Summary of Decisions of the Structural Engineering Committee
SEC 5/2005 held on 13.12.2005

(a) Case 8/2005

Issue: Proposed use of glass fiber reinforced polymer (GFRP) bars as reinforcement in reinforced concrete structures.

Recommendation: To accept the use of GFRP bars (25mm and 32mm in diameter) as reinforcement for the reinforced concrete diaphragm wall at launching positions of tunnel boring machine.

Decision: Noting the background information provided, members endorsed the recommendation subject to satisfactory verification of the following conditions: -

i) The strength, integrity and limitations on internal radii of bends of the GFRP bars as shear links shall comply with its designed standard – "Guide for the Design and Construction of Concrete Reinforced with FRP bars ACI 440.1R-03".

ii) The performance of the parent concrete structure shall be justified for the effect of compressive forces existed in the GFRP rebars during the temporary stage such as the bursting effect of the rebars under compression; and the effect due to the remnants of GFRP bars in the lapping positions in the long-term.

iii) The handling stress induced in the GFRP bars when the reinforcement cage of the diaphragm wall is being lifted and transported from the fixing yard shall not adversely affect the structural integrity of the GFRP bars

iv) Qualified site supervision, including the storage and fabrication of the GFRP rebars and the construction of the associated foundation works should be provided by the Registered Structural Engineer and Registered Specialist Contractor, as specified in Practice Note for Authorized Persons and Registered Structural Engineers 242.

Attachment: PNAP 242

Quality Supervision Requirements for Foundation Works

Introduction

As the design and construction of buildings become more complex, it is necessary to exercise closer supervision during construction to ensure quality of the building works. Buildings Ordinance (BO) section 17 provides that the Building Authority may impose condition when approval of plans or consent to commence building works is given, to require qualified supervision to be provided. PNAP 131 explains in general the requirements for such qualified supervision.

2. The foundation of a building is a fundamental structural element which supports the whole building. Moreover as the foundation, when constructed, is buried in the ground, its built quality is not readily visible. In view of the above considerations, there is a need to enhance the supervision of foundation works during construction and the testing of the completed works in order to ensure that the quality of the foundation works is up to standard. This practice note promulgates the quality supervision requirements at various stages of foundation works which I may impose as condition of approval and/or consent under BO s17. The requirements on testing of foundation works are given in PNAP 66.

Principles of Quality Supervision

3. When imposing conditions under BO s17 for quality supervision, the principles described in para. 4 to 7 below will be followed.

4. In accordance with Building (Administration) Regulation (B(A)R) 37(1) and (2), the Authorized Person (AP) and Registered Structural Engineer (RSE) should each give such periodic supervision and make such inspections as may be necessary for building works. For such purpose, they should each have a team of supervisors to inspect the works at a specified frequency and supervise the carrying out of a specified percentage of the works. The AP, RSE and their team of supervisors should all be respectively accountable under the BO for the quality of building works but in accordance with their respective responsibilities as specified. The AP and RSE may delegate their respective specified supervision responsibilities to another AP/RSE.

5. As the AP and RSE have overall responsibility for the works, they should personally inspect and supervise the works at such frequency and extent as they consider appropriate in the circumstances of each case.

/6……

6. The Registered General Building Contractor (RGBC) and Registered Specialist Contractor (RSC), represented by their Authorized Signatories (AS), should have a similar system of supervision as that of the AP and RSE above, but they should give continuous supervision in accordance with B(A)R 41(1). Even if some of the building works are carried out by its sub-contractors, it remains the responsibility of the RGBC/RSC to ensure that the building works and continuous supervision are properly done in accordance with the provisions of the BO and the system of supervision described above.

7. Inspection records should be kept for each member of the supervision team who should report any non-conformities to the AP, RSE or AS, as the case may be. The recommended communication and reporting system for quality supervision is at Appendix A.

App. A

Quality Supervision Requirements for Foundation Works

8. Paragraphs 9 to 13 below set out the usual quality supervision requirements which will be imposed under BO s17 as conditions for qualified supervision of foundation works. It should be noted that this is in addition to the site safety supervision required under the Technical Memorandum for Supervision Plans and the relevant provisions of the BO (e.g. s16(3)(bc).

9. Quality supervision of foundation works should be provided by the RSE and his senior and junior site supervisors, as well as by the AS of the RSC and his senior and junior site supervisors. However, the project RSE may nominate another RSE within his organization to carry out the supervision on his behalf. Depending on the nature of the various stages of foundation works, site supervisors should either be full-time on site or inspect certain percentage of the works. For any foundation works, one Assistant Engineer under RSE and one Construction Supervisor under RSC are required to be resident full-time, on site during the relevant stages of the works, for every, or any part thereof:

(a) 30 large diameter bored piles/barrette piles;

(b) 150 socketted H-piles; and

(c) 300 mini-piles/driven piles.

10. The extent of quality supervision required for different stages of foundation works are shown at Appendix B. Actual supervision requirements will be imposed at plan approval and consent stage on a case-by-case basis depending on the scale and complexity of the foundation works.

App. B

/Minimum……

Minimum Qualification and Experience Required for Site Supervisors for Foundation Works

11. The senior supervisor of the RSE, the Senior Engineer, should be at least a registered professional engineer of civil, structural or geotechnical discipline with 5 years relevant working experience, whereas the junior supervisor, the Assistant Engineer, should be at least a degree holder in civil, structural or geotechnical engineering with 2 years relevant working experience or a holder of Higher Certificate or Higher Diploma in civil, structural or geotechnical engineering with 4 years relevant working experience.

12. The senior supervisor of the RSC, the Construction Engineer, should be at least a holder of a recognized degree in building (except for piling works) or civil/structural/ geotechnical engineering with 5 years relevant working experience. The junior supervisor, the Construction Supervisor, should be either a holder of Higher Certificate or Higher Diploma in building (except for piling works) or civil/structural/geotechnical engineering with 3 years relevant working experience or a holder of Certificate or Diploma in the same subjects with 5 years relevant working experience.

13. A person without the required academic qualification but with 10 years relevant working experience may also be accepted as the Construction Supervisor. However, he is required to attend top-up training courses on foundation works. The arrangement for these courses will be made in liaison with the local training institutes e.g. Construction Industry Training Authority or Vocational Training Council.

Quality Supervision Plan for Foundation Works

14. For the purpose of complying with the imposed condition for quality supervision of foundation works, the RSE and RSC should jointly submit a quality supervision plan, specifying the name of the supervisors appointed and frequency of inspection and/or extent of supervision, and carry out inspections and supervisions in accordance with the plan. The plan should be submitted prior to or at the time of submission of Form BA10. However no prior approval of the supervisory personnel is required before commencement of the works. The RSE/RSC are responsible to ensure that their supervisors satisfy the qualification and experience requirements specified in para. 11 to 13 above, and should notify the BA of any subsequent changes of supervisors. The plan should be kept on site for inspection by BD staff when required.

15. The quality supervision plan for foundation works should be in the form as App. C Appendix C.

/**Commencement**……

Commencement of Quality Supervision Requirements for Foundation Works

16. The quality supervision requirements specified in paragraph 9 to 13 above will be imposed as conditions of consent to commence foundation works, under BO s17, for applications for consent or renewal of consent submitted on or after 15 August 2000.

(C M LEUNG)
Building Authority

Ref. : BD GP/BORD/65

First Issue June 2000 (AD/LM)

Index under : BO s17 - Quality Supervision Requirements for Foundation Works
Quality Supervision
Supervision - Foundation Works

Appendix A
(PNAP 242)

Communication and Reporting System for Quality Supervision

Communication

1. Quality supervisors of the AP, RSE, RGBC or RSC stream should have effective communications to ensure the proper carrying out of building works to the required standards and quality.

2. Quality supervisors should take all reasonable and practical steps to inform in good time the heads of their respective stream and their counterparts of any aspect of the works which gives rise to concern and which may affect the quality of the whole or part of the building works.

3. An example of the communication channels is shown in Figure 1 attached.

Reports

4. There are two types of inspection reports:
   (i) Routine Inspection Reports; and
   (ii) Non-conformity Reports.

5. Routine inspection reports should be made by all quality supervisors immediately after inspections have been made. These reports should be properly filed and maintained on sites for inspection by representatives of the Building Authority (BA).

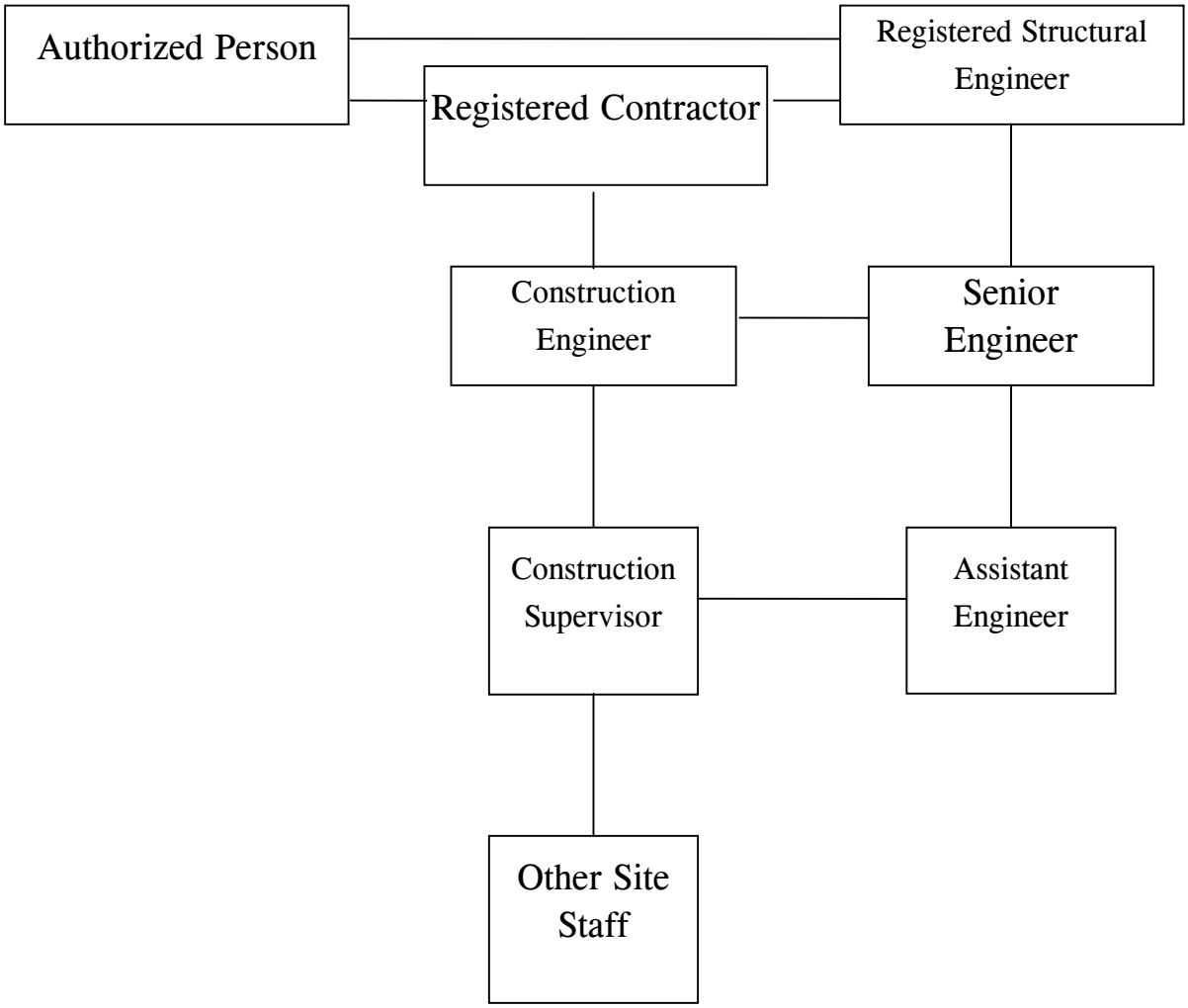
6. If a non-conformity arises and comes to the attention of a quality supervisor, the following procedures should be followed:
   (i) The Junior Supervisor informs the Senior Supervisor of his own functional stream who will in turn inform the AP, RSE and the Contractor of the non-conformity;
   (ii) AP/RSE issues Instruction to the Contractor to rectify the non-conformity;
   (iii) AP/RSE or his Senior Supervisor will ensure that the rectification works are completed promptly and satisfactorily;
   (iv) AP/RSE certifies the completion of the rectification works; and
   (v) Records of the non-conformity and rectification works are to be properly filed and maintained on site.

7. For non-conformities which are not rectified by the contractor, the AP should report to the BA.

Appendix A
(PNAP 242)

Figure 1

Example of Quality Supervision Management Structure and Communication Channels



Appendix B
(PNAP 242)

Quality Supervision for Foundation Works

Stages of Building Works	Objective for Supervision	Supervision to be provided by	
		RSE*	RSC
(a) Driven piles			
(i) Setting out of piles	To check that the locations of piles agreed with approved plan.	J FT S AN RSE AN	J FT S AN AS AN
(ii) Driving Test	To check that design assumptions agreed with actual site conditions.	J FT S All test piles RSE 1st pile	J FT S All test piles AS 1st pile
(iii) Driving of piles	To check that the accepted working procedures are followed and anomalies rectified.	J FT S AN RSE AN	J FT S 10% AS 4%
(iv) Splicing of piles	To check the accuracy of design details.	J FT S 5% RSE AN	J FT S 10% AS 4%
(v) Final sets	To check that the required final set has been achieved and the capacity of each pile complied with approved plan.	J 100% S 10% RSE 4 piles (for less than 200 piles) 6 piles (for 200 to 500 piles) 8 piles (for more than 500 piles)	J FT S 10% AS 4%
(vi) Proof test (Verification on the performance of the as-constructed piles by the imposition of test load)	To check that the testing procedures and acceptance criteria are in accordance with PNAP 66 and measurements are properly recorded during the test.	J FT S 100% RSE min 1 pile	J FT S 100% AS min 1 pile

Legend : Under RSE J = Assistant Engineer, S = Senior Engineer
Contractor J = Construction Supervisor, S = Construction Engineer AS = Authorized signatory
FT = Full Time on site during the relevant stages of the works
AN = As necessary
% = percentage of the works to be supervised
* = The project RSE may nominate another RSE within his organization to carry out the supervision as necessary.
# = These works are required to be carried out by RSC-Ground Investigation Field Works (PNAP 132 refers).

Notes : 1. The roles of the site supervisors within the RSE or the RSC stream may be combined provided that the prescribed qualifications and experience requirements are satisfied.
2. For complex foundation works, the Building Authority may impose condition to require more inspections to be carried out by the RSE, RSC and their site supervisors.

Stages of Building Works	Objective for Supervision	Supervision to be provided by	
		RSE*	RSC
(b) Large Diameter Bored Piles, Barrette Piles and the like			
(i) Setting out of piles	To check that the locations of piles agreed with approved plan.	J FT S AN RSE AN	J FT S AN AS AN
(ii) Pre-drilling# (To determine the proposed founding levels of piles)	To supervise the drilling operation; the logging of soil/rock samples, and to measure the depth of drill holes. To ensure the retrieved samples are not tampered.	J FT S 10% RSE AN	J FT S 20% AS AN
(iii) Verification of founding stratum	To measure the depth of excavation and check the quality of retrieved materials at the founding stratum.	J FT S 100% RSE 2 piles	J FT S 100% AS 4%
(iv) Installation of piles (Grouting operation when required)	To check that proper working procedure are followed and anomalies rectified. To check the correct grout mix, grout pressure and grout volume are being used and the adjacent building structures are not adversely affected.	J FT S 10% RSE AN	J FT S 10% AS AN
(v) Preparation of pile base	To ensure pile base is clean.	J FT S 10% RSE AN	J FT S 10% AS 4%
(vi) Fabrication & installation of rebar cage and placing of concrete	To check that sufficient and correct amount of rebars are provided and proper concreting method is used.	J FT S 10% RSE AN	J FT S 10% AS AN
(vii) Interface core-drilling#	To check that the quality of concrete and foundation rock conform with that specified in the approved plan and that concrete and rock are in good contact at the interface.	J 100% S 10% RSE 2 piles	J 100% S 10% AS 4%

Stages of Building Works	Objective for Supervision	Supervision to be provided by	
		RSE*	**RSC**
(viii) Proof test# (Verification on the performance of the as-constructed piles)	To supervise the drilling operation and the logging of concrete/rock samples and to measure the depth of drill hole. To ensure the retrieved samples are securely stored and delivered to laboratory for testing.	J 100% S 100% RSE min 1 pile	J 100% S 100% AS min 1 pile
(c) <u>Mini-piles, Socketted H-piles and the like</u> (i) Setting out of piles	To check that the locations of piles agreed with approved plan.	J FT S AN RSE AN	J FT S AN AS AN
(ii) Pre-drilling# (To determine the proposed founding levels of piles)	To supervise the drilling operation; the logging of soil/rock samples, and to measure the depth of drill holes. To ensure the retrieved samples are not tampered.	J FT S 10% RSE AN	J FT S 20% AS AN
(iii) Verification of founding stratum	To measure the depth of excavation and check the quality of retrieved materials at the founding stratum.	J FT S 100% RSE 2 piles	J FT S 100% AS 4%
(iv) Installation of piles (Grouting operation when required)	To check that proper working procedure are followed and anomalies rectified. To check the correct grout mix, grout pressure and grout volume are being used and the adjacent building structures are not adversely affected.	J FT S 10% RSE AN	J FT S 10% AS AN
(v) Installation of rebar and grouting	To check that sufficient and correct amount of rebars are provided and proper grouting method is used.	J FT S 10% RSE AN	J FT S 10% AS AN

Stages of Building Works	Objective for Supervision	Supervision to be provided by	
		RSE*	**RSC**
(vi) Proof test (Verification on the performance of the as-constructed piles by the imposition of test load)	To check that the testing procedure and acceptance criteria are in accordance with PNAP 66 and measurements are properly recorded during the test.	J 100% S 100% RSE min 1 pile	J 100% S 100% AS min 1 pile
(vii) Post-installation borehole drilling#	To verify the rockhead profile and socket length of piles.	J FT S 100% RSE AN	J FT S 100% AS AN
(d) <u>Rafts and Spread Footings</u>			
(i) Setting out of rafts and spread footings	To check that the locations and sizes of footings agreed with approved plan.	J FT S AN RSE AN	J FT S AN AS AN
(ii) Inspection of bearing stratum	To check the compliance of ground bearing stratum with approved plans, site investigation reports and design assumptions.	J 100% S 10% RSE AN	J FT S 100% AS 4%
(iii) Fixing of rebars and checking of concrete covers	To check that sufficient amount of rebars and good workmanship are provided.	J FT S 10% RSE AN	J FT S 10% AS AN
(iv) Placing, compaction and curing of concrete	To ensure the quality and workmanship of concrete works.	J FT S 10% RSE AN	J FT S 10% AS AN
(v) Plate loading test (where required) (To verify the adequacy of ground bearing stratum)	To check that the accepted testing procedure are followed and measurements are correctly recorded.	J FT S 100% RSE min 1 test	J FT S 100% AS min 1 test

Appendix C
(PNAP 242)

BUILDINGS ORDINANCE
(Chapter 123)

Quality Supervision Plan for Foundation Works

Jointly By Registered Structural Engineer and Registered Specialist Contractor

Date : _____

To the Building Authority,

Having considered the details of the foundation plans approved on _____ (DD/MM/YY), and in accordance with the conditions of approval imposed in your letter of _____(DD/MM/YY) and conditions of consent imposed in your letter of_____ (DD/MM/YY), we submit the quality supervision plan for the _____ _____ works at the site located at (address of site) _____ _____on (Lot No.)_____.

2. The site supervisors under the Registered Structural Engineer (RSE) and Registered Specialist Contractor (RSC) streams required for the above foundation works are :

Site Supervisors	**Name in English**	**Name in Chinese**	**I.D. No.**	**Inspections to be carried out**
RSE Stream				See Appendix I
Registered Structural Engineer				
Assistant Engineer				
Senior Engineer				
RSC Stream				
Authorized Signatory				
Construction Supervisor				
Construction Engineer				

3. The CVs of the site supervisors showing their relevant experience and academic qualifications are attached at Appendix II.

/4. …..

4. The management and execution of quality supervision of the foundation works covered by this supervision plan are to be carried out in the manner prescribed by the provisions of the Buildings Ordinance and Regulations.

5. I, the Registered Structural Engineer (name in full)_____ (Chinese) _____, certify that this Quality Supervision Plan is prepared by me in conjunction with the RSC. I shall provide the supervisors for quality supervision under me and I and my supervisors shall carry out the supervision duties in accordance with this supervision plan and in compliance with the provisions of the Buildings Ordinance and Regulations.

Certificate of Registration No. : _____

Date of expiry of registration : _____

Signature : _____

6. I, the person appointed to act for */the Registered Specialist Contractor (name of AS in full)_____ (Chinese) _____, certify that this Quality Supervision Plan is prepared by me in conjunction with the RSE. I shall provide the supervisors for quality supervision under me and I and my supervisors shall carry out the supervision duties in accordance with this supervision plan and in compliance with the provisions of the Buildings Ordinance and Regulations.

Name of Registered Specialist Contractor : _____

Certificate of Registration No. : _____

Date of expiry of registration : _____

Signature : _____