

The above approach is tentative and its reliability has yet to be proven. It may therefore be desirable to use a Category 3 method to obtain more reliable results.

7.8.4.2 Category 3 approach

The most effective means of carrying out a Category 3 analysis is to employ a pile group analysis program that considers non-linear pile-soil response and pile-soil-pile interaction, and is capable of handling all six components of loading simultaneously (e.g. the commercially available programs REPUTE or GROUP8). In employing such programs, the following procedure can be used:

1. First, to check whether the design criterion for geotechnical strength (Equation 7.3) for the whole foundation system is satisfied:
 - a. The axial and lateral capacities of the piles, and the raft for a piled raft, are reduced by the geotechnical reduction factor ϕ_g (see Section 7.3.1).
 - b. The specified ultimate limit state load combinations are applied in turn, and the analysis is run to see if the foundation system with the reduced axial and lateral capacities can sustain the loads without failure. If so, then the geotechnical strength criterion in Equation 7.3 is satisfied. If not, then the foundation system has to be fortified in some way until it is found to be adequate. It should be emphasised that the geotechnical capacity of the individual components of the foundation system, particularly the piles, do not need to be checked, as such a process is unnecessarily onerous and could result in a very uneconomical design.
2. Second, to check whether the design criterion for structural strength (Equation 7.2) is satisfied:
 - a. The axial and lateral capacities of the piles, and the raft if present, are left unfactored. By so doing, the loads and moments developed within the system are not artificially limited by factoring down.
 - b. The specified ultimate limit state load combinations are applied in turn, and the analysis is run. Now, the computed loads and moments in each of the piles, and the moments and shear forces in the raft, can be multiplied by an appropriate load factor (e.g. 1.5), and then these values are checked to see if they are below the design structural strength of each component. If so, then the structural strength criterion in Equation 7.2 can be considered to be satisfied. If not, then the elements which do not satisfy the structural strength criterion need to be fortified until they are found to be adequate.

The suggested procedure therefore reflects the approach set out in [Table 7.2](#).

In carrying out the analyses described above, there are a number of computational issues that need to be considered when calculating the loads and moments in the piles and raft, as set out below.

7.8.4.3 Effect of soil modulus values used

In principle, the following values of soil Young's modulus should be employed in the Category 3 pile group analyses:

1. For sustained dead plus live load combinations, long-term (drained) modulus should be used.
2. For load combinations involving wind and earthquake loadings, short-term modulus values should be used.