

Pile Foundations

To facilitate the processing of pile foundation submissions the following guidelines should be observed.

Recognized Types of Pile Foundation

2. A recognized type of pile foundation is regarded as the piling system recognized by the Building Authority prior to the approval of piling plans through the submission of relevant technical details for assessment, normally by the registered structural engineer (RSE) in conjunction with the registered contractor experienced in such system. A list of recognized types of pile foundation is available from the Buildings Department.

3. Where it is proposed to use a piling system which is not a recognized type, the RSE is advised to prove its acceptability to the Building Authority (BA) before detailed piling plans are submitted for approval. To enable the BA fully to consider the system, all relevant technical details on material, manufacturing process, structural design, method of installation, method of assessing foundation capacity and applicability relating to ground conditions and selected examples of the use of the system elsewhere, if applicable, should be submitted following which a demonstration of the system may be called for.

Piling Plans Submission

4. The following particulars are required under Building (Administration) Regulations 8 and 10 to be included in the piling plans submission for approval :

- (a) a block plan showing the location of the site;
- (b) details showing the characteristic features of the site and environs, including locations of site investigation boreholes, slopes, existing foundations, nullahs, retaining walls and the like;
- (c) layout arrangement, identification, expected depths and cut-off levels of the piles;
- (d) layout arrangement of the pile caps;
- (e) size, shape and structural details of the pile element, including details of the shoe, head, splices and cap/pile connection;

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- (f) specification of structural materials;
- (g) magnitude of characteristic dead, imposed and wind loads and their critical combinations acting on each pile or each group of piles;
- (h) installation specifications, such as founding criteria, method of excavation, anticipated driving performance, characteristics of driving equipment (hammer, energy rating, blow rate at final set, driving tube, capblock, follower and the like), method of overcoming underground obstruction;
- (i) details of monitoring requirements;
- (j) site investigation report including results of ground investigation and necessary field and laboratory tests; and
- (k) design calculations based on recognized foundation engineering principles. The adverse effects of such piling works on surrounding land and structures should be assessed, and shoring proposal included as necessary.

5. Some special requirements for pile foundations in the Scheduled Areas are given in PNAP 161.

Group Reduction Factor

6. The group reduction factor should be determined with respect to the bearing capacity and settlement of the group by recognized foundation engineering principles. In the case of a group of 5 or more vertically loaded piles driven to a satisfactory set in cohesionless soil, a group reduction factor of 0.85 may be considered as generally acceptable. Alternative values of group reduction factor supported by a justification based on recognized principles and relevant to a particular site and building may also be adopted.

7. Generally, group reduction factors need not be applied where -

- (a) the spacings are of more than 3 times the perimeter of the piles, measured from centre to centre; or
- (b) the load capacity of the piles is derived from end-bearing on rock with unconfined compressive strength of not less than 10 MPa and with equally strong material beneath.

Piling Record Plan and Reports

8. Upon completion of the piling work two sets of piling record plan and reports should be submitted as may be required under Building (Administration) Regulation 10 to certify the satisfactory completion of the piling works. These should include :

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- (a) a plan showing characteristic features of the site and the identification, location, depth and size of each pile as constructed;
- (b) a report listing the date of construction, the quality and quantity of materials used and driving performance or excavation record of each pile; and
- (c) reports on any tests as required for the particular piling system.

Within 14 days of the receipt of these documents, the Buildings Department would make every endeavour to inform the AP/RSE of the representative piles identified for proof tests. To avoid unnecessary delay, the AP/RSE should ensure that full information on the completed piles is included in the piling record plan and reports.

Proof Tests

9. Proof tests on foundation units are required under Building (Construction) Regulation 30. Except in special circumstances where the standard of acceptance is to be determined according to the design and factor of safety, the BA will normally be satisfied if the following procedure and criteria described in paragraphs 10 and 11 are followed. Alternative procedures and acceptance criteria, supported by a justification based on recognized foundation engineering principles and relevant to a particular site and building may also be adopted.

10. For proof tests carried out by means of the imposition of test loads:

- (a) the pile should be tested to the load capacity at cut-off level with no allowance for group effect;
- (b) the test load should be applied in 2 equal increments upto the design working load of the pile, then released and reapplied in 4 equal increments up to 2 times the design working load and maintained for at least 72 hours before removal;
- (c) the load at each stage should be held for a period of 10 minutes or longer until the rate of settlement is less than 0.05 mm in 10 minutes.
- (d) the test load should be measured by a calibrated load measuring device and also by a calibrated pressure gauge in the hydraulic system; and
- (e) the test shall be deemed to be unsatisfactory if any of the following conditions apply :

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- (i) the maximum settlement at the head of the pile during the test exceeds the value

$$\frac{2WL}{AE} + \frac{D}{120} + 4 \text{ mm},$$

- where - W is the design working load in kN;
- L is the length of the pile in mm;
- A is the cross-section area of the pile in mm²;
- E is the Young's modulus for the material of the pile in kN/mm² and
- D is the least lateral dimension of the pile in mm;

- (ii) when the rate of recovery after the removal of the maximum test load is less than 0.1 mm/hour observed in a period of not less than 15 minutes, the residual settlement at the head of the pile exceeds the value $D/120 + 4 \text{ mm}$.

11. For proof tests carried out by core-drilling:

- (a) the core-drilling should be taken through the full depth of the pile and carried down to a distance of at least half a diameter of the pile base, or 600 mm, whichever is larger, into the ground upon which the pile is founded;
- (b) the completed core so taken should be properly marked and arranged in order for inspection;
- (c) the concrete cores should not show evidence of honeycombing or segregation of individual materials and the extent of voids in the cores should not be more than "few" in accordance with the classification defined in Table 4 of CS1:1990;
- (d) any rock core obtained shall be visually examined to conform with the required rock material specified in the design; and
- (e) where piles are founded on soil, standard penetration tests shall be carried out at a maximum interval of 1.5 m from the pile founding level down to a distance of at least 3 times the diameter of the pile base, or 5 m, whichever is larger, to verify the required soil strength.

12. Alternative procedures and acceptance criteria, or methods other than test loading or core drilling, which can demonstrate the performance of the foundation under loads or verify the integrity and the load-response interaction between the foundation unit and the bearing stratum may also be adopted. In this connection, the following should be submitted well in advance of the completion of the foundation works so that the Building Authority (BA) may fully consider the suitability of the proposed method of testing:

- (a) relevant recognized engineering principles and theories for the proposed method of testing;
- (b) detailed procedures of testing;
- (c) acceptance criteria;
- (d) interpretation of the test results; and
- (e) any verification tests performed to justify the parameters to be used in the proof test.

Amendments to Approved Plans

13. For submission of amendment plans and their related consent applications, the fast track procedures for securing consent for amendments outlined in PNAP 215 shall apply.

Form BA 14

14. Upon completion of the piling works, a specified Form BA14 certifying the completion should be submitted in the manner prescribed in Building (Administration) Regulation 25. For exceptionally large sites, foundation works may be suitably phased and separately considered for proof testing. The Buildings Department should be consulted as early as possible on this special arrangement.

15. Consent to the commencement of the pile cap and superstructure works will not be given until:

- (a) satisfactory piling records have been submitted;
- (b) specified Form BA14 has been submitted;
- (c) the required proof tests have been satisfactorily carried out; and
- (d) all relevant imposed conditions including materials testing requirement have been complied with.

To expedite the selection of piles for proof tests, piling record plans and reports may be separately submitted prior to the submission of the specified Form BA14.

/Concurrent

Concurrent Processing of Applications

16. Procedures are in place in Buildings Department for concurrent processing of applications for approval and consent in respect of new foundation works. Except in cases where any imposed condition should require to be first met, e.g. shoring to adjoining buildings to be completed before piling works may commence, Buildings Department will consider giving approval of plans for foundation works and consent for such works at the same time. If an AP or RSE wishes to take advantage of these procedures, he should co-operate with the department by ensuring that an application for consent is not submitted before the 32nd day of the submission of plans for approval, to avoid unnecessary complications in administrative work.

17. To minimize the idling time on construction sites, applications may also be made for consent to commence excavation works for substructures prior to the final completion of foundation works, provided that the supervision plan for the excavation works is submitted and any earth-retaining elements (such as sheet piles) have been satisfactorily installed. These procedures mean that earth-retaining elements may be installed concurrently with the foundation works, thereby allowing excavation works for substructures to be carried out while foundation record plans are being examined and proof tests arranged. Consent for the construction of substructure elements (pile caps, for example) will be given only after satisfactory completion of the required proof tests.

18. The procedures given in paragraph 17 will take effect only when the provisions under the Buildings Ordinance in relation to supervision plans come into operation.



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