THE CONSTRUCTION OF BORED PILES SOCKETED INTO SHALE AND SANDSTONE

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1 INTRODUCTION

Design and construction of socketed bored piles has progressed by the use of research work and field test data to the stage where load capacities considerably greater than those allowed by established code and ordinance design values are now used. Experience has shown that construction aspects are crucial to the design assumptions of these new methods. Without careful supervision, the construction methods adopted tend to follow practice which may be adequate for the established code and ordinance design values but are inadequate for the higher load capacities required by the new methods.

This document commences with design sections covering the basic assumptions relating to construction that are involved with modern design methods. The Draft Specification Clauses (Appendix A) define the quality of workmanship that is required during the construction stage in order for the design assumptions to be valid and for satisfactory load carrying capacity to be achieved. In each particular case the specification writer should review these draft clauses to ensure that they are consistent with the individual project and contract requirements. It is expected that minimal alteration will be required for most cases. The term "engineer" is used for the designer or construction supervision authority and should be altered to Engineer, Engineer's Representative, Superintendent, etc. as appropriate for each particular contract.

A basic prerequisite of modern design methods is that the socket be inspected for cleanliness and sidewall roughness. The high standards of construction associated with achieving the requisite cleanliness and roughness may not be economic in certain projects and in such cases high end bearing and sidewall capacities should not be invoked. The design methods and specification are based on conditions found in the Sydney area. They may, however, be adopted for use in other areas where geological conditions are similar.

Only construction aspects relevant to the design assumptions have been specifically covered by the draft specification clauses; aspects such as setting out, concreting, and reinforcement should also be included as required by each specific project.

2 DESIGN METHODS

Bored piles socketed into sandstone or shale may be designed on the basis of the parameters and methods given in Pells et al (1998), Williams and Pells (1981), Williams et al (1980), Pells and Rowe (1983) and Rowe and Armitage (1989). The sidewalls should be substantially free of crushed and/or smeared rock or soil and the bases free of debris. These methods presume that the major portion of the pile load will be carried by a combination of side shear on the walls of the socket and end bearing on the base of the socket.

Piles may be formed in the dry, or under water using tremie concrete, provided the Engineer is satisfied that satisfactory socket cleanliness has been achieved. Piles formed under drilling mud should not normally be designed using side shear and end bearing parameters applicable for piles formed in the dry or under water. As stated in 3.2, piles formed by methods which preclude inspection of the base and sidewall should not be designed using side shear and end bearing values applicable for piles able to be inspected.

3 INSPECTION

3.1 NEED FOR INSPECTION

Crushed rock or soil smeared on the sidewalls of sockets may attain a thickness of 20mm or more and will form an infill on the grooves and undulations in the rock. The presence of sidewall smear will limit skin friction on the sidewall of the socket such that it may be less than that assumed in the design. Similarly debris (comprising softened

and/or broken and/or crushed rock) on the base of the pile will alter the load deflection characteristics and may result in working load deflections greater than those assumed in the design. Therefore the principal purpose of inspection is to check that sidewall and base cleanliness are within the limits assumed by the design. Inspection must also confirm that the pile is socketed into rock of the quality assumed in the design.

The creation of sidewall smear is usually worst when drilling in moist weathered shale or sandstone using a flight auger. Consequently adequate cleanliness is not usually achieved and special measures must be undertaken to remove the sidewall smear. The problem is usually minimized by drilling under water. Adequate socket sidewall cleanliness and roughness can usually be easily achieved in sockets excavated by hand.

Base cleanliness will depend on the design of the base cleaning tool used. Buckets or flight augers fitted with drag picks do not usually remove sufficient base debris and final cleaning by hand or a special bucket is required. The addition of limited quantities of water during base cleaning operations may assist in achieving an acceptable degree of cleanliness.

3.2 INSPECTION METHODS

Inspection of pile socket cleanliness may be achieved by either descending the pile (by ladder or in a special cage) or be means of a special TV camera (Holden, 1984). Piles of less than 600mm diameter cannot be descended and will therefore require the use of a special TV camera for inspection. There are different Statutory Requirements in various States in regard to safe working practices for descending bored pile holes. In NSW these require the provisions of safety harnesses, breathing apparatus and a crane license to lower personnel (OHSR, 1990). While these requirements discourage the inspection of sockets they in no way preclude such work. Competent piling contractors have the requisite equipment and the work cover requirements do not provide a cause for eliminating inspections.

Piles that cannot be inspected for cleanliness should not be designed on the basis of the parameters and methods set out in the references.

4 SITE INVESTIGATION AND PROVING

The design methods require site investigation by cored boreholes, strength testing of the cored rock and proving of individual foundation locations. Conditions encountered on site should be checked to ensure that the design assumptions are valid. It is noted that in some cases information necessary for design may not be adequate for construction supervision, inspection and approval purposes, thus necessitating further investigation or proving during construction.

5 CONTRACT REQUIREMENTS

The contract documents must include a Specification that will ensure the piles are constructed to at least the degree of cleanliness assumed by the design method. The Draft Specification Clauses given with this paper are intended to form a guide that should be rewritten to include all the necessary features of the particular design and contract.

6 PILE CONSTRUCTION AND INSPECTION

Inspection of completed sockets should be undertaken or supervised by appropriately experienced and qualified geotechnical personnel or their delegated representative. The assessment may be done on the basis of knowledge from nearby cored boreholes or by means of cored or percussion holes drilled in the base of the socket.

The person inspecting and approving the piles should be employed by the Principal (not the contractor). This ensures there is no contractual relationship between the contractor and the person to avoid a potential conflict of interest and to ensure construction is in accordance with the design.

Documentation covering the inspection of the piles should include the items required to be reported (Clause A6.2) and should only certify that the inspections were carried out and that the resulting piles are considered to have been constructed in accordance with the design assumptions and accepted practice.

It is to be noted that the placement of concrete under water is a specialist operation and all Contractors who perform such work should have proven experience in this field and be supervised by persons on the job who are familiar with such work. The contract documents may therefore need some special clauses in this regard.

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