

Chapter V Incident No. 1 - Shatin Area 14B Phase 2

Introduction

5.1 Shatin Area 14B is situated in Yuen Chau Kok (YCK) area in the eastern part of Shatin New Town. The site was placed under a fast-track programme by HA for HOS flat production to be completed in five phases by March 2001. The layout of the site is in **Appendix V(1)**. Phase 2 comprised five residential blocks and one car-park building with ancillary facilities. The term "YCK" in this Report stands for the development in Shatin Area 14B Phase 2 only.

5.2 YCK was a HD in-house project. The Piling Contract commenced on 10 February 1998 and was completed on 19 December 1998. A chronology of important activities of the project is in **Appendix V(2)**.

5.3 In the course of a comprehensive building settlement monitoring exercise for all HA construction sites initiated by HA in mid-1999, settlement problem was discovered at two domestic blocks in YCK, namely Blocks D and E. In December 1999, HA appointed C M Wong & Associates Ltd. (CMW) to carry out an independent investigation into the adequacy of the as-built bored pile foundation of Blocks D and E. According to the findings of the investigation, of the 18 Large Diameter Bored Piles (LDBPs) in each block, only three piles in Block D and one pile in Block E complied with the Contract Specification. Three piles in Block D and six piles in Block E were shorter than the respective reported lengths by more than 10 m. 10 piles in Block D and 16 piles in Block E were not founded on bedrock. On 16 March 2000, HA announced that the two blocks which were then constructed up to the 34th floor would be demolished for safety reasons.

5.4 Two directors and the site agent of the piling subcontractor were charged with conspiracy to defraud on 8 January 2001. On 3 September 2002, the two directors were convicted and sentenced to 12 years' imprisonment. They have appealed against both conviction and sentence and the appeals were

pending as at the date of this report. The site agent pleaded guilty on 11 October 2001 and was sentenced to 3½ years' imprisonment.

5.5 Based on the evidence obtained by the Select Committee, this Chapter describes the ways in which the YCK project proceeded, identifies the problems of the YCK project and analyzes the roles of different parties concerned. Since problems were found only in Blocks D and E, the Select Committee has focused its attention on the construction of these two Blocks.

Management of the project

Contract Team

5.6 Like other in-house piling projects of HD, a contract team comprising HD staff was responsible for all stages of work, including planning and design, preparation of tender documents and contract administration. The Contract Team was headed by a CSE nominated by the Project Director/Works (PD/W) as the Contract Manager (CM). CM was supported by a senior structural engineer (SSE) as Assistant Contract Manager (ACM) and a structural engineer as Project Structural Engineer (PSE) and Contract Manager's Representative (CM's Rep). Where geotechnical matters were concerned, the Contract Team would seek advice from the geotechnical engineer (GE) designated for the project. During the relevant period, Mr David LEE Sai-cheung was PD/W. Mr HO Shu-kee and Mr Richard LIU Ping-man were CM/YCK and PSE/YCK respectively throughout the project. Mr R.P. PANKHANIA was the ACM (ACM1/YCK) until 30 May 1998 and was succeeded by Mr Francis WONG Chi-chiu, ACM2/YCK, who occupied the post until the end of the Contract. The GEs designated for the project were successively Mr Sammy CHEUNG Ping-yip (GE1/YCK) and Mr Ralph CHUN Yiu-man (GE2/YCK).

5.7 Although YCK was an in-house project, quantity surveying was outsourced to a consultant, Davis Langdon & Seah Hong Kong Limited which assigned Miss Cynthia SZETO Kit-fong as the Project Quantity Surveyor (PQS/YCK).

Site staff

5.8 Site inspection was carried out by HD's site staff. The site team for the YCK project comprised a Project Clerk of Works (PCOW), an ACW and a WS. Mr CHAN Kui-chiu was PCOW/YCK from commencement of the project until 29 July 1998. From 30 July 1998 onwards, Mr LI Kwok-sing, who was the ACW (ACW1/YCK) originally, became the PCOW. Mr WONG Kai-wah assumed the post of ACW (ACW2/YCK) on 1 September 1998. Mr TANG Siu-tat and Mr SIT Man-wai were WSI/YCK and WSII/YCK respectively during different periods of the project. Except for the month of August 1998 when ACW1/YCK took up the post of PCOW and ACW2/YCK had yet to assume duty, the site staff for the YCK project comprised one PCOW, one ACW and one WS.

5.9 The organization chart of the key personnel of the Contract Team and the site inspection staff of HD for the YCK project is in **Appendix V(3)**.

Planning and design

Layout of the development

5.10 According to the client brief submitted to BC for consideration on 19 December 1996, the YCK project originally comprised two 41-storey Concord I Blocks (Blocks D and E) and two 37-storey Concord I Blocks on a 3-storey car-park podium. In order to provide an efficient car-park and to shorten the construction time, HD proposed to replace the two 37-storey Concord I Blocks on a car-park podium with three 33-storey Concord II Blocks (Blocks F, G and H) and one independent 4-storey car-park building with ancillary facilities. The change of design sought to advance the completion date of the whole development from August 2001 to March 2001. The proposed change was discussed by BC on 19 December 1996 and was approved on 20 October 1997 by way of a "presumption paper".

Ground conditions of the Yuen Chau Kok site

5.11 The YCK site was formed by reclaiming the foreshore of Shatin Valley to a flat land in the early 1980's. HA commissioned an initial ground investigation on Shatin Area 14B in April 1996. In December 1996, another ground investigation was conducted specifically on the YCK site. These ground investigations involved sinking drillholes, obtaining soil and rock samples and carrying out laboratory tests to determine the strength parameters. A total of 61 drillholes were sunk in the two ground investigations, of which 20 lay underneath Blocks D and E.

5.12 Results of the two ground investigations revealed that the YCK site was underlain in succession by fill, marine deposits and in-situ decomposed materials. The bedrock was generally dominated by quartz monzonite with some minor intrusion of granite. The bedrock varied from roughly -35mPD to -63mPD across the site. Bedrock of Grade III or better was generally shallower underneath Blocks D and E, ranging from -35mPD to -48mPD. The bedrock surface was deepest at the centre part of the car-park podium and extended to a depth of -62mPD.

Foundation options recommended in the Foundation Advice Report

5.13 Based on the information obtained from the two ground investigations, GE1/YCK compiled the Foundation Advice Report in July 1997. The Report recommended that driven piles or LDBPs were feasible foundation options for the YCK project. Driven steel H-piles and LDBPs could be used for all the blocks. Large displacement driven piles, i.e. precast prestressed concrete (PPC) piles, would be feasible for Blocks D and E only. If LDBPs were to be adopted, they should be founded on good quality quartz monzonite and predrilling at each bored pile location should be carried out to verify the design bearing capacity and to determine the founding level of the bored piles. Predrilling holes should penetrate the bedrock to a minimum of 5 m or to a depth equivalent to three times the diameter of the pile, whichever was the deeper. The Report also advised that permanent lining of at least 1 m should be installed into the in-situ material to reduce the risk of cave-in of the pile shaft and necking of the piles within the soft and loose transported deposits

strata. The bored pile foundation for Blocks D and E was expected to range from -34mPD to -45mPD.

Tendering

Project estimate via-a-vis pre-tender estimate

5.14 Based on the design parameters provided by PSE/YCK, PQS/YCK worked out the pre-tender estimates for the project. In the pre-tender letter dated 11 October 1997 from PSE/YCK to PQS/YCK, PSE/YCK advised that steel H-piles could be used for the estimates for all the blocks; LDBPs could be used for all the blocks except the car-park building; and PPC piles could be used for Block D only. The estimated pile lengths of LDBPs for Blocks D and E were 43.5 m and 50.5 m respectively. In accordance with these parameters, PSE/YCK provided four combinations of pile foundation to PQS/YCK, who was asked to identify the most economical combination.

5.15 On the same day, PSE/YCK sent another letter to PQS/YCK to revise the estimated pile lengths for the blocks. The letter stated that:

"The net pile lengths are to be calculated from the bottom of the pile caps and thus are adjusted."

The estimated pile lengths of different types of piles for each block were reduced by about 3.5 m. With reference to the revised estimated pile lengths, PQS/YCK worked out the pre-tender estimate.

5.16 On 21 November 1997, PQS/YCK advised PSE/YCK in writing that the pre-tender estimate of the most economical design, i.e. PPC piles for Block D and steel H-piles for all the other blocks, was \$74.661 million. This pre-tender estimate was only about 59% of the project estimate of \$126.557 million approved by BC in July 1997. PQS/YCK explained to the Select Committee that the approved project estimate was worked out on the basis of using PPC piles for Blocks D and E and steel H-piles for other blocks, whereas the pre-tender estimate was calculated on the basis of using PPC piles for

Block D only and steel H-piles for all the other blocks. The difference between the two estimates was also attributable to the prevailing downward trend in pile price.

Assessment and award of tenders

5.17 On 17 October 1997, HD invited tenders from all 27 contractors on the relevant approved lists for the piling works. As YCK was a design-and-build project, tenderers had to design and carry out the piling works in accordance with the Contract Specification. The acceptable pile types listed in the Specification were driven piles including PPC piles, LDBPs and steel H-piles. PPC piles, however, could only be used for Block D. Since the ground conditions of the site were not considered by the Contract Team as particularly complex, there was no pre-tender meeting. When the tender was closed on 28 November 1997, 10 tenders were submitted to HD.

5.18 The proposed tender price and pile types of the three lowest tenders for the five domestic blocks are in Chart 5.1.

Chart 5.1

Tender	Tender price (in million)	Proposed pile type
Lowest	\$63.267 M	LDBP (all blocks)
Second lowest	\$65.438 M	PPC (Block D) and LDBP (other blocks)
Third lowest	\$67.60 M	PPC (Block D) and LDBP (other blocks)

5.19 The proposed tender price of the lowest tender was 15.26% less than the pre-tender estimate of \$74.661 million. However, the Select Committee notes that the lowest proposed tender price should not be compared with the pre-tender estimate as they were based on different pile types. The pre-tender estimate was worked out on the basis of the most economical pile types in the market, i.e. a combination of PPC piles and steel H-piles. But in the lowest tender, a more expensive pile type, i.e. LDBPs, was proposed for all the

domestic blocks. To compare the two prices on the same basis, PQS/YCK advised the Select Committee that the pre-tender estimate would be about \$88 million if LDBPs were used for all five domestic blocks. In other words, the lowest tender price could have been up to about 28.41%, i.e. \$25 million less than a pre-tender estimate calculated on the basis that LDBPs would be used for all the blocks.

5.20 In accounting for the price difference between the pre-tender estimate and the lowest tender sum, PQS/YCK explained to the Select Committee that the piling design parameters proposed by the lowest tenderer were at variance with those anticipated by PSE/YCK. The pile lengths estimated by the lowest tenderer and PSE/YCK were different. The quantity of reinforcement in the lowest tender was 200 tonnes less than the pre-tender estimate. The lower price could also be attributed to the availability of a large number of machinery in the market as the projects related to the Chek Lap Kok Airport were at its final stage at that time. PQS/YCK stressed that the unit cost of the lowest tender was within the price range worked out by her at that time. The cost was on the low side, but not so low as to cause concern on her part.

5.21 The structural engineers in HD also provided similar explanations to the Select Committee. According to them, the price of LDBPs was competitive at that time because of the near completion of the projects related to the Chek Lap Kok Airport and the release of LDBP machinery to the market. They pointed out that resources could be saved if one type rather than two types of piles was used in a project. That perhaps was the reason why the prices of the second and third lowest tenders, albeit proposing the use of less expensive PPC piles for Block D, were higher than that of the lowest tender. The Contract Team, however, did not take any action to ascertain the reason for the low tender price of the lowest tender.

5.22 The three lowest tenders were considered by PQS/YCK to be contractually in order. However, in her tender report, PQS/YCK suggested that PSE/YCK should examine the differences between his design and that of the lowest tenderer. PSE/YCK told the Select Committee that he did examine the latter's design but concluded that there was nothing worth commenting on.

CM/YCK also confirmed that the lowest tender was technically in order. However, the lowest tender price was about 28.41% less than the pre-tender estimate calculated on the same basis that LDBPs would be used. Despite such a great disparity in price, the Contract Team did not enquire about the reasons. The Select Committee considers that the Contract Team did not attach sufficient importance to PQS/YCK's advice to examine the variance in design parameters.

5.23 The lowest tender was submitted by Zen Pacific Civil Contractors Ltd. (Zen). In considering Zen's technical competence for the project, HD took into account the fact that Zen was formerly Shui On Civil Contractors Ltd (Shui On). Shui On changed its name to Zen in April 1997 and remained on HD's list of Approved Contractors for Large Diameter Bored Piling Works for HA works.

5.24 However, according to the Executive Director of Zen, Shui On's experience in LDBP was mainly in civil works and not high-rise buildings. The YCK project was the first works contract entered into by Zen with HA. This information was revealed to the Contract Team in its interview with Zen after the close of tender.

5.25 Zen was recommended for the award of the Contract. The paper recommending the award of the Contract to Zen was approved by BC as a straightforward item without discussion on 15 January 1998.

Subletting

5.26 Clause 3 of the General Conditions of Contract prohibited total assignment of the Contract. Clause 4 provided that unless expressly prohibited by the Contract, the Contractor could sublet part of the works without permission in relation to provision of labour and material or the provision of labour on a piece-work basis. Where provision of constructional plant by subcontractors was concerned, the Contractor should submit a written request to the CM who might disapprove it within 14 days from the date of receipt.

5.27 According to the Executive Director of Zen, after HD had invited Zen to tender, Hui Hon Contractors Ltd. (Hui Hon) approached Zen indicating its interest in the project. According to the verbal enquiries made by Zen, Hui Hon had a good track record of designing and undertaking LDBP foundation works. After assessing Hui Hon's capability, resources, equipment and proposed price, which was about \$2 million lower than the price of another company, Zen entered into a pre-contract agreement with Hui Hon during the tender stage of the YCK project. Under the agreement, Hui Hon was responsible for the design, calculation of the tender price and the construction of pile foundations. Zen was responsible for the procurement of major materials such as concrete, reinforcement, permanent linings, etc. Zen would charge 4% of the total contract price and 3% of the cost of the materials procured as administrative fees.

5.28 Zen informed the Select Committee that HD should not be unaware of the subcontracting to Hui Hon at the outset. In its letter to PSE/YCK dated 16 February 1998 notifying him of the appointment of the quality control engineer (QCE) and the site staff for the project, the résumé of the staff concerned stated that they were employed by Hui Hon. On close examination of the letter, the Select Committee finds that Zen did not explicitly inform PSE/YCK that QCE and the site staff were employed by Hui Hon. The name "Hui Hon" was shown against "Employer" under the heading "Working Experience" in the résumé of the staff concerned. It was marked on the résumé of one of the site staff that Hui Hon was the employer from May 1997 to December 1997. However, the YCK Contract did not commence until 10 February 1998. In any event, the information did not appear to be provided as notification to HD that Hui Hon was the Subcontractor and the employer of the site staff for the project. It may also be useful to note the following. At the initial contract meeting held on 12 February 1998 between the Contract Team and the Contract Manager of Zen, Zen introduced Hui Hon's staff as its staff. The minutes recorded that Zen had been requested by HD to furnish full particulars of subcontractors to be employed for the project, but Zen did not furnish information to HD about subcontracting of the piling works. Nor did it furnish information on subcontracting of constructional plant which was expressly required under Clause 4(2) of the General Conditions of Contract. In addition, the Select Committee notes that in the 11 Main

Contractor's Reports prepared by Zen and attached to the minutes of the site meetings, the word "NA" was shown under the heading "Subcontracting". The Select Committee also notes that all the correspondence between the Site Agent of Hui Hon and PSE/YCK were prepared on papers with the letterhead of Zen.

5.29 Except for PQS/YCK, who told the Select Committee that she had informally learnt about the subcontracting to Hui Hon in the course of casual conversation with the site staff concerned at the later stage of the project, the Contract Team of HD and PCOW/YCK told the Select Committee that they were not aware of the subcontracting arrangement. Some members of the Contract Team considered that the Contractor was obliged under the Contract to inform HD about the subcontracting arrangements. HD staff would not act like detectives to investigate whether subcontracting had been made. The site staff, including ACW1/YCK, ACW2/YCK, WSI/YCK and WSII/YCK, admitted that they knew about Hui Hon's presence on site. Upon questioning as to why they had not drawn the matter to the attention of PSE/YCK, the two WSs/YCK said that they assumed that he should know, as subletting required HD's approval. ACW1/YCK explained that since the staff of Hui Hon denied their employment relationship with Hui Hon, he did not follow up on the issue.

The Contractor's Project Team

The Contractor

5.30 Under the Contract between Zen and HA, Zen was fully responsible for the works of the YCK project. The key employees of Zen involved in the project included a contract manager and a project quantity surveyor. A foreman was also deployed to supervise the works full-time on site for about a month.

The Subcontractor

5.31 Zen subcontracted the construction of pile foundations to Hui Hon. The key site staff employed by Hui Hon included a QCE, a site agent (also the

Site Engineer), an assistant site engineer, a general foreman and a site foreman. Mr Eric LI Wai-hang and Mr Roy LI Chi-him were the Site Agent (SA/YCK) and the Site Foreman respectively. Mr Tommy LEUNG Wah-hing was assigned as QCE/YCK for the project.

5.32 The organization chart showing the key personnel of Zen and Hui Hon responsible for the project is in **Appendix V(4)**.

Construction

5.33 According to the Specification and the method statement submitted by SA/YCK and approved by PSE/YCK, the construction of LDBPs for the YCK project entailed the following major sequential work steps:

- (a) predrilling at the centre of the location of each of the bored piles for establishing the proposed founding level;
- (b) excavating the pile shaft to form foundation for the pile to a minimum of 800 mm deep into bedrock of Grade III or better rock;
- (c) while excavating the pile shaft, driving simultaneously a temporary steel casing of 2500 mm internal diameter down to the bedrock;
- (d) after confirmation of the founding level, enlarging the pile base to form a bell-out so that its side must be at an angle of 60 degrees with its base;
- (e) cleaning the pile shaft until the water pumped from it was clear;
- (f) installing the permanent liner down to the rock socket;

- (g) installing the reinforcement steel cage down to the approved founding level;
- (h) installing four full-length steel sonic logging tubes which must be fixed to the reinforcement cage down to the approved founding level; and
- (i) after cleaning the pile shaft again, concreting it in one continuous operation to above the cut-off level. The temporary casing would be extracted simultaneously in the course of concreting.

The major steps for installing LDBPs are shown in **Appendix V(5)**.

5.34 Inspection procedures on the major steps of the construction of LDBPs were set out in section 12 of the Engineering Division Site Inspection Manual (EI Manual). As problems occurred in the construction of LDBPs in the private sector, a memorandum was issued by HD on 20 May 1998 reminding structural engineers and site staff to be vigilant in site supervision of foundation works using LDBPs. A set of comprehensive supervision guidelines for LDBPs was subsequently issued by PD/W on 10 July 1998 to improve the supervision of the critical foundation processes. The EI Manual was revised in September 1998 to incorporate the supervision guidelines.

Predrilling

Requirements in the Specification

5.35 Specification PIL 1.T210.1 provided that at every LDBP location, before the commencement of excavation, cores of minimum NX size⁹ should be taken to the proposed founding level for a depth of 5000 mm or three times the diameter of the pile into bedrock, whichever was the greater. Specification PRE 9.210C.P stipulated that the carrying out of ground investigation work must be done by a contractor whose name was on the

⁹ NX size is a specialized term used to specify the diameter of the core.

relevant approved list. As predrilling fell within the definition of ground investigation work, the Contract required that predrilling for the YCK project be conducted by a contractor on the approved list.

5.36 The Select Committee was told that Hui Hon approached Chi Shing Drilling Engineering Co Ltd (Chi Shing) about predrilling works. Chi Shing was not on the approved list of contractors but claimed to have extensive predrilling experience. For the compliance of Specification PRE 9.210C.P, Chi Shing agreed with a contractor on the approved list that Chi Shing would use the name of that contractor at a fee of \$1,330 per drillhole while the actual predrilling works were to be carried out by Chi Shing. According to a witness, Hui Hon's directors were fully aware of Chi Shing's position, but he believed that Zen did not.

Bedrock level

5.37 The Director of Chi Shing told the Select Committee that Hui Hon did not provide Chi Shing with the borelog information compiled by HD from the two pre-tender site investigations. Chi Shing conducted predrilling in the normal manner, i.e. coring to the bedrock level for a depth as specified by Hui Hon. The core samples were logged and put together for measurement of their total lengths. Chi Shing billed Hui Hon according to the actual depths of the drillholes.

5.38 According to Chi Shing, sample cores of the specified size were taken at the location of each pile for the five domestic blocks for the YCK project. Its foreman notified the site staff of HD when the pile location was drilled to the rockhead level. The site staff of HD then checked and upon confirmation of the rockhead level, measured the depth of the drillhole by a measuring tape provided by Chi Shing. Rock cores were put immediately into boxes after extraction from the borehole, and the site staff of HD signed on them.

5.39 EI-1201(7) required PCOW to check and record the depths of boreholes. Based on Zen's "Request for inspection of work" forms, of the 36 piles for Blocks D and E, ACW1/YCK inspected the rock samples and the

depths of boreholes in respect of seven piles. Inspections on the remaining 29 piles were conducted by WSs/YCK.

5.40 EI-1201(6) required PE, i.e., PSE, to

"inspect the rock core samples and borelogs to ensure that the bedrock below the pile base is rock as specified."

It also provided that PGE should be called for advice if necessary for rock core inspection. Based on records, joint inspections of the predrilling rock cores were carried out by PSE/YCK and GE2/YCK on 31 March, 2 April and 4 May 1998. GE2/YCK advised PSE/YCK in writing on 20 April and 18 May 1998 that after reviewing the predrilling logs submitted by the Contractor against the records of core inspection on site, he had no comment on the bedrock levels reported by the Contractor in respect of Blocks D, E, F, G and H.

5.41 The pre-tender site investigations indicated that the bedrock level of borehole B158 was -41.52mPD. The predrilling records, however, showed that the bedrock level of the borehole at pile BP2 of Block E, which was only 1 m away from B158, was -36.79mPD. Given a difference of about 5 m in bedrock level in two such close-by boreholes, the Select Committee questioned GE2/YCK as to why he had not raised any query on the predrilling records. GE2/YCK explained that in the first place, he was not aware of the close vicinity of the two boreholes, as he did not have the pile layout plan when he conducted the core inspections. Pre-tender site investigation showed that the bedrock level at B158 was at -35mPD, but as there was a seam at a depth of about -40mPD, the bedrock level was recorded to be at -41.52mPD. The predrilling done by the Contractor was at the centre of the pile location, and as such, its result should more accurately indicate the bedrock level at the location of each individual pile. Nevertheless, since the predrilled borehole was only 1000th of the size of the pile, its result only served to give a rough indication of the founding level of the pile. The bedrock level of each pile could only be confirmed in the course of excavation. In GE2/YCK's view, given the varying ground conditions of the site, he did not consider differences in bedrock levels

as revealed in the pre-tender site investigations and predrilling a cause for concern.

5.42 According to evidence, PSE/YCK was aware of the differences in bedrock levels shown in the pre-tender site investigations and in the predrilling records and had consulted GE2/YCK during one of the core inspections. GE2/YCK's advice was that the phenomenon was not uncommon, and that the important thing was to excavate the pile shaft to ascertain whether there was a localized seam.

5.43 From the invoices submitted by Chi Shing to Hui Hon, the depths drilled by Chi Shing before reaching bedrock were at around 44 m to 46 m for most of the piles at Block D. In the case of Block E, the depths drilled varied, ranging from 37.2 m to 53.67 m before reaching bedrock. The predrilling records submitted by SA/YCK to HD showed that the rockhead levels were at the most -37mPD to -39mPD for Block D and -39mPD to -43mPD for Block E, as compared to -35mPD to -48mPD for Blocks D and E as shown in the pre-tender site investigations. A comparison of the depths drilled by Chi Shing and the predrilling records submitted by Zen to HD in respect of Blocks D and E is in **Appendix V(6)**. The Select Committee has not been able to confirm the exact depth of the rockhead level at each drillhole, as the invoices submitted by Chi Shing to Hui Hon only recorded the depths drilled in metre without reference to mPD.

Founding levels proposed by the Contractor

5.44 Ascertaining the founding levels is the most critical step in the construction of LDBPs. According to record, SA/YCK, based on the drillhole information obtained in predrilling, proposed and sought the approval of PSE/YCK on the tentative founding levels of bored piles at Blocks D and E on 9 April and 27 April 1998 respectively. PSE/YCK in turn sought the advice of GE2/YCK. GE2/YCK responded by memoranda dated 20 April and 18 May 1998. His comments on the proposed founding levels for Blocks D and E in the two memoranda were identical and are set out below:

Paragraph 2 of the memoranda dated 20 April and 18 May 1998

"..... On the basis of the available information, please be advised that **I have no comment** (bold type added) on the contractor's reported levels where insitu weathered materials and Grade III or better bedrock have been encountered."

Paragraph 3 of the memoranda dated 20 April and 18 May 1998

"Apart from the material weathering grade of the underlying bedrock, the founding level of a bored pile will also depend on other factors, which could have been governing factors in the contractor's piling design, such as 45° load spread for adjacent piles, requirement for rock socket length, etc.. As such, **I have no comment** (bold type added) in respect of the founding levels of the bored piles proposed by the contractor."

5.45 The Select Committee notes that the phrase "no comment" appears twice in both memoranda. However, according to GE2/YCK, their meaning was different. His remark of "no comment" in paragraph 2 of the two memoranda meant that he agreed with the contractor's reported in-situ materials and bedrock. However, the same phrase in paragraph 3 of the memoranda meant that he was not in a position to comment. He pointed out that in determining the founding levels, other factors such as load spread for adjacent piles and requirement for rock socket length, etc., as stated in the memoranda, had to be considered too. The phrase "no comment" in the context of paragraph 3 was therefore a qualified statement and could not be taken to mean agreement.

5.46 PSE/YCK indicated at a hearing that he had taken the "no comment" remark in respect of the proposed founding levels as "no objection", and therefore approved the Contractor's proposal. In his subsequent submission to the Select Committee, he supplemented that he had considered other factors mentioned in the memoranda when approving the Contractor's proposal.

Excavation of pile shafts

Method of excavation and installation of temporary casings

5.47 To construct a bored pile, the first step is to excavate a pile shaft down to bedrock level to form the foundation. According to Specification PIL1.W1120.1, temporary casings should be installed for the entire length of the pile shaft to prevent soil from collapsing into the excavated pile shaft.

5.48 In February 1998, Hui Hon proposed to use a hammer grab to excavate the boreholes for installation of the bored piles and to use vibrators to drive down temporary steel casings to bedrock. PSE/YCK approved Hui Hon's proposal to use vibrators because vibrators had been shown to be effective equipment to drive down temporary casings in other projects. However, according to a witness, it was soon found out that owing to deficiency in the driving capacity and the limited numbers of the vibrators, the temporary casings could not be driven down to the proposed founding levels. SA/YCK then called on Hui Hon to provide oscillators with cutting teeth but to no avail. About two months later, a Bauer BG40 boring machine was transferred to the site to excavate the pile shaft. The Select Committee notes that ACM2/YCK and PSE/YCK were both aware that the BG machine was used for excavation and accepted the arrangement.

5.49 Given the greater capacity of the BG machine, it appears that excavation could be done at a faster pace. The Select Committee, however, was told by a witness that the BG40 could not achieve its full capacity because of the lack of adequate and suitable accessories. The problem was aggravated by insufficient temporary casings for the purpose and great difficulty in withdrawing the installed temporary casings during concreting due to suction of soil. According to a witness, on one or two occasions, the withdrawal process took a few days to complete. As a result, although some of the pile shafts might have been excavated to the proposed founding levels, Hui Hon did not install the temporary casings down to the excavated levels of most of the pile shafts.

5.50 Notwithstanding the importance of installing temporary casings in the construction process, the Select Committee notes the absence of requirements in the EI Manual concerning measurement of the lengths of temporary casings. EI-1202(3) only required PCOW to inspect that the casings were kept in advance of the pile excavation to prevent soil from collapsing into the excavated shaft. The Select Committee was told that PSE/YCK did not require the site staff to measure the temporary casings, because there was no such requirement in the manual. When responding to questions at the hearing, PSE/YCK did not seem to be aware of the requirement in the Specification in this regard. According to ACW1/YCK, PSE/YCK said that the Contractor might not agree to the checking of the temporary casings, because it would delay the works progress. This was denied by PSE/YCK who, after the hearing, provided to the Select Committee a piling record which shows that the casing length had been checked by PCOW/YCK. Notwithstanding the piling record, ACW1/YCK, to whom PCOW/YCK delegated the inspection duties, admitted to the Select Committee that he had not checked the temporary casings. The Select Committee therefore doubts whether the casing length of each and every pile had been properly checked by the site staff. Had the checking been done properly, the failure to install casings down to the founding or excavated levels should have been found out.

Use of Supermud

5.51 The Select Committee notes from the Strickland Report that Supermud was used in place of temporary casings in the YCK project, and has therefore examined why Supermud was used and why it escaped the attention of HD staff concerned. From the evidence given by various witnesses, Supermud was considered to be able to achieve the same effect of bentonite¹⁰, which was used for exceedingly deep shaft where installation of temporary casings to the base was not possible. According to witnesses, temporary casings were not installed to the entire length of some of the piles in YCK, with

¹⁰ In the construction of LDBPs, difficulty may be encountered in the installation and retrieval of the temporary casing due to the great depth of the pile. Under such circumstances, bentonite slurry, namely a mix prepared from bentonite powder and potable water, may be used to maintain the stability of the lower portion of the pile shaft excavation. It will displace water inside the pile shaft and provide support for further excavation beyond the lower end of the casing until concreting.

a shortage of 5 m to 25 m for a pile. The directors of Hui Hon allegedly instructed that Supermud, which was cheaper than bentonite, be used for the purpose of stabilizing the excavated walls below the temporary casings. Three witnesses claimed that Supermud had been used. The Select Committee was told that by mixing Supermud with water during excavation, Hui Hon hoped that the material would support the excavated walls and prevent them from collapsing. A witness said that many buckets of Supermud, with a capacity of four gallons each, had been used.

5.52 The Select Committee has queried how the large quantity of Supermud could have been used without being noticed by the site staff of HD. Both PCOW/YCK and the Contract Team stated that they did not know Supermud had been used at the site. ACW1/YCK said that he had neither seen the storage nor the use of Supermud at the site. He only noticed that the water at the pile shaft was milky in colour, which in his view should be yellowish. He was then told by the site staff of the Contractor that this was due to the addition of a lubricant on BG40. He claimed to have brought the matter to the attention of PSE/YCK, who nevertheless did not respond. PSE/YCK denied that he had ever been informed.

5.53 However, evidence from some witnesses indicates that Supermud was delivered to the site in batches and stored in the containers on site. Both WSs/YCK of HD had seen the material at site. One WS/YCK had asked the Contractor's site staff about the purpose of the material and was told that it was for excavation. The other WS/YCK said that he saw buckets of Supermud placed outside HD's site office, and he was told by the Site Foreman of the Contractor that the material had been used on the site long before he came. Thus, he did not see the need to raise the matter with his supervisor.

5.54 The Select Committee notes from witnesses that Supermud might be able to support the excavated walls without temporary casings of about one to two metres in height. However, in the case of the YCK project, the lengths of the excavated walls without temporary casings were too long, over 20 m for some pile shafts. Therefore, Supermud might have failed to function as expected and soil collapsed. The Select Committee was told that Supermud was only used for about a month as Hui Hon could no longer afford it. With

the soil collapse, the depth of some pile shafts was thus reduced. There were instances where the excavated walls which collapsed might be over 10 m in height. Allegedly the two directors of Hui Hon, who were informed of the situation, instructed that the works should continue.

5.55 According to CMW's findings, there was a very thick layer of extremely soft materials underneath the base of four piles in Block D. This layer of soft materials might be a mixture of Supermud with soil collapsed in the pile shafts. Zen, however, claimed that it seemed extremely unlikely that Supermud had ever been used in any quantity. The reason put forth by Zen was that the large diameter of the piles would require an unjustifiably vast quantity of Supermud.

Confirmation of founding levels

5.56 As explained by GE2/YCK in paragraph 5.41 above, the bedrock level could only be confirmed upon actual excavation of the pile shaft. Once the bedrock level was confirmed, the founding level, which should be at a depth of 800 mm into bedrock in accordance with the Specification, could be established. The witnesses appearing before the Select Committee all considered that this was the most important step in the construction of LDBPs. To confirm the founding level, two steps were involved:

- (a) measuring the depth of the founding level; and
- (b) ascertaining the presence of sound bedrock at that level.

5.57 According to the site staff of HD concerned, it was practically impossible to witness the excavation process full-time as different stages of excavation took place at different pile shafts at the same time. They were only able to inspect the excavation work from time to time, but usually upon notification by the Contractor that the founding level had been reached. More detailed checking would then take place. The Select Committee finds that PSE/YCK and the site staff concerned had different understanding of the extent and timing of the inspections to be carried out. Even among the site staff themselves, they had different understanding of this critical inspection process.

5.58 EI-1203(1) required the PSE to inspect the bored-out chippings when excavation reached the predicted founding level to confirm the presence of sound bedrock. According to evidence, PSE/YCK was responsible for two to four projects at that time and was not resident at the YCK project site. He had made prior arrangement with the site staff that when excavation reached the proposed founding level, the site staff would inspect the bored-out chippings on his behalf, as it was not difficult to compare the chippings with the specimens of bedrock taken out at the predrilling stage. The Select Committee was told that PSE/YCK and GE2/YCK had taught the site staff in this respect during their earlier joint visits to inspect rock samples taken out during predrilling. PSE/YCK had also instructed that the site staff should measure the depth of the pile shaft, witness the taking out of bored-out chippings, put them into plastic bags, sign on the bags and keep them at the site office for his later inspection.

5.59 PCOW/YCK was aware of the arrangement made by PSE/YCK but did not consider that the site staff had the professional knowledge to verify the bored-out chippings. ACW1/YCK was also aware that chippings were to be excavated and kept for inspection purpose. He said that measurement of the shaft took place twice, i.e. at the rockhead level and the founding level. Comparison should then be made between their depths and those shown in the predrilling records agreed by PSE/YCK. Bored-out chippings should be extracted at the rockhead level under supervision. The site staff should also differentiate whether the bored-out chippings were sound bedrock. ACW1/YCK said that he had briefed WSs/YCK on the way to carry out this inspection procedure at least once before entrusting them with the job. He relied on WSs/YCK to raise questions when they encountered problems. However, he admitted that at the later stage of construction, measurement was mostly taken once when excavation had reached the founding level. It was not possible to take measurement at the rockhead level, as excavation was carried out continuously after 7:00 pm when no site staff was available. In the circumstances, the Contractor proceeded to the next step of work, i.e. excavation to the founding level at a depth of 800 mm into bedrock, without the rockhead level having been checked.

5.60 WSII/YCK, who certified the founding levels for almost all the piles, told the Select Committee that he measured the founding levels upon notification by the Contractor. Contrary to the procedures described above, he reiterated that the bored-out chippings were extracted and checked only after the bell-outs had been formed. He pointed out that before the formation of bell-outs, there was only mud at the bottom of the pile shafts, making it not possible to bore out chippings. He admitted that he had not witnessed the extraction of the bored-out chippings for each and every pile shaft, as extraction was sometimes carried out at night after he had left the site. WSI/YCK, however, claimed to have witnessed the extraction of bored-out chippings. Both WSI/YCK and WSII/YCK considered that they had neither the responsibility nor the ability to ascertain whether or not the bored-out chippings were sound bedrock. The Select Committee notes the absurdity of the delegation of the duty of inspecting bored-out chippings. Such duty was first delegated by PSE/YCK to PCOW/YCK. PCOW/YCK in turn delegated the duty to ACW1/YCK. ACW1/YCK further delegated the duty to WSs/YCK. WSs/YCK, to whom the inspection duty was ultimately delegated, however, did not consider that they had the professional knowledge to verify whether the bored-out chippings were sound bedrock.

5.61 When questioned as to how WSs/YCK knew a pile shaft had reached the rockhead level, they said that they took measurement of its depth to confirm whether the shaft excavated was down to the rockhead level specified earlier by PSE/YCK and GE2/YCK. Both WSs/YCK said that they used the measuring tapes provided by the Contractor to measure the rockhead level and founding level. But they did not examine on each occasion the measuring tapes. They recorded the shaft depth according to the measurement shown on the tape.

5.62 The Select Committee learns from some witnesses that there were malpractices in the construction industry in relation to the extraction of bored-out chippings and the measurement of the depth of rockhead level and founding level. For example:

- (a) pre-arranged bedrock samples could be placed at the bottom of a pile shaft before asking site supervisory staff to inspect bored-out chippings; and
- (b) "magic tapes" were used to measure the excavated depth of pile shafts to inflate the readings of the actual measurements. The "magic tape" is a measuring tape which had been tampered with by way of the removal of certain sections.

WSII/YCK admitted that he had not checked the tapes provided by the Contractor. The measuring tapes, according to various witnesses, were usually placed near the pile shafts. WSI/YCK, however, claimed to have put back the measuring tapes every time after use in HD's site office, which was locked. Both WSI/YCK and WSII/YCK claimed that they were not aware of the existence of "magic tapes".

Formation of bell-outs

5.63 When the pile shaft had reached the founding level, the Specification required that the pile base be enlarged to form a bell-out of the specified size. Under the approved method statement, the side of the bell-out should form an angle of 60 degrees with its base. The Select Committee was told that some pile shafts had not been excavated to the founding levels. It was therefore unlikely that a bell-out could have been formed for each pile. The Select Committee, nevertheless, examines how bell-outs were constructed in the YCK project, which was set out in paragraphs 5.64 to 5.75.

Equipment for formation of bell-outs

5.64 According to the method statement submitted by SA/YCK, after the pile shaft had been excavated to the confirmed founding level, a chisel would be used to enlarge the pile base to form a bell-out. The chisel would be lowered down to the required position and a reference mark would be made on the lifting device of the chisel. The number of chiselling operations required to form a bell-out of the specified size had to be agreed by PSE/YCK on site. The Select Committee notes GE1/YCK's view on the use of a chisel to form

bell-outs. In his memorandum to PSE/YCK dated 24 February 1998, in response to the latter's request for comment on the method statement submitted by the Contractor, GE1/YCK pointed out that:

"for rock chisel supported on metal sling only, the rock chisel will tend to rotate and the formation of bell-out in full diameter may be difficult to achieve. Other methods, such as the use of RCD (reverse circulation driller) machine, may also be considered."

Although GE1/YCK's comments were forwarded by PSE/YCK to the Contractor, the Contractor still retained the use of a bell-out chisel with no objection from PSE/YCK.

5.65 GE1/YCK explained to the Select Committee that RCDs were a better tool for forming bell-outs because cutting tools installed on the flange of RCDs could expand laterally to form the bell-out. Moreover, the extension of the flange could be checked from the lever arm mechanism at the top of the drilling head. A chisel, on the other hand, would have difficulty in forming a bell-out base in complete conical shape because its steel frame would rotate as it went down. GE2/YCK also considered that bell-out chisels were less effective than RCDs and might not be able to form bell-outs of the required shape. ACM2/YCK had similar views and said that in fact, bell-out chisels were no longer used in other projects after that period. PSE/YCK, however, considered that bell-out chisels and RCDs were equally effective. Forming bell-outs by chisel was one of the approved methods stipulated in EI-1202(1)(4). Bell-out chisels were being used in a number of HD piling projects at that time. He therefore accepted the use of chisels to form bell-outs in the revised method statement.

5.66 The Select Committee notes from a witness that Hui Hon was aware of the problems relating to the use of chisels and the difficulty in checking the bell-outs formed by chisels. Hui Hon, nevertheless, maintained the use of chisels.

Duration of formation of bell-outs

5.67 The Select Committee notes from a witness that it took chisels a longer time (at least four to six hours) to form a bell-out, which Hui Hon could not afford under the extreme pressure of a tight piling programme. Many witnesses also told the Select Committee that under normal circumstances, a bell-out could not have been formed in less than four to five hours. The Select Committee, however, notes from the inspection records that the time taken for the formation of bell-outs for piles in Blocks D and E ranged from one and a half hours to seven hours as set out in **Appendix V(7)**.

5.68 According to CMW, it was impossible to form a bell-out within two hours. In his view, the process would take at least half a day to one whole day, depending on the bedrock constitution. To account for the unreasonably short time taken for formation of some of the bell-outs, some witnesses pointed out that the record might not reflect the real situation, because some of the inspection forms were not contemporaneously completed and some were even completed in advance.

5.69 One safeguard in the proper formation of bell-out was provided in EI-1203(3). PCOW was required to check that the actual dimensions of bell-out of every pile were in accordance with the Contractor's design approved by the PSE. As was the case with other critical stages of construction, the task was assigned to Ws/YCK. Based on the inspection records, the number of bell-outs inspected by ACW1/YCK, WSI/YCK and WSII/YCK were 2, 10 and 26 respectively as shown in **Appendix V(8)**. No inspection form could be found in respect of BP7 for Block E, and the pile number had not been identified on two inspection forms. Both ACW1/YCK and WSII/YCK admitted to the Select Committee that some inspection forms were completed some time after inspection, and some had to be completed again after errors were detected in the original forms. However, ACW1/YCK informed the Select Committee that a bell-out could be formed in two hours, as was shown in a demonstration at site. Similarly, PCOW/YCK had the same impression. The Select Committee notes that the demonstration was done at the top of excavation at ground level and not on rock under water.

5.70 According to WSII/YCK, he did enquire why some bell-outs could be formed within such a very short time. The reason given by the Contractor's staff was that some part of the process had begun before the recorded time. The Select Committee gathers from a witness that in fact Hui Hon was under pressure to form the bell-outs expeditiously to minimize the possibility of soil collapse at levels without temporary casings. According to witnesses, works were frequently done at night after HD's staff had left the site, although the inspection records show that the formed bell-outs were all inspected by HD in the daytime. A witness admitted that where the records showed a very short formation time for a bell-out, the bell-out in fact had not been formed.

5.71 As the records show that all the bell-outs had been inspected by HD site staff, the Select Committee has examined why irregularities had not been detected. ACW1/YCK and WSII/YCK said that they measured the vertical displacement of the bell-out chisel between touching the bottom and when fully inserted into the bell-out. However, for those bell-outs which were formed at night, ACW1/YCK said that checking could only be done by lowering down the bell-out chisel the following day. If the chisel could be lowered down to the bottom of the pile shaft, the bell-out would be regarded as formed. This "inspection process" was not even feasible at the later stage when permanent liners were already installed before HD staff had had the opportunity to check the bell-out. ACW1/YCK said that he had questioned the Contractor's staff, who claimed that Ultrasonic Echo Sounder Monitoring (UESM) test could be done to check the bell-outs later on, and had confirmed with PSE/YCK that the UESM test could serve the purpose. PSE/YCK, however, denied that ACW1/YCK had ever consulted him on the matter.

Ultrasonic Echo Sounder Monitoring Test

5.72 PSE/YCK denied knowledge of the formation of bell-outs at night. UESM test, according to him, was not meant to replace the specified method in the method statement for measuring bell-outs. UESM test was proposed by the Contractor to trace the profile of the bell-out inside the pile shaft by measuring the ultrasonic wave propagation time. This was an additional test. PD/W and ACM2/YCK also confirmed that the test could only indicate the profile but not the dimensions of the bell-out, and the result was not conclusive.

5.73 The Select Committee finds that even without measuring the bell-out formed by the agreed method, the unsatisfactory formation was already revealed by the UESM tests. In a letter dated 27 May 1998 from PSE/YCK to SA/YCK, it was stated that:

"I refer to the site inspection on 22.5.98 when the Ultrasonic Earth Echo Sounder Monitoring Method was used for the bell-out checking. The result showed that the completed bell-out had not been done satisfactorily. It appeared that unchiseled rocks and mud was still found within the bell-out. The bell-out was not completed to the required dimensions. It appeared to me that there were problems in your construction method, equipment and site supervision. You are required to provide method statement which could improve construction, site supervision and quality standard taking into account of the necessary tolerance. Demonstration should be carried out to prove your method can improve the quality of the work."

When questioned at a hearing as to how he had followed up the matter, PSE/YCK said that the Contractor had originally proposed to conduct UESM tests on just 10% of the piles. He had requested the Contractor to undertake UESM tests on bell-outs until satisfactory results were shown. In response to his request, the Contractor submitted a revised method statement for constructing bell-outs in its letter dated 3 June 1998, which was submitted to the Select Committee after the hearing. A witness, however, told the Select Committee that Hui Hon had not followed up on the revelation of unsatisfactory bell-outs. The Select Committee did not find any evidence to show that PSE/YCK had followed up the matter further.

5.74 Records show that the testing contractor conducted 12 UESM tests on seven piles in Blocks D and E but submitted seven reports only. According to a witness, reports on some of the tests were not submitted because their results were unsatisfactory and retests were conducted. It

appears to the Select Committee that PSE/YCK did not know the number of UESM tests conducted.

5.75 CMW expressed to the Select Committee the view that given the thick layer of extremely soft materials found below the pile base of four piles in Block D, it was doubtful whether bell-outs had really been formed in the first place.

Cleaning of pile shafts

5.76 According to the approved method statement, after the formation of bell-outs, the pile shafts had to be cleaned. This process, which is called "air-lifting", should be done by installing a pre-determined number of tremie pipes to the bottom of the pile shaft and cleaning the pile shaft by air-lifting method. The method statement stated that cleaning of the pile shaft would take two to three hours until water pumped out from the pile shaft was clear. EI-1203 provided guidance on the criteria for checking the cleaning process by PCOW. EI-1203(4) stated that:

"Clean-out may be considered satisfactory when a transverse of the air lift pile over the base of the bore produces negligible debris/deposits suspended in water pumped to the ground surface."

5.77 Notwithstanding the clear procedures laid down in the method statement, the site staff of HD had different interpretation of when and how air-lifting should be carried out. ACW1/YCK told the Select Committee that air-lifting should be carried out twice, first after the formation of bell-out and then before concreting, as specified in the method statement. WSII/YCK, who believed he had learnt every inspection step from ACW1/YCK, told the Select Committee that he was not aware that air-lifting had to be carried out twice. All along he only knew that air-lifting should only be carried out before concreting. WSI/YCK also informed the Select Committee that air-lifting was done after reinforcement cages had been lowered into the pile shaft. All inspections of air-lifting, according to records, were carried out by WSs/YCK. As with bored-out chippings, WSs/YCK collected water samples as a matter of

routine for PSE/YCK's subsequent inspection. They were aware that the water collected should be clear without debris or silt deposits.

5.78 The Select Committee notes from witnesses that there were the following irregularities in the air-lifting process for the YCK project:

- (a) the tremie pipes were not laid down to the bottom of the pile shaft as stated in the approved method statement so that the water pumped out would be clearer and free from debris or silt deposits; and
- (b) milky water samples (see paragraph 5.52) were replaced by tap water mixed with soil water.

Both WSs/YCK, who had no experience with LDBPs or foundation works, said that they were not aware of the existence of such irregularities. According to a witness, no question on the air-lifting process had been raised by HD staff even when milky water was spotted in some of the water samples. However, ACW1/YCK claimed that he had enquired about the milky water but was given to understand by the site staff of the Contractor that this was caused by the addition of a lubricant on BG40.

5.79 In examining why WSs/YCK were asked to inspect air-lifting after reinforcement cages had been installed, the Select Committee was told by witnesses that air-lifting had flushed up the Supermud, hence accelerating soil collapse within the excavated walls not protected by temporary casings. Hui Hon, as a result, revised the work procedures in the later phase of work by advancing the installation of permanent liners and reinforcement cages before air-lifting. Even by so doing, collapse of soil within the excavated walls still could not be prevented. According to CMW, in its investigation of the as-built bored piles, four piles in Block D and four piles in Block E showed signs of soil collapse.

Installation of permanent liners and reinforcement cages

5.80 According to the method statement, after the pile shaft was cleaned, permanent liners and reinforcement cages of the required length and number should be installed into the pile shaft and down to the pre-determined level before concreting. EI-1204(2) and (3) respectively required PCOW to inspect the size of prefabricated reinforcement cages prior to installation, and check that the reinforcement cages were fixed and correctly placed in position. The supervision guidelines on LDBP issued by PD/W also reminded the HD staff that the length of LDBP installed should be counter-checked by the cumulative length of reinforcement cages.

5.81 Records show that the installation of permanent liners and reinforcement cages on 17 piles in Block D and 16 piles in Block E were checked by WSII/YCK. Given that the depth of some pile shafts was reduced as a result of soil collapse and some were not excavated to the founding levels, the cumulative length of the reinforcement cages installed should be less than the designed length, and this should have been detected by the site staff during inspection.

5.82 According to ACW1/YCK and WSII/YCK, they had measured the length of the reinforcement cages before installation for each pile shaft and found the cumulative length of the cages tallied with the reported founding level. Each reinforcement cage was 12 m in length and approximately four cages were required for each of the pile. However, they had not witnessed the welding and installation of each of the reinforcement cages into the pile shaft as the process took time, and by the time they left the site, installation had yet to be completed for most of the piles. ACW1/YCK said that nevertheless, to ensure that the reinforcement cages installed at night were proper, he had requested the Contractor's staff to lift up two sections of the reinforcement cages installed, but not the whole length for inspection. ACW1/YCK also claimed that he had raised his concern with PSE/YCK and requested that either the site staff be allowed to work overtime to supervise the whole installation process, or the Contractor be asked to stop working after the HD site staff had left the site. According to him, PSE/YCK said that if the upper section of the cages could be seen to have been installed, and provided that reinforcement

cages had been used up, the required number of reinforcement cages could be regarded as having been installed.

5.83 PSE/YCK, however, denied that he had ever been informed of the installation of reinforcement cages at night. Nor had he made the above remarks to ACW1/YCK. Both PSE/YCK and PCOW/YCK stressed that they had not received any report about the Contractor working at night to install the reinforcement cages. Their instruction to the site staff was to monitor the entire process of the installation of reinforcement cages.

5.84 A witness admitted to the Select Committee that not the entire lengths of the reinforcement cages were installed into the pile shafts. The surplus reinforcement cages were disassembled and used in the construction of pile caps. This explains why the quantity of steel supplied was consistent with the claimed depth of the bored piles. The witness also told the Select Committee that the site staff of Hui Hon had been instructed to drop the reinforcement cages down the pile shaft in the hope that the cages could penetrate more into the collapsed soil and reach a deeper level. Installation of the reinforcement cages of at least ten piles was done in such a manner. This process was carried out at night when the site staff of HD had left the site.

Concreting

5.85 The last step in the construction of LDBPs, in accordance with the approved method statement, is concreting. Casting of concrete into LDBPs requires a lot of skill and attention. It involves accurately positioning the tremie pipe through which the concrete is discharged, incrementally raising the temporary casing, scheduling the delivery of the concrete to avoid the formation of cold joints, etc. At the same time proper records have to be kept of each load poured into the boreholes and the boundary levels. The inspection procedure for concreting is set out in EI-1205.

5.86 The concreting process for LDBPs has to be continued uninterrupted once started. Arising from a number of problem cases involving the construction of LDBPs in the private sector, PD/W issued a memorandum on 3 June 1998 alerting the HD staff to the need for vigilant

monitoring of concreting works relating to LDBPs. PD/W advised that where necessary, overtime work after 7:00 pm should be performed by the site staff to see through the concreting process.

5.87 Concreting works for Blocks D and E in the YCK project were conducted during the periods from April to early July 1998 and from June to August 1998 respectively. A summary of the concreting records for Blocks D and E is in **Appendix V(9)**. As shown in the summary, the time taken for concreting varies and the operation, in most cases, was completed well after 7:00 pm.

Duration of concreting

5.88 PCOW/YCK and ACW1/YCK, who verified the concreting records, had not noticed the unusual variance of concreting time for a pile which ranged from as short as 4 hours 55 minutes to as long as 13 hours 5 minutes. ACW1/YCK said that he mainly checked the volume of concrete delivered to the site to ensure that it reconciled with the reported depth and diameter of the pile and had not paid attention to other details. WSII/YCK said that he had once queried the short concreting time for some of the piles, but the Site Foreman of Hui Hon had explained that it was the result of smooth delivery of concrete.

Supervision after 7:00 pm

5.89 Record shows that except for six piles, concreting for the rest of the piles in Blocks D and E was finished after 7:00 pm, one of which at 1:00 am. The Select Committee believes that concreting beyond 7:00 pm was common, otherwise PD/W would not have issued to the HD staff the memorandum concerning overtime supervision. When questioned by the Select Committee, ACM2/YCK and Senior Clerk of Works (SCOW1), who was responsible for the deployment and management of site staff, said that concreting after 7:00 pm was common in the industry at that time, because concrete suppliers might not be able to meet the delivery schedule. PCOW/YCK further said that since it was not a mandatory requirement to start concreting in the morning, the site staff were not in a position to stop work that commenced in the

afternoon. The Select Committee notes that when PD/W's memorandum was issued, 10 piles in Block D and all the piles in Block E had yet to be concreted. Despite PD/W's memorandum and that overtime estimate had been submitted by PCOW/YCK on 22 June 1998 and approved by PD/W on 18 July 1998, the Select Committee finds that no site staff ever claimed overtime allowance for supervising concreting beyond 7:00 pm. Different witnesses gave different explanations to the Select Committee for the absence of claims.

5.90 According to HD Departmental Staff Circular No. 2/93 which set out the general principles governing overtime work on a departmental basis, site staff at the rank of ACW and below were eligible for overtime allowance. SCOW1 informed the Select Committee that the memorandum concerning overtime work issued by the Assistant Director/Housing Architect (AD/H Arch) on 19 August 1995 remained effective at the time of the YCK project. The memorandum states, among other things, that:

- (a) it is the contractor's obligation not to carry out noisy operation, e.g. concreting work, beyond the "permitted working hours" stipulated in the relevant construction noise permit;
- (b) overtime work can be put in by site staff beyond the "permitted working hours", e.g. inspection of reinforcement, keeping site records, etc.; and
- (c) if contractors are found contravening the Noise Control Ordinance, the PCOW shall report to the CM and his representatives, so that appropriate action will be taken under the contract.

5.91 According to SCOW1, site staff all along followed the overtime instruction given by AD/H Arch, i.e. where necessary, they worked overtime from 5:00 pm up to 7:00 pm, in order not to involve in any contravention of the Noise Control Ordinance. As no new instruction had been given in this regard, the site staff for the YCK project acted accordingly.

5.92 ACM2/YCK and PSE/YCK told the Select Committee that they believed that the site staff of the YCK project were reluctant to work after 7:00 pm, lest they would be seen as party to the Contractor's illegal activities in contravention of the Noise Control Ordinance. They claimed that this was a general issue and was not unique to the YCK project, and the senior management of HD was aware of the problem. They, however, had not ascertained with the YCK site staff why they were reluctant to stay after 7:00 pm to supervise the works. PSE/YCK claimed that he had been given such an impression by PCOW/YCK. The approval of overtime budget for YCK was merely to ensure that funds were available if required. He did not consider it necessary to convey the approval to the site staff, as they could apply to work overtime irrespective of whether it was after 5:00 pm or after 7:00 pm, so long as it was justified. He stressed that he had never given any instruction to the site staff that they could not work after 7:00 pm. ACM2/YCK and PSE/YCK said that the absence of overtime allowance claim did not necessarily mean that the site staff had not stayed behind to supervise the work.

5.93 The site staff, however, told the Select Committee a different story. All the concerned site staff at the rank of ACW and WS told the Select Committee that they were willing to work beyond 7:00 pm should approval be given by the management. PCOW/YCK said that he had not received any response from PSE/YCK about the overtime budget application before he was transferred to another site in late July 1998. According to ACW1/YCK, SCOW1 told him that the overtime budget for supervision of works after 7:00 pm had been rejected. Should site staff wish to supervise works after 7:00 pm, they should consult PSE/YCK. ACW1/YCK claimed to have consulted PSE/YCK on a number of occasions, but the response of the latter was negative.

5.94 WSII/YCK said that he understood from ACW1/YCK that the application for overtime had been rejected. He only knew that he could work overtime for inspection of reinforcement until 6:00 pm and of concreting until 7:00 pm. As such, he usually worked up to 6:00 pm. Although the site staff had left the site after 7:00 pm, they still certified the concreting records for works which they had not supervised. When questioned by the Select

Committee as to how HD could ensure the quality of piles cast after 7:00 pm, HD staff concerned said that sonic and coring tests would be conducted to verify the integrity of such piles afterwards.

5.95 With the different approaches adopted by the professional and site staff to overtime work, concreting of piles beyond 7:00 pm went unsupervised for as many as 30 piles out of the 36 piles in Blocks D and E. At the same time, ACW1/YCK continued to issue site memoranda to the Contractor warning against concreting work after 7:00 pm, with a copy to PSE/YCK. A total of 29 site memoranda were issued in this regard. It appears to the Select Committee that the issue of all these site memoranda became a matter of routine. PSE/YCK, who failed to take follow-up action on the 29 site memoranda, conceded that the site memoranda were for record purpose only. He claimed that concreting after 7:00 pm was prevalent in HD construction sites in 1998, and it was then the common practice that project engineers would not take further action after the issue of such site memoranda. He further explained that it was not until 27 January 1999 that a memorandum was issued by Business Director/Development (BD/D) instructing HD staff to ensure strict compliance with the Noise Control Ordinance by contractors.

Quality of concrete

5.96 The investigation result of CMW shows that eight out of 36 piles in Blocks D and E were of satisfactory concrete quality. The others demonstrated honeycombing, steep or vertical joints of fracturing. A witness explained to the Select Committee that the poor quality was due to the deviation from the approved method statement and the collapse of excavated walls of some pile shafts because of the lack of a full temporary casing installed down to bedrock.

Quantity of concrete

5.97 According to witnesses, concrete was ordered by the Site Foreman of Hui Hon, purchased directly by Zen and delivered to the site. Record shows that the volume of concrete delivered reconciled with the concrete poured and that the quantities of concrete paid for were consistent with the

claimed depth and diameter of the LDBPs. The quantity of concrete delivered to the YCK site was 11% more than the volume calculated according to the claimed length. Many witnesses considered that such a level of excess was acceptable, provided that the claimed depth was correct.

5.98 However, the investigation conducted by CMW reveals that many of the piles were shorter than the claimed depth as explained in paragraph 5.3 above. Theoretically speaking, the amount of surplus concrete should be substantial if all the recorded quantity had actually been delivered to the site. The Select Committee notes from the evidence of witnesses that surplus concrete was in fact dumped into the cave-in area of the site or used for the construction of the pile caps for Blocks D and E. Some surplus concrete was also dumped into the periphery of the site at night, hence HD site staff could hardly notice any change to the site environment the following morning. A witness also informed the Select Committee that surplus concrete arising from short piling was not excessive, because the actual consumption of concrete was usually higher than the theoretical calculation.

Tests after concreting

5.99 Two types of tests were conducted after concreting to test the integrity of concrete and to verify the pile length. They were sonic tests and concrete coring tests. According to the Specification, all LDBPs had to be sonic tested; while concrete coring tests must be conducted on 5% of the piles.

Sonic test

5.100 Sonic coring test is a non-destructive test which may be applied to ascertain the integrity of cast in-situ concrete bored piles after construction. According to PRE12.520.P(f), four full-length sonic logging tubes of uncoated, untreated steel, free from any blockage down to the approved founding level, had to be installed in each bored pile. The sonic tubes must provide clear passage. During testing, an emitting probe and a receiving probe are placed inside two separate sonic tubes, to be hoisted up and down the bored pile. The speed at which the sound waves travel would give an indication of defects in the concrete, if any, but it cannot detect what the defects are.

5.101 According to Specification PIL.T1510.P, sonic coring tests on the quality of concrete should be done on all LDBPs. Under the Contract, the tests should be conducted by a contractor employed directly by HD. Sonic tests on piles for Block D were conducted in July and August 1998 and for Block E in September and October 1998. It was found that out of the 18 piles in each block, three piles in Block D and 11 piles in Block E had all four sonic tubes blocked, and four piles were not tested. A summary of the sonic test results is in **Appendix V(10)**.

5.102 The Select Committee notes from a witness that some of the tubes were deliberately blocked to conceal the fact that piles were shorter than the required length. Some piles were blocked near the top of the access tubes, making it not possible to carry out any sonic test from the very start. In fact, serious blockage of the sonic tubes was noticed by the Contract Team of HD. CM/YCK and ACM2/YCK found the blockage rate exceptionally high. However, they suspected that the problem was possibly due to poor quality of tubes and poor workmanship during installation. The matter was brought to the attention of PD/W. Knowing the unsatisfactory results of sonic tests on some of the piles in Block D, as a remedial measure, SA/YCK suggested on 28 July 1998 that vibration tests be conducted to test the integrity of concrete. Nevertheless, the proposal was turned down by HD.

5.103 According to CM/YCK, having regard to the poor result of the sonic tests in Block D, he and his supervisor insisted that coring tests was the only option to verify the quality of the bored pile concrete and the pile length. The intention of PD/W, as he told the Select Committee, was that every pile with blocked sonic tubes should be core tested.

Concrete coring tests

5.104 A coring test is done by drilling into the full length of a pile to take out concrete core samples section by section, with each section not exceeding 1.5 m long. The concrete cores taken out are logged and put together for measurement of the total length and then delivered to the laboratory for compression test. To ascertain the pile length, site staff have to attend the concrete coring to ensure that drilling on the pile is properly done and that the

concrete cores are directly taken from that drilling exercise. For the concrete coring tests in the YCK project, the Specification required cores to be taken down to not less than 600 mm into the rock upon which the pile was founded.

5.105 Following the instruction of the Contract Team, Hui Hon conducted concrete coring tests. Records show that coring tests were carried out on 13 piles in Blocks D, including the four piles which had not been sonic tested. On 8 October 1998, when the sonic tubes of nine piles in Block E were found to have been blocked, SA/YCK again wrote to PSE/YCK to request that vibration tests be done on doubtful piles in Block E and concrete coring test on one of the doubtful piles therein. Nine piles in Block E had yet to be sonic tested then. On 18 October 1998, PSE/YCK advised SA/YCK in writing that his proposal had been accepted.

5.106 The Select Committee notes the different views held by structural engineers regarding the appropriateness of using vibration tests to assess the concrete quality of piles. There is, however, no dispute that vibration test is only a means to provide an estimate of the length and integrity of a pile. The results of vibration tests are not conclusive and, where there are doubts, it is necessary to conduct concrete coring tests to assess and verify the quality of specific piles. Therefore, before deciding on whether vibration tests could be conducted in place of coring tests, some reasonable indication of the quality of the piles at a block should be available. In other words, a reasonable percentage of piles should have been core-tested and the results shown to be satisfactory before adopting the vibration tests.

5.107 In the YCK case, the Select Committee was told that vibration tests were accepted on the grounds that a substantial number of coring tests had been conducted, the results of which were shown to be satisfactory. In order not to delay the progress of works as coring tests took time to complete, the Contract Team allowed vibration tests, which they considered also an effective means to test the quality of concrete, to proceed. When questioned why only two piles in Block E had undergone coring tests, ACM2/YCK and PSE/YCK explained that as works for Block D commenced before Block E, it was inevitable that more coring tests were conducted in Block D. It appears to the Select Committee that the Contract Team was not sufficiently alert to the fact that

blockage of sonic tubes was more prevalent in Block E than Block D. As such, more coring tests in Block E should have been conducted. The Select Committee also notes from records that the coring tests on the two piles in Block E were in fact carried out after the vibration tests on most of the piles had been completed. In other words, when the decision to use vibration tests was made, no pile in Block E had undergone any coring tests.

5.108 Hui Hon again hired Chi Shing to conduct the concrete coring of piles. With his experience in predrilling and coring works for over 30 years, the Director of Chi Shing told the Select Committee that malpractice in the course of coring was not impossible or uncommon. Nevertheless, this could be avoided by full-time supervision by trustworthy parties who took immediate possession of the cores after extraction for storage in a secure place so that the cores could not be tampered with. The Select Committee learns from Chi Shing that in the YCK project, the cores taken were only placed in the site car-park with no supervision by HD's staff.

5.109 Invoices submitted by Chi Shing to Hui Hon showed the number of core locations and the total length of cores extracted from each pile, a summary of which is in **Appendix V(11)**. As shown in the summary, many piles were cored at several locations and at different lengths. According to the Director of Chi Shing, his company conducted the coring in accordance with the instruction given by Hui Hon. It was not his concern as to whether the coring was done at the right locations, at the right depth or up to the required length. It was also not the coring subcontractor's duty to know how the cores would be used and what the results of the tests were supposed to mean. Chi Shing was paid in accordance with the number of core locations and the total length of cores extracted. He recalled that in the YCK project, where only a short section of concrete could be cored from a pile, he was instructed to core at another location or another pile.

5.110 According to the Director of Chi Shing, less than ten piles reached the bedrock level. On many occasions, soft material, debris, mud, etc, were encountered in the course of coring, making it not possible to core further. He also said that normally it would take about four to five days to core a pile of about 40 m but in the YCK project, coring of one pile was completed in about

two days and 99% of the cores were extracted at night. He informed the Select Committee that he had noted the poor quality of concrete from the cores extracted.

5.111 Some witnesses informed the Select Committee that on a number of occasions, cores were extracted at several locations within the same pile. Irrespective of which piles the cores were extracted from, the concrete cores of satisfactory quality were put together to represent cores from a pile for submission to HD.

5.112 According to HD's Supervision Guidelines for LDBP, site staff were required to

"attend during concrete coring, mark up and sign on all core samples immediately."

Evidence, however, suggests that none of the site staff attached any importance to the Supervision Guidelines concerning concrete coring. ACW1/YCK, who had already been promoted to the rank of PCOW by the time coring tests were conducted, substantially delegated his core inspection duties to WSII/YCK, who had no experience with LDBP construction and its related activities. The Select Committee notes that Form 25, which recorded details of coring inspection, was completed solely by WSII/YCK. According to ACW1/YCK, he taught WSII/YCK the way to inspect concrete coring and measure the depth of the core to ensure that the pile reached the founding level. He also instructed WSII/YCK to witness the last core during drilling. He claimed to have marked the core locations and instructed WSII/YCK to check the position.

5.113 WSII/YCK informed the Select Committee that as many activities were going on at the site, and concrete coring was time consuming, it was not possible for him to witness the taking of cores full-time. Nevertheless, he inspected the coring work hourly and witnessed the process when the Contractor's staff informed him that the core was ready for extraction from the drilling exercise. The Select Committee has the impression that the core samples were simply accepted by HD site staff in whatever manner they were presented by the Contractor's site staff.

5.114 On the handling of core samples, ACW1/YCK was not sure whether he had signed on samples which he claimed to have inspected. WSII/YCK said that he had checked the cores taken out directly from the piles and had signed on all the core samples before he got off from work. He, however, conceded that a lot of coring work was done unsupervised after 7:00 pm, but he nonetheless signed on the core samples extracted at night. He felt uncomfortable about the arrangement and had conveyed his concerns to ACW1/YCK who, according to WSII/YCK, responded that the samples had to be signed as this was the rule of the game. When questioned by the Select Committee, ACW1/YCK denied that he was aware of coring work conducted at night.

5.115 According to EI-814(13), PCOW must check that cores were kept secure in the site office until the date of dispatch to the laboratory. However, the Select Committee learns from Chi Shing that the boxes of core samples after extraction were passed to Hui Hon, who placed them in the car-park just outside HD's site office. ACW1/YCK claimed that there was no space inside the site office to store these boxes. A witness recalled that there was no padlock on the boxes. Needless to say, such arrangement could have provided ample opportunities for changing the cores.

Vibration test

5.116 Following the approval by the Contract Team, vibration tests on all the 18 piles in Block E were carried out in late October 1998 by a company employed by the Contractor. PSE/YCK said that the site staff had witnessed the vibration tests and ACW1/YCK told the Select Committee that WSII/YCK had guided the testing contractor to conduct test on the relevant piles to ensure that vibration tests were conducted at the right location. WSII/YCK, however, told the Select Committee that he was totally unaware of the conduct of vibration tests, not to mention supervising or witnessing them on site.

5.117 A witness admitted that the testing contractor was purposely guided to conduct vibration tests on quality piles where satisfactory results could be produced. As a result, the conclusion of these tests was that:

"The piles are proven continuous to the pile toe and are therefore regarded as being of acceptable integrity."

5.118 Like PD/W, CMW considered that vibration test was not suitable for testing the integrity of LDBPs, as the diameter of the piles was too large and the result was inconclusive. As subsequently confirmed by CMW's investigation, 12 piles of Block E were built shorter than the reported lengths by 1.48 m to 15.41 m, and the concrete quality was poor.

Registered Structural Engineer Report

5.119 Under Specification PRE.6.130 A.P., the Contractor was required to appoint an RSE with geotechnical experience to certify the design and completion of works in accordance with the Specification. Hui Hon appointed Mr Lysander P C LAM as RSE in February 1998. According to Zen, the invoice submitted by the RSE was not settled by Hui Hon, and he refused to compile the RSE Report. After Zen took over the project from Hui Hon on 23 September 1998 because Hui Hon experienced financial difficulties and withdrew, Zen appointed a new RSE, Mr Richard Smart, in December 1998, when all the works had been completed.

5.120 Notwithstanding the completion of the foundation works on 19 December 1998, the RSE report was outstanding. On 5 July 1999 PSE/YCK issued a letter to Zen urging submission of the RSE report. CM/YCK explained to the Select Committee that the delay in submitting the RSE report was partly due to the dispute between Zen and the superstructure contractor over the responsibility for repairing the pile caps. It did not occur to him that the delay was caused by the technical non-compliance of the foundation works.

5.121 Even without the RSE report, CM/YCK issued the Certificate of Completion to Zen on 17 June 1999. CM/YCK explained that given that Zen had completed the foundation works and all the tests had shown to be satisfactory, the Contract Team, having consulted PQS/YCK, concluded that HD was obliged under Clause 53 of the Contract to issue the Certificate of Completion. In addition, consideration had been given to carrying out the

superstructure work without delay. The Contract Team decided that the RSE report could be an outstanding item to be provided after the issuance of the Certificate. According to CM/YCK and ACM2/YCK, the practice of issuing the Certificate of Completion before endorsement of the RSE report was not uncommon and was accepted by HD.

5.122 The Select Committee notes that 18 months after the completion of the foundation works, Zen submitted the RSE report to HD in June 2000.

Quality assurance and quality control

The Contractor

5.123 Under the Contract, the Contractor had the responsibility to design and execute the piling works in accordance with the Specification. Under Clause 6 of the Special Conditions of Contract, Zen should appoint a QCE for the project whose duties included ensuring that all materials and tests complied with the Specification. QCE should also inspect works and certify that it was in accordance with the Specification before seeking approval for covering up¹¹. Mr Tommy LEUNG Wah-hing, who was a staff member of Hui Hon and was also responsible for another two HA projects in Tseung Kwan O, was recommended to HD as QCE/YCK for the project. When questioned by the Contract Team on how Mr LEUNG could manage several projects at the same time and ensure good quality of the YCK project, Zen gave an assurance in writing that its project manager and the assistant of the site engineer would also provide support. The Contract Team raised no further objection.

5.124 QCE/YCK claimed that he was QCE in name for the YCK project for the purpose of meeting the relevant requirement in the Contract. He devoted most of his time to the Tseung Kwan O projects. Of the 11 monthly site meetings, he attended only six. From the commencement of the project until 3 December 1998 when he was replaced by another engineer, he visited

¹¹ Covering up in this context means building material being incorporated into the permanent construction work and put out of view.

the site three times together with PSE/YCK. His frequent absence from site prompted HD to deduct \$100,000 from the contract sum. Although he signed on all the inspection forms of HD entitled "Examination of work before covering up" to certify that he had checked the works, including founding level, installation of permanent liners and reinforcement cages, he told the Select Committee that he had not in fact inspected the works concerned. The Select Committee notes that QCE/YCK did not have much idea of Zen's Quality Manual and Company Operating Procedures, although the Executive Director of Zen claimed that all employees and subcontractors of Zen were required to work to the requirements set out in these Procedures. QCE/YCK in fact did not need to report to Zen about the quality of works.

5.125 On the overall management of the project, Zen stressed that it supervised and managed the project off-site. Zen deployed a contract manager and a foreman to monitor the quality and progress of works. Staff of Zen who were responsible for quality assurance visited the site five times over the period from March to June 1998. The Select Committee nevertheless notes from site records that the contract manager only attended five of the 11 monthly site meetings. As regards the foreman, he was only deployed to work at the site for a period of about three to four weeks in mid-April 1998, two months after the commencement of the piling contract.

5.126 The Select Committee also notes that the focus of Zen was all along on the progress of the project. Zen relied on HD to inspect the work to ensure its quality and its compliance with the contract. Zen held the view that the inspection system adopted by HD should be able to ensure that every step of work was inspected and approved by HD staff before the next step of work could proceed. Under the circumstances, Zen considered that there should not be any question of non-compliance with HD standard if the next step of work in the construction process was allowed to proceed.

5.127 According to Zen, it had no knowledge of the problems encountered at site, including the failure to install temporary casings to the entire length of the pile shaft, collapse of soil within excavated shafts, carrying out of important work steps after 7:00 pm, and serious blockage of sonic tubes in Blocks D and E. The Select Committee notes that it was only when Hui Hon was no

longer able to pay its staff and when Zen began to worry about the slow progress of works that it took over the project on 23 September 1998. However, Zen continued to engage the same team of staff of Hui Hon to carry out the work. Zen did not inspect the works already completed in respect of Blocks D and E. Its focus remained on progress. Both the coring tests and the vibration tests on Block E were conducted in October 1998 after Zen had taken over the project, but Zen did not do anything to ensure that the two tests were properly conducted.

Housing Department

Monitoring at the directorate level

5.128 As stipulated in the relevant job description, BD/D assumes overall responsibility and accountability for the development and construction projects of HD. With more than 100 projects at active stages of construction at the time of the YCK project, BD/D monitored these projects at the macro level through meetings with Project Directors and the CSEs. In the bi-weekly Development and Construction Management Board meetings, BD/D discussed with Project Directors issues of wide policy implications. At monthly Project Progress Review meetings, the CSEs reported to BD/D on project-related issues, including progress, quality and the contractors' performance. Apart from these regular meetings, according to BD/D, items of concern could also be brought to his attention direct on file. Where the matters were professional and technical in nature, the CSEs would handle by themselves or in consultation with the respective Project Directors.

5.129 BD/D was aware of the problems identified in the private sector concerning the construction of LDBPs. The subject was discussed at BC meetings, followed by the issue of supervision guidelines for LDBPs by PD/W. Throughout the contract period of the YCK project, there was no report of adverse performance against the Contractor. The serious blockage of sonic tubes and the change of design to steel-H piles for three of the domestic blocks, which BD/D regarded as professional matters, were not reported to him.

5.130 Like BD/D, PD/W also monitored the projects under his charge at a macro level. He relied on the CSEs to make regular reports on project-related matters at the monthly Project Progress Review meetings and by other means such as filing a report for his attention. As described in paragraph 5.34 above, in response to the reported malpractices in the private sector concerning LDBPs and recognizing the importance of concreting, he issued the memorandum dated 3 June 1998 to remind staff to properly supervise concreting and arrange overtime supervision if necessary. Though he approved the overtime allowance for supervising concreting in respect of five projects, he did not know whether the allowance was actually claimed. PD/W was aware of the blockage of sonic tubes but not the extent. He instructed the conduct of concrete coring tests. He informed the Select Committee that his intention then was to conduct concrete coring test on every pile with blocked sonic tubes. Unfortunately, he did not formally or properly convey his intention to the staff concerned. When the Contractor proposed to conduct vibration tests to verify the concrete quality of piles with blocked sonic tubes in Block E, he was not consulted. In his view, it was not appropriate to conduct vibration tests to assess the integrity of concrete and the length of piles.

5.131 The Select Committee notes that both the BD/D and PD/W never visited the YCK site during the course of the contract.

Monitoring by the Contract Team

5.132 The Administration Manual (Engineering Division) (EA) lays down the responsibilities of professional staff in the engineering discipline, including CSE, SSE and SE. In the context of a works project, the duties of CSE and SE, in their respective capacity as CM and CM's Rep from the commencement to completion of a contract, are set out in detail in the Project Procedures Manual for PHDP, Volume Two (BPP2). Where the project involves the construction of foundations using LDBPs, the Engineering Inspection Manual, as explained in the preceding paragraphs, further prescribes the inspection duties at each stage of construction. The Select Committee has examined how the Contract Team of YCK discharged the responsibilities and duties in their respective capacities as laid down in the manuals to ensure quality of work.

➤ *Monitoring by the Contract Manager*

5.133 EA-103 1.3.1(2) provides that CSE should be responsible for organizing the work and disposition of staff within the Structural Engineering Section under his charge. CM/YCK was therefore responsible for the deployment of structural engineers under his charge to individual projects. When the YCK piling contract commenced in February 1998, PSE/YCK had joined HD for 18 months. The Select Committee notes from Appendix III(7) that the established workload indicator for a PSE at the material time was two active projects. PSE/YCK, however, was concurrently responsible for four active projects. His workload was also heavier than his peers who, on average, were each responsible for 2.3 active projects.

5.134 Under the established practice, the need for resident engineer for individual piling contracts was also decided by CSE depending on the complexity and remoteness of the site. During the time of the YCK project, there were 20 ongoing projects which involved LDBPs. Of these projects, only four were provided with a resident engineer. No resident engineer was deployed to the YCK project.

5.135 EA-103 1.3.1(6) provides that CSE should act as the CM. According to BPP2, CM has to perform, amongst others, the following duties:

- (a) to carry out a review to determine the adequacy of the contract, the programme and resources necessary to complete the works (BPP2-203(2));
- (b) to determine percentages of inspection to be carried out by site supervisory team at the commencement of the contract (BPP2-204(5));
- (c) to maintain an adequate level of inspection to carry out checks, inspections and tests according to site inspection procedures and the provisions under the contract (BPP2-204(4)); and

- (d) to visit the site periodically to monitor the performance and progress of the contract (BPP2-204(10)).

5.136 Having about 130 work projects at various stages under his charge during the relevant period, CM/YCK, at the commencement of the project, delegated most of his duties and powers vested in him under the contract to PSE/YCK, i.e. CM's Rep. However the delegation did not cover, amongst others, removal of subcontractors and certification for completion of the works. Although BPP2-204(5) required him to determine the percentage of site inspection, he told the Select Committee that in line with HD's practice, he did not determine the extent of site inspection for this particular project and expected the site staff to follow the requirements in the relevant manuals. When the site staff considered that there were difficulties in complying with the requirements in the manuals, they should bring the matter to his attention. Throughout the Contract, he had not received any report in this respect.

5.137 According to CM/YCK, owing to the large number of projects he had to oversee, he had to rely on report of problems on individual projects by subordinates. Like other projects under his charge, CM/YCK monitored the YCK project mainly through holding regular and ad hoc meetings with the two successive ACMs/YCK and PSE/YCK. CM/YCK told the Select Committee that the time he had spent on the YCK project was no more and no less than other projects. Ad hoc meetings with ACM2/YCK and PSE/YCK were more frequent after the report on blockage of sonic tubes, but the time devoted to the project was not exceptionally more than before, as he then considered that the blockage might be caused by poor material and workmanship. He was involved in making the decision to request the Contractor to conduct concrete coring tests and to accept the Contractor's proposal to do vibration tests to verify the concrete quality of piles with blocked sonic tubes in Block E. The Select Committee notes that CM/YCK visited the site twice at the later stage of the project, on 9 October and 27 November 1998, when the construction of pile caps was slow and the workmanship was reportedly poor.

➤ *Monitoring by the Assistant Contract Manager*

5.138 EA-103 1.3.2(20) provides that SSE should act as the ACM for piling projects, but the role and responsibilities of ACM are not defined in BPP2 in the context of a works project. The role and responsibilities of ACM are reflected indirectly from the general duties of SSE to supervise structural engineers in carrying out their duties as CM's Rep for all new works projects and to report on the performance of contractors as stipulated under EA-103 1.3.2(17) and (6) respectively.

5.139 The first ACM for the YCK project has retired from the civil service and is residing in the United Kingdom. The Select Committee could not obtain information from him as to how he monitored the project in his capacity as ACM and as the supervisor of PSE/YCK. Site record books show that he visited the site three times from the commencement of the Contract until 2 June 1998 when ACM2/YCK took over the project.

5.140 According to ACM2/YCK, eight of the 36 piles at Blocks D and E had been completed when he took over the project. At the time of the YCK project, he was looking after 23 projects. Three projects were at the feasibility study stage; four at the planning and tender stages; and 16 at the construction stage. Of the 16 projects at the construction stage, six were piling contracts. ACM2/YCK monitored the YCK project through day-to-day contact and discussion with PSE/YCK. Site record books show that ACM2/YCK visited the site six times from June 1998 to the completion of the Contract in December 1998. The records, according to ACM2/YCK, were incomplete because he visited the site on at least three other occasions to attend site meetings but the visits were not recorded. His focus during site inspections was on the progress of work and the way in which the work was done. Apart from paying visits periodically, ACM2/YCK also monitored the YCK project through reading the correspondences in relation to the project before they were put on files. Test reports done by testing contractors employed by HD were also sent to him direct. He was therefore fully aware of the blockage of sonic tubes and agreed with the Contractor's proposal to conduct vibration tests to verify the concrete quality of piles with blocked sonic tubes in Block E.

5.141 The Select Committee notes that ACM was the approving officer for overtime payments to site staff. Despite the memorandum from PD/W concerning overtime supervision on concreting and no overtime allowance claim beyond 7:00 pm was lodged by site staff, ACM2/YCK had little knowledge of what the situation actually was. He was under the impression that the site staff should have stayed beyond 7:00 pm to supervise concreting even if no overtime allowance was claimed. He considered that the senior management should be aware of the general issue of concreting work beyond 7:00 pm without site supervision and did not raise the matter with CM/YCK or at the monthly SSE meetings.

➤ *Supervision by the Contract Manager's Representative*

5.142 Both BPP2 and EA stated in no uncertain terms the important role played by structural engineers in their dual capacity as CM's Rep and PSE for individual projects. Being CM's Rep, structural engineers are contractually delegated with the authority to exercise most of the powers vested in CM under the contract. Being PSE for a project, structural engineers are professionals at the operational level to supervise the execution of the project in accordance with the requirements in the contract. To mention but a few, PSE as CM's Rep is:

- (a) to supervise the construction of permanent structural works to ensure that it is executed in accordance with contract drawings and that materials and workmanship comply with the specifications (EA-103 1.3.3(B)(7));
- (b) to order and supervise tests of concrete materials, steel reinforcement, structural steelwork, etc and on constructed structural works for quality control purposes (EA-103 1.3.3(B)(8));
- (c) to check temporary works, methods of construction, alternative designs and materials provided by the contractor for compliance with contract design and specification (EA-103 1.3.3(B)(12)); and

- (d) to ensure that proper site records on structural works are kept by site staff, especially on matters relating to potential claims (EA-103 1.3.3(B)(21)).

5.143 In the context of a LDBP project, the general duties of CM's Rep/PSE are translated into specific inspection duties at different stages of construction as laid down in EI. Given the pivotal role of CM's Rep/PSE in a project, his competence in discharging the duties and the manner in which he discharges them affect the quality of supervision and contract administration to a large extent. With reference to these aspects, the Select Committee has examined how CM's Rep/PSE for the YCK project discharged the responsibilities as specified in the manuals.

5.144 The Select Committee finds that PSE/YCK had only had a few months' experience in the construction of LDBPs before he was deployed to the YCK project. He emphasized to the Select Committee that apart from the YCK project, he was also responsible for another piling project and two building projects. He claimed that his workload exceeded the established indicator which, as he understood it, should be two active projects. The projects should also be manned by resident engineers. According to records, he conducted 61 visits to the site. However, the visits did not take place during the critical stages of works which required his presence, e.g. inspection of bored-out chippings to confirm the founding levels before the formation of bell-outs.

5.145 The fact that PSE/YCK did not inspect the bored-out chippings in time to confirm the presence of sound bedrock before the excavation of bell-outs in respect of most of the piles in Blocks D and E reflects the small degree of significance he attached to this process. This process, as stated by many witnesses, is the most critical one in the construction of LDBPs. PSE/YCK considered it relatively simple for PCOW and ACW to distinguish hard rocks from mud. He delegated the inspection of bored-out chippings to PCOW/YCK. PCOW/YCK delegated the duty further to ACW1/YCK. ACW1/YCK in turn delegated the duty to WSs/YCK who claimed that they did not have the professional knowledge to verify whether the bored-out chippings were sound bedrock.

5.146 As explained in detail under "**Construction**" in the foregoing paragraphs, PSE/YCK delegated most if not all of his inspection duties under EI to PCOW/YCK. He made prior arrangement with PCOW/YCK that it was not necessary for him to examine the work before proceeding to the next stage. The Select Committee notes that EI-201(2) allowed PSE to make prior arrangement with the PCOW/ACW to classify circumstances into those which required PSE's examination and those which did not. However, there is no evidence that PSE/YCK gave any consideration to the extent of delegation. Since the inspection forms were signed by PSE/YCK, he should have been aware that the inspection duties were eventually delegated to Ws/YCK and should have taken action to ensure that the delegated duties were carried out properly.

5.147 The Select Committee notes from evidence that the site staff received little guidance from PSE/YCK, who seemed to be even less familiar with the work procedures. Air-lifting is one example. ACW1/YCK told the Select Committee that air-lifting was to be done twice, after the formation of bell-out and before concreting, which were stated explicitly in the method statement. When questioned by the Select Committee, PSE/YCK did not seem to be certain of the correct procedures, although the method statement was approved by him in the first place. He subsequently wrote to the Select Committee to explain that there were occasions when air-lifting was carried out more than twice.

5.148 The Select Committee notes from a witness that many pile shafts were not excavated to the proposed founding levels and difficulties were encountered in driving the temporary casings down to the excavated levels. Supermud was thus used in some pile shafts to prevent soil collapse. As Supermud failed to achieve its intended function, excavated walls collapsed in the pile shafts. According to the witness, because of all these problems, it was necessary to take quite a number of critical work steps, e.g. formation of bell-outs and installation of reinforcement cages at night, so that malpractices could be carried out in the absence of HD staff. PSE/YCK claimed that other than concreting, he was not aware of works undertaken beyond 7:00 pm by the Contractor, but ACW1/YCK claimed to have repeatedly told him about the situation. According to ACW1/YCK, PSE/YCK gave no response when his

attention was drawn to work by the Contractor at night. The Select Committee finds it incredible that PSE/YCK did not know about works being undertaken after 7:00 pm.

5.149 The Select Committee also notes that PSE/YCK did not take proper follow-up actions. He issued a letter dated 27 May 1998 to the Contractor about the unsatisfactory formation of some of the bell-outs. Although the Contractor submitted a revised method statement for the construction of bell-outs, he did not follow up the matter further. In addition, as many as 29 site memoranda were issued by PCOW/YCK to the Contractor warning against concreting beyond 7:00 pm, yet PSE/YCK did not take up the issue with the Contractor. The Contractor paid no attention to the 29 warnings and continued concreting works beyond 7:00 pm.

5.150 Similar attitude was also shown in the way PSE/YCK handled the application for overtime work from site staff. When it had become a departmental policy to ensure that concreting after 7:00 pm should be supervised throughout the entire process, PSE/YCK did not follow up whether or not the site staff did carry out the overtime work despite the fact that he had supported the application.

5.151 PSE/YCK claimed that he was unaware of malpractices in the construction of LDBPs. He had no idea that tremie pipes could be manoeuvred to collect water not from the bottom of pile shafts to provide cleaner samples. He did not know that wetting concrete cores could show whether they were taken out from the same pile. Without knowledge of and sensitivity to possible irregularities and without sufficient practical experience with LDBPs, PSE/YCK was not well-equipped, under the circumstances, to deal with other than honest contractors.

Supervision by site staff

➤ *Establishment of site staff*

5.152 As YCK was an in-house project, the site staff for the project were deployed from and supervised by the Chief Technical Officer Unit of HD.

Supervision of site staff for in-house construction projects within a designated area was put under the responsibility of a SCOW who oversaw at the same time site staff for about 10 projects in a designated region. Apart from personally supervising a major project, the SCOW also had to assist in the deployment of site staff and to ensure consistency in the standard and level of site supervision. For each piling project, there should be a PCOW and a WS, according to the then prevailing manning ratio of HD. The staffing complement of half PCOW, one ACW and one WS for the YCK project cannot be said to be below the standard manning ratio at that time.

5.153 PCOW/YCK claimed that he could spend only about 10% to 20% of his time on the YCK project because he needed to devote more attention to another project. He said that PSE/YCK was aware of the situation. PSE/YCK, however, denied such knowledge.

5.154 PCOW/YCK also told the Select Committee that as the two projects were in close vicinity, he visited the YCK site daily mainly to deal with paper work. At the initial stage of the project, he spent more time on inspection. With the limited time he spared for the YCK project, PCOW/YCK delegated most if not all of his inspection duties to ACW1/YCK and advised the latter to notify him or PSE/YCK of important occurrences.

➤ *Qualifications of site staff*

5.155 The Select Committee notes that in deploying the PCOW and ACW to the YCK project, SCOW1 had considered their previous experience with LDBPs, although the two successive WSs did not have piling experience. One of the duties of SCOW as stipulated in EI-1503(3d) is to advise the CM/ACM on the training needs of the site staff. The site staff for the YCK project informed the Select Committee that they did not receive any training provided by HD concerning the construction of LDBPs. According to SCOW1, the training programme for the site staff was co-ordinated by the department. The site staff were expected to study the relevant manuals and learn the construction of LDBPs from experienced colleagues and through on-the-job training. Even in the case of WSII/YCK, who was a new recruit with no experience in piling or LDBPs, there was no hand-over from his

predecessor WSI/YCK, although he took over the job in the middle of the piling works. The only "training" he received was an induction by ACW1/YCK who took him round the site in the first week after he had assumed duty.

➤ *Way of supervision*

5.156 The intention of deploying experienced PCOW and ACW to the YCK project was for them to lead the inexperienced WSs to perform inspection duties. As explained in paragraph 5.154 above, PCOW/YCK delegated most of his inspection duties to ACW1/YCK. Likewise, ACW1/YCK adopted the same approach. The bulk of the inspection of works was carried out by the two successive WSs/YCK. ACW1/YCK rarely checked their work but expected the respective WSs/YCK to report unusual findings to him. Although ACW1/YCK was stationed on site full-time, he claimed that he needed to spend most of his time on handling papers and reports and attending meetings. He demonstrated to WSs/YCK how each work step should be performed. As WSs/YCK could answer work-related matters correctly upon enquiry, he considered that they were capable of discharging the inspection duties independently.

5.157 As explained in paragraphs 5.58 to 5.62 and paragraphs 5.76 to 5.79, there were differences in the understanding between ACW1/YCK and WSII/YCK over a number of important inspection processes. One of the factors attributed to the differences might be that the sequence of construction of LDBPs as stipulated in the method statement was only made available to WSII/YCK in mid-July 1998, more than one month after he had taken up the post. Nevertheless, the Select Committee is of the view that WSII/YCK did not seem to fully comprehend the contents and misunderstood the correct inspection procedures, and ACW1/YCK did not seem to have detected this problem. The Select Committee doubts if ACW1/YCK provided adequate instructions to WSII/YCK. Records also indicate that ACW1/YCK rarely carried out inspection throughout the entire project. When questioned by the Select Committee as to why he did not inspect the works himself, ACW1/YCK explained that he had to study the drawings and concentrate on the construction of H-piles. However, at the initial stage of the Contract, only the foundations

of the car-park building were built by H-piles. It was only in October 1998, two months after he was promoted to PCOW, that Zen accepted the conditions imposed by HD concerning the change of design to steel-H piles in respect of Blocks F, G and H. In other words, before October 1998, it was unlikely that the construction of H-piles for the car-park building only should have occupied most of the time of ACW1/YCK. The Select Committee cannot find sufficient reasons to explain why ACW1/YCK should have left the inspection duties almost entirely to WSs/YCK.

5.158 Zen implied that the close relationship between the site staff of HD and the staff of Hui Hon had affected the way supervision was carried out and claimed that Hui Hon had spent \$100,000 to entertain the HD site staff. In this respect, the Select Committee has examined how far the alleged close relationship might have been a reason for the substandard works. From the evidence given by various witnesses, it could be confirmed that the site staff of HD did have frequent lunches with the site staff of Hui Hon. The bills were allegedly shared amongst the participants, except that the site staff of Hui Hon paid the bills on a few occasions. The Select Committee notes from the lunch records used for the purpose of collecting money from participants on a monthly basis that the cost of a meal per person was \$30. Apart from lunches, some site staff of HD also told the Select Committee that they had played mahjong with the staff of Hui Hon once and had been to karaoke with them twice on a cost sharing basis. A witness told the Select Committee that the sum of \$100,000 was not spent on entertainment for HD staff, but were expenses paid by him and to be reimbursed by Hui Hon for purchasing items used for the works, such as stationery, gasoline and working tools, and meal allowances for the site staff of Hui Hon working overtime. Since Zen took over the project from Hui Hon, the witness therefore sought reimbursement from Zen.

5.159 The Select Committee is of the view that although it appears that the site staff of HD maintained a cordial relationship with the site staff of Hui Hon, it cannot come to the view that the relationship affected the way of supervision.

Observations

5.160 The acceptance criteria for constructing LDBPs are clearly laid down in HD's Specification. It is therefore important that the construction procedures set out in the method statements are followed. The Select Committee notes that in this respect, HD has established clear guidelines on how each step of work in the construction process should be checked in its inspection manuals.

5.161 The Select Committee notes that despite the guidelines, there were problems in the construction of LDBPs in the YCK project right from the beginning. Zen, the Contractor, had no experience in LDBP works in relation to high-rise buildings and had to totally rely on Hui Hon, which took up almost the entire project at a low contract price. According to evidence, Hui Hon did not purchase adequate temporary casings or provide the machinery capable of installing temporary casings in the pile shafts during excavation down to the bedrock level. This set in motion a chain of events beginning with some pile shafts not excavated to the founding levels; the temporary casings not installed to the founding levels; collapse of excavated walls in some pile shafts; use of Supermud and failure to prevent further soil collapse; hasty formation of bell-outs; the use of "magic tape" (see paragraph 5.62) and the manoeuvring of tremie pipes in air-lifting; installation of reinforcement cages and concreting at night; and concrete being mixed with the collapsed soil and Supermud at the lower end of piles. The series of irregularities or even fraudulent acts occurred as attempts were made to cover up one problem after another, culminating in the extremely poor quality of some of the piles.

5.162 It is obvious to the Select Committee that Hui Hon had great difficulties in completing the works since the beginning of the project. With the presence of the site staff and the existence of all the built-in checking mechanisms, it is inconceivable that irregularities remained undetected throughout the construction process. The fact that all the inherent safeguards failed in the YCK project suggests that there were serious problem in the management of the project and in site supervision.

Assessment of tenders

5.163 The selection by HD of a contractor who had no experience with LDBP foundation works in relation to high-rise buildings sowed the seeds for the failure of the YCK project. Although Zen was on the approved list of HA for foundation works, it had not undertaken HA's works previously and did not own the specialist plant necessary to execute LDBP works. The YCK project was the first works contract Zen entered into with HD, hence there was no track record to assess its competence in undertaking LDBP works. The Select Committee considers that HD did not take adequate measures in the selection process to ensure that Zen had the necessary expertise and machinery for undertaking the works. Also, HD did not state clearly in the BC paper which summarized the tender results that Zen had no prior experience with HA's works and had no experience with LDBP works in relation to high-rise buildings. The paper did not facilitate BC members in considering the appropriateness of awarding the contract to Zen, and BC members approved the paper without raising any query. It appears to the Select Committee that although technical competence was an important criterion for the award of the contract, tender price was the principal factor considered by HD in selecting Zen as the Contractor for the YCK project.

Control over subletting

5.164 The Select Committee appreciates that given the history and the features of the local construction industry and the variety and complexity of works projects, subletting, to a certain extent, is inevitable and indeed desirable, as special skills and knowledge can be utilized and specialized construction plants mobilized. However, to ensure that the advantages of subletting are optimized without the associated problems, control over the quality of subcontractors is necessary.

5.165 While HD prohibited total assignment of a contract, it is clear from the provisions of the General Conditions of Contract (Clauses 3 and 4) for the YCK project that HD recognized and accepted a certain degree of subletting. The Contractor could sublet, without permission from HD, part of the works in relation to the provision of labour and material. As regards subletting of

constructional plant, the Contract required the Contractor to seek the permission from CM in writing. The Select Committee notes that HD's control over subletting basically operated on an "honour system", i.e., it relied entirely on the contractor to take the initiative to report on any subletting. Although the Contract Team requested Zen at the initial contract meeting held on 12 February 1998 to submit full particulars of the subcontractors to HD, Zen did not give any response. It appears that if a contractor chose not to report, there was no built-in mechanism to ensure that the provisions regarding subletting were complied with. The very loose attitude towards subletting seems to be common in HD projects, as reflected in the way the HD site staff and the Contractor of the YCK project handled subletting.

5.166 The Select Committee believes that the intention of restricting tenders to contractors on the relevant approved lists for piling works is a measure to ensure the quality of works, as contractors have to fulfil certain criteria before they are put on the list. This purpose would be defeated if a contractor on the approved list, once having secured the contract, sublets the bulk of works to a subcontractor who is not on the approved list. This was exactly what happened in the YCK case. The Contractor was not required under the Contract to seek the approval of HD for subletting the works, other than the subletting of constructional plant. There was no mechanism for HD to assess the financial and technical competence of subcontractors. It was Hui Hon which approached Zen indicating its interest in the Contract. It was Hui Hon which prepared the piling design for tender submission to HD. It was also Hui Hon which carried out the entire construction works until Zen took over in late September 1998 when Hui Hon failed to complete work according to schedule. Effectively it was Hui Hon which took charge of the bulk of the contract works. Zen's involvement was mainly on the procurement of major materials. Its overseeing role was performed through attendance at site meetings. In the light of the above, the Select Committee considers that Zen exercised inadequate control over the work processes. Without any meaningful control by HD over subletting, restricting tenders to contractors on the approved lists serves little useful purpose.

Competence of Housing Department's staff

Contract Team

5.167 While the Contractor's technical competence is instrumental to the successful execution of a contract, the competence of the staff administering it is of equal importance. The technical competence of the PSE to whom the site staff turn to for professional guidance and decisions is pivotal. The Select Committee considers that in order to discharge PSE's duties effectively, the project engineer must not only have sufficient knowledge of the characteristics of the type of pile under construction and the method statement, but should also be equipped with sufficient knowledge of the practical problems encountered during construction. As the head of the frontline supervisory staff, he should be alert to common malpractices relating to the construction of that particular type of pile. Such knowledge and alertness enable the project engineer to detect problems and direct the site staff to pay attention to signs of malpractices in the course of construction.

5.168 The PSE in the YCK project was at the same time CM's Rep. This position calls for a person with sound technical knowledge in piling construction works and good managerial skills. However, PSE/YCK failed to impress the Select Committee that he possessed these qualities. He was unfamiliar with the construction process of LDBPs, hence was not aware of the critical stages. The Select Committee finds that PSE/YCK:

- (a) failed to provide adequate professional guidance to the site staff concerned, e.g. in confirming the founding levels, in the formation of bell-outs, in air-lifting, and in supervising concrete coring tests, etc. (see paragraphs 5.56 to 5.62, 5.69 to 5.71, 5.77, 5.108 to 5.115 and 5.147);
- (b) failed to take follow-up actions as exemplified in the issue of 29 site memoranda warning against concreting after 7:00 pm. (see paragraphs 5.95 and 5.149); and

- (c) failed to ensure that the inspection duties delegated were carried out properly by competent persons (see paragraphs 5.145 and 5.146).

5.169 The Select Committee is disappointed that the senior management of HD deployed an engineer with only limited practical experience in LDBPs to manage the YCK project, especially when problems relating to LDBPs were known in the private sector. Relevant experience is a fundamental factor in considering deployment of staff and should under no circumstances be overlooked or compromised. The Select Committee also notes that PSE/YCK's workload was apparently heavier than the average workload of his peers. In assigning work to PSE/YCK, it seems that the senior management had failed to take into account the relevance of his experience and his workload. With four active projects in hand, PSE/YCK still managed to pay as many as 61 visits to the YCK site. However, PSE/YCK did not notice any malpractices and irregularities, let alone fraudulent acts, during those visits. This may be attributed to his limited practical experience in LDBP works. The Select Committee considers that the supervisors of PSE/YCK did not give adequate attention to the experience and capability of individuals in the deployment and management of staff.

Site staff

5.170 Given that the daily inspection duties rest with the site staff, the competence of the site staff is equally important. The Select Committee notes that in deploying the site staff to the YCK project, the Chief Technical Officer Unit had taken into account the experience of PCOW/YCK and ACW1/YCK, both of whom had some experience with LDBPs. Notwithstanding their experience, PCOW/YCK spent most of his time on another project, while ACW1/YCK spent most of his time inside the site office. Almost all inspections were carried out by the two WSs/YCK posted successively to work for this project. These two WSs/YCK had no experience with piling works at all prior to taking up the YCK project. They had no basic knowledge of the construction of LDBPs. Many of the work steps and common malpractices in the construction industry were unknown to them. They acted upon invitation by the Contractor to inspect, and they completed the

inspection forms as a matter of formality, as they had little understanding of the works they were inspecting.

5.171 The Select Committee notes that one of the duties of SCOW is to advise on the training needs of site staff. However, none of the site staff for the YCK project were provided with any systematic training on the construction of LDBPs. The training WSs/YCK received was mainly through ACW1/YCK, who showed them around in the first week after they had assumed duty. There was even no hand-over from the first WS to his successor. The Select Committee considers that HD paid inadequate attention to the technical training of site staff and to the induction of new recruits. To enable an inexperienced WS to carry out his inspection of site works independently, sufficient hands-on guidance by his supervisor was required. In the YCK case, the site staff, irrespective of their lack of experience, were expected to carry out the inspections on their own. They were asked to follow the relevant manuals, which were written in English, a foreign language not easily comprehensible to them.

5.172 The Select Committee considers that without sufficient experience and training on the construction of LDBPs, both PSE/YCK and the site staff for the YCK project were not competent to deal with contractors or subcontractors if they resorted to malpractices in the course of the works.

Practicality of guidelines and delegation of responsibility

5.173 The Select Committee finds that the duties and responsibilities among members of the Contract Team and among the site staff were well-defined in the HD manuals. As far as the construction of LDBPs was concerned, section 12 of the EI Manual set out the inspection procedures and specified the action officers. The EI Manual was supplemented by a comprehensive supervision guidelines for LDBPs issued by PD/W in July 1998.

5.174 The Select Committee believes that HD had considered the complexity and the importance of the inspection task in question when determining the appropriate rank of the action officer for a specific task.

However, it appears that the manuals were written by the professionals without due regard to their practicality. The Select Committee is unable to comprehend how PSE/YCK and PCOW/YCK, given their span of work, could carry out the tasks properly in accordance with the manuals. The manuals were also silent on the level and extent of delegation. Hence, there was no mechanism to ensure that inspection duties were not delegated to a level which were beyond the capability of the staff concerned. As a result, in HD, especially during the peak production period, it was not uncommon for the PSE to delegate his work to the PCOW; the PCOW to delegate his work to the ACW; and the ACW to delegate his work to the WS.

5.175 Where delegation of duties is necessary, it is important to ensure that the staff to whom the duties are delegated are technically qualified and competent to do so. After delegation, the officer should also follow up to ensure that the delegated work has been properly done. In the YCK case, inspection of bored-out chippings was one of the most critical steps to ensure that bedrock level had been reached. PSE/YCK was required under EI-1203(1) to inspect the bored-out chippings for each pile to confirm the presence of sound bedrock at the founding level estimated jointly by him and GE/YCK after predrilling. This predicted founding level might not be accurate, given the varying ground conditions of the site. It was thus necessary to check the quality of excavated rock chippings. The Select Committee notes that for a PSE who was responsible for more than one project and who was non-resident, it was practically difficult, if not impossible, for him to inspect the bored-out chippings of every LDBP immediately after the shaft was excavated to the predicted level. Especially when the construction time frame was tight, it was not practicable for works to be put to a halt to allow PSE/YCK to inspect the bored-out chippings for each of the 36 LDBPs. As it happened, PSE/YCK delegated this duty to the site staff concerned. He did not seem to be aware that their inability to distinguish different types of rocks might result in failure to reach bedrock being left unnoticed. Given that the construction of LDBP involves a number of critical steps, the provision of professional advice on site is important. Unless the workload of PSE allowed him to provide on-site professional advice, the deployment of a competent resident engineer was necessary.

5.176 Another important part of LDBP construction works is the conduct of coring tests. Coring in YCK took place twice: one at the predrilling stage and the other after most of the sonic tubes were found blocked. According to the supervision guidelines for LDBPs, attendance by site staff during concrete coring was required. In both cases, this was not done. Although there was one ACW and one WS working full-time on site, the actual inspection work was undertaken by WSII/YCK. For a LDBP of over 40 m in length, the coring process could take as long as four to five days to complete. It was not possible for WSII/YCK, the only staff to supervise coring, to attend throughout the coring process, not to mention that there were other inspection duties to be performed. There was also no arrangement to stop the coring process when HD site staff was not present. The Select Committee is of the view that if the inspection requirements in the manuals and supervision guidelines were to be followed, sufficient manpower resources for inspection work should be provided. However, this was not evident in the YCK case.

5.177 In the light of the above, the Select Committee considers that the procedural guidelines were not practicable.

Work attitude of Housing Department staff

5.178 The Select Committee is most disappointed with the bureaucratic and lax attitude of some of the HD staff involved in the YCK project in project management and quality assurance. Little attention was directed to why they were doing certain tasks and what the best way to carry out those tasks should be. The response of some of the HD staff concerned to the memorandum issued by the management in May 1998 on the supervision of foundation works using LDBPs is a good example. The memorandum aimed to remind structural engineers and site staff to be vigilant in site supervision of foundation works using LDBPs. However, some HD witnesses did not take this memorandum and the subsequent issue of the supervision guidelines for LDBPs in July 1998 seriously. These instructions were treated as no more than routine circulars and were simply filed away. No action was taken to strengthen the supervision of the project or to comply with the guidelines, such as supervision beyond 7:00 pm. The inaction of the Contract Team

concerning the issue of overtime work after 7:00 pm reflects the little importance, if any, they attached to supervision of works.

5.179 The senior management of HD was similarly indifferent to the carrying out of works after 7:00 pm without supervision. The Select Committee notes from witnesses that concreting works carried out after 7:00 pm without supervision was common in HD's construction sites at the time. The situation was tolerated, thereby creating opportunities for malpractices. It was not until 27 January 1999 that BD/D issued a memorandum instructing HD staff to request contractors to strictly comply with the Noise Control Ordinance in their programming of works.

5.180 The Select Committee finds that the site staff concerned failed to appreciate the significance of their role in inspecting the work of the Contractor. Throughout the Contract, the site staff concerned were not vigilant in supervision. They adopted a lax attitude towards inspection, which can be seen from the following examples:

- (a) WSII/YCK allowed bored-out chippings to be extracted at night and accepted the samples as produced (see paragraph 5.60);
- (b) WSs/YCK did not examine on each occasion the measuring tapes provided and kept by the Contractor/Subcontractor before measuring the founding level (see paragraph 5.61);
- (c) ACW1/YCK and WSII/YCK left work after 6:00 pm or 7:00 pm with the full knowledge that important steps of works such as formation of bell-outs, installation of reinforcement cages and concreting were still going on (see paragraphs 5.71, 5.82, 5.93 and 5.94); and
- (d) the cores obtained from coring tests were simply placed in the site car-park unlocked and were easily accessible (see paragraph 5.115).

5.181 The Select Committee is of the view that it is important that the successful execution of projects depends on the commitment of staff to ensure that the end product achieves the required standard. With the lax attitude adopted by HD site staff concerned towards inspection work, it provided ample opportunities for the quality of the works to be compromised.

Over-emphasis on progress

5.182 The Select Committee finds that the tight piling schedule and the substantial liquidated damages for delay inadvertently resulted in both the Contractor and the Contract Team placing their primary focus on the progress of the works. The Select Committee notes that the liquidated damages in the YCK case amounted to over \$170,000 per day beyond the scheduled completion date. With such a hefty amount of liquidated damages, the Select Committee considers that the Contractor might have been tempted to complete the works on schedule at the expense of quality.

5.183 Progress of the works was the primary concern of the senior management of HD. The only reports they made to BC on current projects were those which were behind schedule for over three months. Similarly, the Contract Team of YCK agreed with the Contractor's proposal to conduct vibration tests in lieu of coring tests for checking the integrity of concrete partly because of its concern about possible delay due to the coring process.

5.184 With work progress being placed as the primary objective, quality assurance was given little attention, apart from following the procedures. The philosophy of Zen on quality assurance was total reliance on the checking system of HD. Zen stressed that the inspection system adopted by HD should ensure that every step of work complied with the contract requirements before approval was given to proceed to the next step. Zen pointed out that the fact that Hui Hon was allowed to proceed with the works indicated that the works were properly done. Zen seems to have ignored the fact that the primary responsibility for ensuring quality falls on the Contractor and not HD. QCE/YCK, who was engaged by the Contractor, admitted to the Select Committee that he was only QCE in name and he devoted most of his time to

another project. Under the circumstances, the appointment of QCE could not achieve the intended purpose of ensuring quality.

Concluding observation

5.185 The debacle of the YCK project was the direct consequence of fraud. However, the fraudulent acts might not have been so easily perpetrated if not for the combination of a number of factors and the aggregate failure of various parties in performing their duties, including wrong choice of contractor/subcontractor, wrong working methods, inadequate supervision of works, incompetent staff, and ineffective monitoring and checking mechanism.