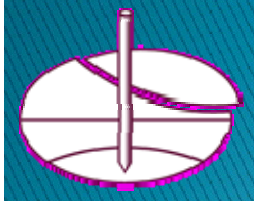
Results of the NDP Survey 2009/10

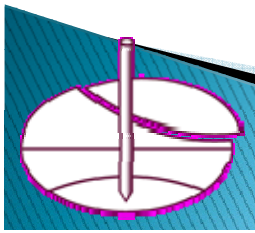
Andrew Bond



2nd International Workshop on Evaluation of Eurocode 7, Pavia, Italy, April 2010

Results of the NDP Survey 2009/10

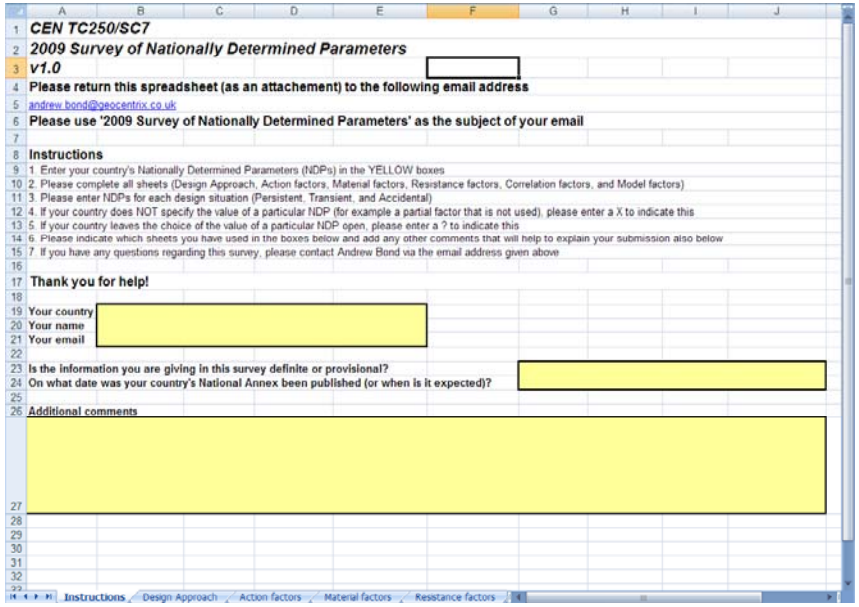
- Survey procedure
- Some unexpected results
- NDPs for slope stability
- NDPs for shallow foundations
- NDPs for deep foundations
- Accidental design situations
- Conclusions



Survey procedure

Results of the NDP Survey 2009/10

Spreadsheet posted on CEN LiveLink for countries to complete with their NDPs



CEN TC250/SC7

2009 Survey of Nationally Determined Parameters

v1.0

Please return this spreadsheet (as an attachement) to the following email address

andrew.bond@geocentrix.co.uk

Please use '2009 Survey of Nationally Determined Parameters' as the subject of your email

Instructions

1. Enter your country's Nationally Determined Parameters (NDPs) in the YELLOW boxes
2. Please complete all sheets (Design Approach, Action factors, Material factors, Resistance factors, Correlation factors, and Model factors)
3. Please enter NDPs for each design situation (Persistent, Transient, and Accidental)
4. If your country does NOT specify the value of a particular NDP (for example a partial factor that is not used), please enter a X to indicate this
5. If your country leaves the choice of the value of a particular NDP open, please enter a ? to indicate this
6. Please indicate which sheets you have used in the boxes below and add any other comments that will help to explain your submission also below
7. If you have any questions regarding this survey, please contact Andrew Bond via the email address given above

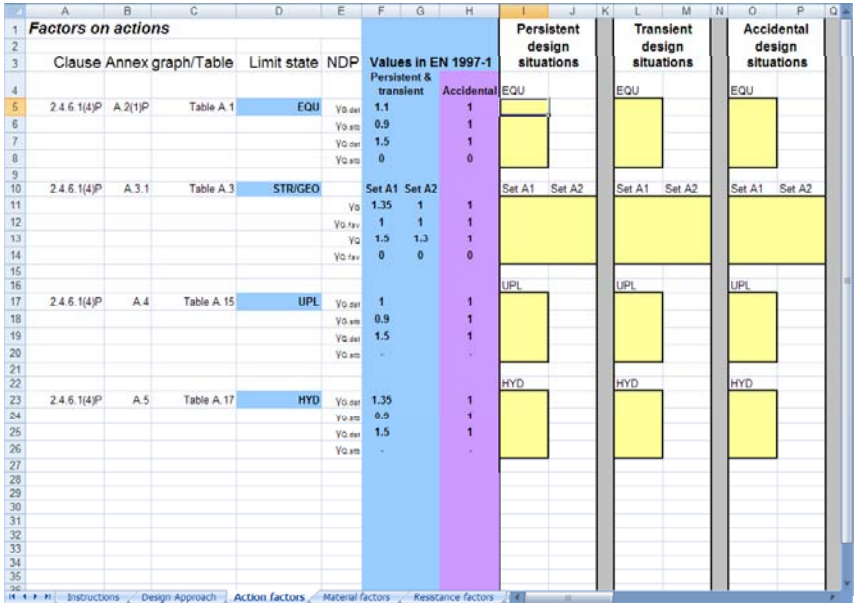
Thank you for help!

Your country
Your name
Your email

Is the information you are giving in this survey definite or provisional?
On what date was your country's National Annex been published (or when is it expected)?

Additional comments

Instructions | Design Approach | Action factors | Material factors | Resistance factors



Factors on actions

Clause	Annex	graph/Table	Limit state	NDP	Values in EN 1997-1 Persistent & transient		Accidental	Persistent design situations	Transient design situations	Accidental design situations
2.4.6.1(4)P	A.2(1)P	Table A.1	EQU	$\gamma_{G,dst}$	1.1		1	EQU	EQU	EQU
				$\gamma_{G,stb}$	0.9		1			
				$\gamma_{Q,dst}$	1.5		1			
				$\gamma_{Q,stb}$	0		0			
2.4.6.1(4)P	A.3.1	Table A.3	STR/GEO		Set A1	Set A2		Set A1 Set A2	Set A1 Set A2	Set A1 Set A2
				γ_G	1.35	1	1			
				$\gamma_{G,fav}$	1	1	1			
				γ_Q	1.5	1.3	1			
				$\gamma_{Q,fav}$	0	0	0			
								UPL	UPL	UPL
2.4.6.1(4)P	A.4	Table A.15	UPL	$\gamma_{G,dst}$	1		1			
				$\gamma_{G,stb}$	0.9		1			
				$\gamma_{Q,dst}$	1.5		1			
				$\gamma_{Q,stb}$	-		-			
								HYD	HYD	HYD
2.4.6.1(4)P	A.5	Table A.17	HYD	$\gamma_{G,dst}$	1.35		1			
				$\gamma_{G,stb}$	0.9		1			
				$\gamma_{Q,dst}$	1.5		1			
				$\gamma_{Q,stb}$	-		-			

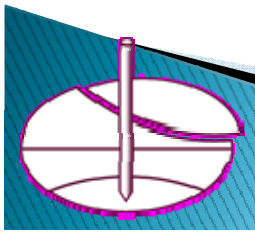
Instructions | Design Approach | Action factors | Material factors | Resistance factors

Answers received from 20 out of 30 countries, based on published or provisional NAs

Thank you to all these correspondents

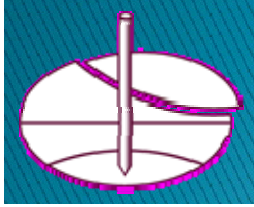
Manfred Fross (Austria)
Carsten Sorensen (Denmark)
Lea Tuberik (Estonia)
Tim Länsivaara (Finland)
Roger Frank (France)
Bernd Schuppener (Germany)
Michael Kavvadas (Greece)
Robert Szepesházi (Hungary)
Trevor Orr (Ireland)

Liudvikas Furmonavicius (Lithuania)
Giuseppe Scarpelli (Italy)
Adriaan van Seters (Netherlands)
Fritz Nowacki/Roald Sægrov (Norway)
Marek Świeca/Agnieszka Gawryluk (Poland)
Iacint Manoliu (Romania)
Rui Correia (Portugal)
Lovisa Moritz (Sweden)
Brian Simpson (UK)



Some unexpected results

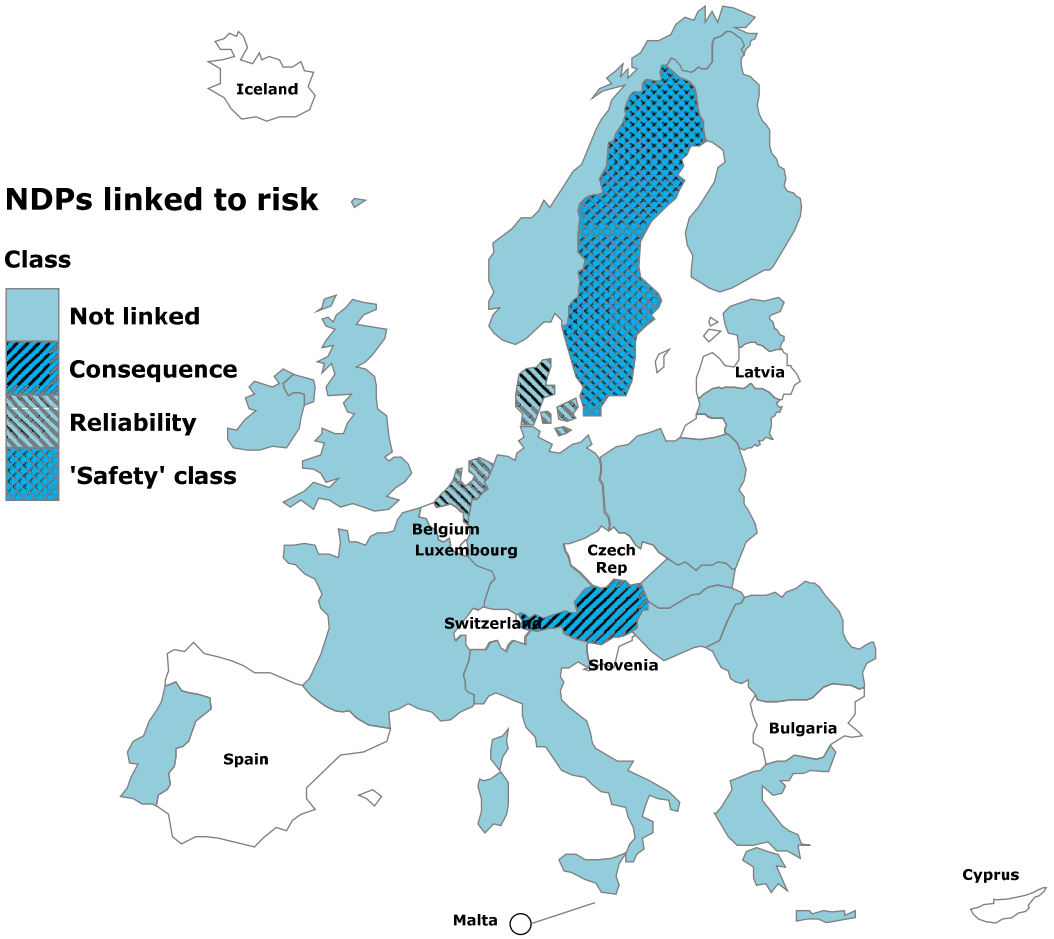
Results of the NDP Survey 2009/10



Reliability discrimination via consequence or reliability classes

Consequence or reliability class	Description of consequence		Examples	Minimum β values		K_{FI}
	For human life	Economic, social, or environmental		1 year	50 years	
CC1/RC1	Low	Small or negligible	Agricultural (e.g. storage) buildings, greenhouses	4.2	3.3	0.9
CC2/RC2	Medium	Considerable	Residential and office buildings	4.7	3.8	1.0
CC3/RC3	High	Very great	Grandstands, public buildings (e.g. concert hall)	5.2	4.3	1.1

Countries linking NDPs to risk



Two ways of assessing fundamental combinations of actions for STR/GEO

Single verification using Eq. 6.10 from EN 1990:

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}+\gamma_{Q,1}Q_{k,1}+\sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i}$$

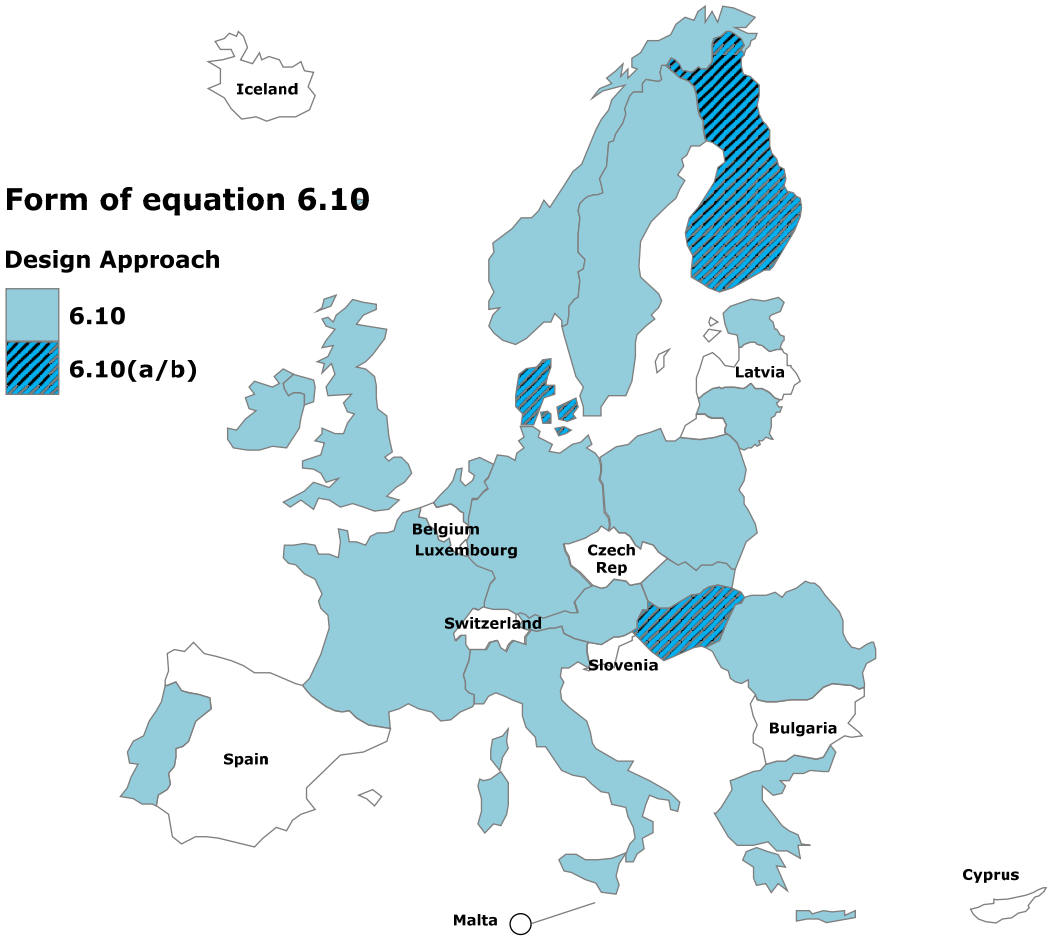
or, less favourable of Eq. 6.10(a) and (b):

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}+\gamma_{Q,}\psi_{0,1}Q_{k,1}+\sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i}$$

$$\sum_{j\geq 1}\xi_j\gamma_{G,j}G_{k,j}+\gamma_{Q,1}Q_{k,1}+\sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i}$$

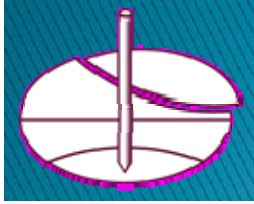
where the circled terms reduce the effect of the corresponding action

Preferred form of Equation 6.10

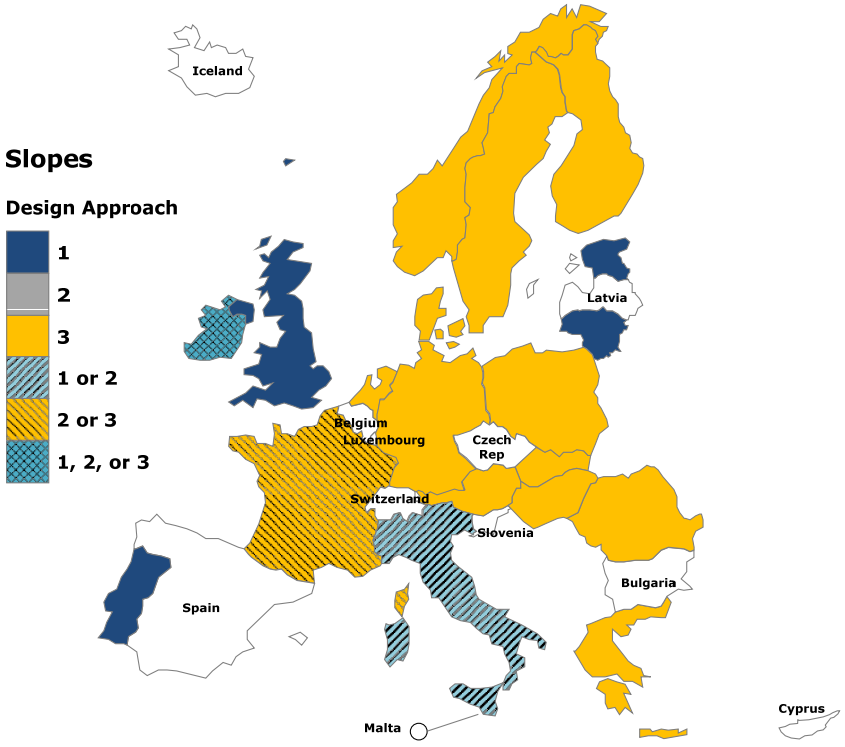


NDPs for slope stability

Results of the NDP Survey 2009/10

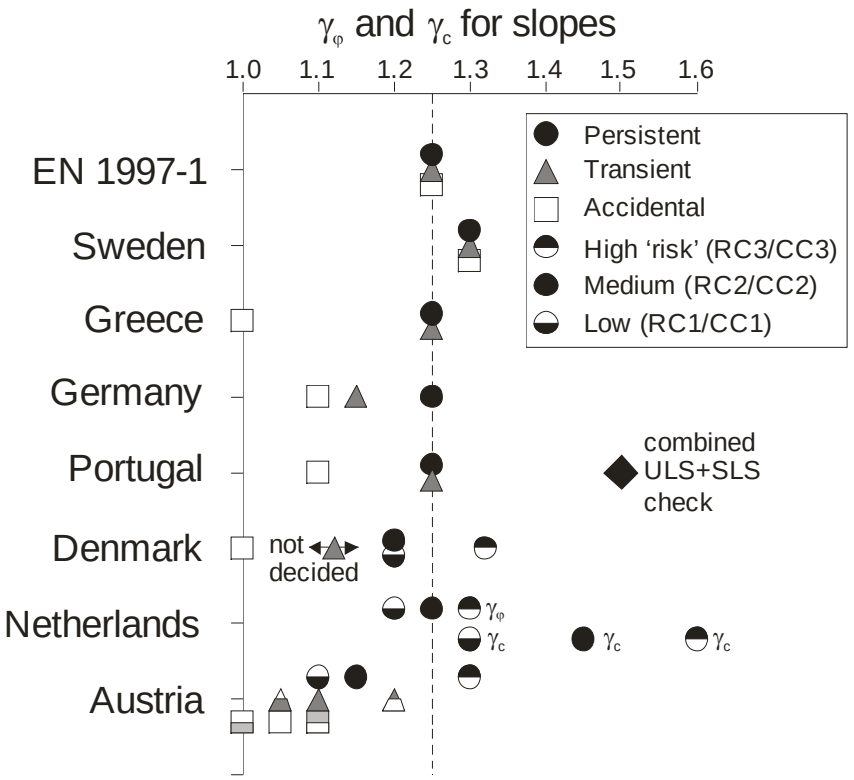


Design Approaches allowed for design of slopes

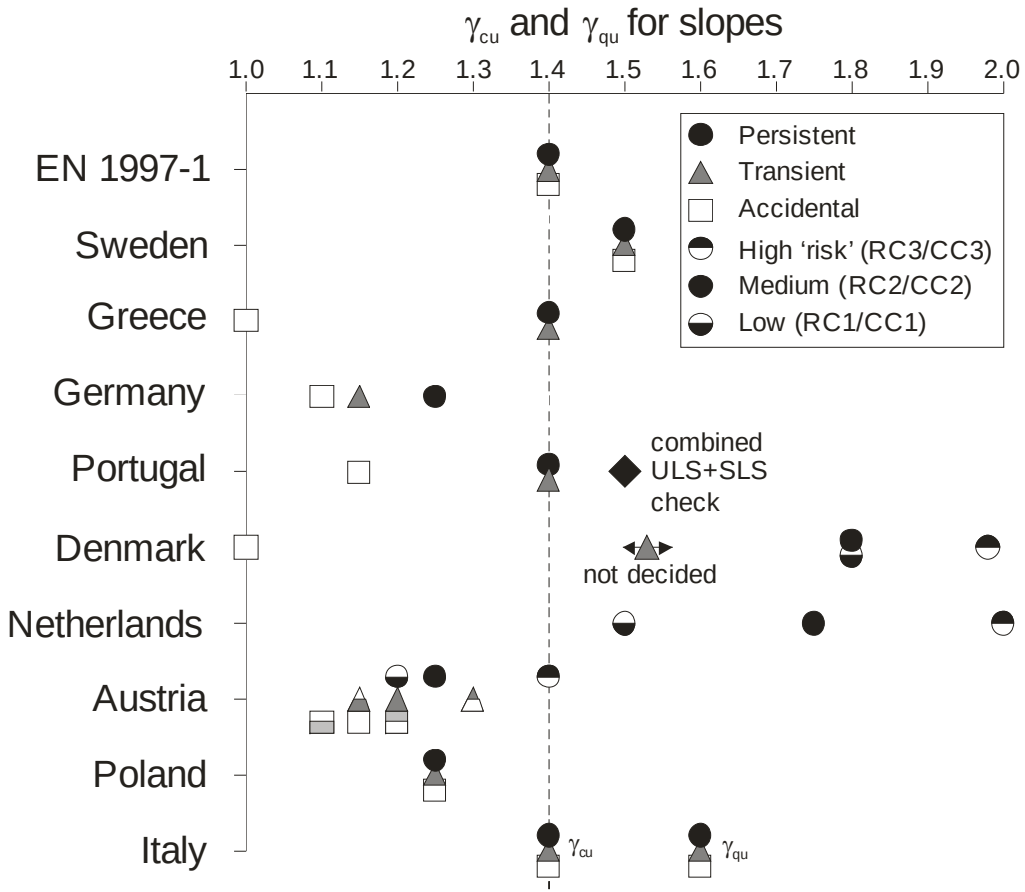


Design Approaches allowed		
DA1	DA2	DA3
EST IRL ITA LTU PRT UK (6)	FRA IRL ITA (3)	AUT, DNK, FRA, FIN, DEU, GRC, HUN, IRL, NLD, NOR, POL, ROM, SVK, SWE (14)

Material factors for drained slopes

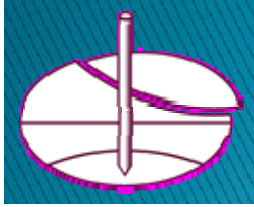


Material factors for undrained slopes

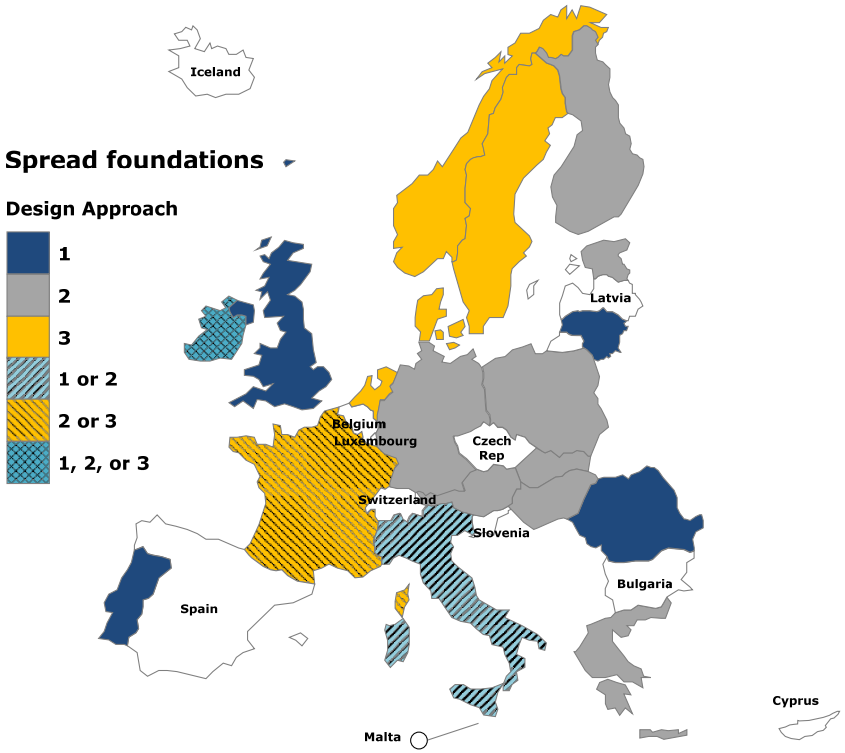


NDPs for shallow foundations

Results of the NDP Survey 2009/10



Design Approaches allowed for design of spread foundations



Design Approaches allowed		
DA1	DA2	DA3
IRL ITA LTU PRT ROM UK (6)	AUT, EST, FIN, FRA, DEU, GRC, HUN, IRL, ITA, POL, SVK (11)	DNK, FRA, IRL, NLD, NOR, SWE (6)

How can we compare partial factors used to verify STR/GEO for spread foundations?

In Design Approach 1, check two combinations of:

$$E\left\{\gamma_F F_{rep}, X_k / \gamma_M, a_d\right\} \le R\left\{\gamma_F F_{rep}, X_k / \gamma_M, a_d\right\}$$

In Design Approach 2, check one combination:

$$\gamma_F E\left\{F_{rep}, X_k, a_d\right\} \le R\left\{F_{rep}, X_k, a_d\right\} / \gamma_R$$

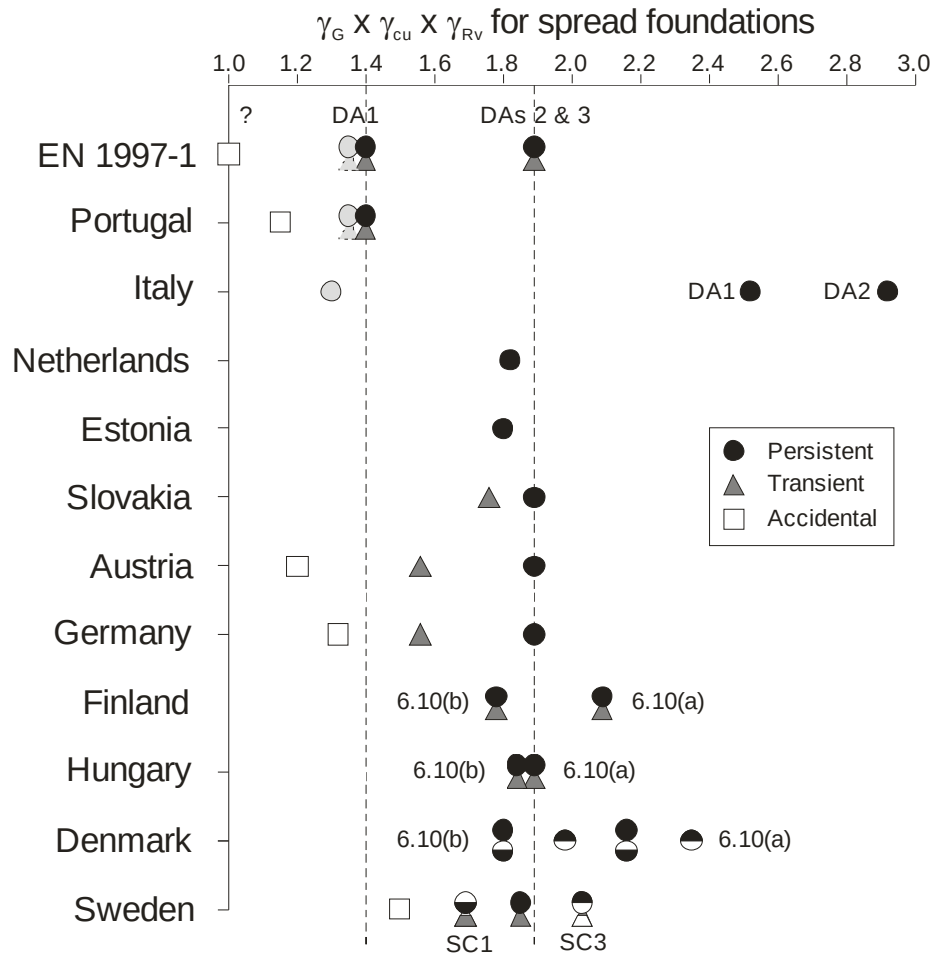
In Design Approach 3, check one combination:

$$E\left\{\gamma_F F_{rep}, X_k / \gamma_M, a_d\right\} \le R\left\{\gamma_F F_{rep}, X_k / \gamma_M, a_d\right\} / \gamma_R$$

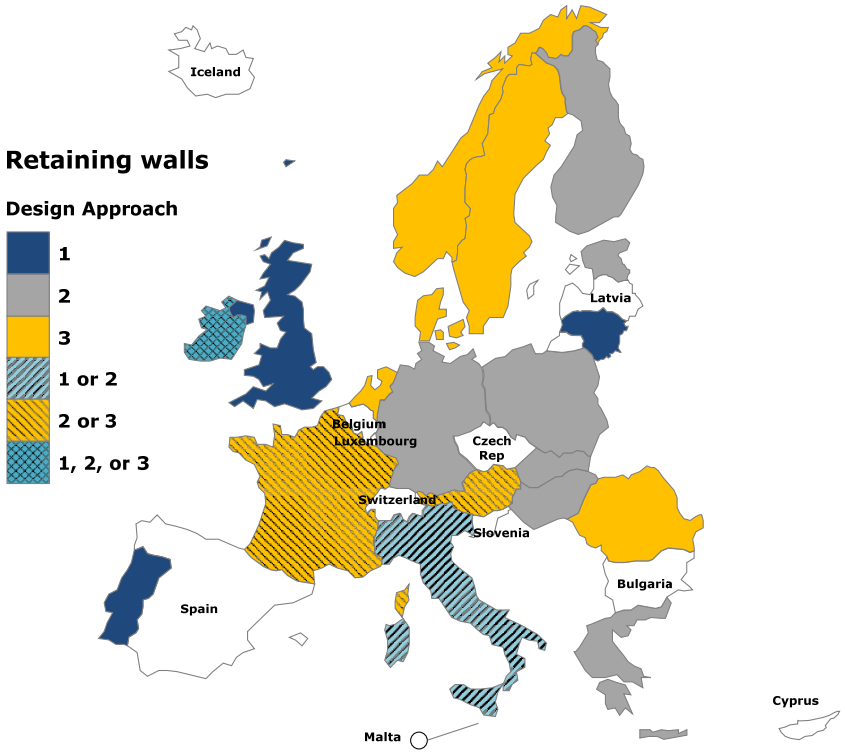
One measure of required reliability is:

$$\gamma_G \times \gamma_{cu} \times \gamma_{Rv}$$

Combined partial factors for undrained design of spread foundations



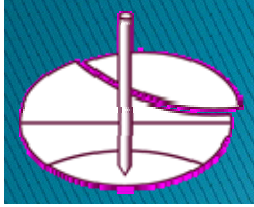
Design Approaches allowed for design of retaining walls



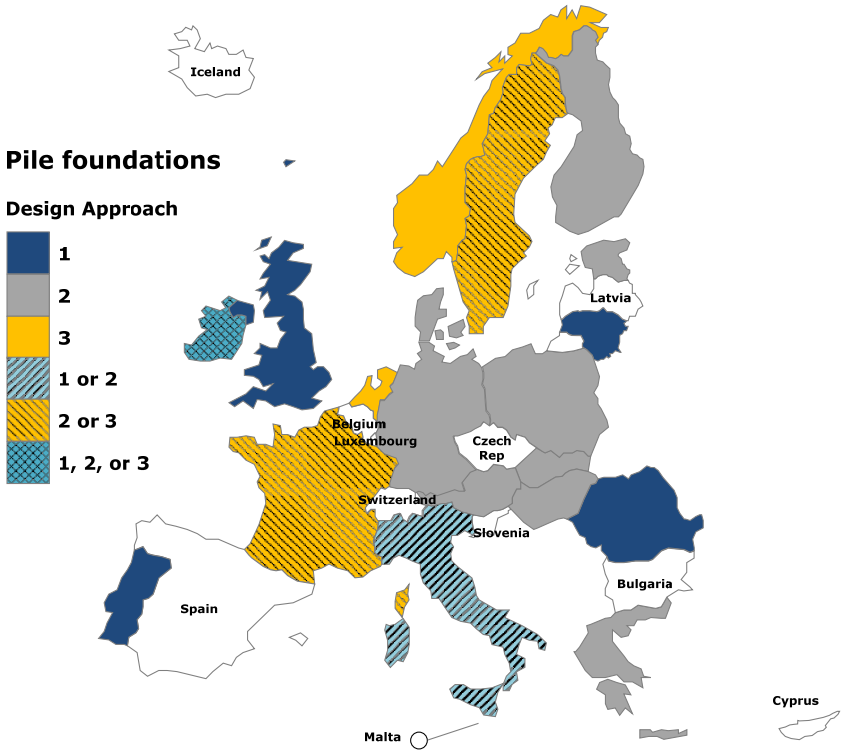
Design Approaches allowed		
DA1	DA2	DA3
IRL ITA LTU PRT ROM UK (6)	AUT, EST, FIN, FRA, DEU, GRC, HUN, IRL, ITA, POL, SVK (11)	AUT*, DNK, FRA, IRL, NLD, NOR, SWE (7)
*for numerical analysis		

NDPs for deep foundations

Results of the NDP Survey 2009/10

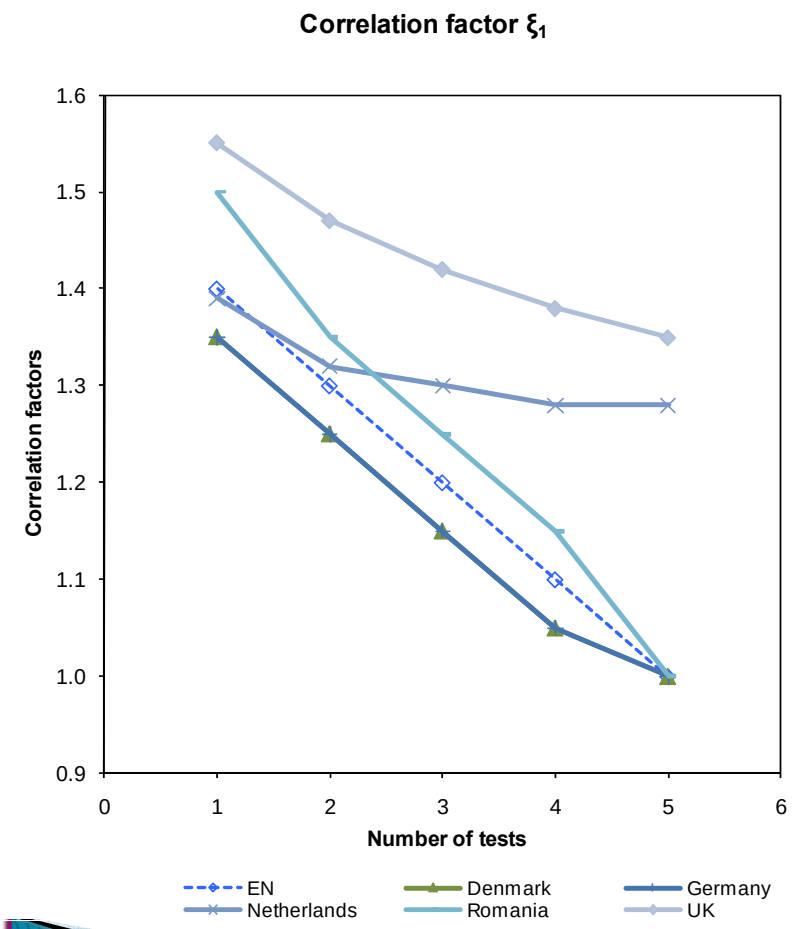


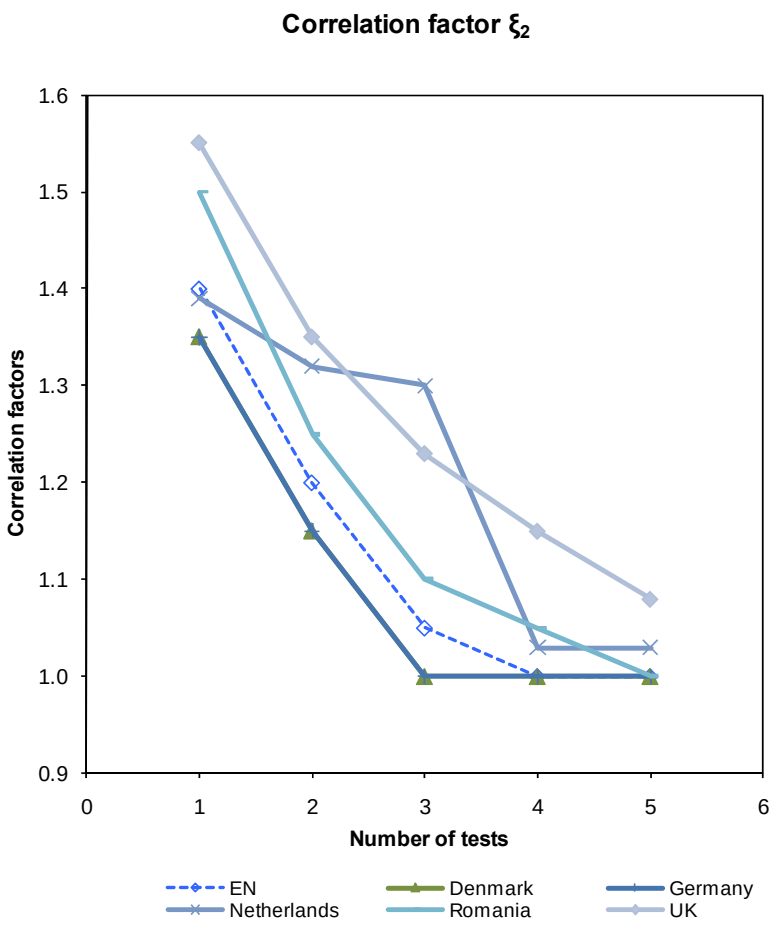
Design Approaches allowed for design of pile foundations



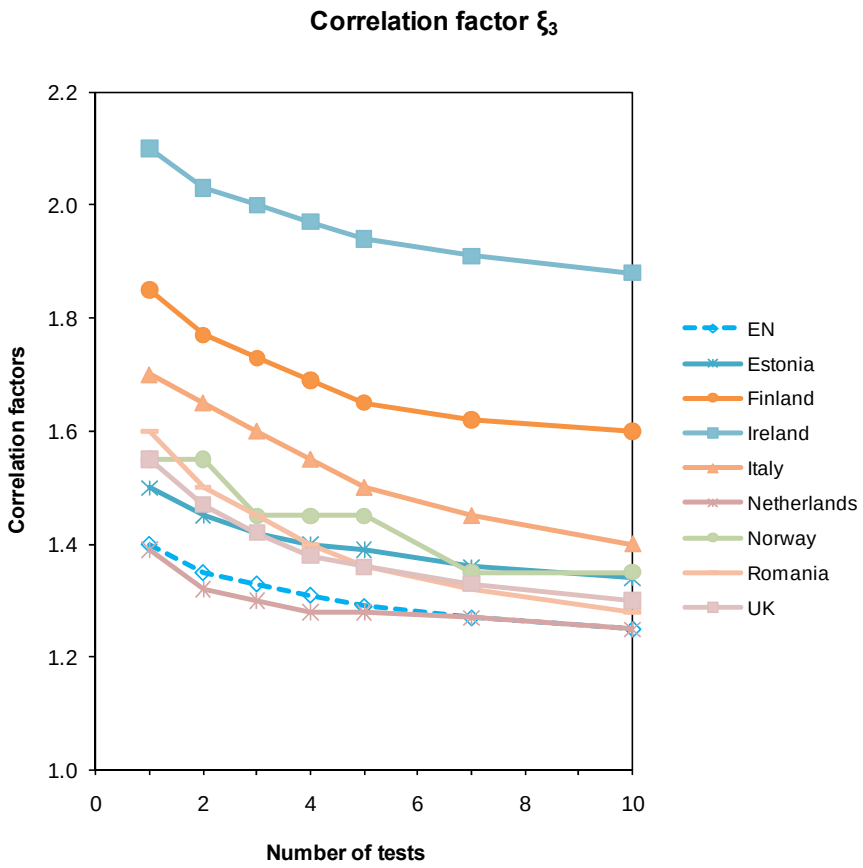
Design Approaches allowed		
DA1	DA2	DA3
IRL ITA LTU PRT ROM UK (6)	AUT, EST, FIN, FRA, DEU, GRC, HUN, IRL, ITA, POL, SVK, SWE (12)	DNK, FRA, IRL, NLD, NOR, SWE (6)

Correlation factors for static load test results (ξ_1 applied to mean; ξ_2 applied to minimum)

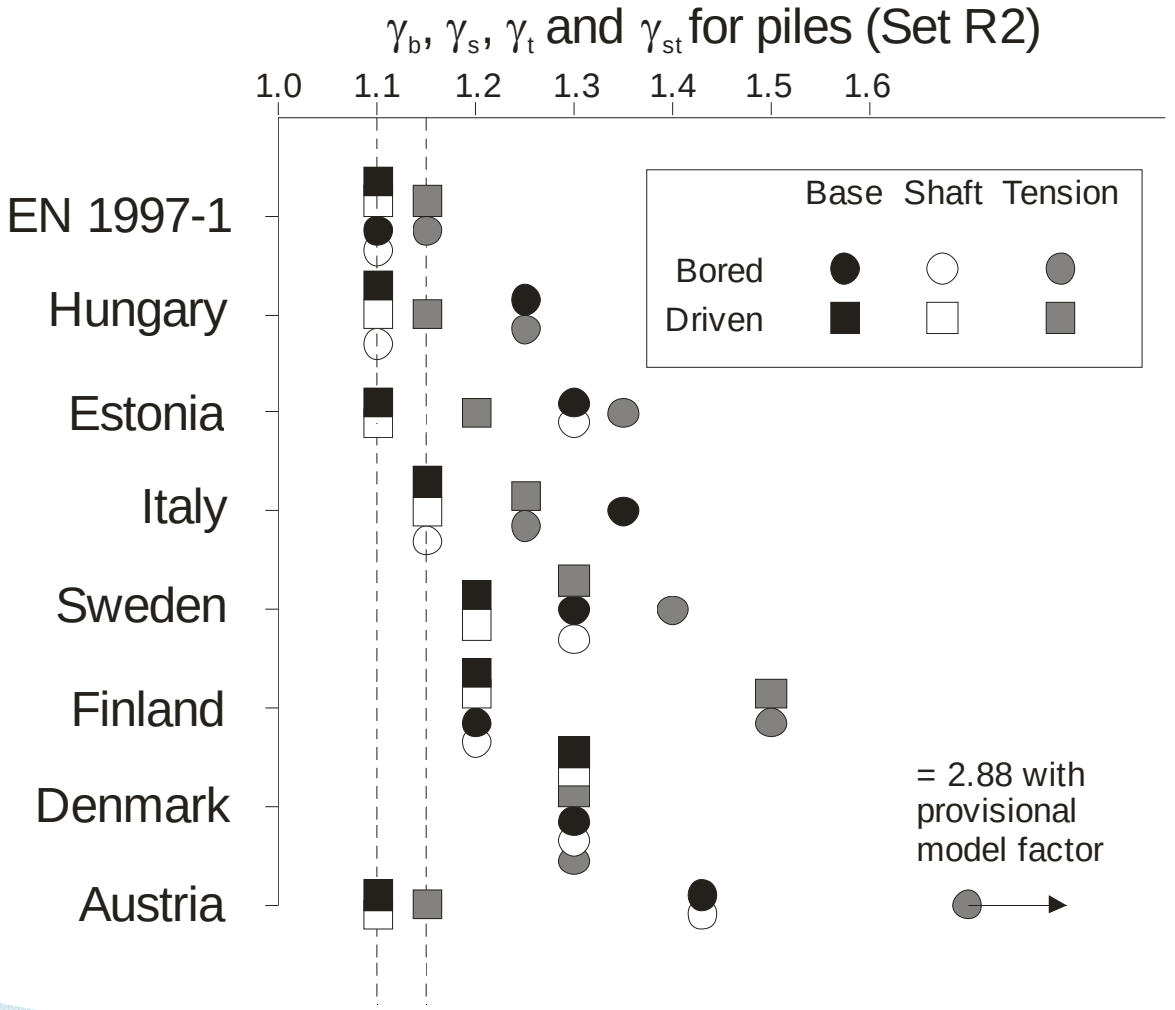




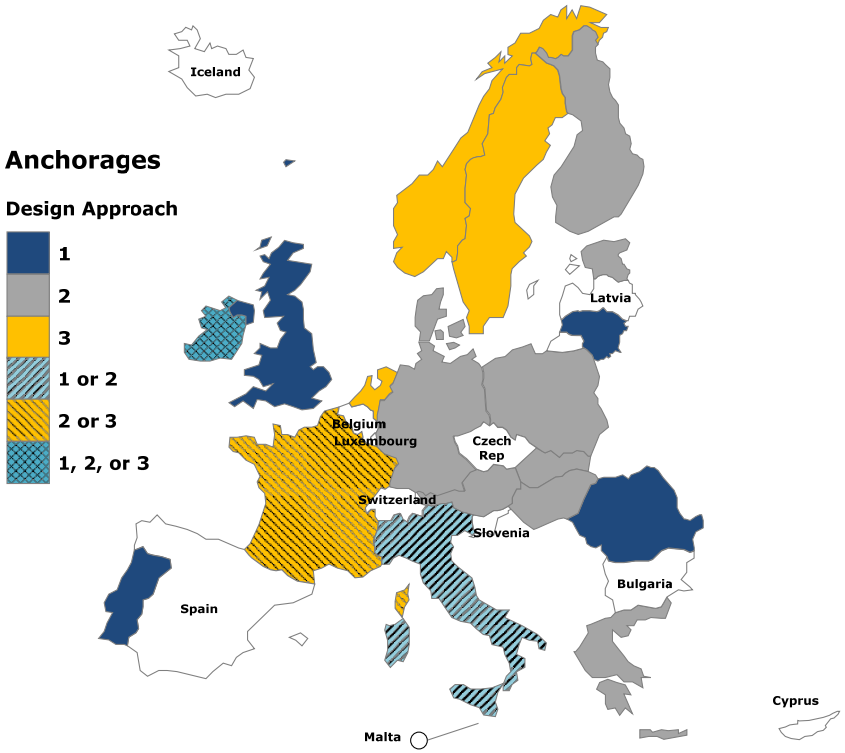
Correlation factors for ground test results (ξ_3 applied to mean)



Partial resistance factors for design of pile foundations with Design Approach 2 (Set R2)



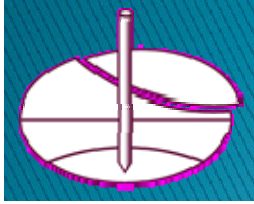
Design Approaches allowed for design of anchorages



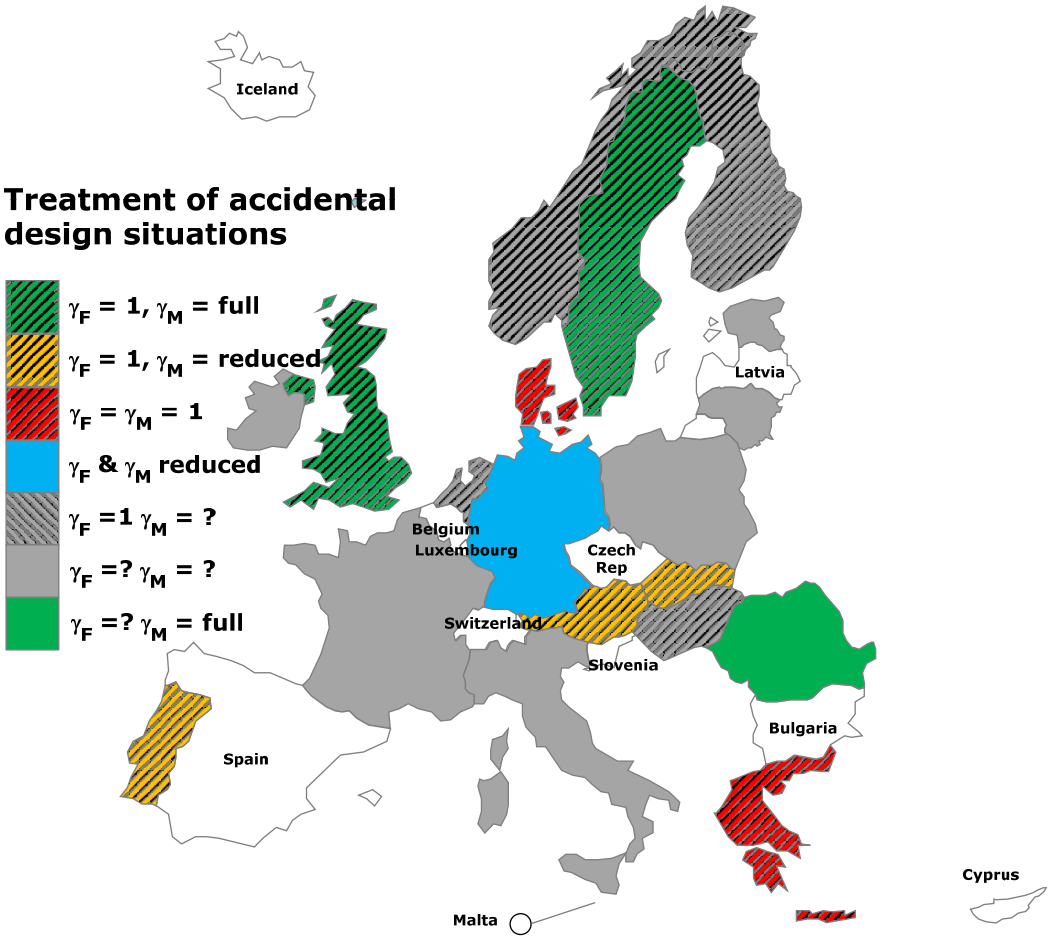
Design Approaches allowed		
DA1	DA2	DA3
IRL ITA LTU PRT ROM UK (6)	AUT, EST, FIN, FRA, DEU, GRC, HUN, IRL, ITA, POL, SVK (11)	DNK, FRA, IRL, NLD, NOR, SWE (6)

Accidental design situations

Results of the NDP Survey 2009/10



Treatment of accidental design situations: which partial factors are set to 1.0?

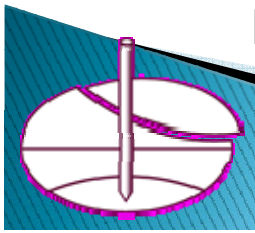


Conclusion

Results of the NDP Survey 2009/10

Some observations on the NDP Survey results

- Enormous variation in values of NDPs
  - Does this prevent further harmonization of national practice?
  - Why have countries felt the need to change so many NDPs from their recommended values?
  - Did we get the recommended values wrong?
- Several countries have 'refined' their NDPs
  - Different values used for different levels of risk (e.g. CC, RC, 'safety class', amount of pile testing)
  - Should Eurocode 7 provide better coverage of this idea?
  - What other ideas from different countries 'NAs should be 'promoted' to the EN?
- Complexity is growing (which is NOT desirable)
  - How can we simplify to make the important ideas accessible to practicing engineers?



Suggestions for future research

Variation of partial factors with:

- Design situation (Persistent > Transient > Accidental)
- Risk (RC3/CC3 > RC2/CC2 > RC1/CC1)

Less onerous combination of actions:

- Explicit consideration of equations 6.10(a) and (b) from EN 1990

Partial factors for use in accidental design situations:

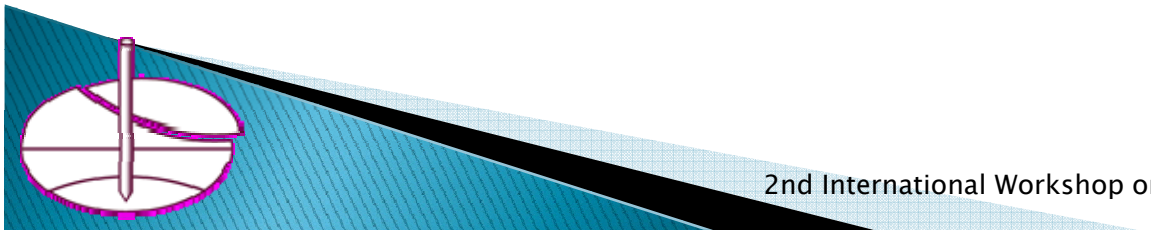
- Factors on actions = 1.0?
- Factors on material properties/resistance > 1.0

Correlation factors for pile design

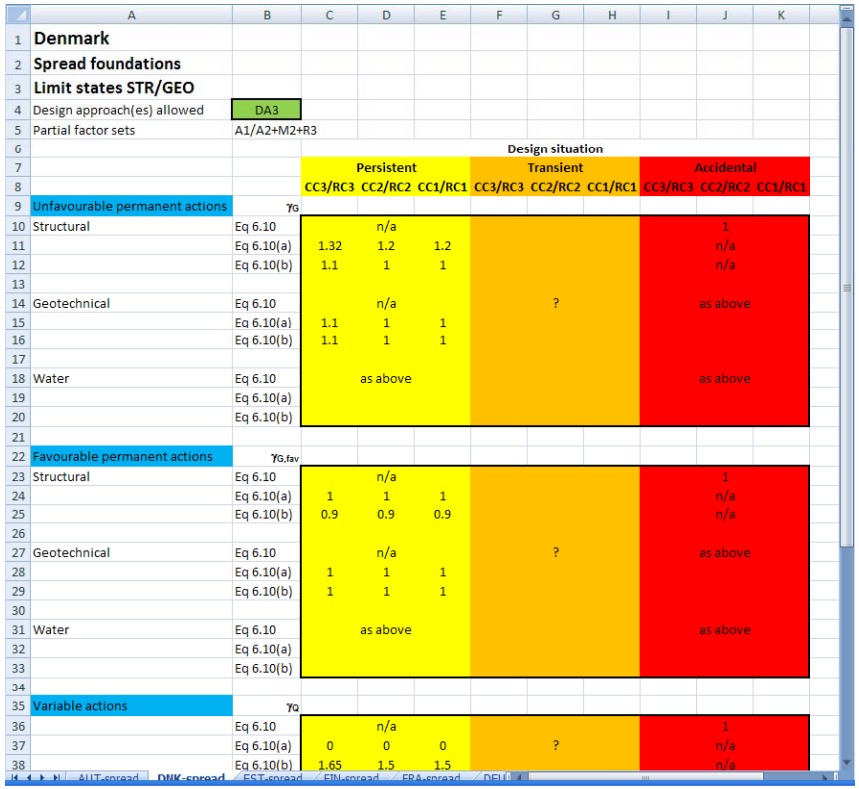
- Why have these factors been increased by such a large amount?
- Do we need different factors for different ground tests?

Partial factors for combined SLS+ULS check

Combine Design Approaches into one simpler scheme



Next phase of the NDP Survey



	A	B	C	D	E	F	G	H	I	J	K
1	**Denmark**										
2	**Spread foundations**										
3	**Limit states STR/GEO**										
4	Design approach(es) allowed	DA3									
5	Partial factor sets	A1/A2+M2+R3									
6						Design situation					
7				Persistent			Transient			Accidental	
8			CC3/RC3	CC2/RC2	CC1/RC1	CC3/RC3	CC2/RC2	CC1/RC1	CC3/RC3	CC2/RC2	CC1/RC1
9	Unfavourable permanent actions	γ_G									
10	Structural	Eq 6.10		n/a						1	
11		Eq 6.10(a)	1.32	1.2	1.2					n/a	
12		Eq 6.10(b)	1.1	1	1					n/a	
13											
14	Geotechnical	Eq 6.10		n/a			?			as above	
15		Eq 6.10(a)	1.1	1	1						
16		Eq 6.10(b)	1.1	1	1						
17											
18	Water	Eq 6.10		as above						as above	
19		Eq 6.10(a)									
20		Eq 6.10(b)									
21											
22	Favourable permanent actions	$\gamma_{G,fav}$									
23	Structural	Eq 6.10		n/a						1	
24		Eq 6.10(a)	1	1	1					n/a	
25		Eq 6.10(b)	0.9	0.9	0.9					n/a	
26											
27	Geotechnical	Eq 6.10		n/a			?			as above	
28		Eq 6.10(a)	1	1	1						
29		Eq 6.10(b)	1	1	1						
30											
31	Water	Eq 6.10		as above						as above	
32		Eq 6.10(a)									
33		Eq 6.10(b)									
34											
35	Variable actions	γ_Q									
36		Eq 6.10		n/a						1	
37		Eq 6.10(a)	0	0	0		?			n/a	
38		Eq 6.10(b)	1.65	1.5	1.5					n/a	

AUT-spread | DNK-spread | EST-spread | FIN-spread | FRA-spread | DEU

Previous NDP survey ('09/10)

- Questions unanswered
- Questions unasked
- Ambiguities
- NAs not finalised
- 10 countries did not answer

New NDP survey (2010/11)

- Existing answers already included
- NSBs will be asked to correct the mistakes and 'fill in the gaps'