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SC 7 / PT 4

WG 3 / TG 3-Meeting in Berlin

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Handover Documents by WG 3 /TG 3 to PT 4

1. **SC 7/EG 7´s final report 2015**
2. **proposal for new structure of section ´pile foundation´**
3. **WG 3/TG 3´s proposal for a revised section ´pile foundation´ (working document)**
4. **WG 3/TG 3´s comments to systematic review of EC 7-1**
5. **compilation of NDPs for pile design**
6. **Summary of Warsaw-meeting of WG 3/TG3**
7. **Response of WG 3/TG 3 to PT 2´s proposal**

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WG 3/TG 3´s proposal for a revised section ´pile foundation´

Which clauses should remain / be deleted / are missing – and why?

… improving ease of use …

TC 250/ SC 7/ EG 7: EC7-1, Section 7 ´Pile Foundations´ Doc EG7-D106 Rev. 7

~~*etc. Base grouting is a routine construction procedure (e.g. in Poland 1000 to 2000 piles a year – nobody counts them now!). It has proven as an effective, economic technique and assuring high safety of a foundation.*~~ ~~*ADD TO THE LIST: - piled raft foundations of heavy loaded structures. (Not all!)*~~ ~~*A (1) and A (2) Structural measures ?? = structures (look at 2.1 (11))*~~	
2 Limit states	**2 Limit states**
[existing Part 1, § 7.2] (1)P The ~~following~~ limit states in accordance to 2.4.7 and 2.4.8 shall be considered ~~and an appropriate list shall be compiled:~~ ~~— loss of overall stability;~~ ~~— bearing resistance failure of the pile foundation;~~ ~~— uplift or insufficient tensile resistance of the pile foundation;~~ ~~— failure in the ground due to transverse loading of the pile foundation;~~ ~~— structural failure of the pile in compression, tension, bending, buckling or shear;~~ ~~— combined failure in the ground and in the pile foundation;~~ ~~— combined failure in the ground and in the structure;~~ ~~— excessive settlement;~~ ~~— excessive heave;~~	(1)P The limit states in accordance to 2.4.7 and 2.4.8 shall be considered.

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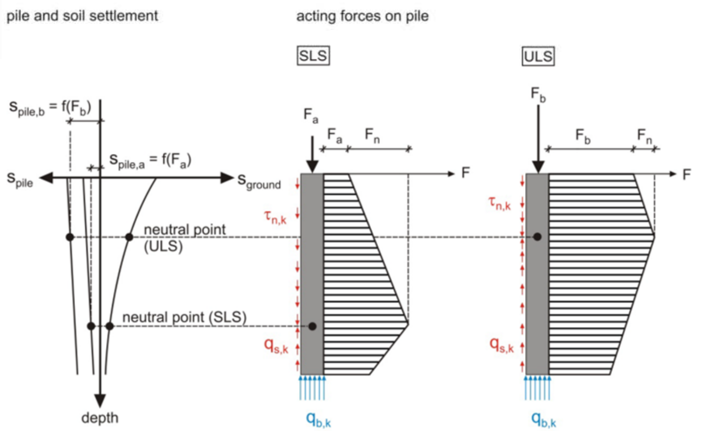
WG 3/TG 3´s proposal for a revised section ´pile foundation´

TC 250/ SC 7/ EG 7: EC7-1, Section 7 ´Pile Foundations´ | Doc EG7-D106 Rev. 7

3.3.2 Downdrag (negative skin friction)	3.3.2 Downdrag (negative skin friction)
[existing Part § 7.3.2.2] (1)P If ultimate limit state design calculations are carried out with the downdrag load as an action, its value shall be the maximum, which could be generated by the downward movement of the ground relative to the pile. ~~(2) Calculation of maximum downdrag loads should take account of the shear resistance at the interface between the soil and the pile shaft and downward movement of the ground due to self-weight compression and any surface load around the pile.~~ *Comment: Basic knowledge.* (3) An upper bound to the downdrag load on a group of piles may be calculated from the weight of the surcharge causing the movement and taking into account any changes in ground-water pressure due to ground-water lowering, consolidation or pile driving. (4) Where settlement of the ground after pile installation is expected to be small, an economic design may be obtained by treating the settlement of the ground as the action and carrying out an interaction analysis. ~~(5)P The design value of the settlement of the ground shall be derived taking account of material weight densities and compressibility in accordance with 2.4.3.~~ *Comment: Is regulated already in Section 2.* ~~(6) Interaction calculations should take account of the displacement of the pile relative to the surrounding moving ground, the shear resistance of the soil along the shaft of the pile, the weight of the soil and the~~	(1) Negative skin friction has to be regarded as a permanent action F_n, originating from relative axial movement between the ground and the pile, when the ground settles more than the pile. (2) The pile continues to settle until the actions from negative skin friction τ_n, together with the actions imposed on the pile by the superstructure, and the pile resistances resulting from the pile end bearing capacity and supporting skin friction q_s, are in equilibrium. (3) Negative skin friction should be taken into account for the justification at SLS and ULS.  **Figure 1** Evaluation of negative skin friction for ultimate limit state (ULS) and serviceability limit state (SLS)

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Identification of issues improved guidance should be provided by EC 7-3

- Structural design of piles
- Correlation factors approach
- Specification of criteria for identification of ultimate pile resistance from static pile load tests
- Numerical simulation of pile foundations
- Handling of situations influenced by stiffness
- …

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Identification of issues so far no guideline provided by existing EC 7-1

- downdrag / negative skin friction (proposal elaborated)
- ground heave
- transversally loaded piles
- design of pile groups (axial/lateral)
- design of piled rafts including cases where piles are used as ´settlement-reducer´
- pile resistance and design for cyclic, dynamic and impact loads
- seismic design of pile foundations
- serviceability proof of pile foundations
- structural design of piles for lateral loading and buckling
- …

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WG 3/TG 3´s comments to systematic review of EC 7-1

SC7 / WG3 /TG3-Piled Foundations Template for TG member comments	EN 1997-1 Systematic review 2014	Date: 31 / 10 / 2015	Reviewer: Compilation of all national comments received by 2016-04-24 [CM]

SC 7 ref	MB/NC[1]	Line number (e.g. 17)	Clause/Subclause (e.g. 3.1)	Paragraph/Figure/Table/ (e.g. Table 1)	Type of comment[2]	Comments	Proposed change	Observations of the secretariat	Reviewer's decision: C: confirm D: deny Austria (Fross)	Cyprus (Papadopoulos)	Finland (Uptinen)	France (Burlon)	Germany (Henke)	Germany (Piling-WG)	Italy (Gobbi)	Italy (Mandolini)	Macedonia (Josifovski)	Poland (Klosinski)	Portugal (Pinto)	Sweden (G. Axelsson)	UK [Raison CAR]	Reviewer's written comment [& name]
15	FR8				ge	More details should be given for the analysis of geotechnical structures submitted to cyclic loadings.		prA WG3-TG1,2,3,4,5 U		C	C	C	C	C	C	C	C	C	C	C	C	MACEDONIA: Maybe a basic formulation could be proposed in the Annex [Josif Josifovski]
51	GB253			National annex	Ge	Use of the model factor increases the pile length considerably	Review the effect of the combination of all the factors of safety which have to applied and perhaps revisit the value of the model factor.	WG3-TG3	A		?		C	C	C			C	C		C	GERMANY(SH): [S. Henke]: Use of model factors is mainly for cases where the pile capacity is evaluated based on soil parameters/experience. Furthermore, when dynamic pile testing with wave propagation measurement is used, the model factor may also be <1.0 such that this "shortens" the piles. Nonetheless, this should not be rejected at this moment but a thorough review of all factors of safety together with model factors should be done. Especially, the case of dynamic pile testing in the present form (in Germany) leads to very high safety factors involving all model factors etc. even if a high number of tests is done. Probably this case is worth of a further investigation. FINLAND [Uotinen] Depends on what's the philosophy behind the model factor. Revisiting the model factor value should rest on relation between probabilistic behaviour of reality i.e. relation between designed length and real

1 **MB** = Member body / **NC** = National Committee (enter the ISO 3166 two-letter country code, e.g. CN for China; comments from the ISO/CS editing unit are identified by **)
2 **Type of comment:** **ge** = general **te** = technical **ed** = editorial

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ISO/IEC/CEN/CENELEC electronic balloting commenting template/version 2012-03

Handover Documents by WG 3 /TG 3 to PT 4

- **Compilation of NDPs nationally used for pile design**

Piles — Rev 2 — 01.11.2015

Code	Country	NSB	EN 1997-1	Ultimate Load Test	Proof Load Test	Table A.6 Resistance factors - driven γ_b	γ_s	γ_t	γ_{st}	Table A.7 Resistance factors - bored γ_b	γ_s	γ_t	γ_{st}	Table A.8 Resistance factors - CF γ_b	γ_s	γ_t
			Factor Set													
			R1			1,0	1,0	1,0	1,25	1,25	1,0	1,15	1,25	1,1	1,0	1,1
			R2			1,1	1,1	1,1	1,15	1,1	1,1	1,1	1,15	1,1	1,1	1,1
			R3			1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
			R4			1,3	1,3	1,3	1,6	1,6	1,3	1,5	1,6	1,45	1,3	1,4
GBR	UK	BSI	DA1-1(R1)	N		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	Chris Raison			Y		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	Confirmed 09 Jun 15		DA1-2(R4)	N	N	1,6	1,5	1,6	2,0	2,0	1,6	2,0	2,2	2,0	1,6	2,0
				N	Y	1,4	1,3	1,4	1,7	1,7	1,4	1,7	1,7	1,7	1,4	1,7
				Y	N	1,6	1,5	1,6	2,0	2,0	1,6	2,0	2,2	2,0	1,6	2,0
				Y	Y	1,4	1,3	1,4	1,7	1,7	1,4	1,7	1,7	1,7	1,4	1,7
DEU	Germany	DIN	DA2(R2)			1,1	1,1	1,1	1,15	1,1	1,1	1,1	1,15	1,1	1,1	1,1
	Christian Moormann E-mail 09 Jun 15		Experience			1,4	1,4	1,4	1,5	1,4	1,4	1,4	1,5	1,4	1,4	1,4
FRA	France	AFNOR	ELU fond			1,1	1,1	1,1	1,15	1,1	1,1	1,1	1,15	1,1	1,1	1,1
	Sebastien Burlon E-mail 08 Jun 15		ELU acc			1,0	1,0	1,0	1,05	1,0	1,0	1,0	1,05	1,0	1,0	1,0
POL	Poland	PKN	DA2(R2)			1,1	1,1	1,1	1,15	1,1	1,1	1,1	1,15	1,1	1,1	1,1
	Boleslaw Klosinski E-mail 08 Jun 15															
BEL	Belgium	NBN	DA1-1(R1)			axially loaded piles : only DA1-1 (revision not yet published) ; $\gamma st = \gamma s$ (different installation factor for tension)										
	Monika De Vos E-mail 08 Jun 15		normal QC			1,0	1,0	1,0	1,0	1,2	1,0	1,1	1,0	1,1	1,0	1,05
			higher degree of QC			1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
			DA1-2(R4)													
			normal QC			1,35	1,35	1,35	1,35	1,65	1,35	1,50	1,35	1,50	1,35	1,43
			higher degree of QC			1,35	1,35	1,35	1,35	1,35	1,35	1,35	1,35	1,35	1,35	1,35
														Table A.8bis Resistance factors - Screw		
			DA1-1(R1)													
			normal QC											1,07	1,00	1,00
			higher degree of QC											1,00	1,00	1,00
			DA1-2(R4)													
			normal QC											1,45	1,35	1,40
			higher degree of QC											1,35	1,35	1,35
CYP	Cyprus	CYS	DA2(R2)			1,1	1,1	1,1	1,15	1,1	1,1	1,1	1,15	1,1	1,1	1,1
	Panicos Papadopoulos E-mail 08 Jun 15															
DNK	Denmark	DS	LC1 (6.10a), GEO/STR			1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3
	Ole Møller		LC2 (6.10b), GEO/STR			1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3
	E-mail 12 Jun 15		LC3 (6.10a), GEO/STR			1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}
			LC4 (6.10b), GEO/STR			1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}	1,3 K_{FI}
			LC5 (6.10a), STR *			1,0*	1,0*	1,0*	1,0*	1,0*	1,0*	1,0*	1,0*	1,0*	1,0*	1,0*
						* in LC5 (STR) the partial coefficients on the structural materials are increased (multiplied) by a factor γ_0 = 1,2 K_{FI}. Thus the geotechnical resistance is not relevant (or decisive) in LC5										
SWE	Sweden	SIS	DA2(R2)			1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,4	1,3	1,3	1,3
	Gary Axelsson E-mail 08 Jun 15															
ITA	Italy	UNI	R1			1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	Alessandro Mandolini		R2			1,45	1,45	1,45	1,6	1,7	1,45	1,6	1,6	1,6	1,45	1,55
	E-mail 08 Jun 15		R3			1,15	1,15	1,15	1,25	1,35	1,15	1,3	1,25	1,3	1,15	1,25
FIN	Finland buildings	SFS	DA2(R2)			1,2	1,2	1,2	1.35/1.5	1,2	1,2	1,2	1.35/1.5	1,2	1,2	1,2
	Finland bridges Veli-Matti Uotinen E-mail 04 Jun 15															
ESP	Spain	AENOR	R2			1,25	1,05	1,15	1,05	1,35	1,10	1,25	1,10	1,45	1,15	1,30
	José Estaire E-mail 12 Jun 15															
MKD	Macedonia	ISRM	Any			no change				no change				no change		
	Josif Josifovski E-mail 15 Jun 15															
NLD	Netherlands	NEN	R3 - no inv. / use of inst records			1,4	1,4	1,4								
			R3 - no investigaation			1,8	1,8	1,8		1,8	1,8	1,8		1,8	1,8	1,8
	Mandy Korff		R3 - based on tests/CPT			1,2	1,2	1,2	1,35	1,2	1,2	1,2	1,35	1,2	1,2	1,2
	E-mail 26 Jun 15		R3- based on pile load test on specific piles			1,15	1,15	1,15	1,25	1,15	1,15	1,15	1,25	1,15	1,15	1,15
AUT	Austria	ON	DA2(R2)			1,1	1,1	1,1	1,15	1,1	1,1	1,1	1,15	1,1	1,1	1,1
	Schremser Roman E-mail 02 Jul 15															
NOR	Norway	SN	DA2(R2)			1,1	1,1	1,1	1,2	1,3	1,3	1,3	1,4	1,2	1,2	1,2
EST	Estonia	EVS	DA2(R2)			1,1	1,1	1,1	1,2	1,3	1,3	1,3	1,35	1,25	1,15	1,2

Handover Documents by WG 3 /TG 3 to PT 4

- **Compilation of NDPs nationally used for pile design**

Piles	Rev 2 01.11.2015 Country	NSB	EN 1997-1	Ultimate Load Test	Proof Load Test	Table A.6 Resistance factors - driven				Table A.7 Resistance factors - bored				Table A.8 Resistance factors - CF		
			Factor Set			γ_b	γ_s	γ_t	γ_{st}	γ_b	γ_s	γ_t	γ_{st}	γ_b	γ_s	γ_t
			R1			1,0	1,0	1,0	1,25	1,25	1,0	1,15	1,25	1,1	1,0	1,1
			R2			1,1	1,1	1,1	1,15	1,1	1,1	1,1	1,15	1,1	1,1	1,1
			R3			1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
			R4			1,3	1,3	1,3	1,6	1,6	1,3	1,5	1,6	1,45	1,3	1,4
GBR	UK	BSI	DA1-1(R1)	N		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	Chris Raison			Y		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	Confirmed 09 Jun 15		DA1-2(R4)	N	N	1,6	1,5	1,6	2,0	2,0	1,6	2,0	2,2	2,0	1,6	2,0
				N	Y	1,4	1,3	1,4	1,7	1,7	1,4	1,7	1,7	1,7	1,4	1,7
				Y	N	1,6	1,5	1,6	2,0	2,0	1,6	2,0	2,2	2,0	1,6	2,0
				Y	Y	1,4	1,3	1,4	1,7	1,7	1,4	1,7	1,7	1,7	1,4	1,7
DEU	Germany	DIN	DA2(R2)			1,1	1,1	1,1	1,15	1,1	1,1	1,1	1,15	1,1	1,1	1,1
	Christian Moormann		Experience			1,4	1,4	1,4	1,5	1,4	1,4	1,4	1,5	1,4	1,4	1,4
	E-mail 09 Jun 15															
FRA	France	AFNOR	ELU fond			1,1	1,1	1,1	1,15	1,1	1,1	1,1	1,15	1,1	1,1	1,1
	Sebastien Burlon		ELU acc			1,0	1,0	1,0	1,05	1,0	1,0	1,0	1,05	1,0	1,0	1,0
	E-mail 08 Jun 15															

Handover Documents by WG 3 /TG 3 to PT 4

- **Comparison of NDPs and resulting equivalent FOS for Pile Foundations prepared by Chris Raison**

Piles Assessment Rev 0

08/11/2015

	Country	NSB	Combined Factors on Actions: Safety Class	Reduction factor ξ	Factor K_{FI}	Actions: 80% permanent 20% variable	Actions: 20% permanent 80% variable	Combined Resistance Factors: Factor K_{FI}	Model Factor	Driven: 80% shaft 20% end bearing	Driven: 20% shaft 80% end bearing	Bored: 80% shaft 20% end bearing	Bored: 20% shaft 80% end bearing	CFA: 80% shaft 20% end bearing	CFA: 20% shaft 80% end bearing	Equivalent Lumped Factor of Safety: Driven: 80% shaft 20% end bearing	Driven: 20% shaft 80% end bearing	Driven: 80% shaft 20% end bearing	Driven: 20% shaft 80% end bearing	Bored: 80% shaft 20% end bearing	Bored: 20% shaft 80% end bearing	Bored: 80% shaft 20% end bearing	Bored: 20% shaft 80% end bearing	CFA: 80% shaft 20% end bearing	CFA: 20% shaft 80% end bearing	CFA: 80% shaft 20% end bearing	CFA: 20% shaft 80% end bearing
			1.0	1.0	1.0	1.38	1.47	1.0	1.0	1.00	1.00	1.20	1.05	1.08	1.02	1.38	1.38	1.47	1.47	1.66	1.45	1.76	1.54	1.49	1.41	1.59	1.50
			1.0	1.0	1.0	1.38	1.47	1.0	1.0	1.10	1.10	1.10	1.10	1.10	1.10	1.52	1.52	1.62	1.62	1.52	1.52	1.62	1.62	1.52	1.52	1.62	1.62
			1.0	1.0	1.0	1.38	1.47	1.0	1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.38	1.38	1.47	1.47	1.38	1.38	1.47	1.47	1.38	1.38	1.47	1.47
			1.0	1.0	1.0	1.06	1.24	1.0	1.0	1.30	1.30	1.54	1.36	1.42	1.33	1.38	1.38	1.61	1.61	1.63	1.44	1.91	1.69	1.51	1.41	1.76	1.65
GBR	UK	BSI	1.0	1.0	1.0	1.38	1.47	1.0	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.93	1.93	2.06	2.06	1.93	1.93	2.06	2.06	1.93	1.93	2.06	2.06
	Chris Raison					1.38	1.47	1.0	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.66	1.66	1.76	1.76	1.66	1.66	1.76	1.76	1.66	1.66	1.76	1.76
	Confirmed 09 Jun 15																										
			1.0	1.0	1.0	1.06	1.24	1.0	1.40	2.21	2.13	2.69	2.35	2.69	2.35	2.34	2.26	2.74	2.64	2.85	2.49	3.33	2.92	2.85	2.49	3.33	2.92
						1.06	1.24	1.0	1.20	1.66	1.58	1.97	1.75	1.97	1.75	1.76	1.68	2.05	1.96	2.09	1.86	2.44	2.17	2.09	1.86	2.44	2.17
DEU	Germany	DIN	1.0	1.0	1.0	1.38	1.47	1.0	1.0	1.10	1.10	1.10	1.10	1.10	1.10	1.52	1.52	1.62	1.62	1.52	1.52	1.62	1.62	1.52	1.52	1.62	1.62
	Christian Moormann																										
	E-mail 09 Jun 15					1.38	1.47	1.0	1.0	1.40	1.40	1.40	1.40	1.40	1.40	1.93	1.93	2.06	2.06	1.93	1.93	2.06	2.06	1.93	1.93	2.06	2.06
FRA	France	AFNOR	1.0	1.0	1.0	1.38	1.47	1.0	1.15	1.27	1.27	1.27	1.27	1.27	1.27	1.75	1.75	1.86	1.86	1.75	1.75	1.86	1.86	1.75	1.75	1.86	1.86
	Sebastien Burlon					1.38	1.47	1.0	1.18	1.30	1.30	1.30	1.30	1.30	1.30	1.79	1.79	1.91	1.91	1.79	1.79	1.91	1.91	1.79	1.79	1.91	1.91
	E-mail 08 Jun 15																										
						1.38	1.47	1.0	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.59	1.59	1.69	1.69	1.59	1.59	1.69	1.69	1.59	1.59	1.69	1.69
						1.38	1.47	1.0	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.63	1.63	1.73	1.73	1.63	1.63	1.73	1.73	1.63	1.63	1.73	1.73
POL	Poland	PKN	1.0	1.0	1.0	1.38	1.47	1.0	1.0	1.10	1.10	1.10	1.10	1.10	1.10	1.52	1.52	1.62	1.62	1.52	1.52	1.62	1.62	1.52	1.52	1.62	1.62
	Boleslaw Klosinski																										
	E-mail 08 Jun 15																										