

AGS (HK)
Book Prize Report Submission on
Ground Forum on Bored Pile Interfaces

Name: Leung Cheuk Wah Jeannie

**Company: Geotechnical Engineering Office,
Civil Engineering Department**

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**AGS (HK)- Book Prize Report Submission on
Ground Forum on Bored Pile Interfaces
by
Dr. Jack Pappin, Mr. Arthur So, Dr. Andy Pickles**

Submitted by: Jeannie Leung

Introduction

On 16th September, the Association of Geotechnical and Geoenvironmental Specialists (AGS) – Hong Kong, organized a ground forum on bored pile interfaces. The ground forum consisted of several short presentations given by Dr. Jack Pappin, Mr. Arthur So, and Dr. Andy Pickles which were followed by an open forum for discussion amongst the participants. This report consists of a summary of the findings presented and the proposed improvements from the speakers.

Issues related to bored pile interfaces

In Hong Kong, bored piles are frequently adopted as the foundation for high-rise buildings and other major structures. Post-construction drilling is required to prove that the concrete/rock interface of the bored piles is acceptable, in accordance with the recommendations given in the Practice Note for Authorized Persons and Registered Structural Engineers (PNAP) No. 66. However, problems such as unbound aggregates or core loss are often identified in the proof drilling, requiring analysis on their effects on the pile performance and thereby any necessary remedial measures to rectify the defects. There arises a need to review the incidents at the pile toe interface and assess the pile behaviour to better facilitate bored pile construction.

Case History Review (by Dr. Jack Pappin)

In the first presentation, Dr. Jack Pappin reviewed the findings of a case history review on 5 projects involving interface (proof) coring for 263 nos. of piles. About 40% of all the piles were found to have problems such as unbound concrete aggregate and soil inclusions. As part of the study, oedometer tests were carried out at normal stresses up to 15MPa for typical soil inclusion materials including decomposed granite and volcanics and 10mm unbound concrete aggregates to portray their stress-strain behaviour. Finite element modelling of pile toes having interface soil inclusions were also conducted. The findings of the study indicated that a material thickness of 100mm at the interface can generally be tolerated to control the differential settlement to be within 1/500. Also, if the soil inclusion thickness is not uniform, as long as 1/25 of the pile area is in direct contact with rock and the inclusion material is only up to 300mm thick, the pile behaviour is acceptable. In other words, when soil inclusion is identified in the interface core, if another drilled core has an intact interface, the pile does not require any remedial actions.

Bored Pile Interface – A Contractor’s Viewpoint (by Mr. Arthur So)

In the second presentation, Mr. Arthur So presented his viewpoint on practical construction techniques to minimize the occurrence of problems at bored pile interface and some enhancement methods and recommendations for further improvement of interface quality. Firstly, he discussed some possible causes for the occurrence of unbound aggregates and soil inclusion at the pile interface. Then, he went on to discuss some typical treatment methods, including sinking investigation holes to locate the extent of the defects and afterwards cleaning with water and filling with grout. Verification holes were sunk thereafter to prove the effectiveness of the treatment method. This approach is technically feasible, but it is also very time-consuming and costly. The above treatment procedures conducted on a 60m long bored pile in one of Mr. So’s projects required an additional 128 days and one million dollars on the investigation holes only. Therefore, Mr. So made some queries on the current practice and suggestions for improvement. He also proposed the use of additional grout tubes to serve as a reserve for any future investigation or verification cores in order to save time and cost.

Pile Interface Coring – An Alternative View (by Dr. Andy Pickles)

Dr. Andy Pickles provided an alternative view on pile interface coring by introducing potential problems with the interpretation of interface drilling results and also discussed the design issues of end-bearing bored piles. To illustrate a potential problem in the interpretation of interface cores, Dr. Pickles conducted an experiment in which an interface core using a double barrel (with water) and another one using a triple barrel (with polymer) were sunk in the same bored pile. The inferred inclusion material is completely decomposed granite and highly decomposed granite respectively. Therefore, the experiment indicated that the quality of rock core retrieved is highly dependent on the drilling method. On this basis, Dr. Pickles urged practitioners to employ a high quality of drilling to avoid problems arising from the interpretation of badly retrieved cores.

Dr. Pickles then went on to discuss the over-conservative design approach commonly adopted in the determination of bearing capacity of end-bearing piles. He also mentioned that the assumption of horizontal jointing is not realistic. Instead, inclined jointing are always observed in the ground and contributes to a sloping rockhead across the diameter of a pile. Finally, Dr. Pickles gave a verdict that the use of interface core as post-construction proof drilling is not giving us value-for-money as a large proportion of the interface cores are non-compliant and incur additional cost and time. He proposed to either minimize the requirement on proof drilling and maintain the 5MPa bearing capacity, or alternatively, keep the 100% interface coring but double the bearing capacity to 10MPa.

Conclusion

In this ground forum, valuable experience from the speakers were shared with the audience, ranging from case histories to the design and construction aspects of interface problems in bored pile construction. A question-and-answer session was followed by the

presentations. A question was addressed to the speakers as to whether we should abandon the proof coring requirement altogether as the interpretation results of the cores do not seem reliable according to the presentations. The speakers then responded that the quality of interface cores should be assured by minimizing the sample disturbance with the use of high-quality drilling methods as appropriate, such as triple barrel with polymer. Otherwise, poor-quality cores from which no reliable interpretation can be obtained would be completely meaningless and a waste of money. Many other questions addressing the interpretation of interface cores and possible improvements for the poor interfaces were also raised and discussed.

In conclusion, this ground forum served as a good chance for both the experienced and young engineers to better understand these recurrent problems and discuss constructive improvements for bored pile construction in the future.