USE OF THE SPREADSHEET

The spreadsheet can be used for preliminary design of piled raft foundations to determine the number of piles needed to satisfy the overall bearing capacity and settlement requirements. An example spreadsheet calculation is shown in Fig. 5. Because the spreadsheet provides computed results immediately as input data is entered, it can be used efficiently to determine central and differential settlements with various properties of soil, raft, and piles.

Red colored numbers indicate user input values, and blue colored numbers indicate calculated values. In the middle column of the spreadsheet, the input values for soil, raft, and pile are entered as well as other geotechnical parameter values. The geotechnical parameter assessment section is used to provide guidance for pile and raft capacity values. Therefore, SPT values for the geotechnical parameters assessment section are not needed if the user already knows the pile and raft capacities. In the piled raft capacities section, the user can enter the user's own capacity values or the recommended values by Poulos (2002) calculated from the values in the previous section (geotechnical parameter assessment). In this version of the spreadsheet, a potential for block failure of the pile group is not included in the capacity calculation. Due to the approximate nature of these estimates, the capacities of the raft and pile group remain the designer's responsibility, and the designer should enter the best capacity estimates available.

On the right side of the spreadsheet, a calculated average pile spacing based on the assumption that piles are distributed under the whole raft is shown. The computed stiffness of the raft, the single pile, the pile-group, and the piled raft are shown, as well as the load distribution between the piles and the raft. Also, the computed central settlement and the computed differential settlement of the raft without piles and with piles are shown based on the simplified load-settlement curve.

It is important for a user to be aware of that the spreadsheet cannot be used when piles are located strategically in order to reduce the differential settlements. In this spreadsheet, it is assumed that piles are uniformly distributed over the whole raft area with the average center-to-center pile spacing. Also, the soil modulus values have limits to avoid numerical difficulties. The normalized Gibson modulus ratio, β ($= E_0/\Delta E_s d$), should be larger than 0.01. Also, the pile must satisfy the limits that the spacing ratio ($s/2r_0$) and the slenderness

ratio ($l_p/2r_0$) should be within 2 to 12 and 10 to 100, respectively.

The suggested procedure for using the spreadsheet is shown in Fig. 6. If the central settlement exceeds the allowable value, the designer needs to increase the stiffness of the foundation by changing the pile properties, the number of piles, the length of the piles, and/or the thickness of the raft. In this spreadsheet, differential settlements are calculated as a fraction of central settlement based on the flexibility of the raft. For a given set of soil properties, the raft properties have most influence on the differential settlements of the foundation. Therefore, it is recommended that the raft thickness be increased when differential settlements exceed allowable values.