Improving accessibility to technical provisions and ease of navigation between them

Examples form EN1990

Main text

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

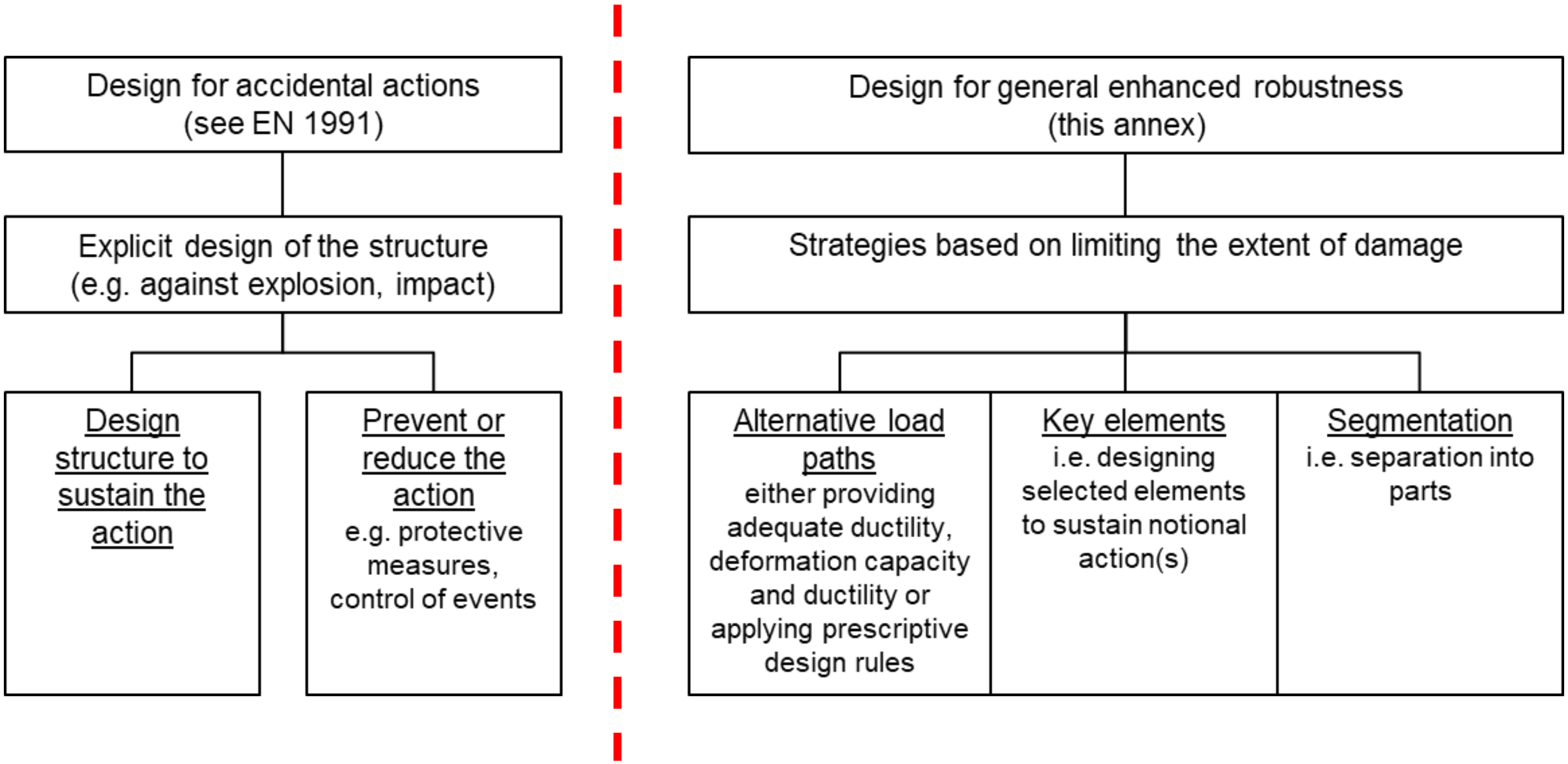
Specialist (informative) Annexes

Evolution of EN1990 – General

Annex E

(informative)

Additional robustness provisions for buildings



Evolution of EN1990 – General

Annex C

(informative)

Reliability analysis and code calibration

C.3
Basis for reliability analysis and partial factor design

Per gli Utenti

	Applied when:
Semi-probabilistic approach: - safety format prescribing the design equations and the analysis procedures to be used.	Default method in the Eurocodes, i.e. to be used for usual design situations.
Reliability-based design and assessment: - reliability requirement to fulfil.	Unusual design situations in regard to uncertainties. Code Calibration.
Risk-informed decision making: - decisions are taken with due consideration of the total risks (e.g. loss of lives, injuries, environmental and monetary losses.	Exceptional design situations in regard to uncertainties and consequences. Derivation of reliability requirements.

C.4
Approach for calibration of design values

Per NSB

Consequence class	β (50 years reference period)
CC3	4,3
CC2	3,8
CC1	3,3

Calibrazione dei fattori parziali

Evolution of Annex C with additional material on Material and Resistance Factors; Load and Combination Factors

7	Evolution of Annex C with additional material on Material and Resistance Factors; Load and Combination Factors	Amend Sections 4 and 6 and extend the scope of Annex C to enhance usefulness for practical users: • Provide background on the determination of γ_M and γ_R factors dependent upon strength parameters and calculation models. • Provide background on the determination of γ_G and γ_Q factors for actions and for model uncertainties. • Provide guidance on inter-relationship of climatic actions • Provide strong links between the load combination expressions and information contained in Annex B.

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.	Opportunity to achieve more economic design without reducing levels of safety and increased clarification.	New and modified clauses in EN 1990 in Sections 3, 4, 6 and Annex C of EN 1990.

La richiesta della SC2 di ricalibrazione dei fattori parziali per le Azioni Permanenti e Variabili

DECISION 195 (Berlin 3) taken by CEN/TC 250/SC 2 on 2013-03-01

Subject: CEN/TC 250/SC 2 – EN 1990

CEN/TC 250/SC 2 asks the EN 1990 EG to recalibrate the γ-factors, e.g. γ_G and γ_Q, considering the actual probability density function of the permanent and variable actions, to give a consistent reliability level across the different construction materials.

The decision was taken by unanimity.

Il punto di partenza

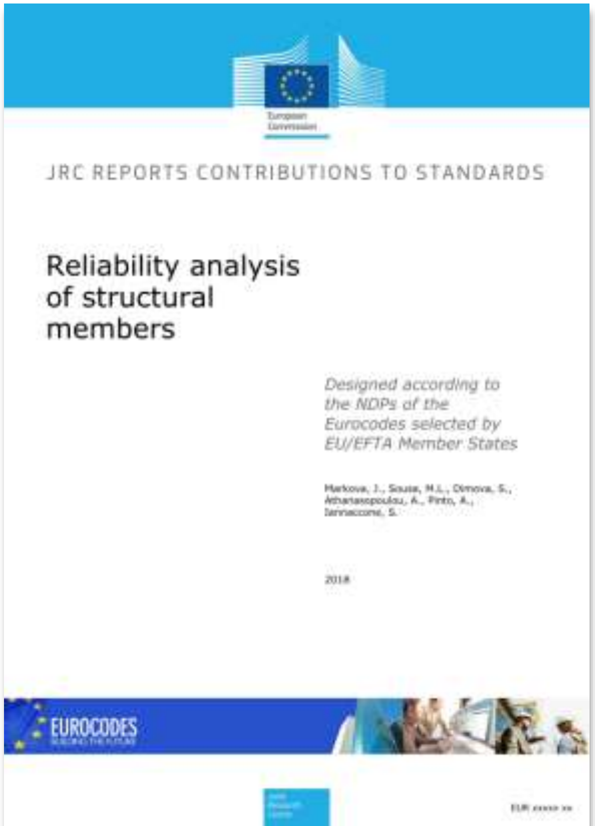
BS EN 1990:2002+A1:2005
EN 1990:2002+A1:2005 (E)

Table B2 - Recommended minimum values for reliability index β (ultimate limit states)

Reliability Class	Minimum values for β	
	1 year reference period	50 years reference period
RC3	5,2	4,3
RC2	4,7	3,8
RC1	4,2	3,3

NOTE A design using EN 1990 with the partial factors given in annex A1 and EN 1991 to EN 1999 is considered generally to lead to a structure with a β value greater than 3,8 for a 50 year reference period. Reliability classes for members of the structure above RC3 are not further considered in this Annex, since these structures each require individual consideration.

https://ec.europa.eu/jrc/en/publication/reliability-analysis-structural-members



1 Introduction

This report aims to present the reliability levels of structural members designed according to the partial factor method given in the Eurocodes, using the Nationally Determined Parameters (NDPs) uploaded in the European Commission Database by the Member States (MS) of the European Union (EU) and of the European Free Trade Association (EFTA). The Eurocodes Database for Nationally Determined Parameters, herein called the "NDPs Database", has restricted access to the interested Commission Services, CEN/TC 250 Coordination Group and its 10 Sub Committees, the interested National Authorities and the National Standardization Bodies of the EU and EFTA Member States, and is administrated by the Joint Research Centre (JRC). The report includes the description of the underlying methodology to evaluate the reliability levels, the presentation of the used data, the analysis of reliability levels for selected structural members, and the presentation of conclusions and recommendations.

It should be noted, that the recommended by CEN values for the reliability index are targeting primarily whole buildings, whose reliability is normally higher than the one of a structural member.

Descrizione dei modelli probabilistici per i Carichi di Occupazione e per la resistenza dei materiali

(Time-Invariant Analysis)

Table 3 - Models of basic variables for time-invariant reliability analyses

Category of variables	Name of basic variables	Symb. X	Dimension	Distribution	Mean μ_X	St. deviation σ_X
Permanent	Permanent*	G	kN/m^2	N	G_k	$0.1\mu_X$
Imposed-area						
Area A	Imposed-5 years	Q	kN/m^2	GUM	$0.2Q_k$	$1.1\mu_X$
	Imposed-50 years	Q	kN/m^2	GUM	$0.5Q_k$	$0.55\mu_X$
Area B	Imposed-5 years	Q	kN/m^2	GUM	$0.2Q_k$	$1.1\mu_X$
	Imposed-50 years	Q	kN/m^2	GUM	$0.6Q_k$	$0.35\mu_X$
Areas C1	Imposed-50 years	Q	kN/m^2	GUM	$0.55Q_k$	$0.5\mu_X$
Areas C2	Imposed-50 years	Q	kN/m^2	GUM	$1.1Q_k$	$0.1\mu_X$
Areas C3	Imposed-50 years	Q	kN/m^2	GUM	$0.6Q_k$	$0.4\mu_X$
Areas C4	Imposed-50 years	Q	kN/m^2	GUM	$0.8Q_k$	$0.2\mu_X$
Areas C5	Imposed-50 years	Q	kN/m^2	GUM	$0.95Q_k$	$0.15\mu_X$
Areas D1	Imposed-50 years	Q	kN/m^2	GUM	$0.55Q_k$	$0.35\mu_X$
Areas D2	Imposed-50 years	Q	kN/m^2	GUM	$0.7Q_k$	$0.25\mu_X$
Material strengths	Steel yield	f_y	MPa	LN	$f_{yk}+2\sigma$	$0.05\mu_X$ -0. $08\mu_X$
	Concrete	f_c	MPa	LN	$f_{ck}+2\sigma$	$0.05\mu_X$ -$0.15\mu_X$
	Reinforcement	f_y	MPa	LN	$f_{yk}+2\sigma$	$0.05\mu_X$ -$0.07\mu_X$
	Timber par. to gr.	f_c	MPa	LN	$f_{ck}+2\sigma$	$0.20\mu_X$ -$0.25\mu_X$
	Solid masonry	f_c	MPa	LN	$f_{ck}+2\sigma$	$0.17\mu_X$ -$0.30\mu_X$
Geometry steel sect.	IPE profiles	A, W, I	m^{2,3,4}	N	$0.99X_{nom}$	$0.01\mu_X$ -$0.04\mu_X$
	L-section, rods	A, W, I	m^{2,3,4}	N	$1.02X_{nom}$	$0.01\mu_X$ -$0.02\mu_X$
Geometry concrete cross-sect.	Cross-section	b, h	m	N	b_k, h_k	0.005-0.01
	Cover of reinforc.	a	m	BETA	a_k	0.005-0.015
	Additional ecc.	e	m	N	0	0.003-0.01
Model uncertainties**	Load effect factor	θ_E	–	N	1	0.05-0.10
	Resistance factor	θ_R	–	N	1-1.25	0.05-0.20

* For the self-weight the standard deviation is commonly in a range from 0.03 to 0.05. Permanent actions and and self-weight are not distinguished here.

** Depend on uncertainty of loading, its effects, material properties and models for resistance.

Le regole di combinazione EN1990:2002

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}"+"\gamma_P P"+"\gamma_{Q,1}Q_{k,1}"+"\sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i} \qquad [6.10]$$

a

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}"+"\gamma_P P"+"\gamma_{Q,1}\psi_{0,1}Q_{k,1}"+"\sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i} \qquad [6.10a]$$

b

$$\sum_{j\geq 1}\xi\gamma_{G,j}G_{k,j}"+"\gamma_P P"+"\gamma_{Q,1}Q_{k,1}"+"\sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i} \qquad [6.10b]$$

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}"+"\gamma_P P \qquad [6.10a\ modified]$$

c

Table 5 - Fundamental combination of actions for verification of ULS and partial factors of actions uploaded in the NDPs Database

Countries	Selected combination of actions[1]	EN 1990 expressions		Coefficient ξ	Partial factor γ_G	Partial factor γ_Q
		(6.10)	(6.10a) & (6.10b)			
CEN	**a, b,** c	x	x	**0.85**	**1.35**	**1.5**
BEL	**a** + b	**x**	x	RV	RV	RV
BGR	a	x		-	RV	RV
CYP	a	x		-	RV	RV
CZE	a + **b**	x	**x**	RV	RV	RV
DNK	c		x[2]	1	1.2/1	RV
FIN	c		x[2]	1	1.35/1.15 K_{FI}	1.5 K_{FI}
FRA	a	X		-	RV	RV
GBR	a + b	x	x	0.925	RV	RV
HRV	a	x		-	1.1/1.35	RV
HUN	**a** + b	**x**	x	RV	RV	RV
IRL	**a** + b	**x**	x	RV	RV	RV
LUX	**a** + b	**x**	x	RV	RV	RV
LVA	a + b	x	x	RV	RV	RV
PRT	a	x		-	RV	RV
SVN	a	x		-	RV	RV
SWE	b		x	0.89	RV	RV

[1] Preferred procedure of MS is highlighted in bold

[2] *Procedure c* is used, ($6.10a_{mod}$) & (6.10b)

BEL: *Procedure b* can be used only for permanent actions with low variability.

BGR: National Annex to EN 1990 was uploaded in the JRC NDPs Database.

CZE: *Procedure b* is recommended as favourable in the National Annex.

DNK: The material partial factor γ_M in Denmark is multiplied by K_{FI} and is equal to 1.2 for (6.10a) and to 1.0 for (6.10b).

FIN: NDPs are uploaded in the JRC Database, but information given in the National Annex was considered in the analysis.

HRV: Differentiation of partial factors is given in the National Annex (1.1 for self-weight and 1.35 for other permanent loads) while in the JRC database the partial factors are given as RV. The partial factor γ_G=1.1 was considered in the analysis.

HUN: *Procedure b* is allowed only when SLS are verified by calculation.

LUX: National Annex for EN 1990 was uploaded in the JRC NDPs Database. *Procedure b* can be used in case of assurance of low variability of *G*.

Table 6 - Fundamental combination of actions for verification of ULS and partial factors of actions given in available National Annexes which were not uploaded in 2017 to the JRC Database.

Countries	Selected combination of actions	EN 1990 expressions		Coefficient ξ	Partial factor γ_G	Partial factor γ_Q
		(6.10)	(6.10a) & (6.10b)			
CEN	**a, b,** c	x	x	**1.35**	**1.5**	**CEN**
LTU	a + b	x	x	RV	RV	1.3
NLD	b		x	0.89	RV	RV
NOR	b		x	0.89	RV	RV
SVK	a	x	x	-	RV	RV

SVK: *Procedure b* is allowed only for verification of existing structures.

20 Paesi analizzati (Italia esclusa)

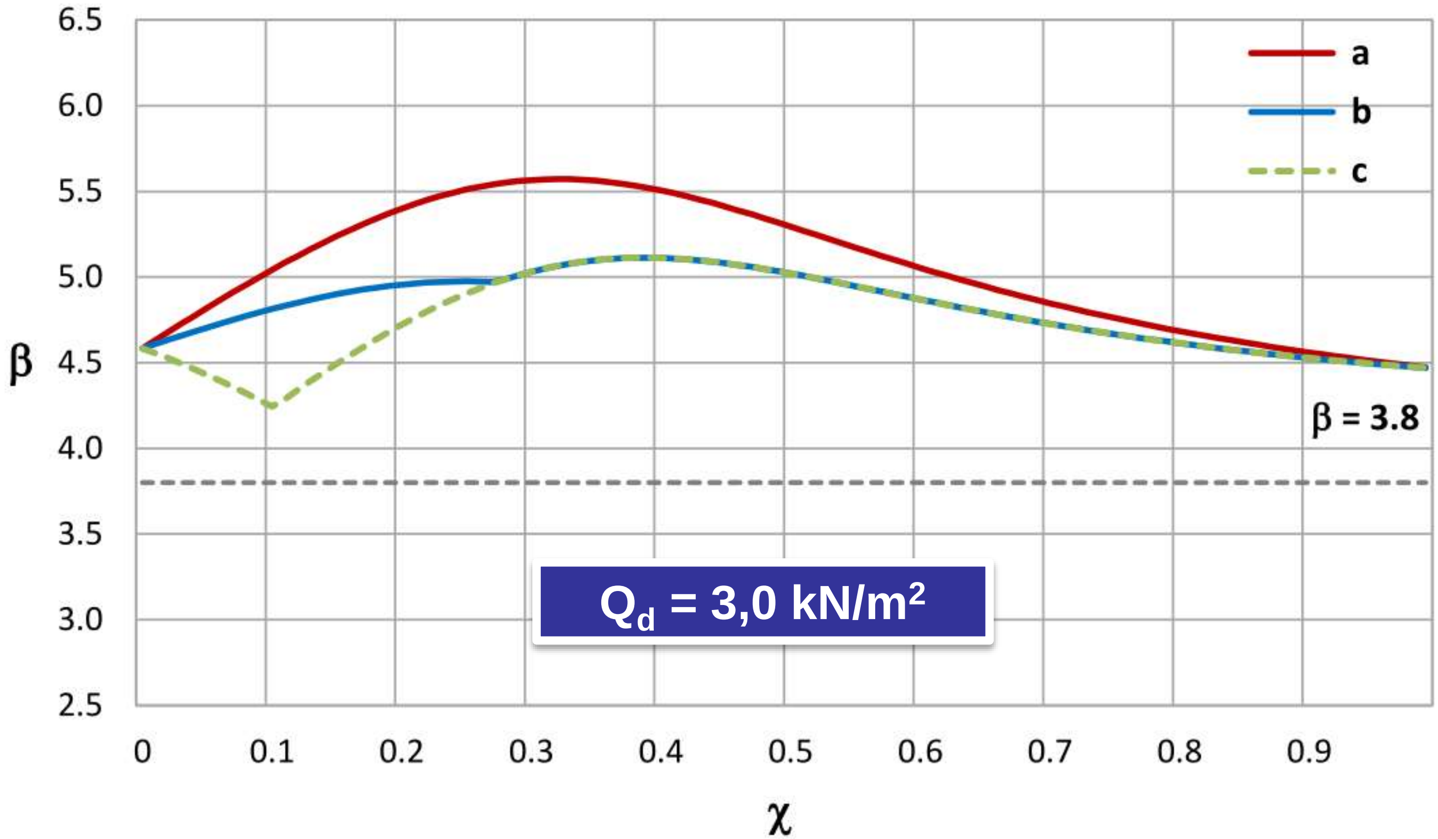
Eq. (6.10): 7 Paesi + IT

Eq. (6.10a + 6.10b): 3 Paesi

Eq. (6.10a mod. + 6.10b): 2 Paesi

Eq. (6.10 and 6.10a mod. + 6.10b): 8 Paesi

Figure 5 - Reliability index β of a **reinforced concrete beam** as a function of the load ratio χ, for the **upper bound** of imposed load of **category B** recommended in EN 1991-1-1.



An economic design of a structural member is considered assuming that the design value of the effect of actions, E_d, is equal to the design value of the corresponding resistance, R_d. The reliability level of the structural members is then verified by probabilistic methods.

Figure 6 - Reliability index β of a **reinforced concrete beam** as a function of the load ratio χ, for the **lower bound** of imposed load of **category B** recommended in EN 1991-1-1.

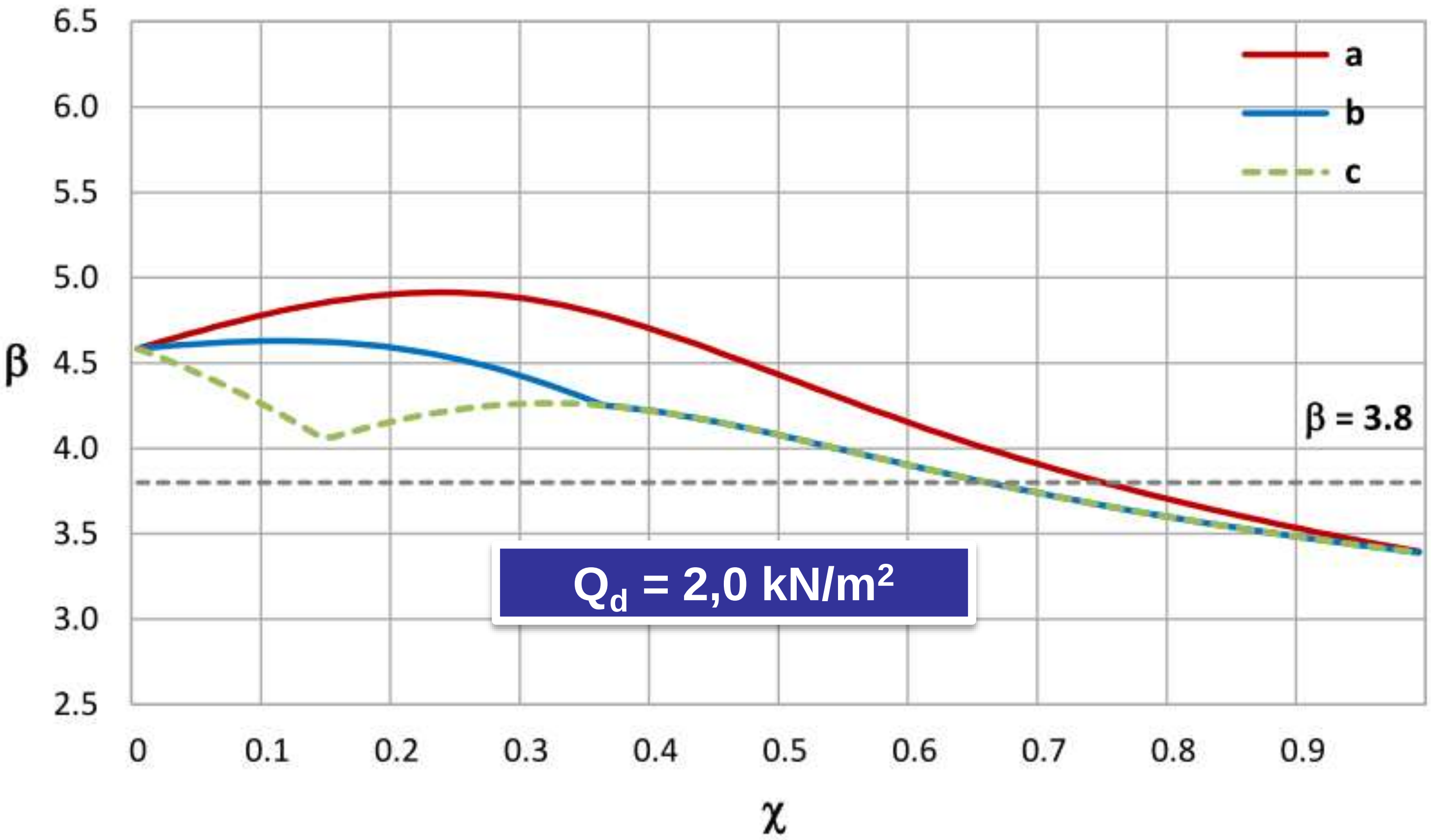


Figure 11 - Reliability index β of a **composite steel concrete slab** as a function of the load ratio χ, for the **upper bound** of imposed load of **category B** recommended in EN 1991-1-1.

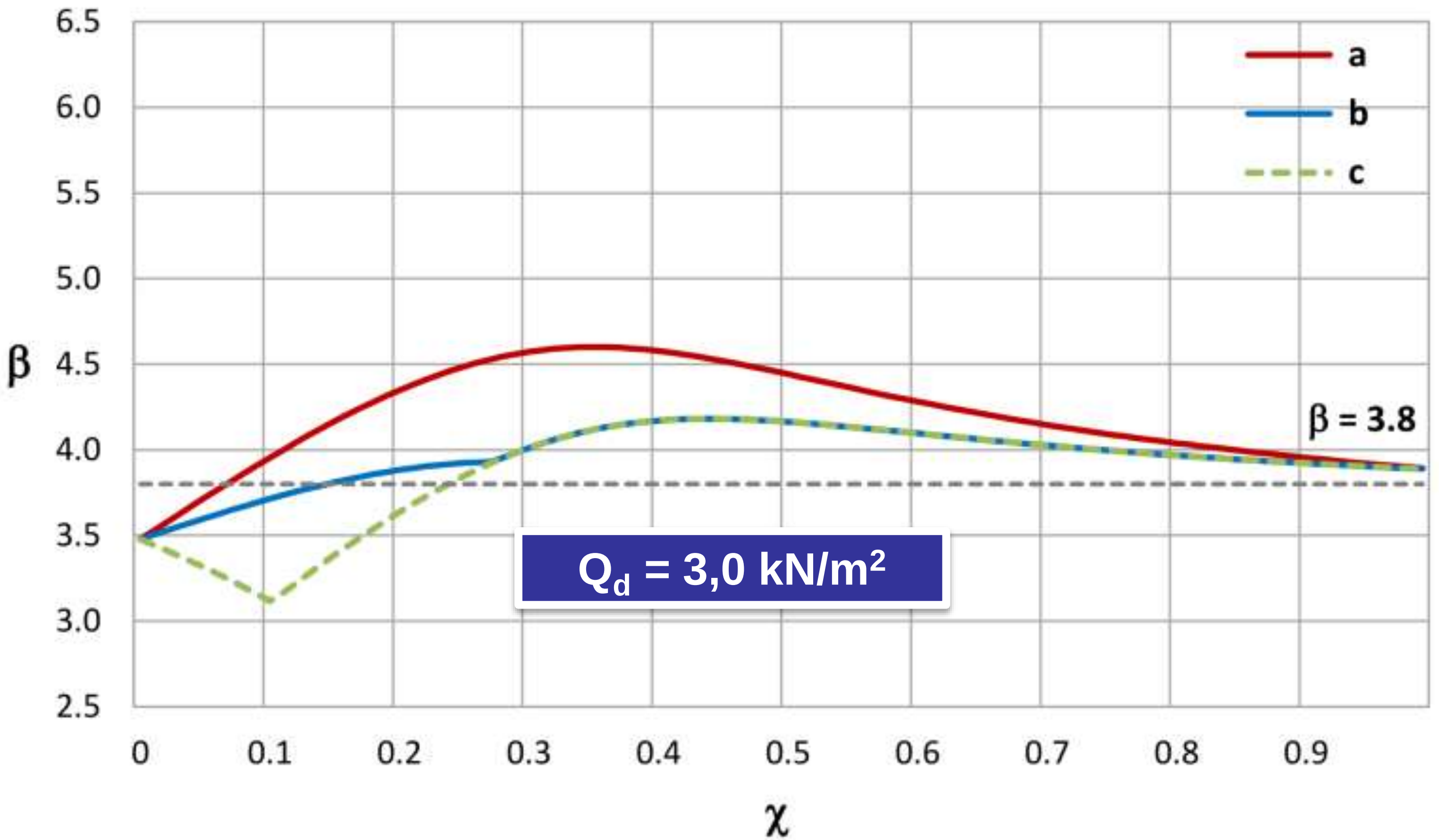


Figure 12 - Reliability index β of a **composite steel concrete slab** as a function of the load ratio χ, for the **lower bound** of imposed load of **category B** recommended in EN 1991-1-1.

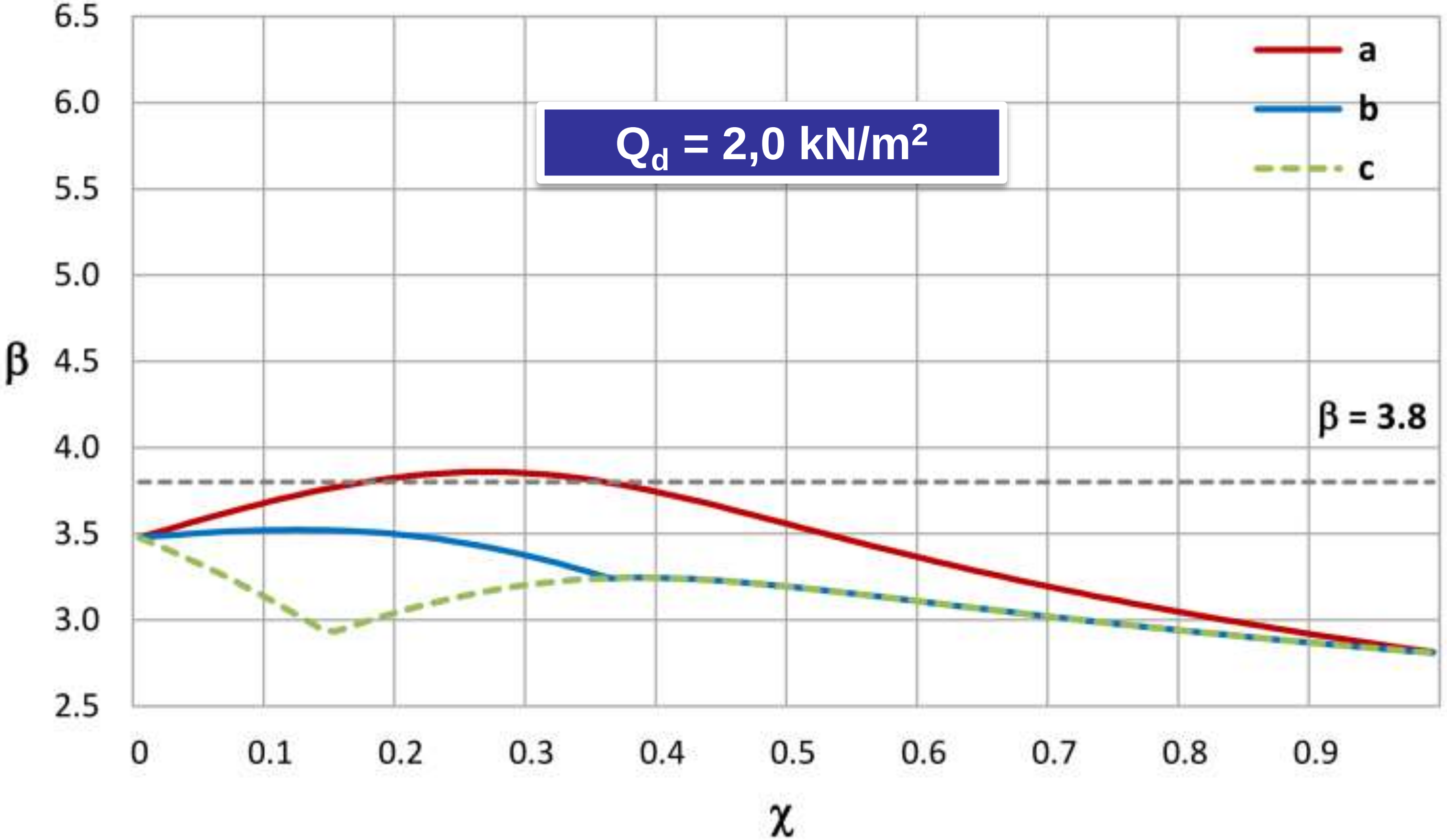


Figure 15 - Reliability index β of a **steel column** as a function of the load ratio χ, for the **upper bound** of imposed load of **category B** recommended in EN 1991-1-1.

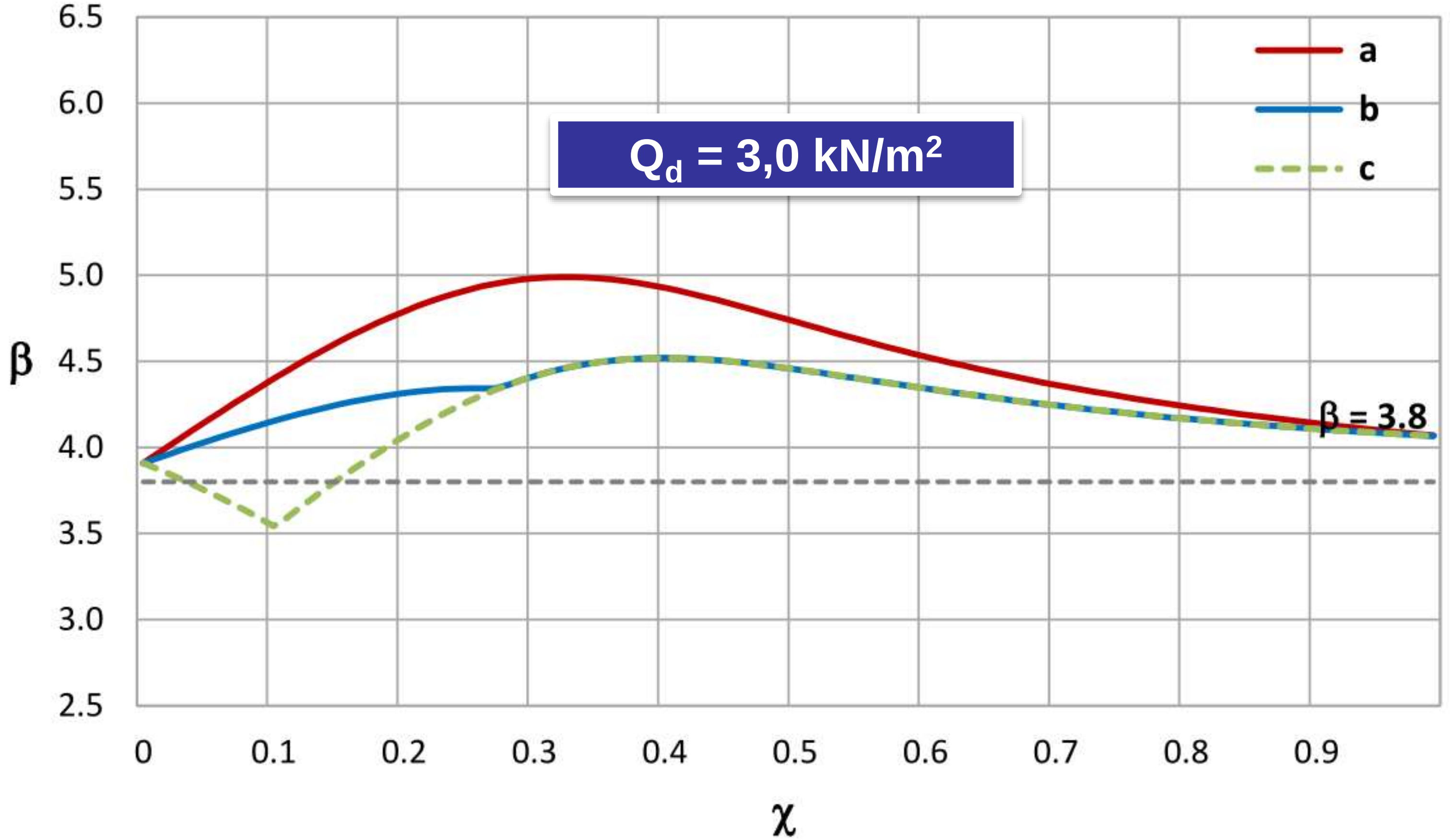


Figure 16 - Reliability index β of a **steel column** as a function of the load ratio χ, for the **lower bound** of imposed load of **category B** recommended in EN 1991-1-1.

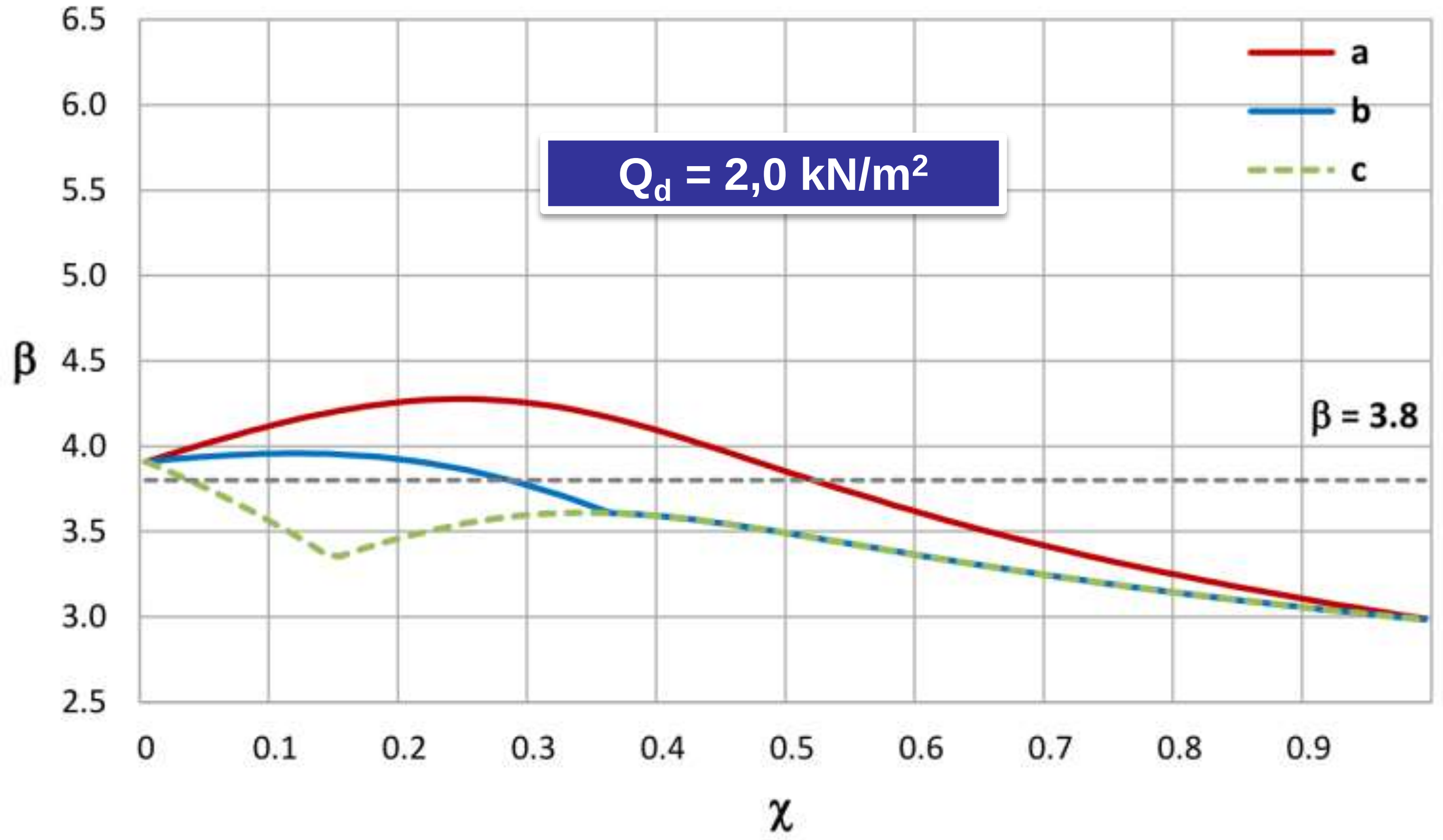


Figure 17 - Reliability index β of a **timber beam** as a function of the load ratio χ, for the **upper bound** of imposed load of **category B** recommended in EN 1991-1-1.

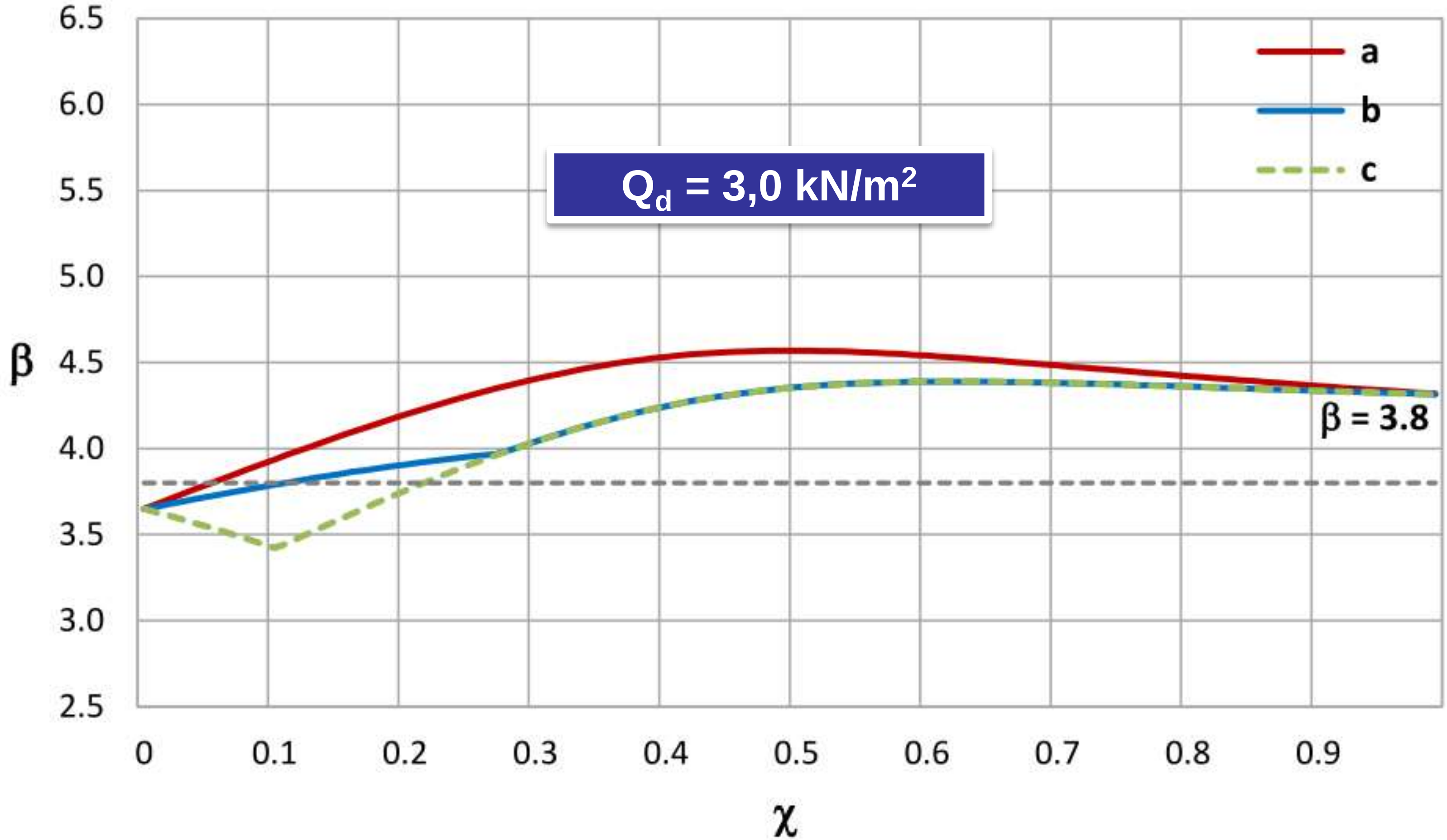
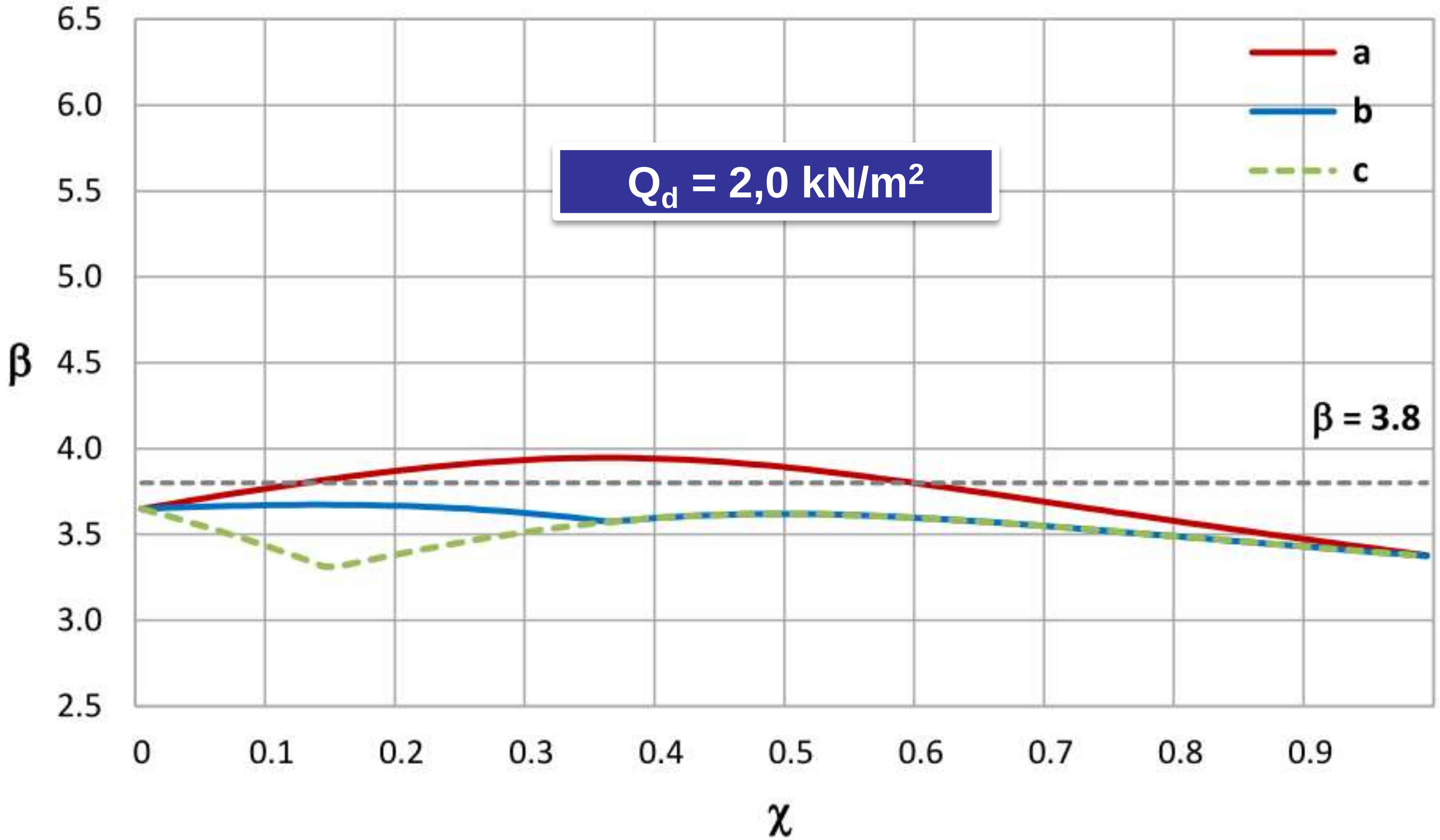


Figure 18 - Reliability index β of a **timber beam** as a function of the load ratio χ, for the **lower bound** of imposed load of **category B** recommended in EN 1991-1-1.



Selected member	**Imposed loads of category B**	**Range of χ for which $\beta > 3.8$**		
		Procedure a	***Procedure b***	***Procedure c***
Reinforced concrete beam	Upper bound	All	All	All
	Lower bound	0 – 0.75	0 – 0.7	0 – 0.7
Reinforced concrete column	Upper bound	All	All	All
	Lower bound	All	All	All
Reinforced concrete slab	Upper bound	All	All	All
	Lower bound	0 – 0.75	0 – 0.7	0 – 0.7
Composite steel concrete slab	Upper bound	> 0.05 (almost all)	> 0.15	> 0.25
	Lower bound	0.2 – 0.35	Not met	Not met
Steel tie	Upper bound	All	All	> 0.15
	Lower bound	0 – 0.45	0-0.25	Not met
Steel column	Upper bound	All	All	> 0.15
	Lower bound	0 – 0.5	0-0.3	Not met
Timber beam	Upper bound	>0.05 (almost all)	> 0.1	> 0.2
	Lower bound	0.1 – 0.6	Not met	Not met
Timber column	Upper bound	> 0.1	> 0.25	> 0.25
	Lower bound	0.3 – 0.65	Not met	Not met
Masonry wall	Upper bound	All	All	All
	Lower bound	All	All	All

Principali conclusioni dello studio:

1. I livelli di affidabilità degli elementi strutturali progettati utilizzando i valori raccomandati dei fattori parziali per i carichi di occupazione in EN1991-1-1, sono generalmente superiori ai valori obiettivo indicati nella tabella B.2 della EN1990:2002 (3,8 per 50 anni in CC2)

2. In alcuni casi (tipicamente per le categorie di occupazione da C1 a C5 – Locali con affollamento) gli elementi in acciaio, in sistema misto e legno sono associati a livelli di affidabilità inferiori a quelli obiettivo, in particolare nel caso di utilizzo delle combinazioni (6.10a) + (6.10b);

3. E’ opportuna la calibrazione dei coefficienti parziali in particolar modo qualora si utilizzino le combinazioni (6.10a) + (6.10b) e (6.10a mod.) + (6.10b)

4. Il ricorso alla combinazione (6.10a) + (6.10b) conduce a livelli di affidabilità più uniformi sul campo di variabilità del rapporto Q/(G+Q).

SC10 / WG1 « Calibration of partial factors » (2016)

In the first meeting of CEN/TC 250/SC 10 the creation of three working groups was decided:

WG 1 Calibration of partial factors and limit states safety format
WG 2 Bridges
WG 3 Safety formats for non-linear problems

WG 1 will be responsible for providing technical advice to SC 10's Project Teams on the subject 'Calibration of partial factors and limit states safety format' as instructed by SC 10, and for reviewing, on behalf of SC 10, the work of the Project Teams on this subject.

WG 2 will be responsible for providing technical advice to SC 10's Project Team which is to be established in Phase 2 of the revision, on bridge related issues in EN 1990 as instructed by SC 10, and for reviewing, on behalf of SC 10, the work of the Project Team on this subject.

WG 3 will be responsible for providing technical advice to SC 10's Project Teams on the subject 'safety formats for non-linear problems' as instructed by SC 10, and for reviewing, on behalf of SC 10, the work of the Project Teams on this subject.

SC10 / WG1 « Calibration of partial factors »

Role	Appointed by	Country	Stakeholder category	Salutation	Name
Convenor	CEN/TC 250/SC 10	-	-	Mr	Sørensen, John Dalsgaard
Convenor/Secretary Support Team	DS	Denmark	-	Mr	Rønnow, Gert
Committee member	AFNOR	France	-	M.	Gallitré, Etienne
Committee member	DIN	Germany	A - Industry and commerce	Mr Prof. Dr.-Ing.	Jäger, Wolfram
Committee member	DIN	Germany	E - Academic and research bodies	Mr Prof. Dr.	Straub, Daniel
Committee member	DS	Denmark	-	Mr	Sørensen, John Dalsgaard
Committee member	IPQ	Portugal	-	Mr	Santos, Luis
Committee member	NEN	Netherlands	-	Mr.	Steenbergen, R.D.J.M.
Committee member	NSAI	Ireland	-	Dr	O'Connor, Alan
Committee member	SN	Norway	-	Mr	Köhler, Jochen
Committee member	UNI	Italy	-	Mr	Croce, Pietro
Committee member	UNMZ	Czech Republic	-	Mrs	Markova, Jana
Document monitor	DIN	Germany	-	Mrs Dipl.-Ing.	Kempa, Susan
Document monitor	SN	Norway	-	Ms	Meløysund, Vivian

2016: 5 esperti

2019: 10 esperti

Scarso collegamento con le altre SC del TC250

Calibration of partial factors

- Definition of safety format
  - (6.10) and (6.10a) + (6.10b)
  - Two permanent loads: G_S and G_P
  - One variable load: Q: wind or snow (or imposed) loads
- Limit states :
  1. Generic (Resistance = model uncertainty x material uncertainty)
  2. Material dependent resistance functions

Framework for the Reliability-Based Assessment of Load Partial Safety Factors in the Eurocodes

The key points of the framework are:

- The assessment is formulated as a calibration problem, where the load partial factors γ_S are the calibration variables.
- The objective of the calibration is the minimisation of variability of reliability levels in the considered domain of design equations D. The corresponding objective function (to be minimized) is

$$M(\gamma_S) = \sum_{i \in D} \left(\beta_i(\gamma_S) - \beta_{\text{target}} \right)^2 \quad (1)$$

- The domain of design equations D is defined as all design equations for which the load partial factors apply.
- The domain of design equations is represented by a reduced set of design equations representing the main structural materials and loads induced by wind and snow, and permanent, sustained and intermittent actions. Assumptions are made for the formulation of this representative set.
- Design equations are represented in a partial factor design format as specified in the Eurocodes and with the corresponding limit states. All load and resistance related variables and model uncertainties are represented as random variables. Assumptions are made for the specification of the random variables.
- The target reliability level β_{target} is defined as the average reliability level of the considered set of design equations with the partial factors of the present Eurocode (EN1990:2002).

$$M(\gamma_S) = \sum_{SD} \sum_{i \in SD} \left(\beta_{SD,i}(\gamma_S) - \beta_{target,SD} \right)^2$$

In alternativa: analisi per Sotto Domini (materiali)

Metodologia

Funzione generica di stato limite

$$g\left(\mathbf{X}, p_{ij}\right) = p_{ij}\Theta_{R,i}R_i - \left(1-a_Q\right)\left[a_G G_{S,U} + \left(1-a_G\right)G_{P,U}\right] - a_Q\Theta_{Q,j}Q_j$$

Parametro di progetto

$$p_{ij} = \max\begin{cases} \dfrac{\gamma_{M,i}}{\theta_{Ri,k}r_{i,k}}\left\{\left(1-a_Q\right)\left[a_G g_{S,k}\gamma_{GS} + \left(1-a_G\right)g_{P,k}\gamma_{GP}\right] + a_Q\psi_{0,j}\gamma_Q\theta_{Qj,k}q_{j,k}\right\} \\ \dfrac{\gamma_{M,i}}{\theta_{Ri,k}r_{i,k}}\left\{\left(1-a_Q\right)\left[a_G g_{S,k}\xi\gamma_{GS} + \left(1-a_G\right)g_{P,k}\xi\gamma_{GP}\right] + a_Q\gamma_Q\theta_{Qj,k}q_{j,k}\right\} \end{cases}$$

(6.10a) + (6.10b)

$$p_{ij} = \frac{\gamma_M}{\theta_{Ri,k}r_{i,k}}\left\{\left(1-a_Q\right)\left[a_G g_{S,k}\gamma_{GS} + \left(1-a_G\right)g_{P,k}\gamma_{GP}\right] + a_Q\gamma_Q\theta_{Qj,k}q_{j,k}\right\}$$

(6.10)

Composizione del campione di verifica (Edifici)

Table 1. Material properties, weights and ranges of variations of a_G and a_Q.

i	Mat. property	$w_{R,i}$ (weight)	a_G ranges	a_Q ranges	$\gamma_{M,i}$ recommended in current Eurocodes
1	Structural steel yielding strength	40 %	[0.6; 1.0]	[0.2; 0.8]	1.00 [6]
2	Concrete compressive strength	15 %		[0.1; 0.7]	1.50 [4]
3	Re-bar yield strength	25 %		[0.1; 0.7]	1.15 [4]
4	Glulam timber bending strength	7.5 %		[0.2; 0.8]	1.25 [5]
5	Solid timber bending strength	2.5 %		[0.2; 0.8]	1.30 [5]
6	Masonry compression strength	10 %		[0.1; 0.7]	1.50 [8]

Modello probabilistico - resistenza

Random variable		Distr. type	Mean (μ)	COV	Percentile (value)
Resistance model unc. (steel)	$\Theta_{R,1}$	Logn.	1.00	0.05	(μ)
Res. model unc. (concrete)	$\Theta_{R,2}$	Logn.	1.00	0.10	(μ)
Resistance model unc. (rebar)	$\Theta_{R,3}$	Logn.	1.00	0.10	(μ)
Resistance model unc. (glulam)	$\Theta_{R,4}$	Logn.	1.00	0.10	(μ)
Res. model unc. (solid timber)	$\Theta_{R,5}$	Logn.	1.00	0.10	(μ)
Res. model unc. (masonry)	$\Theta_{R,6}$	Logn.	1.16	0.175	(μ)
Steel yielding strength	R_1	Logn.	1.00	0.07	$\mu - 2\sigma$
Concrete compr. capacity	R_2	Logn.	1.00	0.15	0.05
Rebar yielding strength	R_3	Logn.	1.00	0.07	0.05
Glulam bending strength	R_4	Logn.	1.00	0.15	0.05
Solid timber bending strength	R_5	Logn.	1.00	0.20	0.05
Masonry compr. strength	R_6	Logn.	1.00	0.16	0.05

Modello probabilistico – Azioni Permanenti

Random variable		Distr. type	Mean (μ)	COV	Percentile (value)
Self-weight (steel)	$G_{S,1}$	Norm.	1.00	0.04	0.50
Self-weight (concrete)	$G_{S,2}$	Norm.	1.00	0.05	0.50
Self-weight (rebar)	$G_{S,3}$	Norm.	1.00	0.05	0.50
Self-weight (glulam)	$G_{S,4}$	Norm.	1.00	0.10	0.50
Self-weight (solid timber)	$G_{S,5}$	Norm.	1.00	0.10	0.50
Self-weight (masonry)	$G_{S,6}$	Norm.	1.00	0.065	0.50
Permanent load	G_P	Norm.	1.00	0.10	0.50
Permanent load (large COV)	G_P^*	Norm.	1.00	0.20	0.95

teorico

Modello probabilistico – Azioni Variabili

Random variable		Distr. type	Mean (μ)	COV	Percentile (value)	Ref. and notes
Wind time-invariant part (gust C_g ,pressure C_{pe} and roughness C_r coefficients)	Θ_{Q_1}	Logn	0.97	0.26	1.1	$\Theta_{Q_1} = C_g C_r C_{pe}$ with: C_{pe} Gumbel, mean=1; COV=0.1, ch. value = 78% quantile C_r Logn., mean = 1, COV=0.15 and ch. value = 1.0 C_g Logn., mean = 1.0, COV=0.1 and ch. value = 1.0
Snow time-invariant part (model uncertainty and shape coefficient)	Θ_{Q_2}	Logn.	1.00	0.30	($\mu+\sigma$)	ch. value equal to $\mu+\sigma$ given in [9, 15]; NB: ch. Value equal to the mean given in [16].
Wind mean reference velocity pressure *	Q_1	Gumb.	1.00	0.25	0.98	When the COV varies over the country and only one PSFs is sought the mean COV over the country can be used, see [17]. Alternatively, PSFs can vary over the territory; this is a national choice.
Snow load on roof *	Q_2	Gumb.	1.00	0.40	0.98	
Imposed load model uncertainty	Θ_{Q_3}	Logn.	1.00	0.10	(1.00)	The COV is assumed since no data are found in the literature. To be further assessed. [Not yet discussed in CEN/TC250-SC10/WG1].
Imposed load *	Q_3	Gumb.	1.00	0.53	0.98	[Not yet discussed in CEN/TC250-SC10/WG1].

2.3.1 Safety level of the existing EN1990

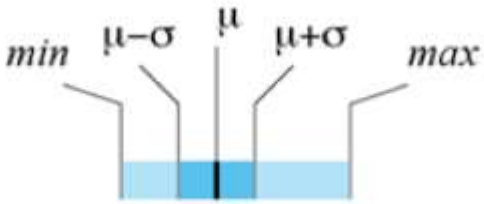
The assessment reliability level of the present Eurocode design equations, i.e. format and partial factors according to EN 1990:2002 [1] is assessed based on Equation (5).

$$E[\beta_{EC}] = \frac{1}{\sum_{i=1}^{6}\sum_{j=1}^{3}\sum_{i_{aG}=1}^{3}\sum_{i_{aQ}=1}^{10} w_{i,j,i_{aG},i_{aQ}}} \sum_{i=1}^{6}\sum_{j=1}^{3}\sum_{i_{aG}=1}^{3}\sum_{i_{aQ}=1}^{10} w_{i,j,i_{aG},i_{aQ}} \beta_{i,j,i_{aG},i_{aQ}} (\gamma_{EC}) \qquad (5)$$

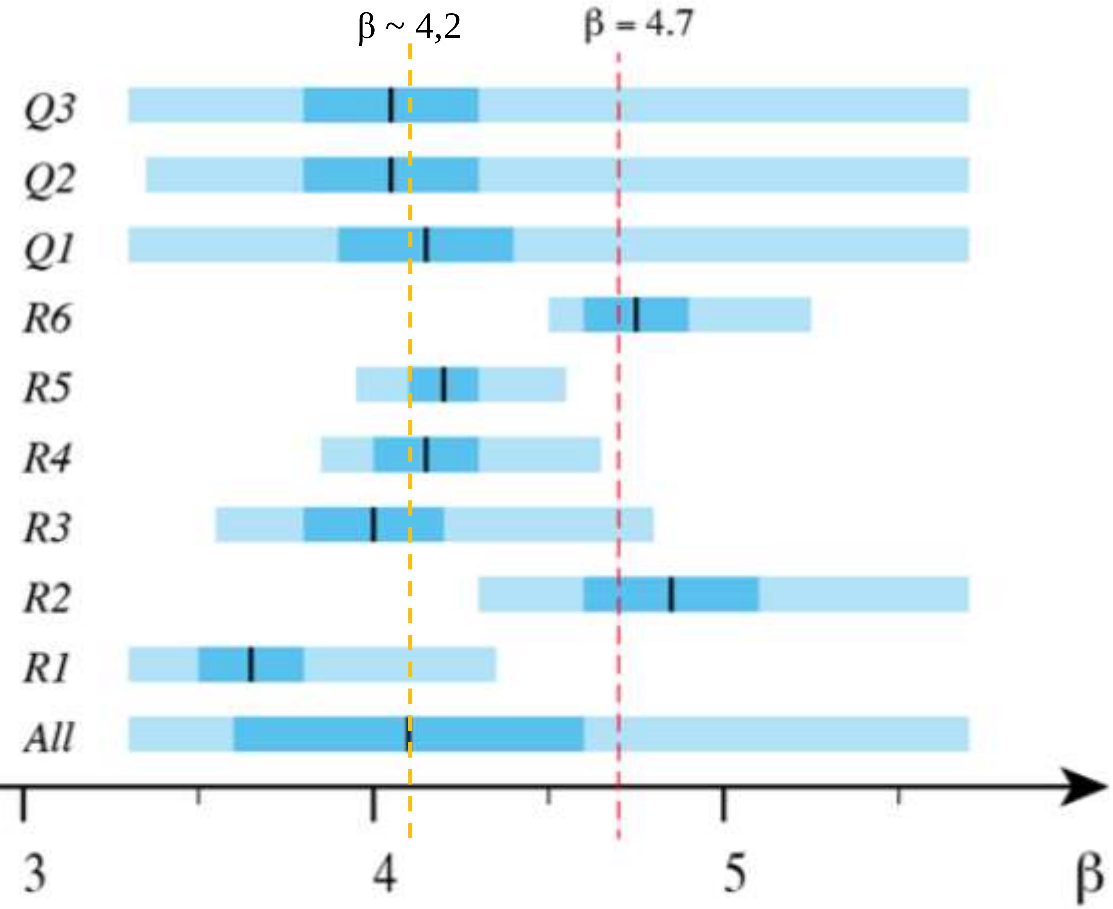
- Sono stati considerati **6 differenti materiali** (*calcestruzzo, acciaio per c.a., acciaio per carpenteria, legno massello, legno lamellare, muratura*)
- **3** differenti azioni variabili dominanti (**Q1** Vento, **Q2** Neve, **Q3** Carichi di occupazione)
- **3** differenti rapporti tra le componenti del carico permanente «strutturale» e «non strutturale»
- **10** differenti rapporti tra azioni variabili e permanenti
- Sono determinanti le assunzioni fatte sui «pesi» $w_{i,j...}$ da attribuire alle varie componenti

540 casi analizzati

Fattori parziali (γ_F e γ_M) raccomandati negli EC



Carichi di occ.
Neve
Vento
Muratura
Legno massello
Legno lamellare
Acciaio per c.a.
CLS – compressione
Acciaio



Variabilità dell'indice di affidabilità β (1 anno) per diversi materiali (da R1 a R6) e azioni variabili (da Q1 a Q3) per tutte le combinazioni di azioni ULS

Calibrazione (sett. 2018)

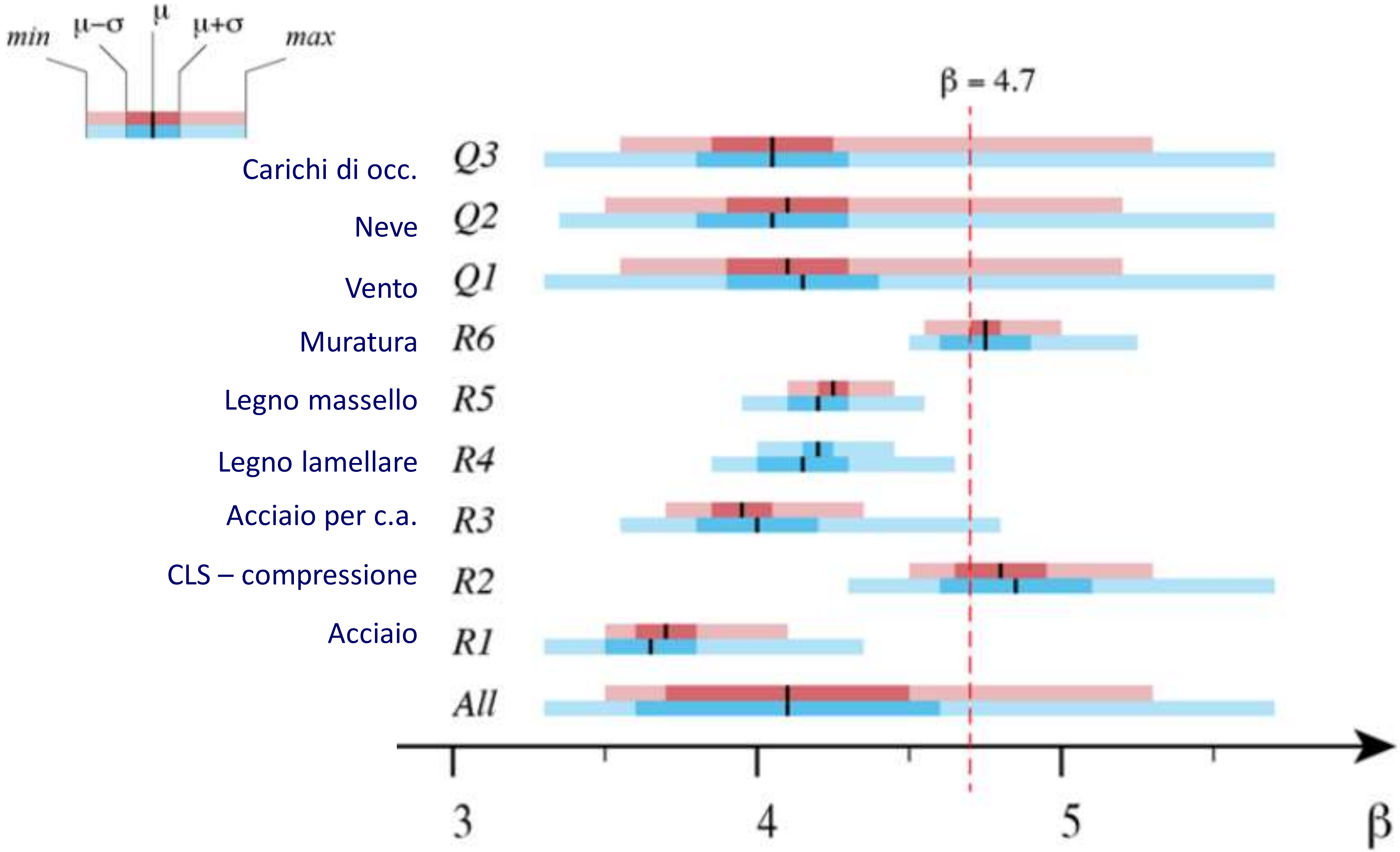
$$\boldsymbol{\gamma}_{S,opt} = \underset{\boldsymbol{\gamma}_S}{\arg\min} \left[\sum_{i=1}^{6} \sum_{j=1}^{3} \sum_{i_{aG}=1}^{3} \sum_{i_{aQ}=1}^{10} w_{i,j,i_{aG},i_{aQ}} \left(\beta_{i,j,i_{aG},i_{aQ}} \left(\boldsymbol{\gamma}_S, \boldsymbol{\gamma}_{R,EC} \right) - \beta_{\text{target}} \right)^2 \right]$$

$\boldsymbol{\gamma}_S = \left[\gamma_{GS}, \gamma_{GP}, \gamma_{Q1}, \gamma_{Q2}, \gamma_{Q3} \right]$ are the load partial factors that are calibrated; $\boldsymbol{\gamma}_{R,EC}$ are the material partial factors that are not calibrated (they are fixed to the values reported in Table 1).

	Eq. 6.10a&b		Eq. 6.10	
	Eurocode recommended values	Calibrated values	Eurocode recommended values	Calibrated values
γ_M	$\gamma_M = [1.00; 1.50; 1.15; 1.25; 1.30; 1.50]$			
γ_{GS}	1.35	**1.18**	1.35	**1.15**
γ_{GP}	1.35	**1.23**	1.35	**1.22**
ξ	0.85	0.85	/	/
γ_Q (wind)	1.50	**1.62**	1.50	**1.63**
γ_Q (snow)	1.50	**1.59**	1.50	**1.64**
γ_Q (imposed)	1.50	**1.62**	1.50	**1.65**

$$M(\boldsymbol{\gamma}_S) = \sum_{SD} \sum_{i \in SD} \left(\beta_{SD,i}(\gamma_S) - \beta_{target,SD} \right)^2$$

Fattori parziali (γ_F e γ_M) raccomandati negli EC / Calibrati



Calibrazione (sett. 2018)

	Eq. 6.10a&b		Eq. 6.10	
	Eurocode recommended values	Calibrated values	Eurocode recommended values	Calibrated values
γ_M (steel)	1.00			
γ_M (concrete)	1.50			
γ_M (re-bar)	1.15			
γ_M (glulam)	1.25			
γ_M (solid timber)	1.30			
γ_M (masonry)	1.50			
γ_{GS}	1.35	**1.21**	1.35	**1.17**
γ_{GP}	1.35	**1.24**	1.35	**1.22**
ξ	0.85	0.85	/	/
γ_Q (wind)	1.50	**1.46**	1.50	**1.47**
γ_Q (snow)	1.50	**1.78**	1.50	**1.86**
ψ_0 (wind)	/	/	/	/
ψ_0 (snow)	/	/	/	/
β_t	/	4.19	/	4.38

Alcune prime conclusioni del TC250/SC10/WG1

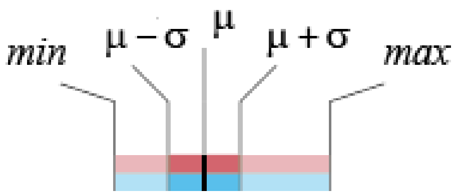
- La procedura di calibrazione dei γ_F consente di ridurre la dispersione degli indici di affidabilità, in generale e per i singoli materiali (a parità di γ_M)
- Il livello di affidabilità determinato si riferisce al singolo elemento strutturale e, più in particolare, ad un determinato tipo di crisi dell'elemento strutturale, sarebbero necessari ulteriori approfondimenti per gli aspetti legati alle modalità di crisi (es. duttile o fragile)
- La variabilità degli indici β per i diversi materiali non viene sostanzialmente modificata
- Per uniformare i livelli di affidabilità tra differenti materiali è necessaria la contestuale revisione dei fattori parziali dal lato della resistenza dei materiali
- Sono necessari approfondimenti dei modelli probabilistici per azioni e resistenze (coinvolgimento di esperti da altre SC)

Modello probabilistico – Azioni Variabili

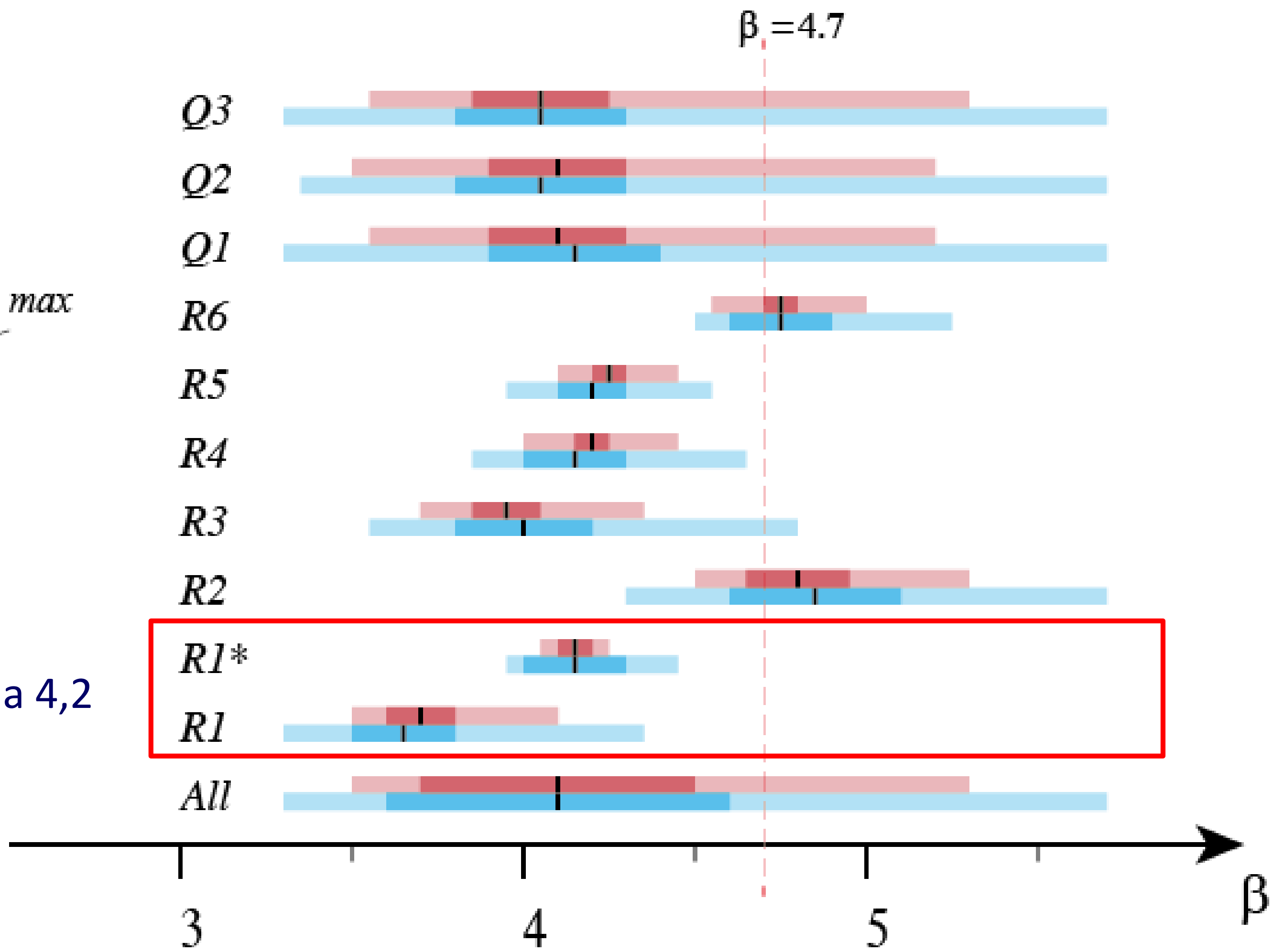
Random variable		Distr. type	Mean (μ)	COV	Percentile (value)	Ref. and notes
Wind time-invariant part (gust C_g ,pressure C_{pe} and roughness C_r coefficients)	Θ_{Q_1}	Logn	0.97	0.26	1.1	$\Theta_{Q_1} = C_g C_r C_{pe}$ with: C_{pe} Gumbel, mean=1; COV=0.1, ch. value = 78% quantile C_r Logn., mean = 1, COV=0.15 and ch. value = 1.0 C_g Logn., mean = 1.0, COV=0.1 and ch. value = 1.0
Snow time-invariant part (model uncertainty and shape coefficient)	Θ_{Q_2}	Logn.	1.00	0.30	$(\mu+\sigma)$	ch. value equal to $\mu+\sigma$ given in [9, 15]; NB: ch. Value equal to the mean given in [16].
Wind mean reference velocity pressure *	Q_1	Gumb.	1.00	0.25	0.98	When the COV varies over the country and only one PSFs is sought the mean COV over the country can be used, see [17]. Alternatively, PSFs can vary over the territory; this is a national choice.
Snow load on roof *	Q_2	Gumb.	1.00	0.40	0.98	
Imposed load model uncertainty	Θ_{Q_3}	Logn.	1.00	0.10	(1.00)	The COV is assumed since no data are found in the literature. To be further assessed. [Not yet discussed in CEN/TC250-SC10/WG1].
Imposed load *	Q_3	Gumb.	1.00	0.53	0.98	[Not yet discussed in CEN/TC250-SC10/WG1].

Wind time-invariant part (gust C_g ,pressure C_{pe} and roughness C_r coefficients)	Θ_{Q_1}	logn	0.6352	0.2976	1	$\Theta_{Q_1} = X_{Q_{ref}} C_g C_r C_{pe}$ with: $X_{Q_{ref}}$ Lognormal with mean = 0.8 and COV=0.2, ch. value=1.0 C_{pe} Gumbel, mean=1; COV=0.1, ch. value = 1.0 C_r Lognormal, mean=0.8; COV=0.1; ch. value = 1.0 C_g Lognormal, mean=1.0, COV=0.1; ch. value=1.0

Annual reliability indices with alternative stochastic model for wind (only permanent load, wind load and steel):



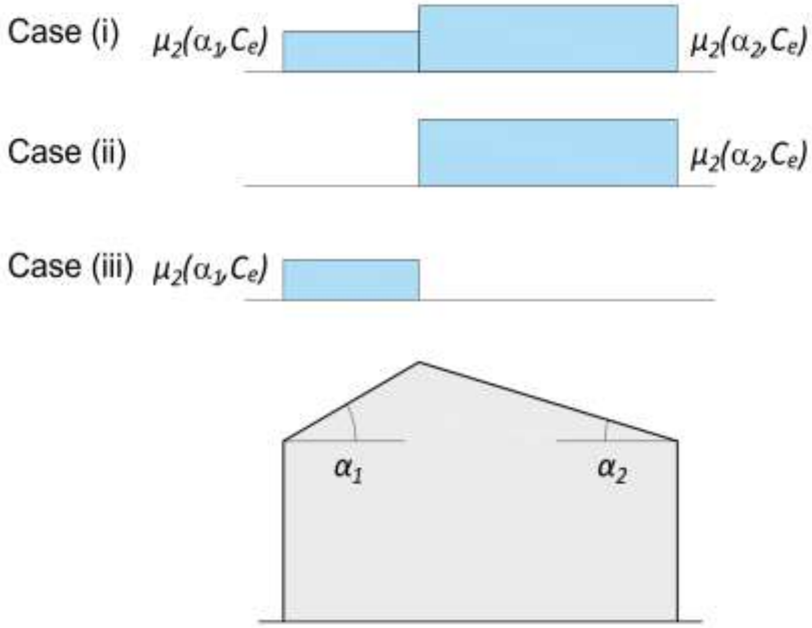
Acciaio: da ~3,6 a 4,2

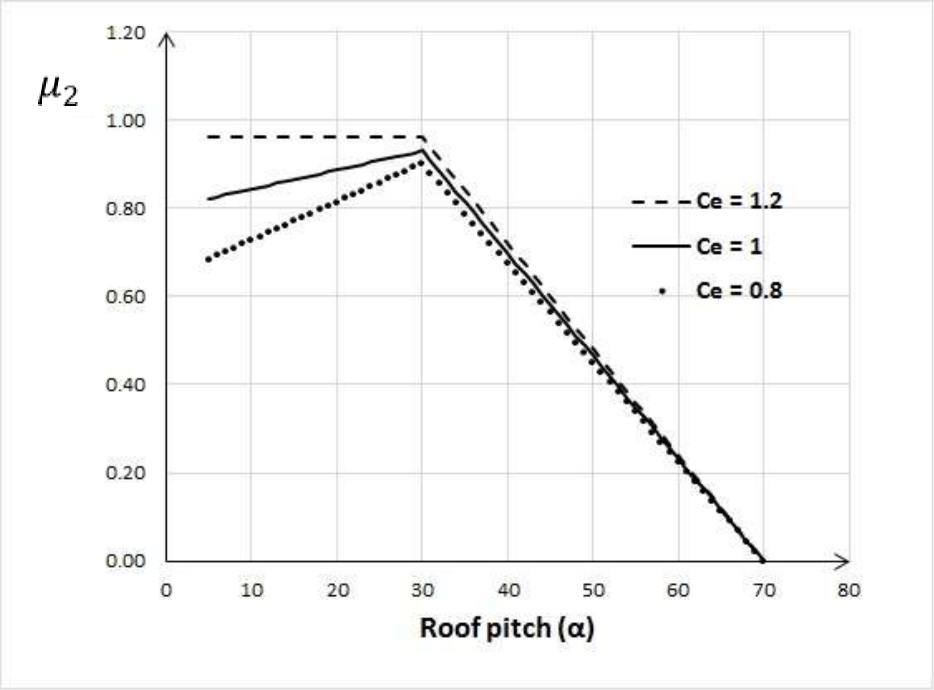


Modello probabilistico – Azioni Variabili

Random variable		Distr. type	Mean (μ)	COV	Percentile (value)	Ref. and notes
Wind time-invariant part (gust C_g, pressure C_{pe} and roughness C_r coefficients)	Θ_{Q_1}	Logn	0.97	0.26	1.1	$\Theta_{Q_1} = C_g C_r C_{pe}$ with: C_{pe} Gumbel, mean=1; COV=0.1, ch. value = 78% quantile C_r Logn., mean = 1, COV=0.15 and ch. value = 1.0 C_g Logn., mean = 1.0, COV=0.1 and ch. value = 1.0
Snow time-invariant part (model uncertainty and shape coefficient)	Θ_{Q_2}	Logn.	1.00	0.30	($\mu+\sigma$)	ch. value equal to $\mu+\sigma$ given in [9, 15]; NB: ch. Value equal to the mean given in [16]
Wind mean reference velocity pressure *	Q_1	Gumb.	1.00	0.25	0.98	When the COV varies over the country and only one PSFs is sought the mean COV over the country can be used, see [17]. Alternatively, PSFs can vary over the territory; this is a national choice.
Snow load on roof *	Q_2	Gumb.	1.00	0.40	0.98	
Imposed load model uncertainty	Θ_{Q_3}	Logn.	1.00	0.10	(1.00)	The COV is assumed since no data are found in the literature. To be further assessed. [Not yet discussed in CEN/TC250-SC10/WG1].
Imposed load *	Q_3	Gumb.	1.00	0.53	0.98	[Not yet discussed in CEN/TC250-SC10/WG1].

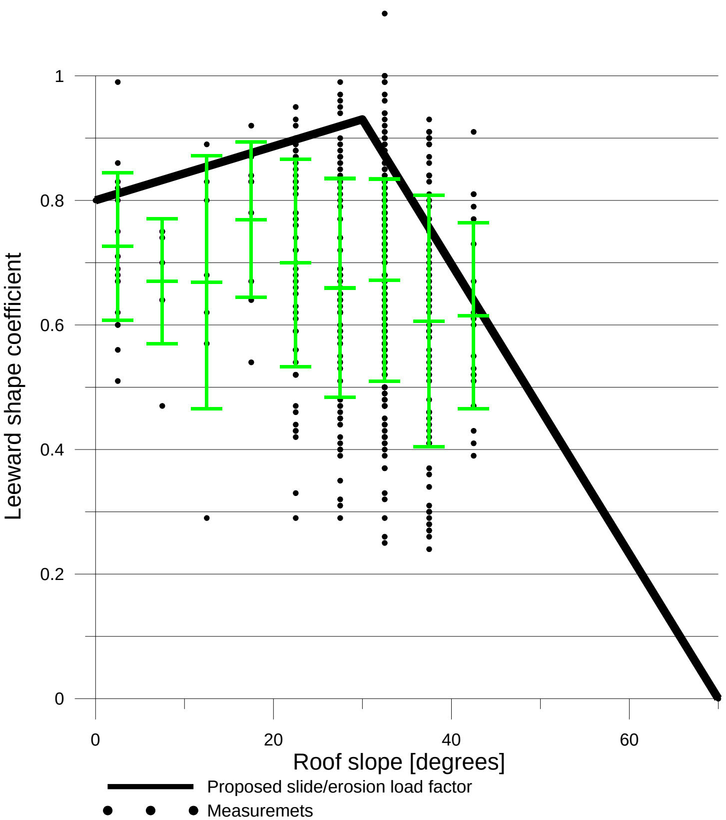
Carico della neve





$$s = \mu_i \, C_t \, s_k$$

Carico della neve



Condizioni di esposizione: Normali

		Eurocode	New CEN	n
Exposed	$\frac{\bar{P}_{s,measured}}{\bar{P}_{s,modeled}}$	1.32	0.88	107
	σ	0.40	0.24	
Normal	$P_{s,modeled}$ σ	1.00	0.82	496
	σ	0.31	0.22	
Sheltered	$\frac{P_{s,measured}}{\bar{p}}$	0.82	0.79	388
	σ	0.21	0.18	
All data	$\frac{\bar{P}_{s,measured}}{\bar{P}_{s,modeled}}$	**0.96**	**0.81**	**991**
	σ	**0.32**	**0.21**	

Ulteriori considerazioni

- La procedura è molto sensibile alle ipotesi adottate per la definizione dei modelli probabilistici (rappresentatività delle ipotesi, es. carichi permanenti/variabili)

- L’influenza delle «*hidden safeties*» nei vari modelli per azioni e resistenze deve essere adeguatamente indagata (es. vento, neve)

- Le «*hidden safeties*» sono determinanti anche nel caso si ricorra alle procedure di «design assisted by testing»

- L’obiettivo di uniformare i livelli di affidabilità per differenti materiali non è perseguibile se non attraverso la ricalibrazione dei coefficienti parziali anche dal lato dei materiali

- La delicatezza dell’argomento ha suscitato numerose e contrastanti reazioni in seno al TC250

SC3

Lettera di Ulrike Kuhlmann (Apr. 2018)

…

Our particular concern is with the planned change to the reference period for reliability assessments from 50 years to 1 year and the changes of the partial factors on the actions caused by attempts to make the safety index β uniform with respect to the ratio η=Q/(Q+P+G).

…

We also note that a change of the reference period from fifty years to one year will imply a suggested modification of the safety index from β = 3.8 to a value of about β = 4.2 (originally β = 4.7). Bearing in mind that the values of partial factors on the resistance is a matter for the material SCs, and that the effective safety requirement on the resistance side (which is αR β = 0.8 x 3.8 = 3.04 according to the current EN 1990) should remain valid, a logical conclusion would be that a change in the influence factor αR would be necessary. A change from αR = 0.8 to αR = 0.7 was recently suggested [1] such that αR β = 0.7 x 4.2 = 2.94, which seems to be rather close to αR β = 0.8 x 3.8 = 3.04.

…

Because the development of the different codes is being undertaken in parallel, the WG for EN 1993-1-1 has made a final choice of the level of partial factors which cannot be easily changed now, so any changes that SC10 may decide to make on the most basic assumptions have really come too late for this Mandate development.

SC3

Lettera di Ulrike Kuhlmann (Apr. 2018)

…

Such agreements should not be changed without very wide consultation across all countries and all materials of construction. The particular change being proposed has a big impact on the costs of construction in different materials and really must be discussed and agreed on a very broad platform.

…

We seriously ask whether the studies have taken into account the real resistance functions of EN 1993, which do indeed include additional safety and extra reserves beyond what is deterministically evaluated as a result of proven over-strength effects, even for statically determinate structures.

…

SC4

Lettera di Graham Couchman (Ago. 2018)

bsi.

Date: 30th August 2018
Our ref N1903

Dear Paulo,

Proposed changes to EN1990

The members of SC4 are aware of the concerns that have been raised by SC3 (CEN/TC250/SC3 N2628) in relation to proposed changes to EN1990. We are in agreement with the concerns of SC3, because composite construction will share the same issues as those identified for steel structures. We note that SC3 feel proposed changes would have a 'disproportionate impact on designs produced using EN1993', and the same would apply for EN1994.
Rather than reproduce the points made by SC3, and/or argue this on a purely technical level, key aspects of our concerns can be easily summarised:

- Changing the basis of reliability assessment such as the reference period, the safety index or the influence factors α_R and α_E will invalidate any calibrations of resistance methods/values that we (and many others) have already carried out.
- Changing, as a consequence, load factors will not help 'ease of use', but rather invalidate existing software, design guides and practice. This will be frowned upon by practitioners.
- We are not aware of any evidence – from practice – to suggest there is a problem with the level of safety that has been achieved previously, and reducing the reference period for reliability assessments from 50 years to 1 year seems a massive jump (a 'revolution' rather than an 'evolution').
- We are concerned about the impact for existing composite structures that could then deemed to be less safe than owners previously thought they were. This has potentially big commercial and legal implications.
- We also have concerns that these changes seem to be motivated by a request from one material sub-committee and based only on theoretical design verifications, without involvement of experts in other materials and without considering the safety level of existing structures.

We hope that these concerns will be taken into account by the teams developing EN1990.

Kind regards

Dr Graham Couchman
Chairman of CEN/TC250/SC4

- Changing the basis of reliability assessment such as the reference period, the safety index or the influence factors α_R and α_E will invalidate any calibrations of resistance methods/values that we (and many others) have already carried out.
- We are concerned about the impact for existing composite structures that could then deemed to be less safe than owners previously thought they were. This has potentially big commercial and legal implications.
- We also have concerns that these changes seem to be motivated by a request from one material sub-committee and based only on theoretical design verifications, without involvement of experts in other materials and without considering the safety level of existing structures.

SC5

Lettera di Stefan Winter (Lug. 2018)

Dr. Steve Denton
CEN/TC 250 Chairman

via e-mail

Munich, 04th July 2018

CEN/TC 250/SC 5: Support of the letter from SC 3 on the revision of safety issues in EN 1990

Dear Steve,

In addition to the discussion of the last CEN/TC 250 Meeting in Oslo, CEN/TC 250/SC 5 hereby expresses its clear support for the opinion of CEN/TC 250/SC 3 on the revision of safety issues in EN 1990, made clear by Professor Ulrike Kuhlmann (CEN/TC 250/SC 3 Chairwoman) in her letter to CEN/TC 250/SC 10 on 2018-05-04.

Within the work of Eurocode 5, the Project Teams SC5.T1 and SC5.T2 of Phase 1 have already delivered their final documents. As Chairman of CEN/TC 250/SC 5, I confirmed the finalization of their work meeting the requirements set out in the Specification under Mandate M/515. The final documents of these Project Teams are based on the old valid risk and safety concept. Changes may conflict with the fundamental assumptions of the design resistances of SC 5 and may have a disproportionate impact on the designs produced by SC 5 standards.

We therefore strongly support that the general risk and safety concept as actual stated in EN 1990:2002 and of all design standards of CEN/TC 250 subcommittees shall not be changed.

Many thanks for all your support.

Yours sincerely,

Univ.-Prof. Dr.-Ing. Stefan Winter
Chairman of CEN/TC 250/SC 5

SC2

Lettera di Hans Ganz (Nov. 2018)

…

We consider it an obligation of CEN/TC 250 to ensure a uniform level of safety/reliability across types of structures and materials, and to make sure that the recommended values of partial factors (NDPs) are well founded. SC 2 therefore, considers is most appropriate and necessary to perform a review and re-calibration of partial factors at the time of revising the entire Eurocode suite.

…

The interim results presented by SC 10/WG 1 have shown that the request of SC2 was well justified since the interim conclusion was that the partial factor for self-weight should be about 1,2. In order to maintain the same overall reliability the partial factor for variable actions should be increased to about 1,6.

…

If there should be a wish to extend this study and to review and re-calibrate the absolute values of reliability across all Eurocodes and materials in which the resistance side of materials is also included SC 2 will be happy to contribute to this task and to delegate a representative into SC 10/WG 1. However, as mentioned above, this is not part of the request submitted by SC 2.

JCSS

(Giu. 2017)

Practical values

It is recommended to use β = 4.2 on an annual basis as a value for the central consequence class, normal cost of safety measures, normal scatter (e.g. V_R=0,2, V_G=0,1 and V_Q=0,3), no degradation and design working life of 50 year.

The annual value may be made dependent on other failure consequences, cost considerations, the design working life or scatter (like in some climatic actions) and may be explicitly presented (for instance in a table) or left completely to the member states.

Relative cost of safety measure	Consequences of failure (classes from Table F1)		
	Class 2	Class 3	Class 4
Large	$\beta = 3.1 \left(P_f \approx 10^{-3}\right)$	$\beta = 3.3 \left(P_f \approx 5 \cdot 10^{-4}\right)$	$\beta = 3.7 \left(P_f \approx 10^{-4}\right)$
Medium	$\beta = 3.7 \left(P_f \approx 10^{-4}\right)$	$\beta = 4.2 \left(P_f \approx 10^{-5}\right)$	$\beta = 4.4 \left(P_f \approx 5 \cdot 10^{-6}\right)$
Small	$\beta = 4.2 \left(P_f \approx 10^{-5}\right)$	$\beta = 4.4 \left(P_f \approx 5 \cdot 10^{-6}\right)$	$\beta = 4.7 \left(P_f \approx 10^{-6}\right)$

Table G.4 **Tentative target reliabilities related to one year reference period and ultimate limit states, based on monetary optimization, JCSS[14].**

Azioni

- La SC10 ed il Coordination Group del TC250 hanno discusso a fondo dei risultati del SC10/WG1:
  - Prima di proporre modifiche ai fattori parziali sono necessari ulteriori studi ed approfondimenti con il contributo di esperti delle varie SC
  - L'avanzamento in parallelo delle varie parti degli EC pone problemi di interazione tra EN1990 e EC «materiali» per la ricalibrazione dei relativi fattori parziali
  - La EN1990 nella versione che sarà sottoposta a voto formale conserverà gli attuali valori dei coefficienti parziali lato azioni, che rimarranno, ovviamente, da definire con specifiche determinazioni nazionali
- Si è deciso di predisporre un documento di Background su questi temi, per facilitare la scelta al livello nazionale dei fattori parziali, che sarà elaborato da un AHG in seno alla SC10, cui parteciperanno esperti di tutti i gruppi attivi nel TC250 (SC, HG, WG).
- Il WG1 della SC10 continuerà a lavorare sulla calibrazione, potendo anche far conto sui contributi e dati raccolti nell'ambito dei lavori dell'AHG

CEN/TC 250/SC 10 EN 1990 Basis of Structural Design

DECISION 13 taken by CEN/TC 250/SC 10 on 2018-12-06

Subject: Formation of a CEN/TC 250/SC 10 Ad-Hoc Group to prepare a JRC Science and Policy Report on 'Reliability Background in the Eurocodes'

The CEN/ TC 250/SC 10 EN 1990 – Basis of structural design,

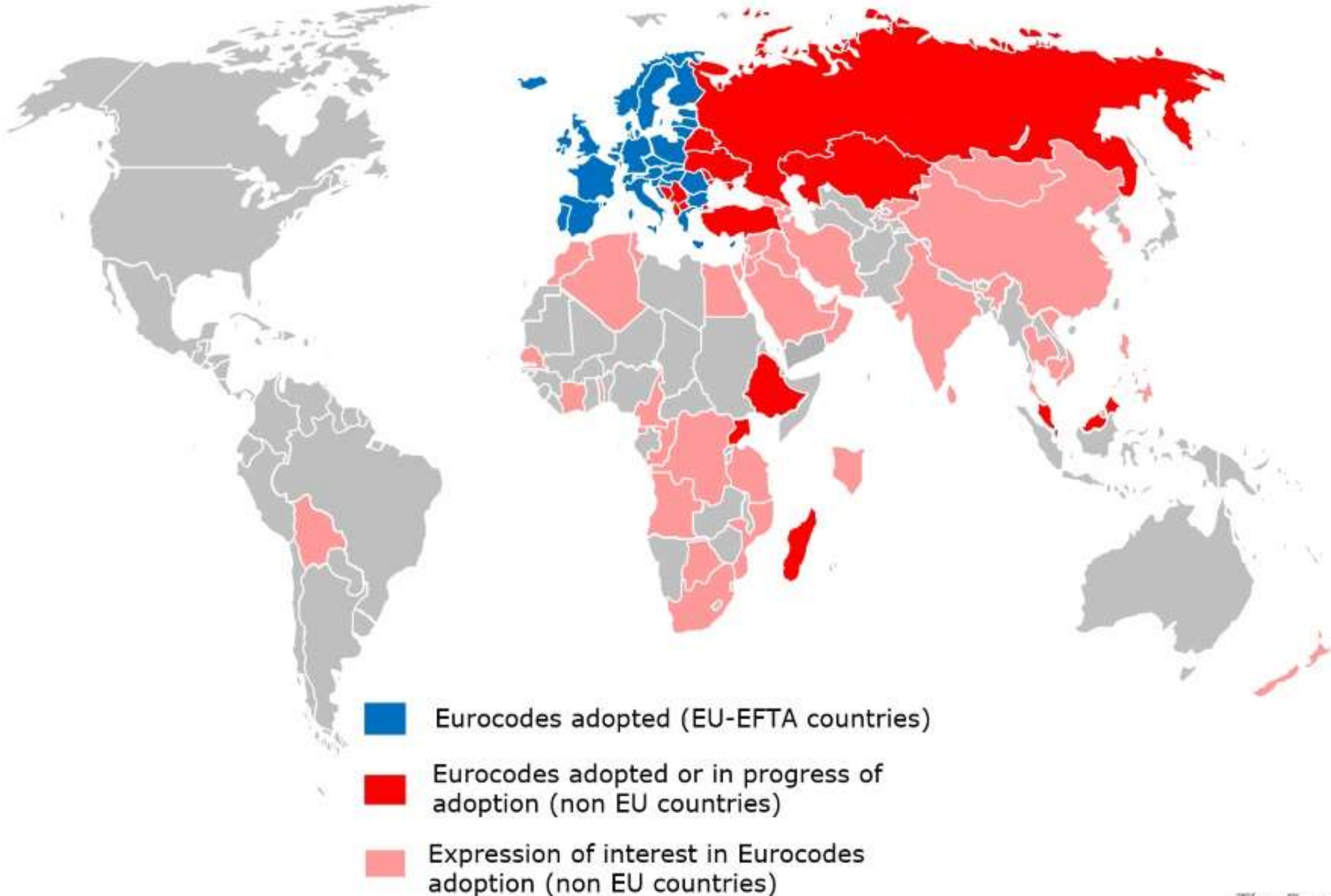
- considering the requirement to engage efficiently with progress of SC10 related outputs from Mandate M/515
- agrees to the formation of an Ad-Hoc Group to prepare a JRC Science and Policy Report on 'Reliability Background in the Eurocodes' with a convenor (TBC), maximum 1 representative from each of CEN/TC 250 subordinate group (SCs, WGs, HGs), 3 members from SC 10 as key members and 2 members from JRC, noting the possibility for the SC Chairman to enlarge the group in the future as needed;
- agrees the following terms of reference for the Ad-Hoc Group:
  - Draft an explanatory report on the assumptions in EN 1990 for the most representative set of partial factors so as to avoid doubts and possible confusion both at national level and for practical users,
  - To provide guidance to NSBs for their decision on partial factors in Annex A.1 of EN 1990 in each country, illustrating common methods, procedures, etc. also by means of examples, taking into account the work of SC 10/WG 1,
  - Provide guidance on stochastic modelling on the most representative failure modes for different materials (e.g. concrete, steel, timber, masonry) and for different loads (e.g. imposed loads, wind actions, snow loads),
  - Provide basic assumptions, methods and provide examples to serve as a reference for the implementation of full probabilistic methods and, potentially, of risk-based methods, in line with EN 1990 guidance given in its informative Annex C,
  - To report regularly on the progress of the work to SC 10, thus enabling SC 10 to report to TC 250,
  - To deliver within the time frame for the publication plan for EN 1990.

SC 10 requests TC 250 to encourage each subordinate group to appoint a member to the Ad-Hoc Group.

The decision was taken by unanimity.

TC250	Esperto nominato
SC1	Jana Markova (CZ)
SC2	Giuseppe Mancini (IT)
SC3	Ulrike Kuhlmann (DE)
SC4	Andreas Taras (DE)
WG2	Peter Tanner (SP)

(al 28.02.2019)



The Eurocodes Map

Grazie per l'attenzione