Example 2.3 Pile foundation in stiff clay
Note: this is a persistent design situation; for simplicity, accidental design situations do NOT need to be checked.

Question		Instruction	Answer		
GENERAL					
1	Please provide your contact details in case we need to clarify your submission*	*Will be kept strictly confidential	Name: **Adam Krasiński** Affiliation: **Gdansk University of Technology** Email address: **akra@pg.gda.pl**		
2	How many structures of this kind have you previously designed?	Tick one	☐ None ☐ 1-2 ☐ 3-6 ☑ More than 6		
3	Having completed your design to Eurocode 7, how confident are you that the design is sound?	Tick one	☐ Very unsure ☑ Unsure ☐ Confident ☐ Very confident		
4	How did you account for the location of boreholes/cone tests relative to the foundation?	Tick one	☐ Did not consider borehole/test location ☐ Considered nearest borehole/test only ☑ Considered 'average' of all boreholes/tests ☐ Considered trend of all b'holes/tests, biased towards nearest ☐ Other (specify) …		
5	Please explain the reasons for your answer to Q4	Free text			
SERVICEABILITY LIMIT STATE					
6	Which parameters did you use for the SLS design of the pile foundation?	Tick all that apply	☐ Cone resistance q_c ☐ Sleeve friction f_s ☐ SPT blow count N ☐ Corrected SPT blow count $(N_1)_{60}$ ☑ UU triaxial test strength c_u ☐ Pressuremeter limit pressure p_{lim} ☐ Undrained Young's modulus of elasticity E_u ☐ Drained Young's modulus of elasticity E´ ☐ Poisson's ratio ν ☐ Shear modulus of elasticity G ☐ Other (specify) …		
7	What correlations did you use to derive soil parameter values (if used) for the SLS verification? If more than one, please list others below	Free text	Description: Transform functions Author: **Gwizdala K., Jacobsen M. (1992)** Title: **Bearing capacity and settlements of piles** Pages:		
7a	Any other correlations? (please give same info as above)				
8	What assumptions did you make in choosing these correlations?	Free text			
9	How did you account for any variation in parameters with depth?	Tick one	☐ Ignored variation with depth ☐ Assumed linear variation ☑ Assumed bi-linear variation ☐ Assumed stepped variation ☐ Other (specify) …		
10	Please explain the reasons for your answer to Q9	Free text	**Because the distribution of average C_u with depth is rather bi-linear, as it can be seen on fig. 2.3b**		
11	What is the characteristic value of N at these levels?	Provide uncorrected values	At +17 m, N =	At +7 m, N =	At –3 m, N =
12	What is the characteristic value of q_c at these levels?	Provide values in units of MPa	At +17 m, q_c =	At +7 m, q_c =	At –3 m, q_c =
13	What is the characteristic value of p_{lim} at these levels?	Provide values in units of MPa	At +17 m, p_{lim} =	At +7 m, p_{lim} =	At –3 m, p_{lim} =
14	What is the characteristic value of triaxial c_u at these levels?	Provide values in units of kPa	At +17 m, c_u = 0	At +7 m, c_u = **150**	At –3 m, c_u = **230**
15	How did you assess these values?	Tick all that apply	☑ By eye ☐ By linear regression ☐ By statistical analysis ☐ From an existing standard (specify) … ☐ From a published correlation (specify) … ☐ Comparison with a previous design ☐ From the soil description, not using the data ☐ Other (specify) …		
16	Which calculation model did you use to determine settlement?	Tick one	☐ Method from national annex (specify) … ☐ Method from national standard (specify) … ☐ Finite element analysis ☐ Finite difference analysis ☐ Other (specify) …Method of transform functions		
17	What length does the pile need to avoid a serviceability limit state?	Provide value in m	L_{SLS} = **13.0**		

ULTIMATE LIMIT STATE						
18	Which parameters did you use for the ULS design of the pile foundation?	Tick all that apply	☐ Cone resistance q_c ☐ Sleeve friction f_s ☐ SPT blow count N ☐ Corrected SPT blow count $(N_1)_{60}$ ☑ UU triaxial test strength c_u ☐ Pressuremeter limit pressure p_{lim} ☐ Other (specify) …			
19	What correlations did you use to derive soil parameter values (if used) for the ULS verification? If more than one, please list others below	Free text	Description: **Polish piling code PN-B-02482** Author: Title: Pages:			
19a	Any other correlations? (please give same info as above)					
20	What assumptions did you make in choosing these correlations?	Free text	**$q_b = 9 \cdot C_u$, $q_s = \alpha \cdot C_u$**			
21	(If determined) What is the characteristic value of unit shaft resistance q_s at these levels?	Provide values in units of kPa	At +17 m, q_s = 0	At +7 m, q_s = **50**	At –3 m, q_s = **58**	
22	(If determined) What is the characteristic value of unit base resistance q_b at these levels?	Provide values in units of kPa	At +17 m, q_b = 0	At +7 m, q_b = **1350**	At –3 m, q_b = **2070**	
23	Which calculation model did you use to determine the pile's compressive resistance?	Tick one	☐ Annex D.6 from EN 1997-2 ☐ Annex D.7 from EN 1997-2 ☐ Annex E.3 from EN 1997-2 ☐ Alternative given in a national annex (specify) … ☑ Alternative given in a national standard (specify) …**PN-B-02482** ☐ Finite element analysis ☐ Finite difference analysis ☐ Other (specify) …			
24	Which country's National Annex did you use to interpret EN 1997-1?	Free text	Polish			
25	Which Design Approach did you use for verification of the Ultimate Limit State (ULS)?	Tick one	☑ Design Approach 1 Combinations 1 and 2 ☐ Design Approach 1 Combination 1 only ☐ Design Approach 1 Combination 2 only ☐ Design Approach 2 ☐ Design Approach 2* ☐ Design Approach 3 ☐ Other (specify) …			
26 26a	What values of partial factors did you use for this ULS verification?	Provide values	1st combination		2nd combination (if used)	
			γ_G = **1.35**	γ_Q = **1.5**	γ_G = **1.0**	γ_Q = **1.3**
			γ_ϕ	γ_c	γ_ϕ	γ_c
			γ_{cu} = **1.0**	γ_s = **1.0**	γ_{cu} = **1.0**	γ_s = **1.3**
			γ_b = **1.25**	γ_t	γ_b = **1.6**	γ_t
27	What correlation factors (if any) did you use for this verification?	Provide values	ξ_3 = **1.28**		ξ_4 = **-**	
28	What model factor (if any) did you use for this verification?	Provide values	γ_{Rd} = **1.0**			
29	What length does the pile need to avoid an ultimate limit state?	Provide value in m	L_{ULS} = **13.0**			
30	What is the design compressive force that the pile must be designed for according to Eurocode 2?	Provide values in kN	Design compressive force **F_{cd} = 630**			
CONCLUDING QUESTIONS						
31	What other assumptions did you need to make to complete your design?	Free text	The q_s and q_b resistance depend not only on soil parameters, but also on pile diameter D and depth z			
32	Please specify any other data that you would have liked to have had to design this type of foundation	Free text	To determine the settlement of pile foundation it is needed the number of piles under the foundations			
33	How conservative do you consider your previous national practice to be for this design example?	Tick one	☐ Very conservative ☐ Conservative ☐ About right ☑ Unconservative ☐ Very unconservative			
34	How conservative do you consider Eurocode 7 (with your National Annex) to be for this example?	Tick one	☐ Very conservative ☐ Conservative ☑ About right ☐ Unconservative ☐ Very unconservative			

35	How does your Eurocode 7 design compare with your previous national practice?	Tick one	☐ Much more conservative ☑ More conservative ☐ About the same ☐ Less conservative ☐ Much less conservative
36	Please provide any other relevant information needed to understand your solution to this design exercise	Free text	
PLEASE SUBMIT YOUR ANSWERS AT www.eurocode7.com/etc10/Example 2.3 THANK YOU FOR YOUR CONTRIBUTION!			