

## Introduction

In order to manage risk Premier Guarantee Surveyors are required to assess the structural design and installation of pile foundations as part of the audit process on behalf of the Underwriter. The following guidance outlines recognised good practice with regard to Pile design that is acceptable to Premier Guarantee.

Pile design and installation should be in accordance with the Premier Guarantee Technical Manual and recognised publications from British Standards, Eurocodes, CIRIA, BRE, ICE and LDSA.

### Drawings and Calculations

A pile layout drawing should be prepared by the Structural Engineer, indicating the pile reference numbers and all loadings to which each pile will be subjected to. Calculations (often referred to as Load Take Down calculations) should clearly demonstrate how the load on each numbered pile is arrived at.

### Site Investigation Report

A site specific geotechnical site investigation should take place and be in accordance with BS 5930/EC7 and extend to depths beneath the pile toe of at least 3 times pile diameter, 5m or the smallest plan dimension encompassing the pile group. The investigation should include enough geotechnical testing along and beneath the pile to enable accurate geotechnical design of the pile in accordance with proven design methods.

### Pile Factor of Safety

The factor of safety is dependent on the extent of site investigation, confidence in the design and proposed pile load testing and should be in accordance with BS 8004 (i.e. between 2 and 3). Where piles are

not to be tested the minimum factor of safety shall be 3. Note that the guidance contained in LDSA Guidelines can be used for piles in London Clay.

### Testing

Piled foundations should be tested to ensure that they meet the design requirements.

#### Static Load Testing

**Preliminary pile tests:** maintained load testing up to at least 2 times working load of Constant Rate of Penetration testing in accordance with BS 8004, SPERW, or other accepted standards; normally carried out before work starts on site or at the very beginning of a project.

**Working pile tests:** maintained load testing up to at least 1.5 times working loads in accordance with BS 8004, SPERW, or other accepted standards. Working load testing is to be carried out at a rate of 1 per 100 piles or part thereof (not less than 1%).

#### Dynamic Load Testing

Dynamic load testing of driven piles are acceptable provided that:

- Settlement analysis is provided for each type e.g. by CAPWAP, SIMBAT etc. and the long term expected settlement including consolidation and creep is derived.
- Dynamic testing should be undertaken to reflect the detail of the site investigation report, the ground conditions and the factor of safety applied to the pile design. Please submit this information prior to commencement on site.

**Please note:** Where there are large variations in substrata revealed either by the site investigation

or during the construction of piles, load tests should be carried out in each zone and the level of testing reassessed accordingly for each design situation. Similarly, load testing should reflect the various pile lengths and loadings.

#### Pile design

The pile design should be carried out by proven design methods, in accordance with BS 8004/EC7 and reflect the ground parameters as confirmed by the site specific Site Investigation Report. The design should prove that the pile can support all expected vertical, horizontal, tensile, heave and negative skin friction forces.

In all cases, a geotechnical design should be carried out in order to confirm the required pile length. A set design (in accordance with proven design methods) for driven piles can be used for installation purposes only and will not be accepted without pile load testing and reference to the ground conditions.

A structural design should be carried out in accordance with BS 8004/EC7. Piles for new development should be not less than 150mm diameter or equivalent.

A pile schedule should be produced indicating the pile numbers (referenced to the drawings), pile loads, pile type and diameter, pile length, required rock socket length and details of required reinforcement.

The pile should be designed to ensure that long term settlement does not exceed 10mm or 1 in 500 at working load and 15mm at 1.5 times working load. The Structural Engineer may require more stringent criteria.

### Pile Integrity testing

The integrity of the full depth and cross-section of the all CFA, SFA, CHD, bored piles should be established by integrity tested using recognised methods. 100% of such piles should be integrity tested. Should integrity testing indicate anomalies, then agreement should be obtained from Premier Guarantee with regard to remedial measures. It is recommended that such agreement is obtained prior to continuance of work.

### Piling installation logs

Logs should be provided for each pile indicating the pile number (referenced to the drawing), pile load, pile length, reinforcement details and any sleeving requirements.

For driven piles, the first pile driven should record the number of blows for the first 100mm of each metre of depth, and the set achieved during installation and on re-strike (if applicable) should be indicated.

Rig telemetry should be available if required, and should be provided as a matter of course for projects with more than 150 piles.

Should driven piles vary considerably in length across short distances, then the pile installation should be immediately re-assessed and details submitted to Premier Guarantee for review.

### Piling in rock / boulders

If rock sockets are required by the pile design, then the achievement of such rock sockets during pile installation should be demonstrated.

Where there are boulders, it needs to be demonstrated that piles are not founded on boulders. If boulders are present on site, some pre-drilling may be required. It is advisable to ensure that piles are taken down through strata containing cobbles / boulders.

### Piling in Chalk

Reference should be made to CIRIA PR86 for pile design and installation. Where the risk of solution features as obtained from a Groundsure or Envirocheck hazard map is higher than low, probing should be carried out at each pile location.

### Piling in ground subject to cavitation (e.g. due to gypsum dissolution, brine dissolution etc.)

Pile design and installation should take into account existing and future cavitation. Some form of redundancy is required to counteract any unknowns. As the presence of dissolution features cannot be readily identified in the construction of piles, it is recommended that probing be undertaken at each pile location. Some form of geophysical investigation or similar is recommended in order to locate existing cavities.

### Piling over mine workings

Reference should be made to CIRIA SP32. Piling adjacent to mine shafts should ensure that adequate competent rock is available, that rock sockets are achieved and that piles won't be affected by a potential future collapse or partial collapse of the shaft.

Alternative pile types and design methods:  
If there are queries with regard to anything not

covered above, please contact Premier Guarantee prior to commencement of piling.

If it is intended that the pile design and / or installation is to deviate from the above guidance, then please contact Premier Guarantee for agreement prior to commencement of piling.

### Documentation required

The following documentation (in accordance with the above guidelines) should be submitted to Premier Guarantee for assessment. Items 1-5(a) should be submitted prior to commencement of piling on site and items 5(b)-6 should be submitted as soon as they become available, preferably prior to construction continuing over the piles.

1. Geotechnical site investigation report (to below the pile toe).
2. Foundation drawings and pile layouts (with pile reference numbers and loadings).
3. Calculations demonstrating how the load on each pile was derived.
4. Pile design calculation (for vertical, horizontal and heave forces) to geotechnical parameters in Site Investigation Report and a copy of the pile set design.
5. (a) Confirmation and justification for proposed number of pile load tests and (b) copies of reports (e.g. static / dynamic / CAPWAP).
6. Pile integrity tests and installation logs (with pile numbers referenced to the pile layout drawing)