Eurocode 7 post BREXIT

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Organizational changes to the 2nd generation Eurocodes

Improvements in EN 1990

- Simplification of EQU, STR, and GEO
- Catering for non-linearity and coupling
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- Simpler presentation of combinations of actions
- Water actions
- Management measures to achieve the intended structural reliability

Improvements in 2nd generation EN 1997

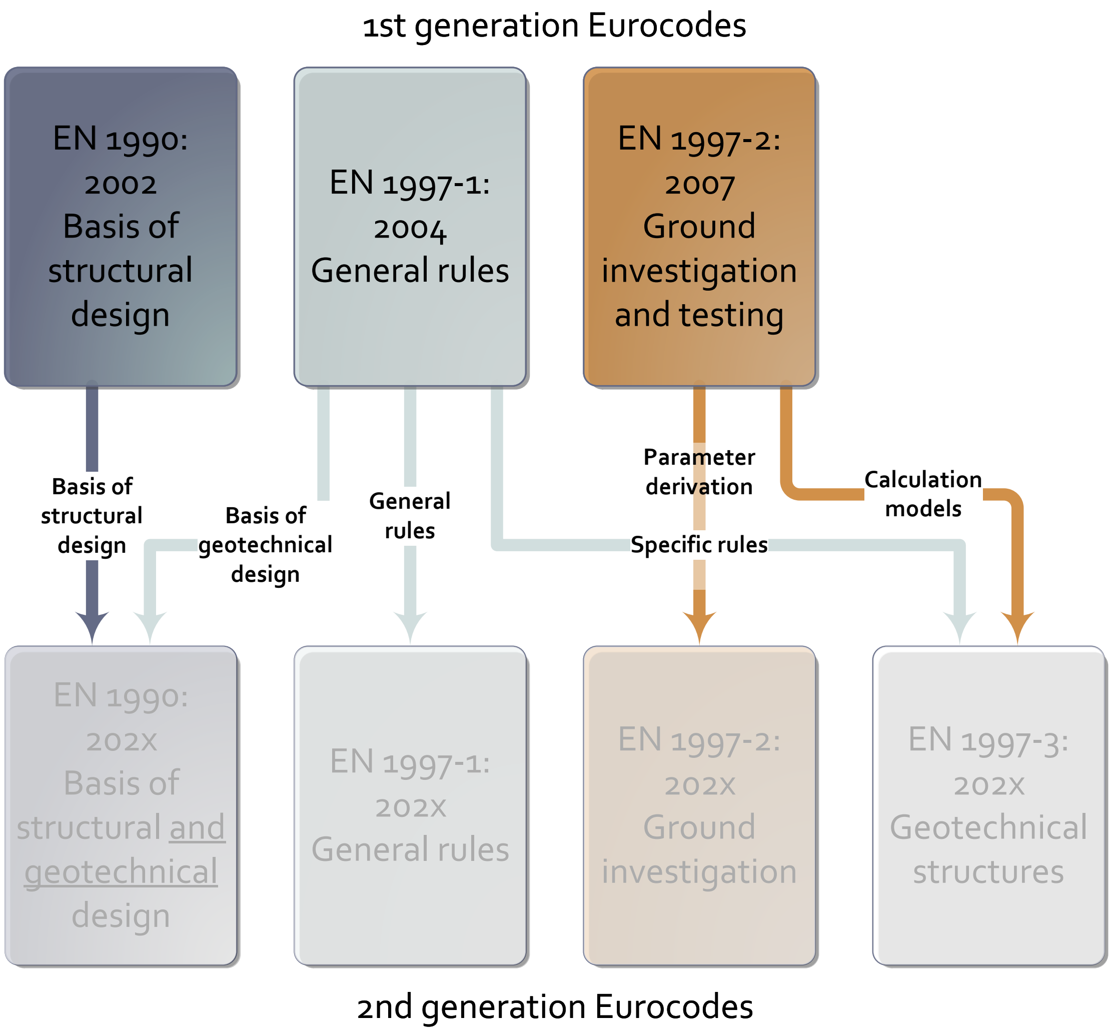
- No more Design Approaches!
- Catering for different groundwater conditions
- Separating consequence from hazard

Summary

Organizational changes to the 2nd generation Eurocodes

Eurocode 7 post BREXIT

Organizational changes to the Eurocodes



1st generation Eurocodes

EN 1990: 2002 Basis of structural design

EN 1997-1: 2004 General rules

EN 1997-2: 2007 Ground investigation and testing

EN 1990: 202x Basis of structural and geotechnical design

EN 1997-1: 202x General rules

EN 1997-2: 202x Ground investigation

EN 1997-3: 202x Geotechnical structures

2nd generation Eurocodes

2nd generation of EN 1990 Contents: old vs new

EN 1990:2002, 114 pp

1. General
2. **Requirements**
3. **Principles of limit state esign**
4. **Basic variables**
5. **Structural analysi testing**
6. **Verification by the pa d**

Annex A1 Application for build gs

Annex A2 Application for bridges

Annex B* Management of structural reliability for construction works

Annex C* Basis for partial factor design and reliability analysis

Annex D* Design assisted by testing

Bibliography

(*informative)

Familiar Clause headings

EN 1990:202x, 145 pp

1. Scope
2. Normative references
3. Terms, definitions and symbols
4. **General rules**
5. **Principles of limit state design**
6. **Basic variables**
7. **Structural analysis and design assisted by testing**
8. **Verification by the partial factor method**

Annex A Application rules

Annex B* Management measures …

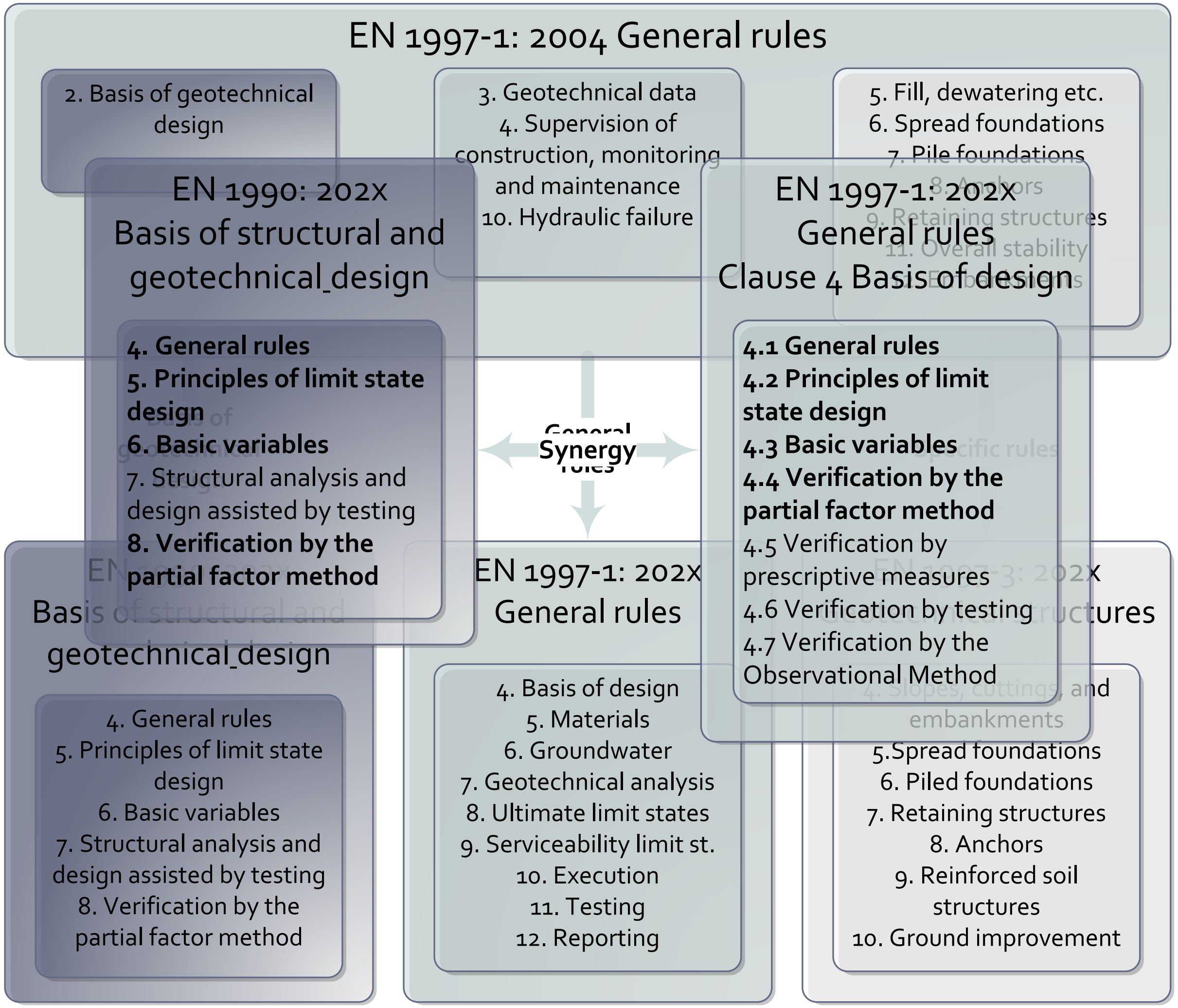
Annex C* Reliability analysis and code calibration

Annex D* Design assisted by testing

Annex E* Specific robustness provisions for buildings

Bibliography

2nd generation of Eurocode 7
Reorganization of Eurocode 7 Part 1



EN 1997-1: 2004 General rules

2. Basis of geotechnical design

3. Geotechnical data
4. Supervision of construction, monitoring and maintenance
10. Hydraulic failure

5. Fill, dewatering etc.
6. Spread foundations
7. Pile foundations
8. Anchors
9. Retaining structures
11. Overall stability
12. Embankments

EN 1990: 202x
Basis of structural and geotechnical_design

4. General rules
5. Principles of limit state design
6. Basic variables
7. Structural analysis and design assisted by testing
8. Verification by the partial factor method

EN 1997-1: 202x
General rules
Clause 4 Basis of design

4.1 General rules
4.2 Principles of limit state design
4.3 Basic variables
4.4 Verification by the partial factor method
4.5 Verification by prescriptive measures
4.6 Verification by testing
4.7 Verification by the Observational Method

General rules

Synergy

Specific rules

EN 1990: 202x
Basis of structural and geotechnical_design

4. General rules
5. Principles of limit state design
6. Basic variables
7. Structural analysis and design assisted by testing
8. Verification by the partial factor method

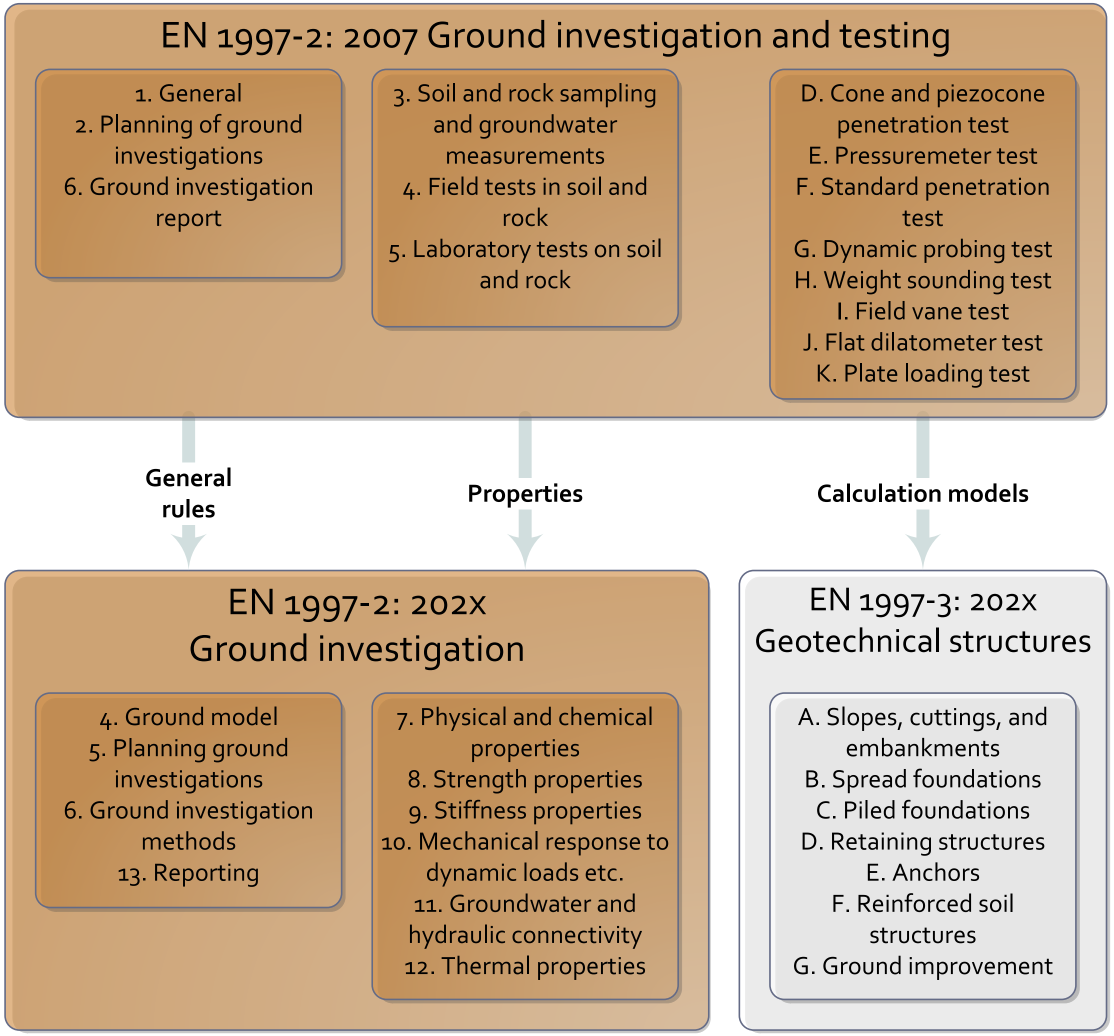
EN 1997-1: 202x
General rules

4. Basis of design
5. Materials
6. Groundwater
7. Geotechnical analysis
8. Ultimate limit states
9. Serviceability limit st.
10. Execution
11. Testing
12. Reporting

EN 1997-3: 202x
Geotechnical structures

4. Slopes, cuttings, and embankments
5.Spread foundations
6. Piled foundations
7. Retaining structures
8. Anchors
9. Reinforced soil structures
10. Ground improvement

2nd generation of Eurocode 7
Reorganization of Eurocode 7 Part 1



EN 1997-2: 2007 Ground investigation and testing

1. General
2. Planning of ground investigations
6. Ground investigation report

3. Soil and rock sampling and groundwater measurements
4. Field tests in soil and rock
5. Laboratory tests on soil and rock

D. Cone and piezocone penetration test
E. Pressuremeter test
F. Standard penetration test
G. Dynamic probing test
H. Weight sounding test
I. Field vane test
J. Flat dilatometer test
K. Plate loading test

General rules

Properties

Calculation models

EN 1997-2: 202x
Ground investigation

4. Ground model
5. Planning ground investigations
6. Ground investigation methods
13. Reporting

7. Physical and chemical properties
8. Strength properties
9. Stiffness properties
10. Mechanical response to dynamic loads etc.
11. Groundwater and hydraulic connectivity
12. Thermal properties

EN 1997-3: 202x
Geotechnical structures

A. Slopes, cuttings, and embankments
B. Spread foundations
C. Piled foundations
D. Retaining structures
E. Anchors
F. Reinforced soil structures
G. Ground improvement

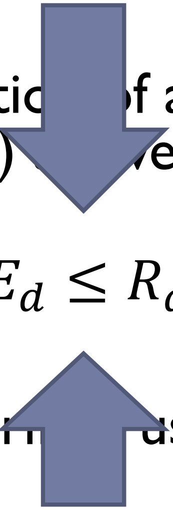
Improvements to EN 1990

Eurocode 7 post BREXIT

1st generation of EN 1990 and 1997-1 Verification of ULS

Loss of static equilibrium (limit state 'EQU') is verified using:

$$E_{d,dst} \leq E_{d,stb}$$



Rupture and excessive deformatio f a section, member, or connection ('STR' and/or 'GEO') verified using:

$$E_d \leq R_d$$

In EN 1997-1, uplift ('UPL') is ver using:

$$V_{dst,d} \leq G_{stb,d} + R_d \left(\equiv E_{d,dst} \leq E_{d,stb} + R_d\right)$$

This expression caters for combined loss of equilibrium and rupture, which is only mentioned in NOTE 2 to Table A1.2(A) of EN 1990

2nd generation of EN 1990 The 'single-source principle'

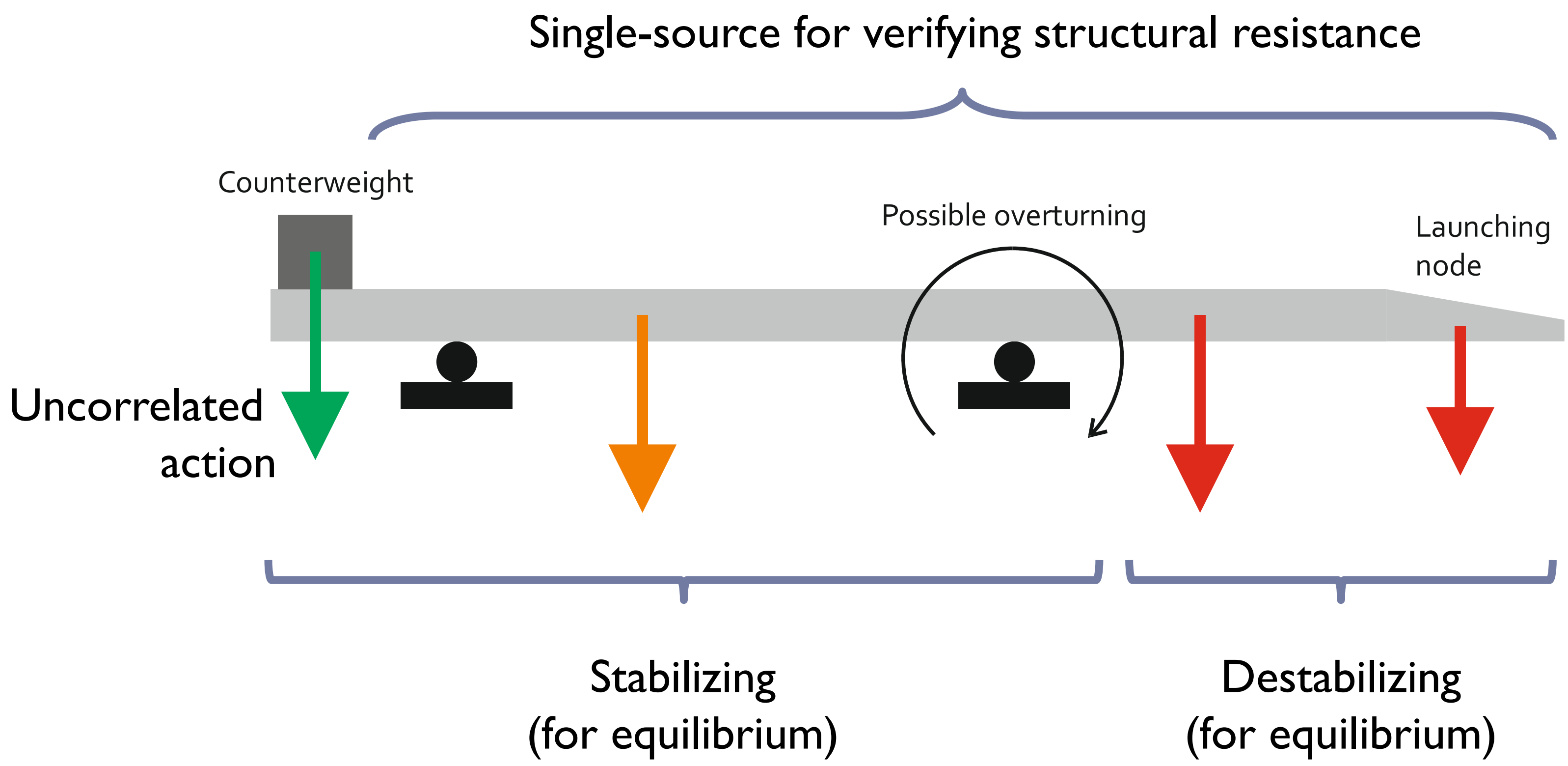
Actions from a single source that, owing to physical reasons, induce effects that are strongly correlated with one another may be treated as a single action, even when they originate in, or act on, different parts of the structure, or originate from different materials.

NOTE 1 This rule is commonly known as the 'single-source principle'.

NOTE 2 The single-source principle typically applies to the self-weight of the structure or the ground and of components made of composite materials as well as for water pressures acting on both sides of a structure with flow passing around or underneath.

When verifying loss of static equilibrium, variations in the magnitude or spatial distribution of permanent actions from a single-source should be considered.

2^{nd} generation of EN 1990 Applying single-source/variation from it



1^{st} generation of EN 1990
Design effects-of-actions and resistance

In EN 1990:2002, design values of effects-of-actions E_d can be calculated from:

$$E_\mathrm{d} = \overbrace{\gamma_\mathrm{Sd} E\{\gamma_{\mathrm{f,i}} F}^{material\ strength\ missing}$$

In EN 19 … wing form:

Equations need to be generalized to cater for non-linear behaviour and geotechnical design

$$\left\{ \begin{array}{l} \gamma_\mathrm{Rd} \quad \left\{\eta_i \frac{X_\mathrm{k,i}}{\gamma_\mathrm{m,i}} ; a_\mathrm{d} \right\} = R\left\{\eta_i \frac{X_\mathrm{k,i}}{\gamma_{M\mathrm{,i}}} ; a_\mathrm{d} \right\} \\ \qquad -or- \\ \qquad \underbrace{R_k/\gamma_\mathrm{R}}_{factors\ on\ resistance} \end{array} \right.$$

2^{nd} generation of EN 1990
Design values of the effects of actions

The design effect of actions

Effects now depend on material properties

$$E_{\mathrm{d}} = \gamma_{\mathrm{Sd}} E \left\{ \overbrace{\Sigma(\gamma_{\mathrm{f}} \psi F_{\mathrm{k}}); a_{\mathrm{d}}; \boxed{X_{\mathrm{Rd}}}} \right\}$$

For **linear structural systems** and **certain geotechnical structures**, E_d <u>may</u> be calculated from:

Factors applied to actions

$$E_{\mathrm{d}} = E \overbrace{\left\{ \boxed{\Sigma F_{\mathrm{d}}}; a_{\mathrm{d}}; X_{\mathrm{Rd}} \right\}}^{F_d=\gamma_{\mathrm{F}}\psi F_{\mathrm{k}}} = \underbrace{E \left\{ \Sigma \left(\boxed{\gamma_{\mathrm{F}}} \psi F_{\mathrm{k}} \right); a_{\mathrm{d}}; X_{\mathrm{Rd}} \right\}}_{\gamma_{\mathrm{F}}=\gamma_{\mathrm{Sd}}\times\gamma_{\mathrm{f}}}$$

For **non-linear structural systems** and **certain geotechnical structures**, E_d <u>may</u> be calculated from:

Factors applied to effects

$$E_{\mathrm{d}} = \overbrace{\gamma_{\mathrm{E}} E \left\{ \boxed{\Sigma F_{\mathrm{rep}}}; a_{\mathrm{d}}; X_{\mathrm{Rd}} \right\}}^{F_{\mathrm{rep}}=\psi F_{\mathrm{k}}} = \underbrace{\boxed{\gamma_{\mathrm{E}}} E \overbrace{\left\{ \Sigma(\psi F_{\mathrm{k}}); a_{\mathrm{d}}; X_{\mathrm{Rd}} \right\}}}_{\gamma_{\mathrm{E}}=\gamma_{\mathrm{Sd}}\times\gamma_{\mathrm{f}}}$$

EN 1997 specifies the geotechnical structures for which these apply

2nd generation of EN 1990
Design values of resistance

The design resistance R_d sho

Resistance now depends on actions

$$R_d = \overbrace{\frac{1}{\gamma_{Rd}} R\left\{\frac{\eta X_k}{\gamma_m}; a_d; \boxed{\Sigma F_{Ed}}\right\}}$$

R_d may be calculated from (the '**material fac**

Factors applied to strength

$$R_d = R\left\{\boxed{X_d}; a_d; \Sigma F_{Ed}\right\} = \underbrace{R\left\{\frac{\eta X_k}{\boxed{\gamma_M}}; a_d; \Sigma F_{Ed}\right\}}_{\gamma_M=\gamma_{Rd}\times\gamma_m}$$

R_d may be calculated from (the '**resistance fa**

Factors applied to resistance

$$R_d = \frac{R\left\{\boxed{X_{rep}}; a_d; \Sigma F_{Ed}\right\}}{\gamma_R} = \underbrace{\frac{\overbrace{R\left\{\eta X_k; a_d; \Sigma F_{Ed}\right\}}}{\boxed{\gamma_R}}}_{\gamma_R=\gamma_M=\gamma_{Rd}\times\gamma_m}$$

2nd generation of EN 1990 ‘Design cases’ replace Sets A, B, and C

design case

set of partial factors applied to actions or effects of actions for verification of a specific limit state

Design cases first appear here:

Annex A (normative) **Application rules**

A.1 General application and application for buildings

Table A.1.8 (NDP) Partial factors on actions and effects for fundamental (persistent and transient) design situations

Similar tables will appear for other structural types:

- for general application and for buildings, in Annex A.1;
- for bridges, in Annex A.2;
- for towers, masts and chimneys, in Annex A.3;
- for silos and tanks, in Annex A.4;
- for structures supporting cranes and other machineries in Annex A.5;
- for marine coastal structures, in Annex A.6.

2nd generation of EN 1990

Partial factors for buildings/geotechnical structures

Action or effect				Partial factors γ_F & γ_E for Design Cases 1-4				
Type	Group	Symbol	Resulting effect	Structural	Static equilibrium and uplift*		Geotechnical design	
				DC1	DC2(a)	DC2(b)	DC3	DC4
Permanent action (G_k)	All	γ_G	unfavourable/ destabilizing	1.35 K_F	1.35 K_F		1.0	G_k is not factored
	Water	$\gamma_{G,w}$		1.2 K_F	1.2 K_F			
	All	$\gamma_{G,stb}$	stabilizing	Set 'B' not used	1.15	1.0 Set 'A'	Set 'C' not used	
	Water	$\gamma_{G,w,stb}$			1.0			
	(All)	$\gamma_{G,fav}$	favourable	DA 1.0	Table A1.2(A) 1.0		DA 1.0	
Prestress (P_k)		γ_P		1-1 See other relevant Eurocodes	NOTE 2		1-2	
Variable action (Q_k)	All	γ_Q	unfavourable	1.5 K_F	1.5 K_F		1.3	1.1
	Water	$\gamma_{Q,w}$		1.35 K_F	1.35 K_F		1.15	1.0
	(All)	$\gamma_{Q,fav}$	favourable	0				DA2*
Effects-of-actions (E)		γ_E	unfavourable	effects are not factored				1.35 K_F
		$\gamma_{E,fav}$	favourable					1.0

*worse outcome of (a) and (b) applies

2nd generation of EN 1990
New presentation of combinations of actions

EN 1990:2002 uses two different expressions specify combinations of actions, e.g.:

$$E_{\mathrm{d}} = E\ \underbrace{\{\gamma_{\mathrm{G,j}} G_{\mathrm{k,j}}; \gamma_{\mathrm{P}} P; \gamma_{\mathrm{Q,1}} Q_{\mathrm{k,1}}; \gamma_{\mathrm{Q,i}} \psi_{\mathrm{0,i}} Q_{\mathrm{k,i}}\}}_{ignores\ dependency\ on\ material\ strength}$$

where the term in brackets is given by:

$$\sum_{j \geq 1} \gamma_{\mathrm{G,j}} G_{\mathrm{k,j}} \text{ "+" } \gamma_{\mathrm{P}} P \quad \overbrace{\text{"+"}}^{\substack{needs \\ explaining}} \quad \gamma_{\mathrm{Q,1}} Q \qquad \text{"} \sum_{i>1} \gamma_{\mathrm{Q,i}} \psi_{\mathrm{0,i}} Q_{\mathrm{k,i}}$$

In EN 1990:202x, this has been re to a single for avoids obscure notation:

$$\overbrace{\sum F_{\mathrm{d}}}^{actions} = \overbrace{\sum_{\mathrm{i}} \gamma_{\mathrm{G,i}} G_{\mathrm{k,i}}}^{permanent} + \overbrace{\gamma_{\mathrm{Q,1}} Q_{\mathrm{k,1}}}^{leading\ variable} + \underbrace{\sum_{\mathrm{j>1}} \gamma_{\mathrm{Q,j}} \psi_{\mathrm{0,j}} Q_{\mathrm{k,j}}}_{accompanying\ Q} + \underbrace{(\gamma_{\mathrm{P}} P_{\mathrm{k}})}_{pre-stress}$$

2nd generation of EN 1990
Tabulated presentation of CoAs

Design action	Ultimate limit states				Serviceability limit states			
	Persistent/ transient	Accidental	Seismic	Fatigue	Characteristic	Frequent	Quasi-permanent	Seismic
Permanent ($G_{d,i}$)	$\gamma_{G,i}G_{k,i}$	$G_{k,i}$	$G_{k,i}$	$G_{k,i}$	$G_{k,i}$	$G_{k,i}$	$G_{k,i}$	$G_{k,1}$
Leading variable ($Q_{d,1}$)	$\gamma_{Q,1}Q_{k,1}$	$\psi_{1,1}Q_{k,1}$ or $\psi_{2,1}Q_{k,1}$	$\psi_{2,i}Q_{k,i}$	$\psi_{2,i}Q_{k,i}$	$Q_{k,i}$	$\psi_{1,1}Q_{k,1}$	$\psi_{2,i}Q_{k,i}$	$\psi_{2,i}Q_{k,i}$
Accompanying variable ($Q_{d,i}$)	$\gamma_{Q,i}\psi_{0,i}Q_{k,i}$	$\psi_{2,i}Q_{k,i}$			$\psi_{0,i}Q_{k,i}$	$\psi_{2,i}Q_{k,i}$		
Prestress (P_d)	$\gamma_P P_k$	P_k	P_k	P_k	P_k	P_k	P_k	P_k
Accidental (A_d)	-	A_d	-	-	-	-	-	-
Seismic (A_{Ed})	-	-	$A_{Ed,ULS}$	-	-	-	-	$A_{Ed,SLS}$
Fatigue (Q_{fat})	-	-	-	Q_{fat}	-	-	-	-

2nd generation of EN 1990
Specification of permanent water actions

Actions that arise from water should be classified as permanent, (G_w), variable (Q_w), or accidental (A_w) according to the probability that the magnitude of the action will be exceeded.

The representative value of a permanent water action ($G_{w,rep}$) is given by:

$$G_{w,rep} = \begin{cases} G_{w,k,mean} \mid \quad (\underbrace{G_{w,k,sup} \mid G_{w,k,inf}}_{\substack{whichever\ is \\ more\ adverse}}) \mid \quad G_{w,nom} \end{cases}$$

2nd generation of EN 1990
Specification of variable water actions

The representative value of a variable water action ($Q_{w,rep}$) is given by:

$$Q_{w,rep} = G_{w,rep} + \underbrace{\overbrace{Q_{w,k}}^{\substack{depending\ on \\ design\ situation}}}_{=Q_{w,k}|Q_{w,comb}|Q_{w,freq}|Q_{w,qper}}$$

Value of variable water action	Symbol	Probability of exceedance	Return period (years)
Characteristic	$Q_{w,k}$	2% per annum	50
Combination	$Q_{w,comb}$	5% per annum	20
Frequent	$Q_{w,freq}$	1% during design service life	-
Quasi-permanent	$Q_{w,qper}$	50% during design service life	-
Accidental	$A_{w,rep}$	0.1% per annum	1000

2nd generation of EN 1990
Consequence classes, examples, and factors

Consequence class/ Description		**Loss of human life***	**Economic, social or environ-mental***	**Examples of buildings**	**Factor K_F**
CC4	Highest	Extreme	Huge	Additional provisions can be needed	
CC3	Higher	High	Very great	Grandstands, large buildings, e.g. a concert hall	1.1
CC2	Normal	Medium	Considerable	Residential and office buildings, small buildings	1.0
CC1	Lower	Low	Small	Agricultural buildings, buildings where people do not normally enter, such as storage buildings, etc.	0.9
CC0	Lowest	Very low	Negligible	Alternative provisions may be used	

*CC is chosen based on the more severe of these two columns

2nd generation of EN 1990
Measures for achieving structural reliability

Measure	Levels*		Description
Design quality	Design qualification and experience levels (DQLs)	3	Have the required level of design qualification and experience to perform … complex design works
		2	Advanced design works
		1	Simple design works
Design checking	Design Check Levels (DCLs)	3	Independent extended checking
		2	Independent normal checking
		1	Self checking
Execution quality	*Execution Classes (EXC)*		Defined in execution standards
Inspection during execution	Inspection Levels (ILs)	3	Independent extended inspection
		2	Independent normal inspection
		1	Self inspection

*Required minimum level to be given in the National Annex

2nd generation of EN 1990
Minimum levels vs consequence class

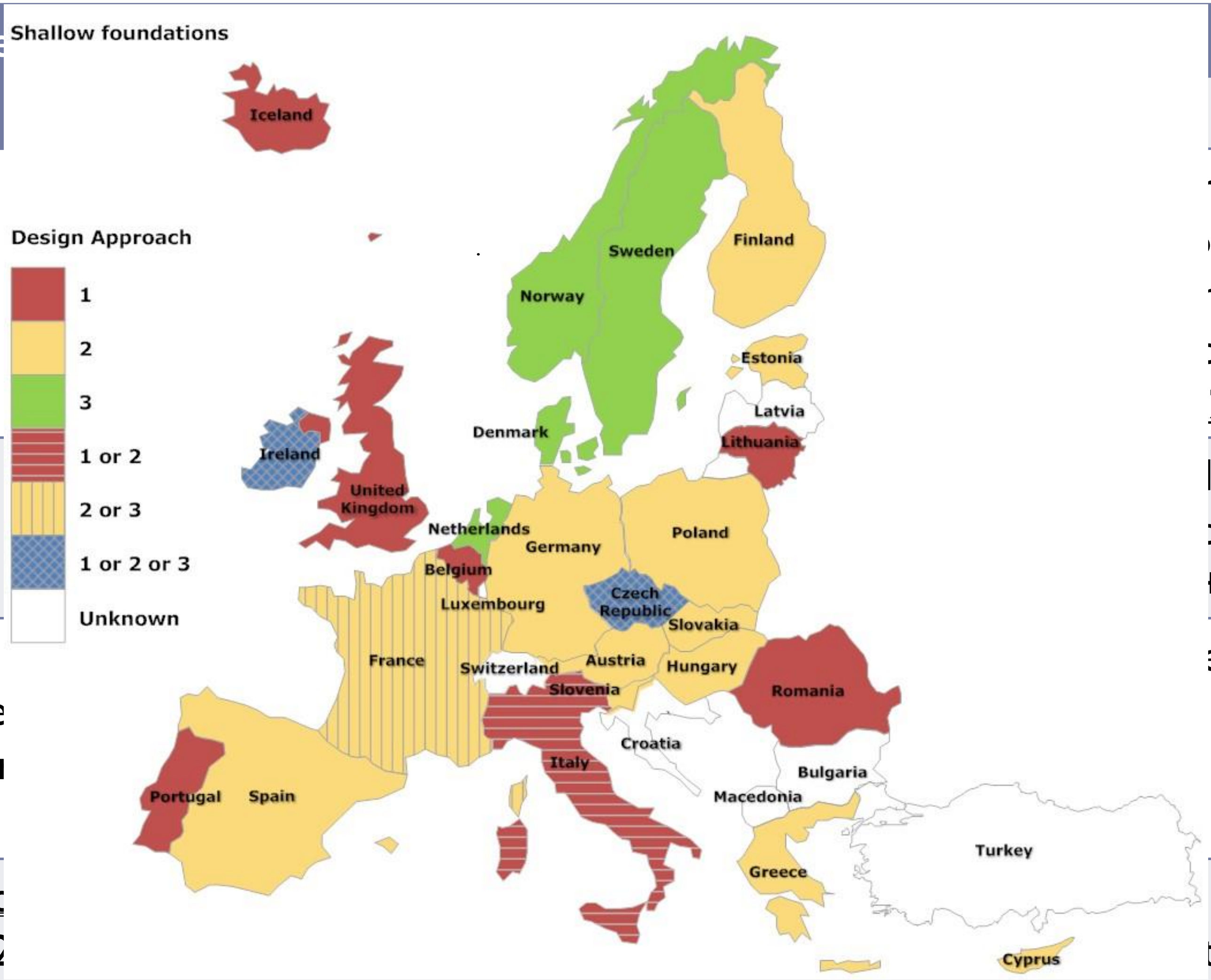
Consequence class	Minimum design quality level	Minimum design check level	Minimum execution class	Min imum inspection level
Higher (CC3)	DQL3	DCL3	See relevant execution and product standards	IL3
Normal (CC2)	DQL2	DCL2		IL2
Lower (CC1)	DQL1	DCL1		IL1

Improvements to EN 1997

Eurocode 7 post BREXIT

1^{st} generation of Eurocode 7 Complexity of Design Approaches (Bond & Harris, 2008)

Structure	
	3
General structures	uctural ns/effects material operties 2+M2+R3
Slopes	aterial operties +M2+R3
Axially loaded pile and ancho	es
(Major) fac Sets A1-A2	tances



2nd generation of EN 1990
ULS verification incl. non-linear behaviour

Ultimate limit states must be verified using:

$$E_d \leq R_d$$

Factor may be applied to actions:

Factored actions (DC1-3)

$\gamma_F = \gamma_{Sd} \times \gamma_f$

Factors may be applied to materials:

$(\eta X_k$

Material factor approach (MFA)

$\gamma_M = \gamma_{Rd} \times \gamma_m$

or to effects:

$$E_d = \boxed{\gamma_F} E\{\Sigma(\psi F_k); a_d; X_{Rd}\}$$

Factored effects (DC4)

or to resistance:

$$R_d = \frac{R\{\eta X_k; a_d; \Sigma F_{Ed}\}}{\quad}$$

Resistance factor approach (RFA)

$\gamma_R = \gamma_M = \gamma_{Rd} \times \gamma_m$

2^{nd} generation of Eurocode 7
Partial factors for ULS (Bond et al., 2019)

Verific-ation of	Partial factor on		Material factor approach*		Resistance factor approach
			a	b	
Overall stability of slopes	Actions/effects	γ_F / γ_E	DC3 $\gamma_G = 1.0, \gamma_Q = 1.3$		Not rmitted
	Ground properties	γ_M	$\gamma_{\tan\varphi} =$		
	Earth resistance	γ_{Re}	Not factored		
Spread foundations	Actions/effects	γ_F / γ_E	DC1 $\gamma_G = 1.35\ K_F$ $\gamma_Q = 1.5\ K_F$	DC3 $\gamma_G = 1.0$ $\gamma_Q = 1.3$	DC4 $\gamma_Q = 1.1$ $\gamma_E = 1.35\ K_F$
	Ground properties	γ_M	γ_{tan} γ_{cu}		ored
	Bearing resistance	γ_{Rv}	Not permitted		1.4
	Sliding resistance	γ_{Rh}			1.1

*Where two cases (a and b) are given, verify both

Harmonized choice
(MFA only)

National choice via NDP
(MFA or RFA)

2^{nd} generation of Eurocode 7
Specification of groundwater pressures

Representative groundwater pressure ($F_{w,rep}$) is given by:

Uncertainty in static water pressure

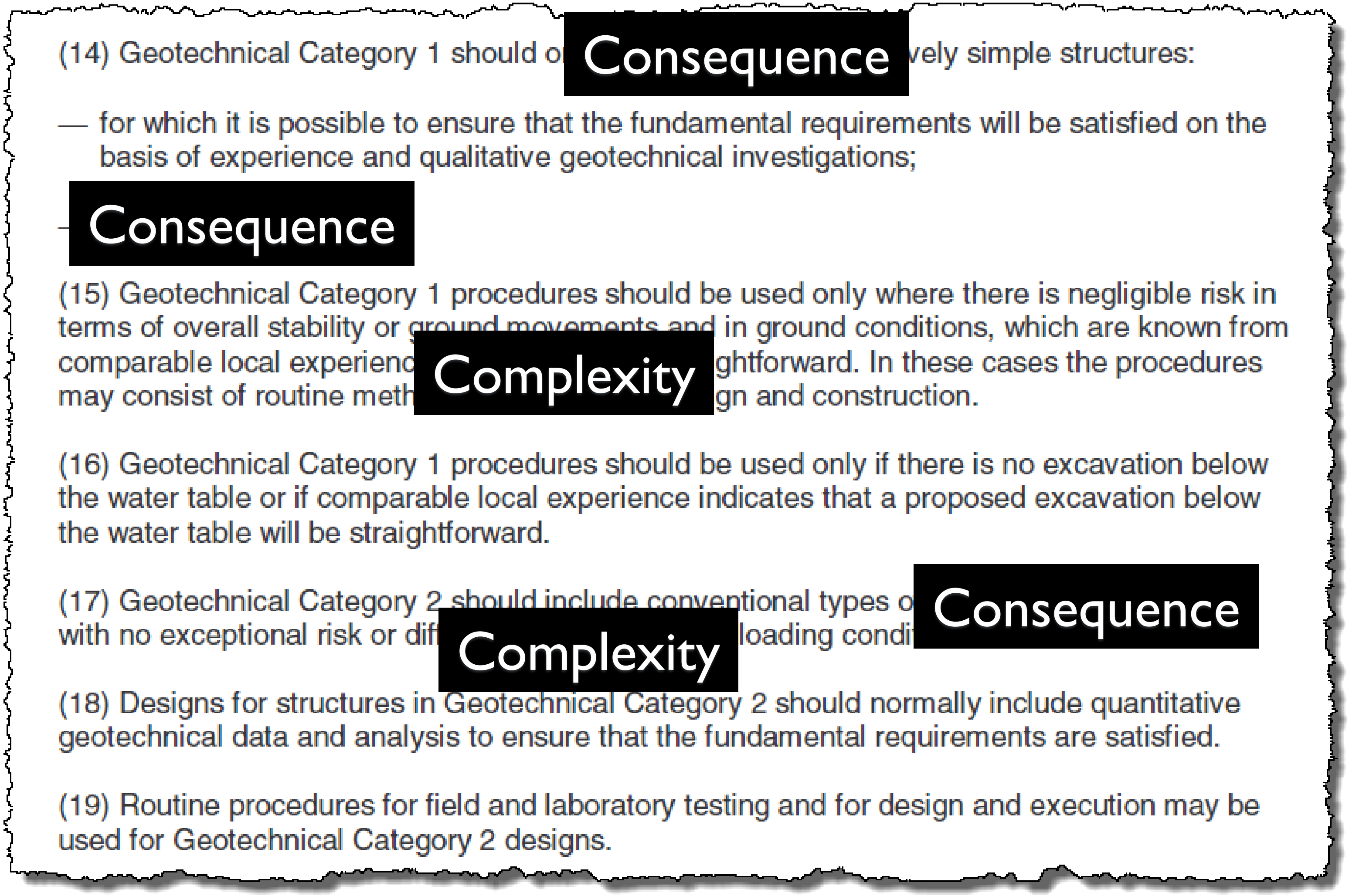
$$F_{w,rep} = \begin{cases} \overbrace{G_{w,k,sup} \text{ or } G_{w,k,inf}}^{whichever\ is\ more\ adverse} \\ -or- \\ G_{w,k,mean} + \underbrace{Q_{w,rep}}_{=\boxed{Q_{w,k}}|Q_{w,comb}|Q_{w,freq}|Q_{w,qper}} \end{cases}$$

depending on design situation

Variability in dynamic water pressure

If there is insufficient data to derive values on the basis of annual probability of exceedance, … $Q_{w,k}$ and $Q_{w,comb}$ should be selected as a cautious estimate of the worst value likely to occur during the design situation

1st generation of Eurocode 7 Geotechnical Categories are confused!



(14) Geotechnical Category 1 should o **Consequence** vely simple structures:

- for which it is possible to ensure that the fundamental requirements will be satisfied on the basis of experience and qualitative geotechnical investigations;
- **Consequence**

(15) Geotechnical Category 1 procedures should be used only where there is negligible risk in terms of overall stability or ground movements and in ground conditions, which are known from comparable local experienc **Complexity** ghtforward. In these cases the procedures may consist of routine meth gn and construction.

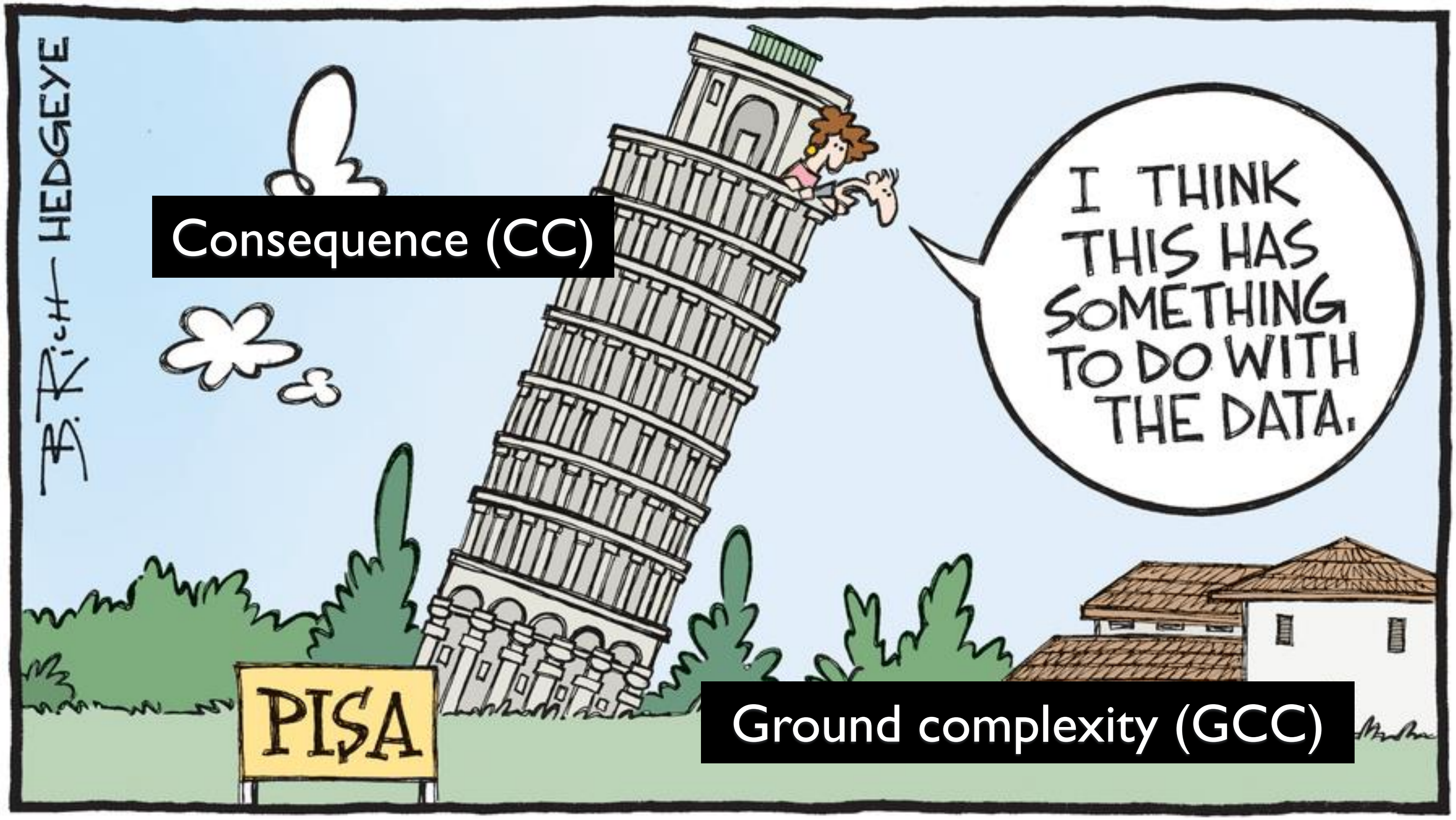
(16) Geotechnical Category 1 procedures should be used only if there is no excavation below the water table or if comparable local experience indicates that a proposed excavation below the water table will be straightforward.

(17) Geotechnical Category 2 should include conventional types o **Consequence** with no exceptional risk or dif **Complexity** loading condi

(18) Designs for structures in Geotechnical Category 2 should normally include quantitative geotechnical data and analysis to ensure that the fundamental requirements are satisfied.

(19) Routine procedures for field and laboratory testing and for design and execution may be used for Geotechnical Category 2 designs.

2nd generation of Eurocode 7
Separation of consequence and complexity



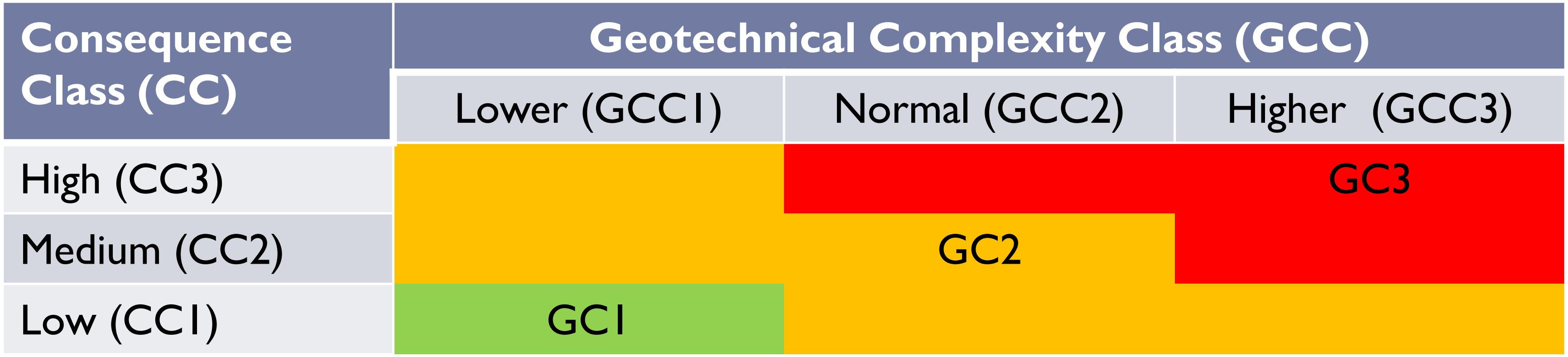
Consequence (CC)

Ground complexity (GCC)

2nd generation of Eurocode 7
Geotechnical complexity classes

Complexity		General features
GCC3	Higher	Any of the following applies • difficult soils • difficult geomorphologies • significant thickness of m Bad und • sliding ground • steep soil slopes • significant geometric variability • significant sensitivity to groundwater conditions • significant complexity of the ground-structure interaction • little experience with calculation models for the current situation
GCC2	Normal	Covers everything not contained in GCC1 or GCC3
GCC1	Lower	All the following conditions apply • uniform ground conditions and standard construction technique • isolated shallow foundatic Good tically applied in the zone • well established design m lable for the local conditions and the planned construction technique • low complexity of the ground-structure-interaction

2nd generation of Eurocode 7
'New' Geotechnical Category = CC x GCC



Consequence Class (CC)	**Geotechnical Complexity Class (GCC)**		
	Lower (GCC1)	Normal (GCC2)	Higher (GCC3)
High (CC3)	🟧	🟥	🟥 GC3
Medium (CC2)	🟧	🟧 GC2	🟥
Low (CC1)	🟩 GC1	🟧	🟧

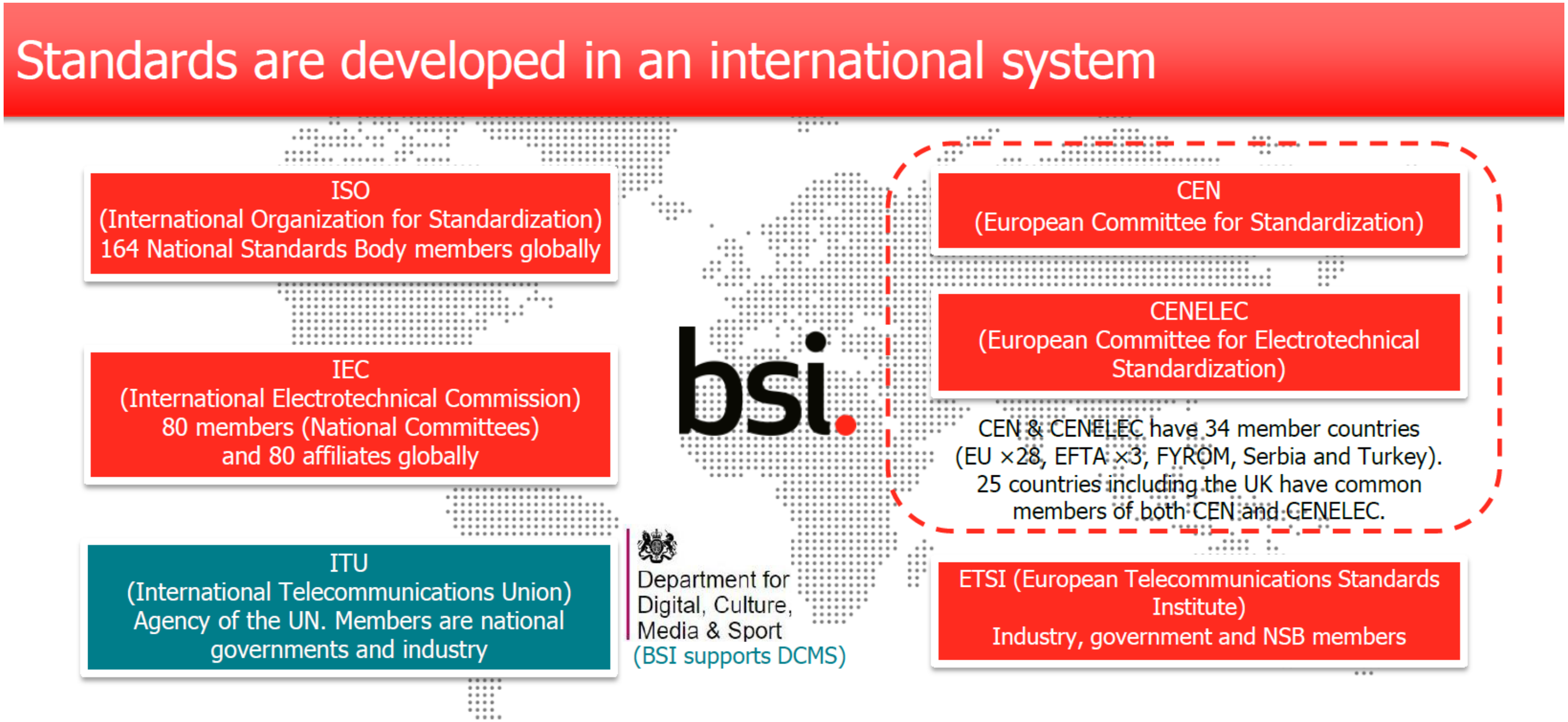
The Geotechnical Category determines:

- minimum amount of ground investigation
- minimum validation of calculation models
- minimum checking of design (EN 1990's *Design Check Levels*)
- minimum checking of execution (EN 1990's *Inspection Levels*)
- minimum control of execution (*Execution Classes*)
- minimum amount of monitoring
- minimum design qualification and experience levels (EN 1990's *Designer Qualification Levels*)

What about BREXIT?

Eurocode 7 post BREXIT

BSI’s place in the international system (Steedman, 2018)



Standards are developed in an international system

ISO
(International Organization for Standardization)
164 National Standards Body members globally

IEC
(International Electrotechnical Commission)
80 members (National Committees)
and 80 affiliates globally

ITU
(International Telecommunications Union)
Agency of the UN. Members are national
governments and industry

bsi.

Department for
Digital, Culture,
Media & Sport
(BSI supports DCMS)

CEN
(European Committee for Standardization)

CENELEC
(European Committee for Electrotechnical
Standardization)

CEN & CENELEC have 34 member countries
(EU ×28, EFTA ×3, FYROM, Serbia and Turkey).
25 countries including the UK have common
members of both CEN and CENELEC.

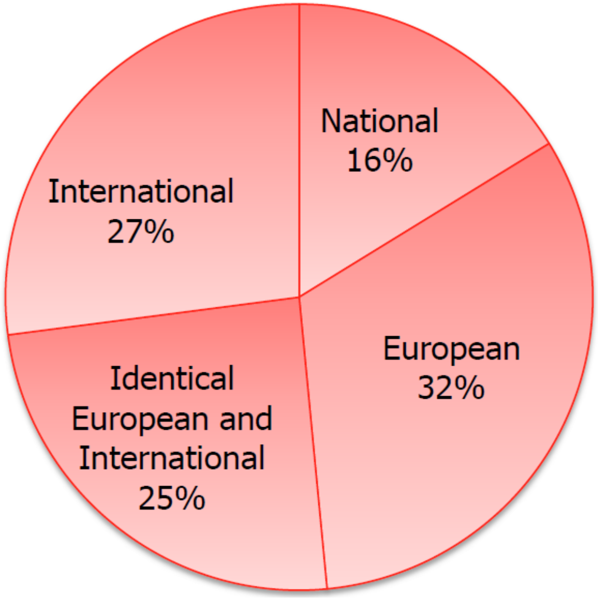
ETSI (European Telecommunications Standards
Institute)
Industry, government and NSB members

Single-standard principle (Steedman, 2018)

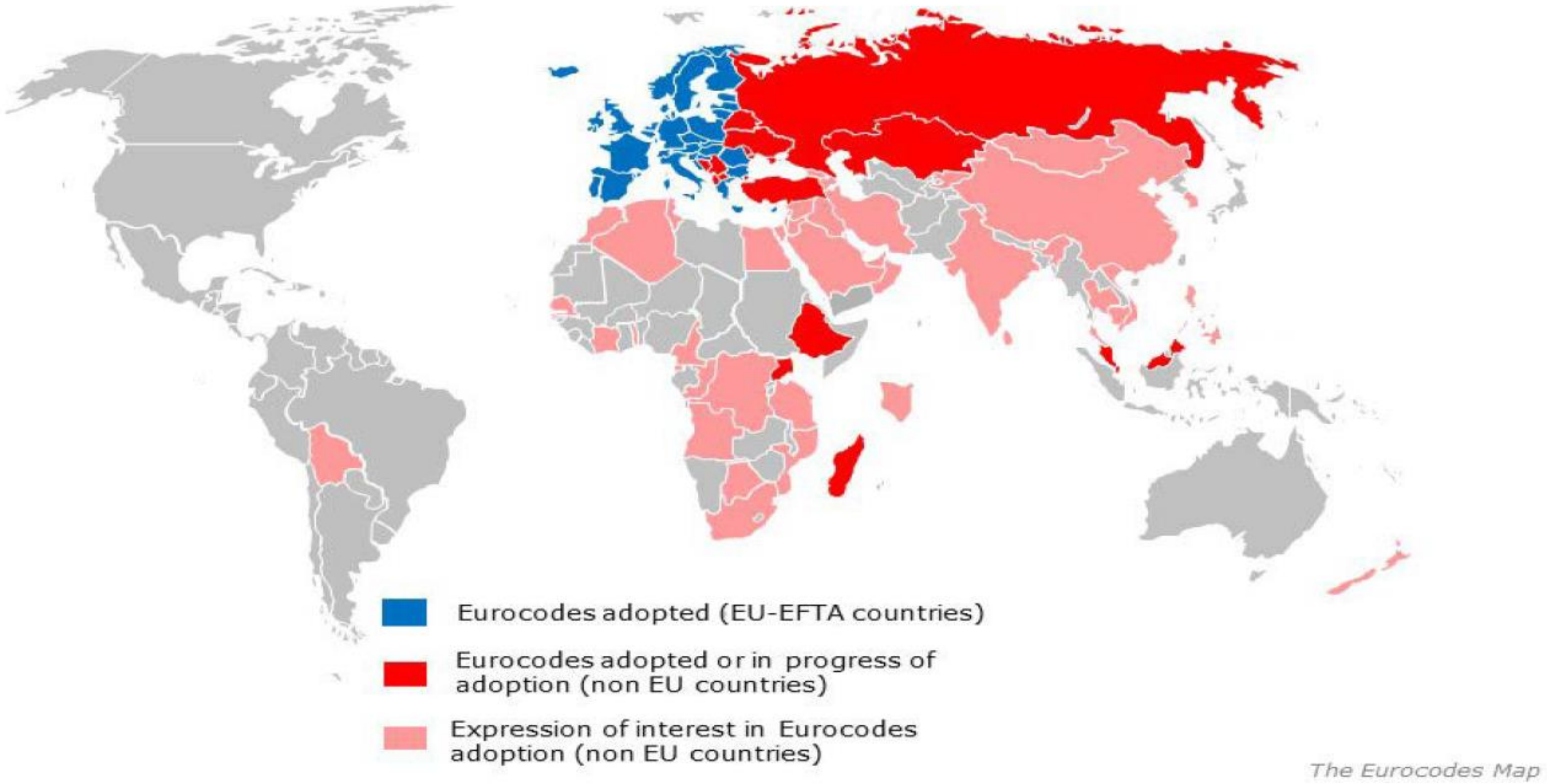
Manufacturers want to make one product for multiple markets based on one standard, one test, rather than products for individual markets based on multiple standards and tests

Stephen Phipson, CEO, EEF

- Aim to develop a single standard on any given issue:
  - adopted worldwide
  - used voluntarily
- Remove barriers to trade and promote market access
- Ensure business and consumers can influence the development of international standards easily through the NSB



Worldwide reach of the Eurocodes



Summary

Eurocode 7 post BREXIT

Improvements in 2nd generation of EN 1990

- Simplification of EQU, STR, and GEO
  - Improves treatment of combined ultimate limit states
- Catering for non-linearity and coupling
  - Incorporates basis of geotechnical design into EN 1990
  - Better treatment of non-linear structural design
- Design cases
  - Simple packaging of complicated loading conditions
- Simpler presentation of combinations of actions
  - Greater clarity in the text
- Water actions
  - Clear specification of probabilities of exceedance
- Management measures to achieve the intended structural reliability
  - Flexible system that caters for national preferences

Improvements in 2nd generation of EN 1997

- Organizational changes to Eurocode 7
  - Clearer layout aids ease-of-navigation
  - Greater consistency with EN 1990 aids ease-of-use
- No more Design Approaches!
  - Simpler (but not simple) choice of partial factors
- Catering for different groundwater conditions
  - Better specification of groundwater pressures
- Separating consequence from hazard
  - Clear distinction between consequence of failure and complexity of the ground
  - Geotechnical Categories now drive meaningful decisions