ETC10 Questionnaire 2.1 (version 07/07/2009)

Example 2.1 Pad foundation with vertical central load on dense sand
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 Paweł Galas Affiliation Department of Geotechnical Engineering, Warsaw University of Life Sciences, Warsaw, Poland Email address galaspawel@o2.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 cone tests relative to the foundation?	Tick one	☐ Did not consider test location ☐ Considered nearest test only ☐ Considered 'average' of all tests ☒ Considered trend of all tests, biased towards nearest ☐ Other (specify) …
5	Please explain the reasons for your answer to Q4	Free text	Distances between soundings are rather comparable. What is more, none of the tests is localized in the nearest proximity of the pad footing. Variability of the test results (particularly up to 4 m below ground level) is not considerable. I decided to take into consideration each of the tests, however, sounding CPT4 was treated as a leading test (the lowest distance between centre of foundation and available soundings).
SERVICEABILITY LIMIT STATE			
6	Which parameters did you use for the SLS design of the spread foundation?	Tick all that apply	☒ Cone resistance q_c ☐ Cone sleeve friction f_s ☒ 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: E' = 2,5 x qc Author: Schmertmann, J.H. Title: Improved strain influence factor diagrams, ASCE Journal of the Geotechnical Engineering Division, Vol. 104, No. 8, August 1978 Pages: 1131-1135
7a	Any other correlations? (please give same info as above)	Free text	-
8	What assumptions did you make in choosing these correlations?	Free text	As far as I know, the equation (E'=2,5 x q_c) was derived by Schmertmann from in situ load tests and relations between deformation modulus and cone penetration resistance for normally consolidated soils.
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	The method used in settlement calculations requires dividing of soil mass on a finite number of layers. Each layer represents a soil stiffness consistent with test results (in this case q_c). As long as q_c value is not constant with depth, automatically stepped variation is taken into account.
11	What is the characteristic value of q_c at these depths?	Provide values in units of MPa	At 1 m, q_c = 11,70 At 2 m, q_c = 14,85 At 4 m, q_c = 15,38
12	What is the characteristic value of E´ for a linear elastic calculation at these depths?	Provide values in units of MPa	At 1 m, E´ = 29,25 At 2 m, E´ = 37,12 At 4 m, E´ = 38,45
13	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) …
14	Which calculation model did you	Tick one	☐ Annex F.1 from EN 1997-1 ☐ Annex F.2 from EN 1997-1

	use to determine settlement?		☒ Annex D.3 from EN 1997-2 ☐ Annex D.4 from EN 1997-2 ☐ Annex D.5 from EN 1997-2 ☐ Alternative from national annex (specify) … ☐ Alternative from national standard (specify) … ☐ Finite element analysis ☐ Finite difference analysis ☐ Other (specify) …			
15	What width does the foundation need to avoid a serviceability limit state?	Provide value in m	B_{SLS} = 2,0			
ULTIMATE LIMIT STATE						
16	Which parameters did you use for the ULS design of the spread foundation?	Tick all that apply	☒ Cone resistance q_c ☐ Cone sleeve friction f_s ☒ Angle of shearing resistance ϕ' ☐ Effective cohesion c´ ☐ Angle of interface friction δ ☐ Other (specify) …			
17	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: ϕ' = 13,5 x qc + 23 Author: Title: DIN4094 Pages:			
17a	Any other correlations? (please give same info as above)	Free text	-			
18	What assumptions did you make in choosing these correlations?	Free text	As it is mentioned in annex D.2 the equation which may be used for evaluation of internal friction angle is valid for poorly-graded sands (Cu < 3) above groundwater and cone penetration resistances in the range 5 $\leq$ qc $\leq$ 28 MPa. It was assumed that soil conditions which are presented in the example satisfy requirements which are needed to implement equation from point 17.			
19	What is the characteristic value of ϕ' at these depths?	Provide values in degrees	At 1 m, ϕ' =37,4	At 2 m, ϕ' = 38,8	At 4 m, ϕ' = 39.0	
20	Which calculation model did you use to determine bearing resistance?	Tick one	☒ Annex D from EN 1997-1 ☐ Alternative given in a national annex (specify) … ☐ Alternative given in a national standard (specify) … ☐ Terzaghi ☐ Meyerhof ☐ Brinch-Hansen ☐ Finite element analysis ☐ Finite difference analysis ☐ Other (specify) …			
21	Which country's National Annex did you use to interpret EN 1997-1?	Free text	Polish standard PN-81/B-03020 Foundation bases. Static computations and design.			
22	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) …			
23 23a	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	γ_Q
			γ_ϕ = 1	γ_c= 1	γ_ϕ	γ_c
			γ_{Rv}	γ_{Rd} = 1,4	γ_{Rv}	γ_{Rd}
24	What width does the foundation need to avoid an ultimate limit state?	Provide value in m	B_{ULS} = 1,4			
25	What are the structural forces (at its centre-line) that the foundation must be designed for according to Eurocode 2?	Provide values in kNm and kN	Design bending moment M_{Ed} = 0		Design shear force V_{Ed} = 2453	
CONCLUDING QUESTIONS						
26	What other assumptions did you need to make to complete your design?	Free text				
27	Please specify any other data that you would have liked to have had to design this type of foundation	Free text	Additionally, flat dilatometer tests are desirable to obtain more reliable soil stiffness parameters (serviceability limit state). If someone uses simple procedure for estimating bearing capacity of shallow foundations in cohesionless soils (e.g.			

			Annex D.4 from EN 1997-1), then from my point of view cone penetration tests results are adequate enough to obtain angle of internal friction.
28	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
29	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
30	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
31	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 2.1 **THANK YOU FOR YOUR CONTRIBUTION!**			