Repute vs Structural analyses

Dr Francesco Basile, Geomarc Ltd, Messina (Italy), www.geomarc.it

The results from Repute are compared with those obtained from simple structural analyses and other commonly used pile-group programs for the case of a 3-pile group under general loading conditions. Three types of approach have been adopted in order to analyse the above group of piles:

1) A simple statical method that ignores the presence of soil and considers the pile group as a purely structural system;
2) The equivalent-bent method that reduces the pile group to a structural system but takes some account of the effect of the soil by determining equivalent free-standing lengths of the piles;
3) Pile group programs that consider the presence of the soil, including the interaction effects between the piles through the soil, specifically Repute (Bond & Basile, 2002; Basile, 2003), DEFPIG (Poulos, 1990), Piglet (Randolph, 1987), and GEPAN (Xu & Poulos, 2000).

The 3-pile group is subjected to a combination of axial load, lateral load and moment, as reported by Poulos & Davis (1980) and shown in Fig. 1. Results from the above methods are compared in Table 1 in which w_3, u and $\boldsymbol{q}$ are the vertical head displacement of Pile 3, the horizontal cap displacement and the rotation of the cap, respectively, and the quantities V, H and M are the vertical load, the horizontal load and the moment taken by the pile heads, respectively.

There is a good agreement between the solutions obtained from all the pile-group programs (which take into account the effects of pile-soil interaction, even if with different degrees of rigour), whereas the structural methods (i.e. the statical and equivalent-bent analyses, as calculated by Poulos & Davis, 1980) give quite different results, thereby showing the pitfall of attempting to model a complex pile-soil system by means of a simple structural frame. In particular, it is crucial to observe the significant differences in the maximum vertical load obtained on pile No. 3: the structural analyses calculate an average value of 329kN, as compared to the average value of 391kN obtained from the programs DEFPIG, Piglet, GEPAN and Repute, i.e. there is an underestimate of about 16%. This would have a **critical impact** on the design pile lengths.

References

Basile, F. (2003). Analysis and design of pile groups. In *Numerical Analysis and Modelling in Geomechanics* (eds J. W. Bull), Spon Press, London, Chapter 10, 278-315.

Bond, A. J. & Basile, F. (2002). *Repute 1.0, Pile-group Design Softwar*e. User Manual, Geocentrix Ltd, London, 60 p.

Poulos, H. G. & Davis, E. H. (1980). *Pile foundation analysis and design*. New York: Wiley.

Poulos, H. G. (1990). *User's guide to program DEFPIG ¾ Deformation Analysis of Pile Groups, Revision 6*. School of Civil Engineering, University of Sidney.

Randolph, M. F. (1987). *PIGLET, a computer program for the analysis and design of pile groups*. Report GEO 87036, Perth, University of Western Australia.

Xu, K. J. & Poulos, H. G. (2000). General elastic analysis of pile groups. *Int. J. Numer. Anal. Meth. Geomechs* **24**, 1109-1138.

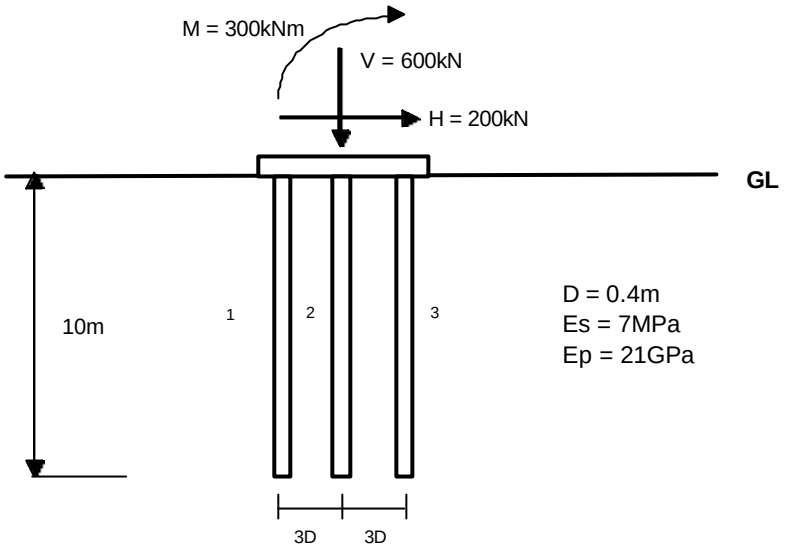

Fig. 1. Group of 3 piles considered in comparison of methods

Table 1. Comparison of different analyses for group of 3 piles

Quantity	Equivalent-Bent Analysis	Simple Statical Analysis	DEFPIG	Piglet	GEPAN	Repute
V_1 (kN)	67.2	75.0	55.8	55.7	54.0	49.6
V_2 (kN)	200.0	200.0	155.1	155.0	156.0	153.0
V_3 (kN)	332.8	325.0	389.1	389.3	390.0	397.0
H_1 (kN)	66.6	66.7	72.0	80.4	73.7	68.9
H_2 (kN)	66.7	66.7	56.0	39.3	50.9	53.5
H_3 (kN)	66.6	66.7	72.0	80.4	75.4	77.6
M_1 (kNm)	-6.2	0	-35.8	-42.0	-38.5	-41.5
M_2 (kNm)	-6.2	0	-28.5	-16.3	-26.1	-31.8
M_3 (kNm)	-6.2	0	-35.8	-42.0	-38.6	-44.0
w_3 (mm)	17.5	NA	13.4	9.9	10.8	14.1
u (mm)	8.9	NA	11.6	11.4	10.5	11.5
θ (rad)	0.00581	NA	0.00242	0.00242	0.00241	0.00263